BILL McCONNELL
EDUCATION HAS NO FINISH LINE

AT 14,000 FEET
A HEALTHY UPGRADE
HOPE IN THE AMAZON
With nearly 50 codes and specifications plus 200+ practices (including all guides and reports), the online version of the ACI Collection of Concrete Codes, Specifications, and Practices is the most comprehensive, always updated, and largest single source of information on concrete design, construction, and materials.

**Always updated**

**Inch-pound and S.I. units**

**Historical editions of codes and specifications**

**New titles as they are published**

The online version of the ACI Collection is structured for individual users—visit [www.concrete.org/publications/collectiononline](http://www.concrete.org/publications/collectiononline) for additional information. For multi-user options, please visit [www.concrete.org/multi](http://www.concrete.org/multi).
THE COVER
Bill McConell:
Education has no Finish Line – story on page 12

BUSINESS NEWS
16  Looking at New Geographies?
18  Addressing the Opioid Crisis on Your Jobsite
20  Preventing Construction Tragedies from Above

CHANNELS
SOFTWARE + TECH
22  Technology Transforming the Construction Site

STRUCTURES + BUILDINGS
24  Bentley: A Unique Building in Western India
26  At 14,000 Feet

WATER + STORMWATER
31  A Healthy Upgrade
33  Hope in the Amazon

TRANSPORTATION
36  Technology and Traffic in the Near Future
38  Structural Plate Project of the Year

ENVIRONMENTAL + SUSTAINABILITY
40  The Environment Whisperer

LAND DEVELOPMENT
44  Smart Design for Smart Consumers
46  Duke Kunshan University

CONTINUING EDUCATION
52  All-in
54  Addressing the Need for Sharp Workers

PRODUCTS + SPECIFICATIONS
57  The ‘Building in a Bag’

DEPARTMENTS
9   Plan Sheets + Red Lines
10  Events
11  Right Brain
49  Benchmarks
64  Reader Index

COLUMNS
5   From the Publisher: Remain Focused
     Chad Clinehens, P.E.
6   Engineering Front Line: Ultimate Sustainability
     Kit Miyamoto, Ph.D., S.E.
Remain Focused

Achieving Long-term Results in a Short-term World

The latest data continues to reinforce a troubling trend – firms are spending less on longer term investments while becoming increasingly mired in short-term demands. Our research team is now collecting over 2.2 million data points on nearly every aspect of an AEC firm you can imagine. It provides a great opportunity to understand how the industry is trending and for firms to benchmark themselves against their peers, enabling them to measurably elevate their practices and results. We are now in the third year of a notable shift in several key statistics that reflect the challenges of managing today’s AEC firm. Add it all up and it provides an obvious conclusion – the industry is busy and the challenges of managing growth and profitability are increasing. Here are some things you can do today to combat the industry trends, maintaining the long-term health of your firm and honing your competitive advantage.

Focus on client experience – While the industry is becoming increasingly aware of this critical business strategy, many are doing worse than ever, according to the data. The experience of your client directly affects your bottom line and must be a great priority. Brand loyalty provides pricing power, yet if we do not carefully manage the client experience, we lose ground in our fight against commoditization. Zweig Group conducts third party client satisfaction surveys and in those surveys of your clients, we are seeing declining satisfaction scores, especially in the areas of accessibility and responsiveness. When I ask audiences in our training sessions why this is, they are quick to answer, “It is because we are too busy.”

High workload is causing many to focus on putting out the fires and thus preventing project and client managers from focusing on the needs of the client. Be careful that your flexible work practices are not eroding the client experience. Accessibility and responsiveness can be greatly affected by these policies so firms must design programs that balance employee perks while maintaining strong client service. Commit to a regular client satisfaction survey and then address every issue that comes out of the data. Asking your clients to do a survey and then not doing anything about the feedback is worse than if you never asked at all. There is a huge opportunity for firms to shine here, differentiating their services and positioning their firms to be very strong in any future economic conditions. To learn more about this or to discuss your own challenges here, feel free to contact me directly.

Spend more on marketing and business development activities – Declining investment here for three years and counting is one of my greatest concerns. The continual decrease in proportion of marketing staff to the rest of the firm is one of the best indicators we are losing long-term focus. Now is the time to be investing in more marketing and business development resources to build backlog and brand preference in a more competitive economic time. Train all your employees in business development and empower them to start finding more work now, work that will fill the pipeline for the future. Hire more creative marketing staff to work on the real marketing and branding tasks like the website, social media, and other awareness activities that will make your company a preferred choice. This is critical to do now, when times are good, so when your clients have fewer dollars to spend they spend those dollars with your firm. For more resources on how you can invest with high returns, contact Jen Newman, our managing director of marketing and business development strategies. She can be reached at jnewman@zweiggroup.com or 904-502-9999.

Deal with problematic employees – This is a particularly difficult area to address as the data is less concrete. Much of the concern here comes from feedback hidden deep in surveys, especially in the comments section, combined with the face-to-face interviews we conduct with key personnel. Overall, the stories and the data together are sending a clear message – firms are not dealing with problematic employees at the risk of losing capacity. This is one of
I am at a vacant and gray 13-story building near Los Angeles International Airport. Construction is underway with noisy jackhammers and pounding metal studs slamming my ears. This development project in LA is ambitious. We and the builder, KCS West, are converting a rundown, 1965-era, ordinary office building on Century Boulevard into a four-star hotel with a new pool deck. Plenty of big-name brand hotels dot this high-profile boulevard and it is not easy to compete in this razor-thin market.

But Aaron, the developer, in conjunction with the California Real Estate Regional Center, CaRE, had a different idea. His plan is to play up the vintage style, add a pool deck floor and convert this to the four-star hotel.

“L.A. hotels are getting expensive and traffic is not getting any better,” he explains. “We are seeing more and more people use LAX hotels as a center for tourism and business activities, so many are staying a week or more.”

He looks up as a Boeing 787 takes off from the runway, then continues.

“I saw a gap in the market. Very few hotels are catering to this new need for longer stays that are more fun. So, we decided to utilize the historic charm of this building and add an activity floor to improve the amenities.”

This is risk taking. Conversion of an office to a hotel requires a full building code upgrade and he is also adding a floor. Obviously, the converted building also must meet L.A.’s strict seismic requirements.

Commit to continuous learning firm-wide – The number one benefit valued by the staff of AEC firms for the past two years is training and development. This is supported by the overwhelming amount of data in our Best Firms To Work For survey indicating that employees believe they work for a great firm, and that this is due in large part to the training programs the firm provides. The unfortunate trend that has worsened in the last year is declining attendance at training seminars and decreased commitment to internal formalized training programs. Get serious about this and you can greatly improve your recruiting and retaining of key staff, combating the number one challenge for all firms. We have increased our investments in this area, expanding our leadership with the hiring of Marci Thompson and our ability to provide more programs as in-house options. If you would like to learn more about training program options for your firm, Marci can help you design a custom solution that’s right for you. She can be contacted at mthompson@zweiggroup.com or 202-725-4871.

I recognize the challenge of committing resources to even the few things listed above. However, you must find a way to make it happen. Many of the recommendations require concurrent or consecutive execution to realize the full benefits possible, making the challenge even greater. The value of maintaining long-term focus in this short-term environment cannot be understated. Your firm can increase your competitive advantage at a time when the industry is lowering the bar. You can become bigger, better, and stronger today, enabling you to be resilient in any conditions of tomorrow. Despite short-term issues eroding long-term focus industry-wide, you can beat the metrics and be the contrary example. If you have questions, are having similar issues, or want to share your own story, reach out to me anytime.

CHAD CLINEHENS, P.E., is Zweig Group’s president and CEO. Contact him at cclinehens@zweiggroup.com.
It’s a big design challenge also.

“We try to keep building form as much as possible for historic authenticity and cost saving,” adds Vicki from the architect, Carrier Johnson. “We were able to keep the central core as the circulation system and all concrete skins. We even have exposed concrete waffle slab in each room.”

No one builds like this anymore. It is like discovering a valuable second-hand item in a vintage store.

The structural engineering challenge was also not insignificant. Our engineering team converted circulation core walls to reinforced concrete shear walls, but they soon found that the foundation had to be bigger than the building footprint! Additional seismic force is created by the additional floor, and there are new seismic code requirements. So, they came up with the idea to tie shear walls at roof level with five-foot-deep beams, essentially providing an outrigger system usually used for high-rise construction, utilized here to reduce foundation size.

To me, this is the ultimate sustainable project. It is easier, perhaps, to tear down an old office building and replace it with new construction. But the development team will end up with a unique architectural gem with faster construction by saving the old structure. Some say L.A. is big and ugly. Maybe so, but LA is like peeling the skin of an orange. There is plenty of sweetness; beauty exists inside the skin; and these heritage buildings are everywhere. Walk through rundown Broadway Street downtown. You would not believe the row of turn-of-the-last-century heritage theaters found there – something I have never seen anywhere in the world. Many were still shut down and rarely used. But each has its own unique history and are like jewel boxes. They need to be discovered soon. Developers like Aaron – using a combination of architectural, engineering, and construction creativity – put the street center stage again.

August 5, 2019
In Santa Monica

A vintage 13-story office building is being converted into a four-star hotel on Century Boulevard in Los Angeles. Photo: H. Miyamoto

H. KIT MIYAMOTO, PH.D., S.E., is the CEO and a structural engineer for Miyamoto International (http://miyamotointernational.com), a California seismic safety commissioner, and president of the technical nonprofit Miyamoto Global Disaster Relief. He specializes in high-performance earthquake engineering and disaster mitigation, response, and reconstruction.
BIOENGINEEREDED LIVING SHORELINE & HILLSIDES EROSION CONTROL

SOX manufactures and distributes a suite of patented, bioengineered erosion control solutions that are stable, long lasting and compliant with the BMP’s of Living Shoreline erosion control systems.

• LONG LASTING
• PATENTED SYSTEMS
• QUICK INSTALLATION
• IMMEDIATE STABLIZATION
• ECO FRIENDLY SOLUTIONS
• ENDLESS OPPORTUNITIES

CONTACT US TO DISCUSS SOX OPPORTUNITIES

833-222-4SOX (4769)

WWW.SOXEROSION.COM
AN UNEXPECTED RAINSTORM

Talk about a rain out. That’s what happened in the famed Chicago high-rise known as 330 North Wabash. An event planning company was setting up for a shindig when one of its employees inadvertently struck a water sprinkler, setting it off. This was on the 23rd floor, so guess what happened to the 22nd. That’s right, it got soaked. Unfortunately for the event planners, the 22nd floor was not only occupied, but occupied by a powerful law firm. The damage estimate came to an astounding $1.5 million-plus, and the events company is on the hook for the bill. All that according to a recent filing in U.S. District Court for the Northern District of Illinois. The building’s owner, and the law firm’s insurance provider, jointly filed the lawsuit this summer.

The sprinkler snafu happened back in November 2017 when the event planners were decorating the 23rd floor, which was used for nothing but special events. We can only guess that one of the company’s employees hit the sprinkler with a ladder, or nicked it with his or her shoulder while hanging something from the ceiling. Regardless of how it happened, the employee “affirmatively admitted to striking the sprinkler head immediately before the discharge,” according to the suit.

The damage has apparently been rectified. The law firm still offices in the building designed by famed architect Ludwig Mies van der Rohe. Now, it seems, it’s time to get the events company to pay for the tab. On the first count of negligence, the building owner is asking for a $508,000 judgement against the events company, and on the second count of negligence, the insurance company is asking for a $1.7 million judgement. That’s a lot of dough, and we can’t help but think that if the requests for judgements are granted, the events company is finished. But think about it. An employee, someone who probably wasn’t making a dime over $20 an hour, caused this catastrophe. By mistake. It’s a crazy world out there, folks. A terrible rainstorm could come from anywhere, even the 23rd floor of a posh office tower in Chicago, and wash everything away.

EYE IN THE SKY

We all know the use of drones for engineering purposes is growing year by year. With greater technology comes greater application, and that pattern will continue to unfold. As is typical, what was once the purview of a few ultimately blossoms into ubiquity. That’s where we find ourselves with drones, and the process shows no signs of slowing down anytime soon. But before looking ahead, let’s look back for a moment.

In 2018, the National Society of Professional Engineers’ Board of Ethical Review considered a case involving some surprise footage captured by an engineer and his unmanned device. This from the NSPE: “During one of Engineer A’s drone inspections for the state Department of Transportation, the drone unexpectedly records an encounter between a law enforcement officer and a motorist that results in the exchange of gunfire.”

The Society’s Board of Ethical Review looked at the case and concluded that the engineer was compliant with the NSPE Code of Ethics in that he brought the drone footage to the attention of both his client and the appropriate law enforcement agency. Good for him. But looking ahead, we can’t help but wonder what interesting slices of life engineers will continue to capture with their drones as the technology works its way deeper and deeper into the AEC industry.

PLAYING NICE

Remember that case we told you about in May, where a New York photographer sued an architecture firm because the firm used his images in their marketing materials without his consent? That case was settled.

If you know of an interesting or off-kilter story taking place in the AEC industry, please contact C+S at rmassey@zweiggroup.com.
Elevating Doer-Sellers  
**SEPT. 12-13 — HOUSTON, TX**
Zweig Group’s Elevating Doer-Sellers – Business Development Strategies that Impact the Bottom Line is designed specifically for technical professionals in A/E/C firms. Participants will walk away with business development strategies and techniques that will empower them to grow their careers as they help their firms grow.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

Hiring and Keeping Great Talent  
**SEPT. 17 — SCOTTSDALE, AZ**
Leverage an array of strategies, skills, and knowledge to build and retain a strong organizational team.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

**OCTOBER 2019**

**M&A NEXT**  
**OCT. 2 – HENDERSON, NV**
Offering deep learning through an interactive experience on the M & A process. Participants will learn what that means for the AEC industry.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

Elevating Doer-Sellers  
**OCT. 10 -11 — HOUSTON, TEXAS**
Business development and marketing strategies that impact the bottom line.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

Commercial UAV Expo Americas  
**OCTOBER 28-30 — LAS VEGAS**
Join more than 3,000 professionals at the leading commercial drone conference and expo October 28-30, 2019.  
[www.expouav.com](http://www.expouav.com)

The Principals Academy  
**OCT. 31–NOV. 1 — NEW YORK CITY**
A total management course for architecture, engineering, and environmental firm leaders.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

**NOVEMBER 2019**

**M&A NEXT**  
**NOV. 12 — ORLANDO, FL**

---

People want to work with who they like and trust, and we aim for connection – not perfection. Learn how to create high impact conversations through presentations with Zweig Group’s Championship Interview Training Program.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

**SUCCESSFUL SUCCESSOR ROUNDTABLE**  
**NOV. 13-15 — NEW ORLEANS, LA**
The Successful Successor Roundtable is an exclusive event for incoming strategic leaders of firms and newly-minted strategic leaders of these firms. The purpose of this seminar is to discuss the highest-level issues facing newcomers to the c-suite and to individuals who are preparing to take on a high-level management role in today’s AEC firm. This two-day event includes educational and networking sessions in an upscale setting.  
[https://free.zweiggroup.com/events-and-seminars/](https://free.zweiggroup.com/events-and-seminars/)

---

Get a quote—overnight.  
Visit:  
[www.insurance4structural.com](http://www.insurance4structural.com)  
Click “Need a Quote”  
Call toll-free:  
866-PE-PROTEK  
(866-737-7683 x.208) Ask for Tim Esler.  
Email:  
tim@Insurance4Structurals.com

---

**Structural Engineers Axiom #7**

**Professional Liability is Essential. Overpaying is Not.**

It pays to have the right professional liability coverage. But you shouldn't overpay.

At Fenner & Esler, we're more than just brokers. We're A/E specialists. Delivering the right coverage and value to design firms of all sizes since 1923. With multiple insurance carriers. And a proven track record serving the unique risks of structural engineers.

---

**Fenner & Esler**

**Insurance Since 1923**

**The Professional’s Choice**
“...AND SO I CALLED THIS MEETING beeeep ‘WHO JUST JOINED?’ ...TO DISCUSS WHY beeeep ‘WHO JUST JOINED?’ ...WE CAN NEVER GET ANYTHING DONE beeeep ‘WHO JUST JOINED?’ ...AROUND HERE.”
Bill McConnell: It’s Kind of Difficult to Describe Bill McConnell. The co-founder and CEO of The Vertex Companies, Inc. is certainly an engineer and an entrepreneur. Simple enough. But if you take everything else into account – the stack of licensures and academic degrees, the refined global outlook, and the talent for conceiving, and then implementing, robust and varied growth strategies – McConnell defies easy definitions. Born on the East Coast but a happy transplant living out West, McConnell is comfortable discussing risk profiles and forensics, or algorithms and derivatives, or oil prices and construction costs. You’ll receive great answers if you ask a few questions, so Civil + Structural Engineer took the opportunity to do just that.

A Conversation with Bill McConnell

Civil + Structural Engineer: Take us back to 1995. Why did you and your co-founders start the firm? What nugget of wisdom has remained with you from that time?

Bill McConnell: I grew up in an entrepreneurial household in Massachusetts and I knew from the time I was in college, if not high school, that I wanted to start an engineering and construction company. My father’s advice to me was simple – success comes to those that work hard and work in the right direction. In other words, have a great strategy and then outwork your competition. I’ve tried my best to follow this advice my entire career. Sometimes great wisdom comes from its simplicity.

When I graduated with a Bachelor of Science degree in Civil Engineering in 1992, the environmental sector was booming. Around 1994, I spoke with a friend of mine, Jeff Picard, and his boss, Jim O’Brien, that worked for a national environmental engineering company, about this booming marketplace. Jeff and Jim expressed a similar desire to open a business, and because environmental services were complimentary to design engineering and construction services, we started to develop a plan to incorporate a full-service AEC firm.

C+S: The buy-back from Tetra Tech was a critical moment in the history of the firm. Tell us about it.

Bill: Vertex experienced significant growth through its first five years of operations. This growth attracted the interest of several large AEC firms. In 2001, Tetra Tech, Inc. acquired Vertex. At that time, as remains the case today, Tetra Tech was a perennial top design firm in the country. It was an honor to work for the likes of Dr. Li-San Hwang, the founder and then CEO of Tetra Tech, and Dan Batrack, the current CEO of Tetra Tech. I liken my experience there to earning an MBA on how to successfully run a billion-dollar business.

Between 2000 and 2005, Vertex expanded its forensic claims offerings that service the insurance and legal industries. At that time, forensics did not fit within any of Tetra Tech’s core service groups, so a strategy divergence developed, which prompted the management buyout of Vertex from Tetra Tech. This buyout created a win-win for both parties, and Vertex continues to work with Tetra Tech on certain projects today.

C+S: A well-known architecture firm in Boston recently surprised a lot of people by closing its doors for good. Why do firms, even ones with brand names, fail and go away?

Bill: Typical A&E design fees, like typical constructor fees, are thin when measured against the risk profiles for such services. Accordingly, taking your eye off the risk management ball, even for a short period, can be catastrophic. Moreover, firms that lack growth over time often realize profit margin erosion due to labor escalation that outpaces rate increases. Properly managing risk while focusing on growth is a balancing act that separates sustainable firms from non-sustainable firms.

C+S: You have extensive experience as an expert witness in construction disputes, particularly for cost and/or standard of care opinions. Is there a “typical” mistake, or pattern, that you have seen in these cases?

Bill: Yes. The majority of disputes that I am involved with have common themes. In terms of construction defect litigation, the disputes typically involve building envelope design and/or construction, and civil design and/or construction, that allegedly is not in compliance with applicable building codes, manufacturer’s recommendations, and/or industry standard publications. Designers and constructors that design and/or build to these requirements, and document adherence, can avoid disputes.

In terms of construction/design disputes that involve contract claims, the trend over the past few years is a significant increase in schedule and quality issues caused by the shortage of skilled construction workers. According to the U.S. Bureau of Labor Statistics, the number of construction workers in 2019 remains less than what it was in 2006, despite the significant rise in put-in-place construction spending between
the two periods. This workforce shortage has caused most construction schedules to slip, and the taxed workforce has led to a rise in quality-related issues.

C+S: What kind of damage can a lost court case do to an engineering firm? Are most firms properly insured or not?

Bill: Claims against design firms generally involve alleged standard of care violations, which often lead to a negligence cause of action. Fortunately, resultant damage due to negligence is typically covered by professional liability insurance. However, it is not unusual for smaller design firms to carry insurance limits that range from $500K to $2M, which can present an under-insurance problem on larger claims. Larger design firms often carry excess policies that cover larger losses. Projects with wrap policies can address insurance limit issues.

C+S: Vertex went to a full ESOP in 2013. Six years in, what’s the headline?

Bill: The headline is that we have had record revenue and income growth since transitioning to an ESOP, and we couldn’t be happier with our decision as this is creating long-term wealth for our employee-owners. Being an ESOP is a differentiator for Vertex, and differentiators are a key to success in the competitive AEC marketplace.

C+S: Vertex has had a location in Mexico for 10 years. What’s the market like there, and what are the long-term prospects?

Bill: The key to a successful business practice in Mexico is to achieve local self-sustainability and to not rely exclusively upon work from outside the country. Doing so avoids the drastic swings in revenue caused by geopolitical issues.

C+S: M&A is in Vertex’s DNA. What’s the secret to successfully integrating firms?

Bill: Vertex is laser focused on embracing a defined integration process at this point in our lifecycle. We understand that integration can be difficult for large and small AEC firms alike, and that it’s always a work-in-progress due to constant changes in how AEC companies operate (new technologies to leverage efficiencies, etc.). Our process now involves an early outline and playbook for each acquisition that covers organizational structure, accounting, branding, marketing, sales, etc. Having a mutually agreeable timeline for implementation – early in the process – helps to avoid differences in expectations downstream. Also, having an executive team (mainly our COO, Ben Strong) that appreciates this process in a proactive manner is essential to getting through known-unknowns that inevitably arise during transitional periods.

C+S: You’ve talked about becoming a $1B company. How do you do that without an IPO?

Bill: We will achieve this goal on or before 2030. Funding to get to $1B in revenue is indeed a challenge, unless several attractive MOEs present themselves. We have self-funded our growth to date, and we are proud of that fact. However, we would be foolish to rule out an IPO option. If we get to the point where we feel that an IPO is necessary to meet this goal, we would present that option to our employee-owners for consideration.

C+S: What’s been the firm’s best project in the last five years and why?

Forensics: In Forensics we measure this in terms of our client base – we are currently working for top property and surety carriers (Travelers, Zurich, Liberty, AIG, Chubb, etc.), top construction law firms (Watt Tieder Hoffar & Fitzgerald, Peckar & Abramson, Fox Rothschild, etc.), top AEC firms (Jacobs/CH2M, Tetra Tech, etc.), and top construction companies (Clark, Turner, Kiewit, etc.).


Construction: Boston University Data Sciences Center (Boston), In-
What’s behind your hyper-drive for education?

C+S: You have three degrees, are currently working on your Ph.D., and completed the part-time, three-year business program at MIT. What’s behind your hyper-drive for education?

Bill: I’m a firm believer that education has no finish line. With this perspective in mind, gaining multiple degrees over a 30- to 40-year window is not a daunting pursuit. To the contrary, attempting to gain a bachelor's, master's, and doctoral degrees while in your 20s is extremely difficult, not to mention expensive. Moreover, pursuing these degrees in one decade is a full-time endeavor, and it comes at a serious opportunity cost, as most individuals establish their career path by 25. Entering the corporate world at age 30 can be a serious handicap. What’s more, obtaining advanced degrees while you are working lets you incorporate lessons learned into your daily routine, which increases retention.

C+S: How did your executive team come together to develop the partnership on the degree program with the University of Colorado Denver?

Bill: One of Vertex’s differentiators is our Lifetime of Learning Program. Vertex understands that the ever-increasing student debt level is a national crisis. We sought to create a win-win program where employees could obtain advanced degrees without taking on additional debt-load, while Vertex would develop a more qualified workforce. Accordingly, Vertex met with several universities and decided to form a partnership with the University of Colorado Denver because they share our entrepreneurial mindset and appreciate how distance learning is a great benefit to students with full-time employment and corporations that have multiple office locations. To tackle this undertaking, Vertex appointed Russell Fitzpatrick as our Chief Learning Officer. Russell is working with CU Denver and a select number of other institutions to provide our employee-owners with a variety of advanced degree options.

C+S: Forensic, Engineering, Construction, and Environmental. Of the four key offerings, which one creates the highest utilization?

Bill: During bull markets, it is common for our Engineering/Construction/Environmental groups to maintain extremely high utility figures. Thus, for the past decade, these three groups have operated at high utility levels, save for a couple of aberrant quarters. During bear markets, utility for Engineering/Construction/Environmental tends to dip on private sector work. To the contrary, our Forensics services are non-cyclical and are steady, if not improved, during bear markets. We consider this economically hedged service blend one of our keys for both short-term and long-term predictability.

C+S: Over the last few years, what state or states have produced the most growth?

Bill: Vertex is fairly mature in the Northeast and Rocky Mountain regions. Thus, our largest growth has come in our Southeast, South, Southwest, and Northwest operations. Vertex’s goal is to achieve regional office sustainability in all 25 of our offices, which will require full service offers in each market.

C+S: Look ahead five to 10 years. What does every CEO of an AEC firm need to know?

Bill: There is no question that the US will face a bear market within the next three years. I almost welcome a minor correction to ease resource issues and construction inflation. This mild recession will be coupled with the already-slowing global markets. In addition, the federal deficit and debt level will soon become the country’s number one issue, which will soon come to the national stage as the percentage of entitlement (health care and social security) and interest spending is on a steady rise. The increase in federal entitlement and interest spending will greatly reduce the available money to fund infrastructure spending, which has been the case for the past decade. In fact, the percentage of US public construction spending as a percentage of the US GDP has dropped by approximately one-third over the past decade alone. Thus, funding will be an issue in the public sector for years to come. That said, CEOs will need to face this brutal reality and need to plan accordingly. Lastly, AI and IOT advances will create great opportunities and cause massive disruptions in the near future. AEC firms that remain ahead of the technology curve will have a leg up. Those that fall behind will face inevitable hardships.

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? How did you handle it?

Bill: Running a $100M business is different from running a $10M business, just like running a $100B company is different than running one that’s $100M. Vertex’s management team is acutely aware of this
fact, and we have supplemented our team with individuals that have helped, and will continue to help, with this transition. We also realize that to be a billion-dollar business, we will need to continue to supplement and/or rework our team to get to the next level.

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

Bill: If you asked me this question 10 years ago my answer would be “a major setback.” Since then, Vertex has put in place an executive and middle management team that is not dependent on any one person. Our four service areas are each run by Managing Directors, and each service that we offer, 16 in total, is managed by Executive Vice Presidents. Since incorporation in 1995, we have never been in a better position in terms of leadership transition.

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

Bill: We spend a lot of time thinking about this topic. Several years ago, we recognized that our approach was too “by the numbers” and not well grounded in a philosophy that is supported throughout the organization. We believe that diversity is having a seat at the table, inclusion is having a voice, and belonging is having that voice be heard. We work to create an environment that supports these beliefs and then work hard to sustain it through our actions. Attracting people of color, women, and other underrepresented groups/protected classes is just one piece of our work. Providing a workplace that fosters the sense of belonging is what engages and retains people.

**C+S: Are you currently pursuing the R&D tax credit?**

Bill: We are researching this issue. As an ESOP, I don’t think we would qualify for any further federal tax credits; however, we are considering the potential for state credit opportunities. Based on the number of Vertex employee-owners that are working towards doctorate degrees, via our Lifetime of Learning Program, we conduct significant R&D on numerous AEC topics every year.

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

Bill: Vertex’s President, Jeff Picard, tackled this challenge head-on several years ago. Our program gives primary responsibility to our dedicated business development team for bringing in new accounts. In contrast, we assigned primary responsibility to expand existing accounts to a number of our production team members. To manage these processes, Vertex’s Marketing Director, Lisa Dehner, and our in-house IT group, developed our OneVertex CRM software that is specifically designed for this “new account/existing account” growth initiative. We also understand and embrace the reality that certain production personnel are simply not cut out for sales interactions, so we require these individuals to participate in business development activities such as authoring white papers and writing blogs; therefore, the entire company is involved in business development.

To view full interview, click here
BEING ABLE TO CAPITALIZE ON OPPORTUNITIES in new geographies is a key competitive advantage. Yet with so many licensing variables from state to state, it can be hard to predict how much time and effort it will take to qualify in a new jurisdiction. This article examines five states that are particularly challenging due to stringent management and ownership requirements. Firms often need to make significant adjustments, such as forming a new entity, to meet them.

The Role of Firm Ownership in Licensing

Many states require engineering and land surveying firms to meet ownership and management requirements before obtaining a certificate of authorization (COA). Since many engineering firms are not wholly owned by engineers or other licensed professionals, these requirements can pose major challenges. Ownership and management requirements are tied to different legal structures in each state, further complicating the picture for out-of-state firms. More than a dozen states, for example, require professional corporations (PCs) or professional service corporations (PSCs) to be fully owned or majority-owned by licensed professionals. Depending on the state, PCs and professional limited liability companies (PLLCs) may be optional, required, or forbidden structures for engineering firms. California and Kansas, for example, permit engineering firms to form PCs, but not PLLCs, while New Jersey provides PCs for domestic entities but bars foreign PCs.

These overlapping requirements can make entry into new states a complex process, as the following examples illustrate. By understanding the biggest challenges and knowing what to look for, firms can approach new jurisdictions with greater ease and confidence.

#5 Minnesota

Engineering firms wishing to offer services in Minnesota must elect to become a Professional Firm under Minnesota Statute 319B. The election is made as part of registration with the secretary of state. Joint practice of engineering, land surveying, geoscience, architecture, landscape architecture, and interior design is permitted. Corporations, LLCs, LLPs, and other entity types may qualify as Professional Firms under the statute, but they must adopt specific name endings.

To qualify, firms must generally be owned and governed by professionals licensed in one or more services provided by the firm, or by partnerships, firms, voting trusts, or employee stock ownership plans (ESOPs) owned by licensed professionals. This requirement can make licensing in Minnesota challenging for out-of-state firms.

#4: Michigan

While Michigan does not have a formal license requirement, the state can be difficult thanks to its requirement that two-thirds of an engineering firm’s principals be licensed in Michigan. Michigan defines principal as a “sole proprietor, partner, the president, vice-president, secretary, treasurer, or director of a corporation, or a member or manager of a limited liability company.” For PCs, all shares must be owned by licensed professionals or by entities that are fully owned by licensed professionals.

Firms that want to provide services in Michigan must apply to the Department of Licensing and Regulatory Affairs and show that they meet these requirements, among others. Once the ownership requirements are met, however, Michigan offers one of the simpler and faster qualification processes, landing it at number four on the list.

#3 Connecticut

Engineering and land surveying firms may practice in Connecticut through PCs, corporations, and LLCs. For all of these structures, the state requires firms to be at least two-thirds owned and controlled by Connecticut-licensed professionals. Firms that provide joint practice of architecture, landscape architecture, engineering, and land surveying must be two-thirds owned by licensed professionals, with each discipline holding a minimum of 20 percent of the voting stock or voting interest of the company.

On top of these requirements, Connecticut’s licensing process is not particularly quick or easy. Firms with Connecticut in their sights will want to plan ahead and allow ample time for licensing.

#2 North Carolina

North Carolina requires engineering firms to qualify as PCs, PLLCs, general partnerships, limited partnerships, or limited liability partnerships (LLPs). PCs and PLLCs must be at least two-thirds owned by licensed professionals. In addition, PCs must have at least one North Carolina licensee for each profession who is a director and one who is an officer and shareholder, while PLLCs must have at least one North Carolina licensee who is a member and one who is a manager. For both entity types, the balance of ownership (up to one-third) may be held by non-licensed employees individually, or in limited cases, via ESOPs. This combination of entity restrictions and ownership requirements,
coupled with a challenging application process, earn North Carolina second place in the top five toughest states.

The licensing process begins with an application to the engineering board for approval. The board provides a certificate to be submitted to the secretary of state along with registration. Many firms have to adopt a fictitious name in North Carolina, adding further steps, and everything has to be notarized. North Carolina also requires a comprehensive list of shareholders to be entered into its online form. For large firms with hundreds of shareholders, this can be a very time-consuming task!

#1 New York

New York lands the top spot on the list, with a high ownership bar and some of the most complex licensing and registration processes in the country. Engineering firms can qualify as design professional corporations (DPCs), professional service corporations (PSCs), PLLCs, partnerships, or LLPs. For PSCs, all officers, directors, and shareholders must be licensed design professionals in some jurisdiction. For PLLCs and partnerships, the bar is higher yet: all members of PLLCs, and all partners in a partnership, must be licensed in New York State.

New York introduced the DPC structure in 2012 to allow greater flexibility in firm ownership, but the requirements for DPCs are substantial nonetheless. More than 75 percent of ownership of a DPC must be held by design professionals licensed in New York. In addition, more than 75 percent of officers and directors must be licensed in New York, as must the president, chief executive officer, and chair of the board of directors. The largest single shareholder must be a New York-licensed design professional or, with certain restrictions, an ESOP.

On top of these requirements, New York’s licensing and registration processes are so complex that more than 80 percent of applications for certificates of authority are rejected, and processing times are measured in months instead of weeks. New York is definitely a state to be approached with time, patience, and attention to detail!

Other Factors That Affect Timing

While ownership and management requirements represent some of the more significant hurdles to clear when expanding into new states, there are other factors that determine the speed and ease of licensing. In some of our top challenging states, as previously noted, the licensing process can be relatively quick and painless for firms with ownership and management structures that meet the requirements. At the same time, there may be states with no ownership or management requirements that nonetheless have rigorous or lengthy processes to navigate on the way to offering services. A good example of this is California, which doesn’t even have a formal license requirement, yet requires in its place an organization record that can take longer to complete than many license applications. Illinois is another state that makes the list for sheer difficulty in the application process.

The Key to Successful Applications

Firms can set themselves up for success when entering new states by researching the structures available to engineering firms and the corresponding ownership and management requirements early. Also pay close attention to name requirements such as required endings for each entity type. By planning ahead and leaving plenty of time for the licensing and registration process, firms can enter new states faster and position themselves to capture more business.

HARBOR COMPLIANCE is not an accounting or law firm and does not provide tax, financial, or legal advice.

CHRISTIAN HARING is an Account Executive at Harbor Compliance specializing in professional licensing for engineering (www.harborcompliance.com/information/engineering-firm-license-certificate-of-authorization), architecture, and construction firms. With a focus on mid-sized and large firms, Christian understands the need for precision and clarity in managing multi-jurisdictional licensing. Christian’s core focus is providing compliance as a growth enabler for his clients. He is available to answer your questions at 717-298-8128 or charing@harborcompliance.com, www.harborcompliance.com.
The opioid epidemic isn’t a problem you can ignore in the construction industry — or anywhere in the U.S. The cost in human lives is high. Every day, 115 Americans die from opioid overdoses.

How did it start? Blame is widespread in the media, but according to the National Institute on Drug Abuse:

In the late 1990s, pharmaceutical companies reassured the medical community that patients would not become addicted to prescription opioid pain relievers, and healthcare providers began to prescribe them at greater rates. This subsequently led to widespread diversion and misuse of these medications before it became clear that these medications could indeed be highly addictive.

Now that the crisis has been identified, governments and health organizations are scrambling to address opioid addiction with greater access to recovery services, education on pain management best practices, and more. But why should construction leaders be particularly aware of the crisis?

Construction jobs carry a high risk of injury. In fact, the injury rate for construction workers is 77 percent higher than the national average. This reality sets workers up to become prime victims of opioid addiction. Many are not trained to bend, lift and do repetitive movements safely. Add in dangerous working conditions and the presence of heavy equipment, and the risk of worker injury goes even higher.

Opioid addiction in construction is a vicious cycle. For example, an injured worker may go to the ER, get a prescription for pain medication, and return to the jobsite before they are fully healed so they don’t lose wages. But this causes the injury to linger or get worse. Meanwhile, the worker is impaired on the jobsite, and that impairment can lead to more worker injuries, which leads to more opioid abuse.

Because of this cycle, almost 15 percent of construction workers are dealing with some form of substance abuse, and opioids represent 20 percent of the total spending on prescription medication in the construction industry.

While not as tragic as the human cost, the business cost of the opioid epidemic can make the difference between a project’s success and failure. Mistakes caused by impaired workers, lost work and theft all count in the “loss” column when it comes to opioids in the construction industry. One study put the 2015 price tag of opioid addiction for construction companies just in the American Midwest at $5.2 billion.

Proactive construction leaders are finding unique ways to combat the opioid epidemic. Prevention, jobsite monitoring, and help for addicted co-workers are all solutions that can combine to create a safe, drug-free workplace.

Train for safety
Safety starts with awareness and training. With such a high injury rate, safety training is critical for the construction industry. Contractors should do everything they can to prevent injury and eliminate hazardous jobsite situations, and that includes training and educating employees at all levels.

Training should include safety best practices, self-care, what to do in the event of an injury and how to identify someone who is operating under the influence.

No less vital, though, is frank discussion of the dangers of opioid addiction and reasonable solutions workers can use to deal with accident and injury. Creating a culture of openness and honesty about the opioid crisis is a key step towards getting workers to come to you with problems instead of hiding them.

Support your workers
Often, the cycle of opioid addiction starts because workers fear losing income or losing their jobs altogether. They use the drugs to mask pain and continue working when their bodies need rest and healing. Contractors should take this pressure into account when addressing the opioid epidemic.

Work with employees and healthcare providers to identify alternatives to opioid painkillers and support workers who choose to take this safer but slower route. Workers who feel secure in their jobs are more likely to come to you with problems and are less likely to make healthcare decisions out of panic.

Construction industry leaders are addressing this issue with benefits like employee assistance programs through their healthcare insurance providers and even employer-sponsored recovery programs. While drug-impaired workers should absolutely not be allowed on a jobsite, research shows that workers in recovery programs have the lowest rates of absenteeism and job turnover, even lower than the general
workforce. In fact, research shows that each construction employee in recovery saves their employer $2,373 in lost productivity, healthcare use and turnover costs.

Monitor your jobsites
In order to effect change on their jobsites, contractors must be able to monitor and document unsafe behavior. Human monitoring by supervisors during the workday and by security personnel after hours is one solution for identifying unsafe or impaired workers. But supervisors can’t be everywhere, and round-the-clock security can be costly. Jobsite cameras, especially those with the ability to record and review footage, can fill in the gaps.

Jobsite cameras can be used to deter and apprehend thieves, another symptom of the opioid epidemic. If your jobsite must be left unattended at night, it is a prime target for thieves since construction equipment and materials have high value. The presence of security cameras can make thieves think twice before striking.

Cameras are an effective deterrent for theft, and they are an excellent motivator to keep employees operating within safety best practices when supervisors aren’t around. They are a solid investment as they save time and money, including insurance costs, injuries, schedules, loss of materials and equipment and more. But when selecting a camera, be sure it has a robust recording and review feature, or you will lose the ability to document jobsite activities.

Finding a balance
When construction leaders address the effects of opioid addiction, they’re finding a balance between the human problem and the business problem. On the one hand, there are employees suffering from injury and addiction and in need of help. On the other hand, contractors have to maintain profitable businesses and safe jobsites.

Construction leaders should consider all the options, both proactive and reactive, to minimize the effects of the opioid epidemic on their businesses and the people they employ. Finding the right mix of training, monitoring and support for your particular business is key to surviving this crisis.

Roger Yarrow is Chief Operations Officer of TrueLook, the only construction camera company to include live jobsite viewing, project time-lapsing, and HD security recording with every camera, pioneering construction camera technologies for over 20 years.
Several high-profile incidents this year brought workplace safety-at-heights failures into public view. Two construction-crane collapses made national headlines: one on April 27 in downtown Seattle, Washington, the other on June 9 in Dallas, Texas, both with fatalities. On May 15, two window washers in a lift basket found themselves spinning and slamming into the side of Oklahoma City's tallest building until rescuers reached them. And a Broadway theater in New York City was the scene of serious injuries on June 27 when a piece of rigging equipment fell on three stage hands, leaving one with a fractured skull, another with a partially severed ear, and a third with a possible broken arm plus neck and back trauma.

All of those examples showed how dramatic — and sometimes deadly — the consequences can be when something goes wrong at heights.

Examples of similar tragedies abound:
• In August 2018, two construction workers were pouring concrete six stories up for a new building near Orlando, Florida, when their scaffolding collapsed. They died from the fall.
• In 2012, two workers in Dallas died as they were disassembling a construction crane when it suddenly collapsed, under circumstances similar to this year's Seattle disaster.
• Several years ago, a construction worker on the ground in Jersey City, New Jersey, was killed by a tape measure that was accidentally dropped by another worker from 50 stories above.

According to government stats, falls and being struck by a dropped object are among the top causes of workplace injuries and fatalities:
• The Bureau of Labor Statistics (BLS) reported that in 2017, “fatal falls were at their highest level in the 26-year history of the Census of Fatal Occupational Injuries (CFOI), accounting for 887 (17 percent) of worker deaths.”
• BLS reported that being struck by falling objects or equipment resulted in 45,940 injuries in 2017 (5.2% of all workplace injuries).
• According to the Occupational Safety and Health Administration (OSHA) dropped objects are the third leading cause of injuries in construction.

Thankfully, Murphy’s Law doesn’t strike workers down like this every day, but even near-misses are way too common. Just ask Henry Skjerven. He was working at the base of a tall grain elevator one day when he felt something heavy fly by his face on its way to the ground. It was a nail-puller tool, and it missed him by less than an inch. Another worker had dropped it from 90 feet above.

“I could have ended up as just another statistic,” said Skjerven, “so I’m glad somebody is trying to do something about the problem. I shudder every time I think about having been an inch or so away from severe injury or even death.”

Construction sites, factories, cell towers, wind-energy turbines — any workplace that sends workers up to build, install or service structures or equipment at heights — all hold the potential for catastrophe. One slip, one dropped object, one unexpected wind blast is all it takes. Gravity is unforgiving.

Addressing Safety at Heights

It’s bad enough when a safety lapse puts workers at risk. But the results can be even worse when a fall or dropped object harms the public. Neither workers nor innocent bystanders should be injured or killed by hazards from above.

That’s why the International Safety Equipment Association (ISEA) launched the “Safety at Heights” campaign this year. ISEA is the trade association in the U.S. for personal protective equipment and technologies. Member companies are world leaders in the design, manufacture, testing and distribution of protective clothing and equipment used in factories, construction sites, hospitals and clinics, farms, schools, laboratories, emergency response and in the home. Since 1933, ISEA has set the standard for the personal protective equipment industry, supporting member companies united in the goal of protecting the health and safety of people worldwide.

The “Safety at Heights” campaign focuses on helping employers reduce the risk of fatalities and injuries from falls and dropped objects in industrial, construction and other occupational settings. The campaign kicked off during Construction Safety Week and the Occupational Safety and Health Administration’s sixth annual National Safety Stand-Down, but it continues throughout 2019, in partnership with the National Association of Tower Erectors (NATE) and The Associated General Contractors of America (AGC).

“The timing of this campaign is perfect,” said NATE Executive Director Todd Schlekeway, “as NATE member companies are currently on the front lines of the 5G deployment cycle leading to technology and equipment upgrades at thousands of communication tower sites around the country. We want to ensure that this protracted, next-generation...
deployment cycle is conducted in a safe and quality manner and that tower technicians are able to return home safely every night.”

“We want to make sure workers are safe at all times and all heights when working in this industry,” added Stephen E. Sandherr, chief executive officer of the Associated General Contractors of America. “The best way to do that is to make sure everyone involved in construction has the right training, the right tools and right information to work as safely as possible.”

Employers & Workers Can Help
How can employers achieve better safety at heights? First, they need to follow best practices. That includes implementing the American National Standard for Dropped Object Prevention Solutions (ANSI/ISEA 121-2018), which ISEA developed in conjunction with industry stakeholders. Employers can also use ANSI/ISEA 121-2018 as a tool to help them comply with existing OSHA regulations to keep their work sites safe from falling objects. The standard addresses four active controls: anchor attachments, tool attachments, tool tethers and containers (e.g., buckets, pouches). It does not, however, include passive controls. Copies of the standard can be purchased online from ISEA and from ANSI’s licensed resellers.

Second, companies should reject the notion of “acceptable risk.” Injuries and deaths are not a cost of doing business, they’re human tragedies that affect families and communities, not to mention companies themselves. Employers — from the C-suite to every employee and contractor — need to nurture and support an internal culture that prioritizes safety over productivity. That means establishing a company-wide no-fault communication policy that encourages workers to bring risks and problems to management attention, while holding supervisors and managers accountable for responding to those issues appropriately.

Third, workers need to recognize that the laws of physics don’t discriminate. Safety at heights not only affects them and their coworkers, but also bystanders, pedestrians and drivers down below. Workers need to remain alert and aware, use the right personal protective equipment, such as safety harnesses and equipment tethers, and help hold one another accountable to best practices.

Learn more at SafetyAtHeights.org.

CHARLES D. JOHNSON is president of the International Safety Equipment Association.
THE CONSTRUCTION SITE IS A HIVE OF ACTIVITY with multiple moving parts and interdependent activities requiring precise synchronization. From excavation, framing and metal works, to millwork, drywalling, roofing and more, contractors are faced with the daunting task of coordinating many moving pieces throughout the project lifecycle, including the management of subcontractors, fabricators, material suppliers, and specialty equipment suppliers.

With contractors coordinating schedules, trades, and deliveries of materials and equipment to the job site, the logistics management of a building project becomes a serious challenge, especially when the scale and complexity of the project escalates.

The Supplier Connection
Given that construction jobs are closely governed by time, resource, and budget constraints, contractors need to be able to rely on suppliers to deliver materials when and where they’re needed. Although price is a differentiating factor in the home building supply industry, in today’s competitive landscape, the primary objective is service.

Whether purveyors of plumbing, electrical or HVAC equipment or distributors of lumber, roofing or landscaping materials, suppliers must ensure delivery of the accurate count of the correct items, in good condition, to the right location at the requested time—no easy feat when juggling multiple customers and job sites.

Delivery Complexities
Operating an efficient supply chain is a relentless challenge for home building suppliers. Consider a large housing development with multiple building sites and various trades awaiting equipment and materials for their particular jobs. Suppliers must grapple with multiple variables that impact their ability to achieve DIFOT (delivery in full, on time), including short lead times on orders (often less than 24 hours), tight delivery windows, variable weather conditions, and custom requests, among others.

In addition, different regions have unique delivery needs; contractors in Texas may prefer to frontload work into the early morning to avoid the midday heat, for example. Different materials have specific loading and unloading times and require distinct types of trucks and off-loading equipment. Without effective logistics management to coordinate the myriad variables in the complex delivery process, productivity decreases, costs escalate, time commitments are not met, and, ultimately, customer service suffers.

Technology Drives Performance
Leading home building supply companies are recognizing the inadequacy of traditional manual practices in managing the delivery challenges of the dynamic and highly-mobile construction industry. To keep pace with contractor expectations of on-time performance, suppliers are turning to technology and mobile solutions to automate the supply chain and optimize last mile delivery.

1. Real-time delivery route planning
Conventional paper and clipboard-based routing is inefficient, time-consuming, and error-prone—a serious impediment to providing a high standard of customer service. Technology, in contrast, transforms traditional route planning, shifting the ability to plan deliveries, schedule appointments, optimize routes, and communicate with drivers to a completely paperless environment. With automated, intelligent route planning, suppliers improve on-time performance, capacity utilization, and contractor satisfaction while driving down their transportation costs.

Plus, integration with suppliers’ other company systems, such as order management (OMS) or enterprise resource planning (ERP), automatically captures data at order entry for routing efficiencies of Return Materials Authorizations (RMAs) and material conditions, and to ensure accurate counts of the correct materials for satisfied customers.

After implementing a route planning solution, lumber and building materials distributor US LBM increased on-time delivery to 95% and improved performance by as much as 35% at many locations. Yard personnel are notified via text message 45 minutes before trucks return, allowing time to stage material. In New Jersey, one of the company’s busiest markets, the team reduced turnaround times to 25 minutes—a 30% reduction.

2. Dynamic delivery appointment scheduling
In the construction environment, appointment scheduling is driven by numerous factors beyond the control of the supplier, such as changing contractor demands, crew or resource availability, inventory requirements, and weather issues.

With dynamic appointment scheduling, suppliers have both visibility into the impact of unforeseen variables, plus the tools to make adjustments on-the-fly and communicate details in real-time to all stakeholders.
3. Real-time updates on mobile devices
In order to manage crews effectively and keep construction projects on track, contractors need to know what materials are arriving when at job sites. To this end, leading distributors are using mobile technology to improve the performance of their delivery team by providing contractors with real-time visibility into the status of work site deliveries, including automated exception notifications.

Drivers access delivery schedules using a mobile device; real-time GPS data is used to track truck location, estimate travel time, monitor appointments, and keep contractors up-to-date throughout the day.

Mobile technology also drives performance gains on the supplier’s sales front. The sales team has instant visibility into what facility or yard is shipping an order, where that load is coming from, the anticipated time of delivery, and what material is on each load. On the inbound side, contractors can contact the sales team with a single click and place orders from an itemized list of materials with anticipated delivery times.

4. Mobile proof of delivery (POD)
Missing signatures, lost paperwork, illegible details, and time-consuming claims disputes between suppliers and contractors plague paper-based POD. With mobile devices, drivers can wirelessly confirm deliveries and other details in real-time. Mobile POD, enhanced by picture and signature-capture functionality, makes it easy to verify that the right materials, in the correct quantities, were delivered undamaged at the expected time.

Removing paper from the equation facilitates immediate processing, faster invoicing, and better cash flow. With electronic POD, invoices are approved in a fraction of the time and end-of-day reconciliations and returns processing is far less time-consuming. And because drivers collect information more efficiently, paperless POD gets them back out on the road faster to meet other delivery commitments, even building up to more deliveries per day.

From a claims management perspective, mobile POD minimizes disputes, streamlines the resolution of claims, and mitigates fraudulent claims. Indeed, building supply distributor US LBM saved tens of thousands of dollars with better delivery claim resolution. In addition, mobile POD technology reduces the costs and labor associated with paper-based practices, such as multipart invoicing and the resources dedicated to processing, imaging, and storing paper documents.

Final Thoughts
The power of mobile technology in the construction industry, like many distribution-intensive industries, lies in its potential to help companies leverage the supply chain as a competitive weapon. Using technology to achieve a streamlined, paperless supply chain helps building materials distributors to meet the strict delivery expectations of contractors—even in the high-intensity summer months—while minimizing transportation and labor costs. And by focusing on driving efficiencies through last mile delivery operations, home building suppliers can ensure an exemplary customer experience.

---

**Sunil Mathew** is Director, Industry Strategy, at Descartes.
This INR 1.2 billion project consists of a basement and 12 floors, totaling an area of 200,000 square feet. Most buildings in the area are mixed use, with office spaces above other businesses. However, K10 wanted to bring something new to the area, so K10 Grand will only be used for offices. This setup would limit the disruption of office life for the inhabitants.

Overcoming Design Issues to Create Column-free Space
To design this impressive structure, VYOM needed to overcome many challenges. Because of the elevation and the internal architectural planning of the building, there were structure design issues that the organization needed to address. The project team wanted to create a building with three towers and a core structure in the middle. The structure bulges outward for the bottom six floors and then tapers upward for the top six floors. Arrangement of columns and shear walls was difficult because of this unique shape. Also, the architect and developer insisted on having a column-free space in the entrance foyer. The center core needed to house all utilities, and it was difficult to have an earthquake-resistant design because the shape of the building was attracting more lateral forces. Finally, the foundation of the building was a combined and raft foundation, making it necessary to carefully evaluate the structure before construction. Currently in the construction phase, the building is expected to become a landmark for the area.

Connecting Structures for More Economical Design
When designing the building, the original plan was to create four separate buildings: three towers and one core structure. However, when VYOM began analyzing the design in STAAD, the project team realized that this initial design proposal was not economical. Instead, the team used STAAD to create a new, optimized design to be more cost efficient. The project team decided to connect all the buildings together, saving money and time. It was critical for the team to make this change before the construction phase.

With this design in place, VYOM then decided where to put structural support columns. STAAD showed the project team that the shape of the building curves considerably from the ninth floor upward, making typical straight columns impossible because they would go through the plane of the building. Stub columns would not have worked either because they would have significantly lowered the ceilings and ruined the office space plans. Instead, VYOM suggested straight columns for the first nine floors and inclined columns from the ninth to twelfth floors. This plan would maintain the architecture while staying within IS code requirements.

Implementing Beams and Columns for Equal Tension
Another feature that helped VYOM create the unique space was using post-tensioned beams. The beams could not be very deep, as the architect wanted the highest possible ceilings. Also, the plan required that the ducts run along the beam. These beams, coupled with columns
and shear walls, prevented torsion in the building, allowing the center of mass and stiffness to be adjacent. VYOM arranged the columns so that the lateral force will rest completely on the center of the building. All the shear walls, lift walls, and columns were arranged so that they can resist 70% of the lateral force. To provide column free space in the foyer, VYOM used 20-foot cantilever beams and slabs for the rest of the floors in the building.

Using STAAD, VYOM realized that there was still a high-tension zone in the building. This zone occurred on the ninth floor due to the ranking columns spacing. The ninth floor carries a high load, so it was necessary to adjust the design. Once the project team realized this situation, team members managed the directional force away from the beams on the ninth floor with reinforcement and cables put into the same beams.

**Saving Design Time for a Workplace of the Future**

By using STAAD, VYOM completed the entire building design with drawings in one month. STAAD saved the project team significant time during the entire design stage, allowing for nearly 70 design iterations to be performed for both design approaches and final design within the month. STAAD reduced the time needed to design and analyze these iterations. The application also allowed these iterations and design changes to adhere to IS code in a user-friendly environment.

The design met all the requirements of the architect and developer, with construction now in progress. The highly anticipated building looks identical to the 3D model, and the commercial spaces are useful without any obstructions. Being located at the center of the city, K10 Grand will allow occupants to have everything they need nearby, including shopping malls, hospitals, grocery stores, and restaurants. The space will include a rooftop deck, shared conference spaces, a lounge, gym, and coffee shop, making it a workplace of the future.

**Project Summary**

**Organization**
VYOM Consultants

**Solution**
Structural Engineering

**Location**
Vadodara, Gujarat, India

**Project Objectives**
- To design an aesthetically pleasing building to meet expectations of Vadodara’s business elite.
- To address structural design challenges while maintaining a cost-effective design.

**Products Used**
STAAD

**Fast Facts**
- K10 Grand is a pioneer office building that is defining new standards of commercial spaces in Vadodara, Gujarat, India.
- After analyzing the design structure in STAAD, VYOM decided to connect the four separate buildings for a more economical design.
- VYOM identified a high-tension zone on the ninth floor with STAAD, making it necessary to adjust the design.

**ROI**
- The entire building design with drawings were completed within one month with STAAD.
- STAAD saved significant time during the design stage, allowing for nearly 70 design iterations to be performed for both design approaches and the final design.
- STAAD reduced the time to design and analyze these iterations while allowing them to adhere to IS code in a user-friendly environment.

Samantha Langdeau is the Manager of Product Marketing, Structural, Offshore, Pipe Stress for Bentley Systems. Langdeau has worked in the structural, offshore, pipe, civil, geotechnical and geospatial industries for over seventeen years. She helps engineers learn how innovative technology can help them achieve their goals by improving their efficiency and their bottom line.
Standing at 14,115 feet above sea level, Pikes Peak is one of the most visited mountains in North America. It is home to majestic views, a National Historic Landmark and more than 500,000 visitors per year. It is also home to some of the harshest building conditions I’ve experienced in my 40-plus years as an engineer.

The weather on Pikes Peak is cold, icy, windy and generally unforgiving. By October, temperatures can plummet to zero, with wind chills falling even lower. Snowstorms sweep in quickly, with wind gusts reaching up to 100 mph, and even up to nearly 195 mph in rare cases. During the winter, temperatures can drop to -40 degrees. Roof snow loads can approach 125 pounds per square foot vs. an average 30 pounds per square foot in nearby Colorado Springs, elevation 6,000 feet. Ground conditions on Zebulon’s namesake are bedrock and alpine permafrost, soil and rock that remains at or below freezing temperatures all year to depths of up to 200-plus feet, only warming above freezing in direct sunlight or due to external sources.

Despite these conditions, the peak will soon house a brand-new $56 million, 38,000-square-foot Pikes Peak Summit Complex. The three-building campus consists of a visitor’s center with dining and rooftop terraces, observation decks and interactive displays, and a high-altitude research and communications center. Because the building will rest on federal land, it must carry a LEED Silver certification and is being prepared to qualify for the Living Building Challenge, one of the world’s most rigorous sustainability programs.

Our task as geotechnical consultants to the owners – a group of six governmental agencies and private companies – was to build a foundation and structure that could withstand the unforgiving conditions and could be built within the mountain’s remarkably short building season – six months at best. Considerations also needed to be made for the altitude – tough on materials and people – and the location at the top of a mountainous road rife with hairpin turns too tight for large trucks to navigate.

Planning began in 2015. Our work, along with that of RTA Architects and HCDA Engineering, focused on solving two primary problems: (1) overcoming issues related to excavating and building in the permafrost layer, and (2) designing structural materials that could perform at the 14,000-foot altitude, but could be partially constructed at a lower altitude to minimize wear and tear on crews and equipment.

Permafrost

When we started this project, we knew what not to do. The existing visitor’s center is a one-story facility constructed in 1963 using a hybrid foundation composed of a reinforced mat with steel beam grid. Due to costs and difficulty in excavation during the initial construction, the initial recommendation of 6 feet of crushed rock fill was changed to 3 feet of crushed rock and 3 feet of foam. The reinforced mat was an attempt to prevent the freezing temperatures from reaching the foundation, but it didn’t work. Construction of the facility on top of the permafrost layer created a zone of warmth that melted portions of the permafrost. In the first 9 months, the building settled 9 inches. It has been problematic ever since.

Alpine permafrost is relatively rare in the lower 48 U.S. states. The physical characteristics and mechanical properties tend to be highly spatially variable and extremely sensitive to changes in temperature. To accurately plan, we relied on a series of subsurface investigations conducted by the US Army Corps of Engineers (USACE) in 2015 and 2016. The CTL team then completed a series of reports based on the USACE investigations and other historic data. The reports were all in agreement that the subsurface conditions consist of an active layer of weathered Pikes Peak Granite, approximately 6 feet in thickness, underlain by an ice-rich permafrost layer and finally Pikes Peak Granite bedrock, the surface of which is significantly fractured in some locations. The thickness of the permafrost layer was unknown.
To account for these conditions – and keeping in mind the failed foundation of the existing Summit House – we recommended that foundations for the new facility be shallow, reinforced concrete spread footings bearing on the granite bedrock. We recommended foundation walls be insulated precast concrete panels, and floors on the lowest level of the facility to be slab-on-grade. Below the floors, the permafrost layer is to be removed and replaced with 3-inch minus, crushed bedrock fill.

Another key consideration was adequate drainage, which is critically important to avoid freezing runoff water from contributing to frost heave of the facility. Foundations were designed to be surrounded by free-draining fill materials and exterior drains that facilitate movement of the water away from the facility.

Building Materials
Building materials are a significant issue at this altitude and in the permafrost. To account for all possible issues, we employed thermodynamicist Bob Pintner from Alaska-based R&M Consultants. Together, CTL’s materials experts and the Alaskan heat engineers devised building materials that could withstand both the cold and altitude and be built in a facility in Colorado Springs, yet maintain integrity at the high altitude.

To manage installation of foundation micropiles, we plan to preheat drill holes, reinforcing rod and grout mix constituents, and admixtures, to ensure proper curing and bonding before the grout freezes.

The team is pre-manufacturing the entire building shell in prefabrication shops in Colorado Springs, including precast concrete structures, foundational formwork for cast-in-place footings, precast exterior walls, rebar cages and components for a hydro radiant-heated flooring system.

Once designed, the size of the transport load needs to be very carefully calculated, as materials need to be delivered and/or hoisted up the steep and winding, limited weight-bearing capacity road. It takes hours to haul heavy loads just a few miles. In some cases, as with the track hoe and rock crusher, the equipment can’t be hauled. Recently we had to drive a steel track hoe up and down the mountain – at speeds barely reaching 3 mph. It took six hours to get down the mountain, in the middle of the night to avoid any car traffic.

It’s not just equipment that has a much lower productivity output on the peak. Construction crews can only work 6.5-hour shifts, and workers need to pass a physical exam that ensures they can handle an oxygen content nearly half that of Colorado Springs. While these requirements don’t affect a geotechnical plan, they absolutely impact the overall construction schedule. Currently, the completion date is scheduled for December 2020.

Construction Resumes
Construction began June 2018 and resumed again this May. To date, crews have blasted 10 to 25 feet below grade with excavation to bedrock, supporting the building below the layer of permafrost. In addition, crews placed 43 cubic yards of concrete footings for the foundation of the center in 2018.

The next phase of the project involves pouring the foundations for the Summit House and the adjoining U.S. Army Corps of Engineers High Altitude Research Laboratory. The team hopes to install the lower portions of the foundation walls this season, along with part of the main structure for the House.

Crews will also place 430 precast pieces of below-grade, load-bearing members, composite veneer sandwich panels comprising 8 inches of structural concrete, 8.5 inches of expanded polystyrene insulation and 3 inches of nonstructural concrete veneer, according to Jack Glavan, manager of Pikes Peak–America’s Mountain.

We are hopeful that Mother Nature cooperates, confident in our planning, but only sure of one thing: We won’t get any easy answers.
5-over-2 Podium Design: Path to Code Acceptance

By Terry Malone, PE, SE, WoodWorks – Wood Products Council

Nationwide, there has been an increase in the demand for multi-story mixed-use and multi-residential structures. Common configurations include up to five stories of residential use over retail, commercial, office and/or parking occupancies, similar in configuration to the building shown in Figure 1. Podium designs are one way to maximize the number of stories, increase unit density and lower construction costs. This article covers important design considerations and traditional approaches related to the design of a five-story wood-framed structure over a two-story concrete or masonry podium.

The 2015 International Building Code (IBC) allows a maximum building height above grade of 75 feet using Type IIIB construction and 85 feet for Type IIIA if NFPA 13 sprinklers are used. However, they only allow up to five stories for Type IIIA or IIIB structures under those same conditions. Structural provisions in the American Society of Civil Engineers’ Minimum Design Loads for Buildings and Other Structures (ASCE 7) limit the maximum height of wood structural panel-sheathed shear walls to 65 feet above the base of the seismic force-resisting system (SFRS) in Seismic Design Category (SDC) D, E, or F. To gain additional stories, increase building area, and stay within the allowable building and seismic system heights, the IBC and ASCE 7 each have provisions which enable podium designs.

IBC 2015 Section 510.2 allows an upper portion of any construction type to be built over a lower portion where the two portions are treated as separate and distinct structures. This is for purposes of determining the allowable area limitation, continuity of fire walls, type of construction, and number of stories. This allowance only applies when:

- The building portions are separated by a horizontal assembly with a minimum 3-hour fire-resistance rating,
- The building below is of Type IA Construction and is protected throughout with NFPA 13 sprinklers,
- Shafts, stairways, ramps, and escalator enclosures penetrating the horizontal assembly have a 2-hour fire-resistance rating, and
- The maximum building height measured in feet above grade is not exceeded.

The 2015 IBC allows multiple-story podiums. This allows two stories of podium with five stories of wood framing above to meet the 85-foot maximum building height limitation and also meet the 65-foot SFRS height limit.

Example floor plan configurations typically encountered in mid-rise multi-family construction are shown in Figure 2. These plans are frequently rectangular, with or without exterior shear walls, or they can have multiple horizontal offsets and wings. The lateral force-resisting system for the flexible upper portion is typically light-framed shear walls sheathed with wood structural panels (WSP). Many if not all of the walls separating the dwelling units are used as interior shear walls in the transverse direction. Lateral forces in the longitudinal direction are typically resisted by the exterior walls and corridor walls. If a rigid diaphragm analysis is warranted, the transverse walls would also act to resist torsional forces.

Designers of these buildings should avoid having more than one SFRS in the flexible upper portion. ASCE 7-10 Section 12.2.3 notes that when combining different seismic force-re-
sisting systems in the same direction, the most stringent applicable structural system limitations of ASCE 7-10 Table 12.2-1 shall apply. For example, light-framed shear walls with WSP sheathing have a response modification coefficient of $R=6.5$. Combining light-framed shear walls sheathed with other materials (e.g., gypsum wallboard) having a response modification coefficient of $R=2$, would require the WSP walls to be designed for forces in excess of three times greater ($6.5/2$) than if only WSP walls are used. Similar force modifications for wind demands do not apply.

**Two-Stage Seismic Analysis**
Structurally, ASCE 7-10 Section 12.2.3.2 provides a two-stage analysis procedure that can be beneficial for seismic design of podium projects. The procedure treats the flexible upper and rigid lower portion portions of the structure as two distinct structures, thereby simplifying the seismic design process. Only the weight of the flexible upper portion has to be considered in its design, not the entire weight of both portions. The two-stage analysis also allows the seismic base of the upper portion to be the top of the lower portion. This allows measuring the maximum SFRS height for a wood structural panel-sheathed shear wall system in SDC D through F of 65 feet, from the top of the podium. The requirements for a two-stage analysis are:

a. The stiffness of the lower section is ten times the stiffness of the upper section.
b. The period of the entire structure is not more than 1.1 times the period of the upper portion considered as a separate structure supported at the transition from the upper to lower portions.
c. The upper portion is designed as a separate structure using the appropriate $R$ and redundancy factor, $\rho$.
d. The lower portion is designed as a separate structure using the appropriate $R$ and $\rho$. The reactions from the upper portion are determined from the analysis of the upper portion amplified by the ratio of the $R/\rho$ of the upper portion over the $R/\rho$ of the lower portion. This ratio is not less than 1.0.
e. The upper portion is analyzed with the equivalent lateral force or modal response spectrum procedure, and the lower portion is analyzed with the equivalent lateral force procedure.

![Figure 3 – Discontinuous shear wall at podium slab](image-url)
Some confusion exists regarding the required amplification of the forces that are transferred from the flexible upper portion into the podium slab. The amplification factor in 12.2.3.2 (d), when used, applies to only the seismic component of the reaction forces, not the entire reaction-included gravity loads. Gravity framing (e.g., beam, post-tensioned slabs, columns) supporting a discontinuous shear wall is designed for overstrength where required by ASCE 7-10 Section 12.3.3.3. Connection requirements to the podium slab are as shown in Figure 3.

**Diaphragm Design**

Distribution of forces to the vertical-resisting elements are based on analysis methods where the diaphragm is modeled as follows:

- Idealized as flexible – The distribution is based on tributary area. In common multi-family shear wall layouts, this can underestimate forces distributed to the corridor walls and overestimate forces distributed to the exterior walls with a similar impact on diaphragm forces being delivered to the walls.

- Idealized as rigid – The distribution is based on relative lateral stiffnesses of vertical-resisting elements of the story below. This more conservatively distributes lateral forces to corridor and transverse walls and allows easier determination of building drift, but can overestimate torsional drift and underestimate forces distributed to the exterior walls, including diaphragm forces.

- Modelled as semi-rigid – The diaphragm is not idealized as rigid or flexible. Shear is distributed to the vertical-resisting elements based on the relative stiffnesses of the diaphragm and the vertical-resisting elements, accounting for both shear and flexural deformations. In lieu of a semi-rigid diaphragm analysis, it is permitted in the American Wood Council’s Special Design Provisions for Wind and Seismic (SDPWS) 2015 Section 4.2.5 to use an enveloped analysis, analyzing for both flexible and rigid conditions and taking the largest forces.

Current practice for light-frame construction commonly assumes that wood diaphragms are flexible for the purpose of distributing horizontal forces to shear walls. ASCE 7-10 Section 12.3.1.1 (c) allows diaphragms in light-frame structures to be idealized as flexible when 1 ½ inches or less of non-structural topping, such as concrete or a similar material, is placed over WSP diaphragms, and each line of vertical elements of the SFRS complies with the allowable story drift of ASCE 7-10 Table 12.12-1. Using the flexible diaphragm assumption would allow the distribution of diaphragm forces to the shear walls to be based on tributary area. In 1999, the Structural Engineers Association of California code and seismology committees recommended that relative flexibility requirements outlined in ASCE 7 Section 12.3.1 be considered for wood-framed diaphragms.

**12.3.1 Diaphragm Flexibility**

The structural analysis shall consider the relative stiffnesses of the diaphragms and of the vertical elements of the seismic force-resisting system. Unless a diaphragm can be idealized as either flexible or rigid in accordance with Sections 12.3.1.1, 12.3.1.2 or 12.3.1.3, the structural analysis shall explicitly include consideration of the stiffness of the diaphragm (i.e., semi-rigid modelling assumption).

Even though diaphragms may be idealized as flexible, it is sometimes good engineering judgement to consider other flexibility conditions. Currently, some designers only perform a flexible diaphragm analysis, and some a rigid diaphragm analysis, but a few use semi-rigid modeling (enveloping). On that basis, some confusion and lack of consistency exists regarding which type of diaphragm analysis should be employed for a given project. Verifying the diaphragm flexibility is becoming increasingly more important given trends toward larger openings in exterior shear walls, shorter wall lengths, and a greater number of wood-frame stories over the podium.

**Conclusion**

Mid-rise structures using podium designs provide many opportunities for cost-effective, higher-density construction. It has become increasingly important to consider the relative stiffness of the diaphragms and shear walls, and the effects of multi-story shear walls as buildings become taller and more complex in shape. Research, full-scale testing and performance-based studies continue to evolve, which impact both changes to the building code and guidelines for engineers. Recognized, comprehensive guidelines and design examples providing in-depth coverage are available demonstrating traditional methods of analyzing mid-rise and podium designs.

For other in-depth resources on the design of wood-frame and mass timber buildings, visit www.woodworks.org/publications-media/solution-papers/. For free technical support related to a commercial or multi-family wood building, contact the WoodWorks expert nearest you at www.woodworks.org/project-assistance or email help@woodworks.org.
Greater Cincinnati Water Works (GCWW) has had a successful program to address the risk of lead in drinking water for many years, always meeting USEPA’s Lead and Copper Rule requirements. Our utility service area has an estimated 44,000 lead service lines, including full lead service lines as well as those partially replaced on the public side with copper pipe. We have proactively offered free lead testing kits and water filter pitchers certified for lead removal to our customers for many years while simultaneously encouraging residents to replace their lead lines when impacted by a GCWW water main replacement project. This campaign had its challenges, however, primarily due to the private-side replacement cost the homeowner must incur. After the well-publicized events of Flint, Michigan, we decided to face this challenge head on. The resulting Enhanced Lead Program emerged from the fact that the best way to approach the risk of lead in drinking water is to remove the sources of lead, including those on private property, and we needed to involve and enable our residents and surrounding communities to achieve this outcome.

We developed a two-tiered approach with a goal of becoming a lead safe water city. The first tier includes public outreach and education strategies, and the second assists customers with lead service line replacement on private property. Customer affordability was identified early on as a major hurdle to private property lead service line replacement, so GCWW focused on developing financial assistance strategies to encourage and enable customer participation. This self-started initiative offers all customers educational resources and financial assistance to completely remove their lead service lines and the associated health risks from drinking water.

Tier 1 program goals focus on public outreach and education. Early on, we sent letters to all residents in our service area who, according to records, had private-side lead service lines on their property. The letters informed residents of the risks and encouraged them to submit samples of their water for free lead testing. Concurrently, a “speakers bureau” of GCWW employees was formed to visit Cincinnati neighborhood councils and inform residents about lead in drinking water and the importance of removing lead service lines. These efforts were supplemented with messaging on social media to direct residents to the website as well as a dedicated phone line for more information.

GCWW recently launched a new website dedicated to the Enhanced Lead Program, where visitors can learn more about the dangers of lead and how to determine if their service lines are made of lead. The new website also includes a GIS-based map of Greater Cincinnati properties, searchable by address, to determine where lead service lines still exist in the GCWW service area. Visitors can sign up for free lead testing and request more information about lead line replacements using the website.

Tier 2 of the Enhanced Lead Program was designed to enable lead service line replacement. The greatest challenge in this effort has been to create a way to alleviate the financial burden of private-side replacement for property owners. At the urging of GCWW, Cincinnati City Council passed an ordinance declaring lead service lines to be a matter of public health and safety. This was a big step. By enacting this ordinance, City Council allowed GCWW to use rate payer funds to assist
with lead service line replacement work on private property in the form of cost share. As one councilmember said, “This is a shared problem that will require shared resources; we all have a stake in this.”

With the groundwork laid, we began the Lead Service Line Replacement Program. The program uses pre-qualified plumbing contractors to do the work for property owners who sign replacement agreements with GCWW. We then coordinate all the replacement work, compensate the plumbing contractor once the work is completed, and then seek reimbursement from the property owner. To assist our property owners with the replacement cost, we created a cost-sharing program that covers 40 percent of the total construction cost of replacement up to a limit of $1,500. The cost-sharing program is available to all GCWW customers who join our Lead Service Line Replacement Program. The remaining amount is the responsibility of the property owner.

When considering reimbursement options for the balance of the cost (i.e., after the cost share amount is deducted), we realized the importance of separating the cost of replacement work from property owners’ monthly water bills. We did not want customers to experience a service shutoff for a delinquent water bill caused by this program. We determined a better, lower risk option was tying lead line replacement costs to the property as a special assessment, payable through property taxes. With this option, property owners can reimburse GCWW over a 5- or 10-year period, and the assessment remains with the property upon any transfer that may occur, further equalizing the cost among those who are benefiting. This financing is offered at a zero percent interest rate.

Despite the benefits listed above, we knew that lead service line replacement, which can run several thousand dollars, would be simply unaffordable for some property owners. For these individuals, the Cincinnati City Council authorized the creation of a customer assistance program designed specifically to help fund lead service line replacement for low-income property owners. The resulting program is called HELP (Help Eliminate Lead Pipes), which allows a one-time credit for an additional 30 percent off the balance of the replacement cost. Any property owner with a verifiable private-side lead service line is eligible to apply, and qualification is based on the most recent area median income levels as defined by the US Department of Housing and Urban Development for Hamilton County, Ohio.

The HELP program is completely funded by donations. GCWW offers a “1, 3, 5” program, where individuals can sign up to add $1, $3 or $5 to their monthly water bill as a donation. There is also an active campaign that allows City of Cincinnati employees to donate a portion of their paycheck to the HELP program. In addition, we seek to raise awareness of the Enhanced Lead Program and the need for funding.

The award-winning Enhanced Lead Program is off to a strong start. For other municipalities looking to begin their own lead service line removal program, we recommend focusing first on what will incentivize and enable people to act. When customers see a utility is willing to be a part of the solution, share the burden of replacement, and work to minimize or eliminate barriers to participation, they are more willing to get on board. Providing this level of support for customers boils down to funding and resources, and we have found creative ways to enable our program while working within our municipal boundaries. We are attempting to further address the funding challenge by reaching out to legislators at both the local and state levels. Additionally, we are collaborating with other agencies, such as the local health departments, to serve as partners to reinforce our message.

We encourage other municipalities to get involved and see how they can initiate a similar program. There is no one-size-fits-all solution to this problem. It must work for both you and your customers. Lead service lines are a problem for people of all backgrounds and income levels, and in order to find a solution, it needs to be an inclusive, community-based effort. If you can come together as a community, removing the risk of lead to a home’s drinking water is a tremendous step toward attaining a lead safe community.

JASON DELAET is the Enhanced Lead Program Manager for Greater Cincinnati Water Works.
HOPE IN THE AMAZON

By Jennifer Roath, P.E.

THE AMAZON RIVER BASIN is the largest in the world, spanning 40 percent of South America and discharging an average 55 million gallons of water per second into the Atlantic Ocean. When the Amazon River flows out of Peru, it only has one-fifth of the final discharge, yet it is still greater than any other river in the world. Despite this massive water resource, industrial and agricultural runoff, combined with insufficient sanitation practices, have unfortunately contaminated the region’s water supply.

Without access to water treatment systems, the 105 inhabitants of Mariscal Castilla, a small Peruvian village located at the headwaters of the Amazon, send family members to the river each day to fetch buckets of water. After drinking this water, they often suffer from debilitating water-born illnesses, leading to missed work or school. Starting in 2017, a team from Engineers Without Borders Central Houston Professional Chapter worked with this village to address its needs and provide a sustainable alternative to drinking untreated stream water.

Bacteria and E. Coli testing confirmed the streams around the village were contaminated and would need treatment if selected as the project’s water source. And, despite the region’s available ground water, many nearby villages have abandoned their wells due to the undesirable taste. In order to pump and treat either water source, a reliable energy supply was critical. Confined by dense jungle, Mariscal Castilla is only accessible via the Amazon River, limiting resource options for the design.

Furthermore, the villagers would need to independently operate the system. Past projects have shown that complicated technology that requires expensive repairs is eventually abandoned; therefore, we decided against a small water treatment plant and groundwater wells as alternatives. Fortunately, the village receives more than 200 inches of rain annually, providing an abundant source of clean water. We determined that installing a rainwater harvesting system and a gravity fed distribution line was the most sustainable solution for this village.

The next step was to calculate tank sizes and identify potential sites. To ensure the entire village has ownership of the rainwater harvesting system, only common buildings were considered as potential locations. At the front of the village, closest to the Amazon River, sat a schoolhouse and meeting space with metal roofs instead of thatching, a prerequisite for rain collection. Taking the combined roof areas and the estimated per capita water consumption, the inputs were compared to local monthly rainfall data to size the storage tanks. To supply the village with 15 liters of drinking water per person per day, three 7,500-liter tanks would be needed. It was assumed that non-drinking water for activities such as washing clothes would still be sourced from the river; therefore, only drinking, cooking, and bathing was used to estimate water usage.

Tank elevation was also a critical design component since the system will be entirely gravity fed. In addition, the heavy seasonal rains inundate most of the village with three to five feet of flood water for months at a time each fall. Homes are built on posts to protect families during these events. This meant our tank platform and filling stations needed to be above the highwater levels too.

The last design consideration was the distance from the homes. The World Health Organization considers “basic access to water” when the taps are between 300 and 3,000 feet from a residence. Since children were often the ones retrieving the water, our team targeted a maximum distance of 500 feet for any family in the village. Given the minimum filling station height set by the flood level, the required tank elevation was calculated to provide sufficient pressure to fill a bucket in less than a minute at a filling station over 1,000 feet away.

After finishing the design and receiving travel approval from Engineers Without Borders USA, we began planning transportation and construction logistics. Constructing the entire system, even with considerable help from the villagers, would take five weeks to complete. Ten of our engineers volunteered to rotate into the village in two week increments to supervise construction, and the first flights were set to take off in October 2018.

Complications Strike

After spending nearly a year drawing detailed plans for the collection, storage, and distribution systems, in July 2018, we received word that a major flooding event had washed away 100 feet of the village shoreline, including our proposed site. The villagers had already started relocating the school and community building, so our best option was...
to relocate the tanks to this new site. Since a roof is the requisite component on the building, the villagers rushed to construct the frame and install the metal sheeting before our arrival in October.

The new tank site was 1,500 feet from the river, and initial reports indicated flooding was only one foot high. However, when our engineers arrived in October, they discovered that the highwater mark was over three feet, meaning the entire system would need to be two feet higher than planned.

The original tank platform design was a manually compacted dirt mound, three feet high with a 1:2 slope. With the help of the villagers, we anticipated mound construction would take three to five days. However, raising the mound to five feet would mean doubling the volume and potentially overrunning the schedule. An alternative wooden platform design was not feasible to construct within the time constraint because harvesting wood is extremely time consuming. This meant we had to stick with the original dirt mound design, despite the additional labor demands and stress on schedule.

Another major complication was the new community building was too short for the tanks. If the roof was left as is, the collection piping would enter the tank at a lower level, reducing storage capacity. After discussions with the community leaders, a skilled group of villagers set out to raise the building’s roof while the rest of the team continued to work on the tank foundation. Using their own technique, the villagers adjusted the roof’s pitch one panel at a time.

To complicate matters further, the seasonal flooding started early in 2018. Our project was a collaborative effort with the village, and we were relying on volunteers to provide a considerable portion of the labor. Each fall, the villagers harvest their rice crops before the rainy season starts. With the harvest schedule in mind, the project was timed for when villagers could help. This year, most villagers were unavailable to help with construction because they were harvesting their rice crops.

We knew the trip would be over in November and our team would not be returning for at least a year. Consequently, during that final week, we made the decision to prioritize the critical components: hang the gutters, connect collection piping, and finish the primary filling station. This would allow the village to start collecting rainwater, even if they had to walk up to 1,500 feet to the site. The distribution portion of the project was postponed until we could make a return trip.

Conclusion

On the penultimate day of our trip, we rushed to get the system operational. We attached the filters at the filling station, covered the overflow discharge pipe with mosquito netting, and placed chlorine tablets in the intake line. Overwhelmed by what seemed like a never ending “punchlist,” we barely noticed the sky darkening overhead. Just as the men attached the final gutter, rain started to pour over the site. We huddled together under the roof, watching as water flowed from the gutters. We could hear the rush of the water reverberating inside the tank as it started to fill.

Thirty minutes later, the clouds cleared, and we gathered eagerly at the filling station with empty bottles in hand ready to test the system. Taking turns opening the valves, the clear water flowed into our water bottles. As the villagers had their first sip of freshly harvested rainwater, we were all beaming with joy. The next day, our team packed up and departed Mariscal Castilla.

Over the last eight months, the villagers have sent word that the system is collecting rainwater. They are already seeing the health benefits of the cleaner water and reporting fewer illnesses. This fall, our team will be returning to Mariscal Castilla to help install the distribution piping and complete this meaningful and impactful project.

JENNIFFER ROATH, P.E., is a water conveyance engineer at Lockwood, Andrews & Newnam, Inc. (LAN), a national planning, engineering and program management firm. She can be reached at JARoath@lan-inc.com.
Establishing an NCEES Record is the most efficient way to complete the licensure process in multiple states. Once established, an NCEES Record will include most—if not all—of the materials you need to apply for comity licensure in additional states and territories. If you are a Council Record holder, NCEES will electronically submit your materials directly to the state licensing board on your behalf each time you apply for a license. This saves time and simplifies the application process when you need to practice in multiple states.

“An NCEES Record makes it fast, easy, and convenient to apply for additional P.E. licenses in other states.”

Alexander Zuendt, P.E.
Zuendt Engineering
Record holder since 2011

Build your NCEES Record today.
ncees.org/records
In recent years, the number of cars on the road in the U.S. has steadily climbed, reaching an all-time high of 272.48 million in 2017. Of course, with the increase in cars, also comes an increase in traffic and road congestion. In addition to being irritating, traffic congestion can cost individual drivers hundreds of lost hours and thousands of extra dollars every year.

Given the high costs of ever-increasing traffic congestion, many are looking to technology to solve this growing problem. So, how can technology impact traffic in the near future?

Self-Driving Cars
One of the most anticipated technological advances of our time is self-driving cars. Every major automotive manufacturer in the world has invested millions (or billions, in some cases) of dollars in technology for autonomous vehicles. Though the technology for a truly autonomous vehicle requiring no human input is still several years away, there’s no doubt that self-driving cars are going to be a major factor on the roads within the next 10 to 20 years.

With regards to traffic, there are a couple of major ways that self-driving cars can contribute to reduced traffic congestion.

Vehicle-to-vehicle (V2V) technology allows vehicles to communicate with other vehicles on the road. V2V technology includes both sensors around the exterior of the car and communication technology that allows vehicles to send and receive information from other vehicles on the road.

Vehicle-to-infrastructure (V2I) technology allows vehicles to communicate with infrastructure, including traffic signals, pedestrian crossings and more. This information will help the vehicle calculate traffic patterns and make route changes based on unexpected situations.

Both V2V and V2I technologies will be important in helping autonomous vehicles navigate roads and determine the most efficient and least congested routes for your trips. In most cases, that should translate to less-congested roadways and faster commute times for everyone.

On the other hand, some studies are predicting that self-driving cars could actually make congestion worse in certain high-population areas. In those cases, researchers believe that some commuters who currently use public transit would opt instead to use automated cars for their commute, thus leading to more vehicles on the road and ultimately making travel problems worse in some areas.
Adaptive Traffic Signals
Adaptive traffic signals work with V2I technology to understand and regulate traffic patterns. Though only in-use in a handful of places currently, these smart systems show great potential for managing traffic patterns and reducing congestion at different times of the day.

Mass Transit
Mass transportation options such as buses, trains, and planes make a significant impact on reducing traffic congestion, especially in heavily populated areas. So, advances in mass transit are another way that some companies are hoping to reduce traffic congestion and improve the lives of commuters. Some exciting mass transit projects in development include:

Hyperloop
Developed by Elon Musk’s SpaceX program, the Hyperloop is a high-speed levitated pod that moves in a low-pressure tube. The pod moves at aircraft-like speeds and can reduce what is now a four-hour drive between major cities to just a 30-minute ride in a pod. The project was created to be open-source, so multiple companies have begun working on this technology and are exploring multiple projects around the U.S. and the world.

Personal Rapid Transit (PRT)
Personal Rapid Transit (PRT) vehicles are another type of pod meant to transport up to 6 people. This type of transportation uses smaller pods on specially-made guideways that are generally built aboveground, like other raised transit systems. It stops at only the stations requested by passengers, allowing it to avoid unnecessary stops and delays. Unlike the Hyperloop, PRT systems are currently in use in a handful of places, including Morgantown, West Virginia and Heathrow Airport in London.

These are just a few of the many technologies currently in development to improve mass transit options around the world. Making affordable mass transportation convenient, and even fun, could be an important key to reducing traffic congestion.

Drones
Amazon has made no secret of the fact that it wants to use flying drone technology to make deliveries to customers. It’s even announced the service, Prime Air, and indicated that it plans to use drones to air-deliver products to customers in 30 minutes or less. The logistics of flying drone delivery are extremely complicated, which is why the service hasn’t launched yet. However, Amazon did recently announce another program to use sidewalk drones to deliver products.

The goal is to deliver products to clients quickly and cost-efficiently. However, one of the benefits that result from exploring alternate means of delivery for products is that fewer delivery vehicles will ultimately be on the road. It will be some time before drones of any kind are making enough deliveries to impact traffic patterns, but if drones can reliably be used to deliver packages by retail giants such as Amazon, it will eventually lead to a sizable reduction in the number of vehicles needed to deliver packages.

From high-speed pods to self-driving cars, technology is poised to make big impacts on traffic and travel over the next two decades. Though it’s anyone’s guess as to how much traffic will be impacted, there’s no doubt it’s an exciting time for both technology and travelers.

What travel-related technology are you most excited to see put to use? What new technology do you think will have the most impact on traffic?

APRIL SPEARS is President and Chief Executive Officer at ELTEC with 15-plus years of experience in the traffic safety industry.
LOCATED NEAR RAS AL KHAIMAH in The United Arab Emirates, this overpass is a Guinness Book of World Records holder. Part of the newly constructed section of Emirates Road, this structure is also the biggest soil-steel structure in the world. The span of this massive overpass is 32.39 m (106 ft. 3 in.) with a rise of 9.56m (31 ft. 4 in). This structure also boasts the title of the first of its type in the Middle East.

The overpass was designed with several extraordinary reinforcements to increase the global safety factor including: four rows of M24 class 10.9 bolts as connections between plates, three rows of anchor bolts on the inlet and outlet as a part of the reinforced concrete collar, each of the construction ends where given a steel collar face, steel grids were installed in several rows along the entire structure on both sides and geotextile was added in a double layer above the crown. The plates were zinc coated in the factory and painted at the construction site. The protective layers included an inside layer of epoxy + polyurethane 400 μm while the outside layer was done in epoxy + polyurethane 120 μm. From the outside, an EPDM membrane was applied as a water isolation barrier before backfilling. Inlets and outlets of arches were finished using retaining walls.

Even with all the additional measures in place, this bridge was built in half the time it would have taken to build a bridge of similar size of concrete. It is also estimated that the bridge will last over 100 years and require less maintenance than other structures that can accommodate the same heavy traffic this bridge will endure.

KATARZYNA ELTMAN is international Marketing Coordinator with ViaCon Group.
The National Precast Concrete Association presents Precast Days 2019, a unique educational opportunity to provide students, specifiers, engineers and contractors with an up-close experience at a local precast concrete plant.

In the last two weeks of October, NPCA plants are opening their doors to explain the precast manufacturing process and demonstrate the equipment, technology and engineering expertise that goes into making precast concrete products. Participating engineers can earn PDHs as part of this event.
WHILE ACHIEVING NET-ZERO for one building is somewhat practical, the developer of Whisper Valley in Austin, Texas decided that the entire 2,000-acre community with some 7,200 homes would be Net-Zero Ready. All structures will be ground source geothermal and solar equipped to meet the Net-Zero energy, or carbon neutral, standard adopted by the City of Austin’s Municipal Building Code. The $2 billion development that also includes apartments, several million square feet of commercial space, schools and other buildings, will be the largest zero-energy capable housing community in the nation. The key component for getting to Net-Zero is the geothermal, or geoexchange, cooling and heating system and its underground distribution piping system.

Each of the 237 homes in Phase I is equipped with a REHAU RAU-GEO™ PEXa double U-bend pipe loop and a ground source heat pump. A total of 313,000 linear feet (95,400 m) of the pipe was used. All builders in Whisper Valley are required to hook up to EcoSmart’s GeoGrid, a five-mile loop of underground distribution piping that links each home to a geoexchange network, engineered by b2E Consulting Engineers. This geothermal system is predicted to reduce heating/cooling energy costs for homeowners by up to 65 percent as compared with conventional air-source heat pumps. EcoSmart Solution LLC is a subsidiary of Taurus Investment Holdings, developer and owner of the site.

“This project is a great example of the use of plastic tubing for geoexchange loops, and all the benefits that ground source systems deliver,” explained Lance MacNevin, P.Eng, director of engineering for the Building and Construction Division of the Plastics Pipe Institute, Inc. (PPI). “The PEX piping material is tough and durable and will provide decades of reliable service. Plus, the REHAU double U-bends increase the output of each borehole by up to 30 percent compared to single U-bends. This reduced the required depth of each borehole, as well as the number of boreholes required. And, naturally, cut drilling costs and the number of days spent drilling on the Whisper Valley jobsite.” PPI is the major North American trade association representing all segments of the plastic pipe industry.

Whisper Valley will consist of seven separate villages with a fire department station and two schools for its nearly 30,000 residents.

Homes and buildings are located next to access roads and on top of the integrated geothermal district loop that will significantly reduce energy costs for homeowners. Those lots are sold to homebuilders with specifications for sustainable construction including hooking up to the loop. The end result will be highly energy efficient Net-Zero Ready homes with very low energy costs.

To use the earth’s relatively constant temperature (45 to 75°F in this location) for heating and cooling, the design incorporates boreholes up to 335 feet (102 m) deep drilled on each lot, into which the REHAU pipe loops were inserted. Boreholes were grouted after pipe insertion. As with all geothermal systems, fluid circulates through the pipes, exchanging heat to and from the earth for cooling or heating operation, respectively.

Each PEX vertical pipe loop connects to a system of horizontal pipes. This larger integrated ‘geo loop’ is augmented by two 250-ton cooling towers for meeting peak cooling loads during periods of high ambient temperatures.

It is estimated that homeowners will pay a monthly service fee of $60 for access to the system.

“This project shows how PEX pipe in a geoexchange application can help in the reduction of the overall carbon footprint by minimizing the energy required to heat and cool homes,” stated Tony Radoszewski, CAE, president of PPI. “The developer providing the geoexchange network and requiring builders to connect to it, is game changing. It removes the primary barrier that prevents more widespread adoption of geo-exchange systems. Whisper Valley is a successful business model that, we understand, Taurus plans to take nationwide. I’m sure other developers will duplicate it, especially as more municipalities set Net-Zero targets. Not only is this project a unique application for PEX pipe, it is also at the forefront of community geothermal technology.”
Whisper Valley was named the 2019 PPI Project of the Year for the association’s Building and Construction Division.

To further support the geothermal market, PPI has established the Geothermal Steering Committee within the Building and Construction Division. MacNevin stated, “PPI and our members promote the adoption of geothermal technologies to help reduce energy consumption for heating and cooling buildings, saving owners money. Other benefits of ground source systems are better reliability and building resiliency, with no exposed outdoor components. Also, water-to-water heat pumps are a perfect match for hydronic heating and cooling distribution systems, which are comfortable and efficient technologies for use in both residential and high-performance commercial construction.

"It is also important to note that the U.S. Bipartisan Budget Act of 2018 reinstated the tax credit for fuel cells, small wind, and geothermal heat pumps. Signed into law in February 2018, it provides a 30 percent federal tax credit for geothermal, which, in some states, also qualifies for a state rebate."

The PPI Geothermal Steering Committee’s activities include supporting industry efforts to update geothermal standards and codes, such as ANSI/CSA/IGSHPA C448, IAPMO’s UMC and USHGC, and ICC’s IMC and IRC; working closely with IGSHPA, GEO and other related organizations; publishing documents about the use of plastic piping systems for geothermal applications; and serving as a technical resource for geothermal system designers, with regards to plastic piping technologies. PPI also is a sponsor of the DOE’s Solar Decathlon – Design Challenge, a design competition focused on zero-energy ready construction.

Whisper Valley has received wide recognition including being named the 2019 Sustainable Community of the Year by Green Builder Media and receiving a Merit Award in the Best Innovative Energy Design category in the 2018 Gold Nugget Awards presented by PCBC.

According to Phil Schoen, president of Geo Enterprise Inc., (Tulsa, Okla.) that installed the system, “Whisper Valley’s district GeoGrid is already performing 20 to 30 percent better than projected. The system will gain efficiencies as it expands and the team works to wring out every possible Btu.”

Additional information can be found at the PPI website: www.plasticpipe.org.

STEVE COOPER has investigated and reported on a variety of energy, pipeline, and construction projects for several decades. Based in New York, he has traveled extensively to conduct on-site news interviews with professional engineers, contractors, government officials and representatives of major companies supplying the industry. He can be reached at 516/623-7615 or steve@scacommunications.com.
Designing Hard-Armored, Flexible Channels with 3D HDPE Geocells

Poured-in-place concrete channels control stormwater & erosion

Hard-armoring channels to resist severe velocities and hydraulic stresses are typically accomplished by reinforced concrete or articulating concrete block (ACB) systems. While both methods are acceptable solutions, they have drawbacks, especially in remote or difficult access areas such as mining sites or through mountainous terrain.

Typical reinforced concrete requires forms and steel reinforcement that may be difficult to source and deploy. The concrete slabs may shift and crack with subgrade settlement, expansion and contraction caused by freeze-thaw allowing water to permeate below the surface and undermine the channel’s integrity. This can be especially problematic if waste material escapes beneath the liner underlayment. Heavy, precast ACB systems are transported to sites on numerous trucks and are placed by heavy equipment. Deployment may be difficult especially in isolated areas.

Better Built Channels with Flexible HDPE System

HDPE GEOWEB® 3D geocells offer an easier way to hard-armor channels and protect them from erosion, cracks and leakage. The system’s 3D cellular network contains concrete without the need for additional reinforcement. Unlike typical reinforced concrete where whole
sections can crack and uplift, GEOWEB® channels are flexible—they flex and conform to minor subgrade movement, controlling concrete cracks along the line of the cell walls.

Sections that expand to 240 sf in the field collapse to small 6 sf bundles for efficient transportation. Onsite, sections are expanded, anchored and filled. Over a liner, a tendon anchoring system holds sections in place without the need for penetrating anchors. A higher concrete slump may be used with geocell channels, facilitating faster concrete placement.

**USBOR Report Gives Geocells/Geomembrane System Top Grade**
A 10-year canal lining study by the US Bureau of Reclamation (USBOR) tested four canal types for numerous factors including construction and maintenance costs, durability, and effectiveness against seepage reduction. The study credited the GEOWEB® geocells over a geomembrane and concrete cover as having the highest long-term performance results.

**Colorado Irrigation Canal Project Includes Geocells**
Colorado’s Mancos Water Conservancy District noted the region had been rehabilitating their canal systems for 15-20 years utilizing various methods including clay and shotcrete to protect canal liners—but regular, costly maintenance was always required. After the USBOR’s study, the district implemented the GEOWEB® channel system on a large irrigation canal system in Southwest Colorado.

**Design Channels for Better Performance**
Channel type, dimensions, hydraulics, foundation soil/underlayment and desired infill influence GEOWEB® channel designs. A free project evaluation from the manufacturer helps determine design feasibility and component.
The past three years have seen an unprecedented demand for multifamily housing, and with it an increasingly competitive landscape driven by social and technological disruption.

Consumer lifestyle-influenced residential units will be dominating the market over the next 20 years, influenced by advances in technology, sustainability, health and wellness, and growing emphasis on community and connection in an increasingly digitized – and isolated – population. Additionally, younger generations are more tech-savvy, career-focused, and willing to pay a premium for ease-of-use. A recent report by the National Multifamily Housing Council (NMHC) showed a vast majority of respondents agreeing – or strongly agreeing – with the statement, “My life is so hectic that I look for ways to make it easier for me.” This demand for expedience and ease of use is having a significant impact on multifamily residential markets nationally.

In Texas, long-known for its wide-open spaces and suburban lifestyles, major metropolitan areas are erupting as millennials flock toward urban centers and surrounding areas, in search of places that offer social activity and affordable luxury. Many of them have found what they are looking for in master-planned communities. Likewise, empty-nesters are turning increasingly towards new developments, driven by similar desires for low-maintenance lifestyles and walkable neighborhoods combining the amenities of suburban neighborhoods with proximity to thriving, “authentic” local settings.

Urbanization and technology intersect
For Texas, this trend is driving the evolution of more “edge cities” like Plano, Frisco and Arlington, which have matured into smaller, distinct urban centers, blurring the distinction between suburbs and cities. Other communities in the Dallas-Fort Worth metroplex have been initially hesitant to embrace this kind of development and densification. To head off the inevitable pushback and “NIMBYism” from local stakeholders, developers investing in municipalities outside of Dallas, Austin, and other large cities are engaging design-side consultants like LandDesign to shed light on the effects of increased density on utilities, transportation, stormwater, and other considerations. Once the results are in, the development team can conduct outreach to educate residents and local officials on the benefits of growth and density, such as lessened individual property maintenance and a more socially activated public square.

Another driver of the evolving residential experience is the parallel evolution of high-tech, and the growing demand for devices and infrastructure to control integrated technology in the home. As voice control devices like Alexa become mainstays and smartphone security monitoring apps become more widely adopted, developers have greater incentive to make cloud-connected technology a standard – and a value-add – in their residential designs. For example, smartphone apartment access is emerging as a popular alternative to key and fob-based systems.

Also, the use of tablets by real estate brokers is becoming integral to the property tour. With help from the developer, brokers can offer tablet tours customized to suit specific buyer interests and needs, or even self-guided tours for prospective residents who prefer to keep their own pace.

Social infrastructure and the “amenity revolution”
One of the most promising trends is the growing interest in including elements of social infrastructure in large-scale multifamily develop-
Innovations seen in this area range from beer gardens to shared workspace to working farms, anyplace where members of the community gather to interact. Places that strengthen the social fabric are in high demand across buyer demographics. The trick for developers is to differentiate among target buyer groups. The under-35 crowd wants places to gather and interact, and so do the 55-plus folks – but these groups are probably looking for somewhat different social settings. With the younger cohort, co-working spaces for remote workers are in higher demand than ever. According to a recent global study by IWG, as many as 70 percent of respondents report working remotely once a week or more – and 50 percent say it’s half of each week. In the U.S. the numbers are lower, but growing steadily. Gallup’s State of the American Workplace report reveals that the number of employees working remotely rose from 39 percent in 2012 to 43 percent in 2016. Millennials looking for a home and community to support their preferred work-life balance will find co-working space to be an attractive shared amenity.

And millennials want lifestyle amenities, too. Once considered cutting-edge, offerings like dog parks and bike storage are now viewed by developers as essential to competing for buyer interest. Asserting a competitive edge requires more innovative thinking. Our integrated design team of landscape architects, civil engineers, and urban designers explores and creates ways to separate developments we work on from the pack. For example, we have introduced elaborate, amenitized pet playgrounds that provide pet owners an outdoor lounge area for “Yappy Hour” gatherings, turning the dog-walking chore into an opportunity to socialize.

**Sustainable innovation, at home and on the road**

Environmentally sustainable design has likewise become a must-have feature. According to a recent report by the National Multifamily Housing Council, many eco-conscious buyers and renters are willing to pay a premium for a planet-friendly, energy-efficient residence with certification from LEED, EnergyStar or another brand-name standard. As with the social infrastructure, innovation and creativity are providing the differentiators.

For example, we worked with one of our clients to incorporate a rooftop apiary. Having honey bees on the roof has been beneficial to the local eco-system and, additionally, the property managers can harvest the honey to offer as gifts to interested buyers. Another example is the raingarden we integrated into a streetscape in the Dallas metroplex, which captures, treats and releases stormwater and features informational signage so residents and visitors understand what it does, and can be proud.

Transportation demands are seeing similarly radical shifts, with benefits for both the developer and buyer. For example, as demand for rideshare services and interest in sustainable living have increased, our team is working with a growing number of clients to address the underused parking garages and surface parking lots in their developments retrofitting them to add more residential units or open up greenspaces. We also study how autonomous vehicles (AVs), electric vehicle (EV) charging stations, Uber/Lyft drop-off points and even electric scooters might impact communities as their popularity rises and implementation becomes commonplace. (If your community doesn’t have a marked Uber drop-off point you’re behind the curve.)

This is an exciting time to be exploring innovation in the multifamily development space. Opportunities abound to revolutionize the way people live, work and play. It is also a time where these shifts are accelerating, demanding more from developers and their design teams. Our firm is constantly working and adapting to attune the communities we work on to the evolving needs and demands of buyers and residents.

**HETH KENDRICK, PLA** is a principal in the Dallas office of LandDesign, where he directs the landscape architecture practice and is responsible for design and business development in that market. With over a decade of design experience related to projects ranging from large-scale mixed-use and transit-oriented developments to smaller multi-family and commercial developments, Heth has proven himself to be an expert in his profession based on his knowledge of project management, master planning, entitlements, design development, and the preparation of construction documents.

**BRIAN DENCH, P. E.** joined LandDesign in 2012 to establish the Dallas-Fort Worth office where he directs civil engineering as a principal with the firm. With expertise in entitlements, land planning, civil design, permitting, and construction phase services for land development, he is responsible for business development, office operations, and design focusing on land development for single family, mixed-use, commercial, industrial, and corporate office projects. His portfolio includes Discovery at The Realm, a successful luxury multi-family development in the Castle Hills community in Lewisville, Texas.

---

*Alexan Henderson in Dallas. Photo: LandDesign*

*Alta Trinity Green in Dallas. Photo: LandDesign*
DUKE KUNSHAN UNIVERSITY
WITH PHASE II JUST BEGINNING, PHASE I DESIGNERS DISCUSS
THE ULTRA-MODERN PROJECT IN EASTERN CHINA
By Editorial Staff

PHASE II OF THE DUKE KUNSHAN UNIVERSITY buildout is now underway. New Facilities will include an employee center, library, student residences, community and administrative centers, and a sports complex. Once Phase II is complete, the university residence halls will have the capacity to accommodate 2,000 undergraduate students, 500-800 graduate students, and 800 employees. All major buildings will be within a three-minute walking distance, and will include no fewer than 26 new classrooms and 18 to 22 laboratories. All buildings within Phase II are expected to receive LEED certifications from the U.S. Green Building Council as well as the equivalent qualifications from the China Green Building Council.

The 200-acre campus in the Jiangsu province in eastern China is a Sino-American joint venture founded by Duke University and Wuhan University. DKU was granted final establishment approval in September 2013, and has hosted students since 2014. In August 2018, the Duke Kunshan campus welcomed its inaugural undergraduate class.

For Phase I, LandDesign was selected to provide landscape architecture and civil engineering in collaboration with Gensler and Futurepolis. Of Phase I’s five buildings, all of them are LEED accredited, with the academic building and conference center rated LEED Gold, and the student residence, faculty residence, and service building rated LEED Silver.

The 30-acre Phase I project featured a four-acre water ecosystem at its center, making the site an absorbent “sponge campus,” where almost every rain drop is absorbed, stored, permeated, purified and reused. Duke Kunshan’s ecological system consists of four major parts: a naturally designed waterscape for rainwater collection and storm control, rainwater gardens to enhance on-site permeability, an underground filtration system for water quality assurance, and an irrigation system which fully uses purified rainwater. The extensive water features symbolize the region’s water towns.

Two people who were instrumental in creating the Phase I Duke Kunshan ecosystem were LandDesign’s Kevin Vogel with civil engineering, and Richard Petersheim with landscape architecture. They spoke with Civil + Structural Engineer about the project as well as working in China.

Civil + Structural Engineer: Looking at the press on the Kunshan project, it looks like LandDesign and Gensler won the contract through an intense international design contest. Describe the contest: How long did the process take, what were a few of the key steps that had to be taken to be considered, what was the competition like and, more specifically, what partnership appeared to be the front-runner as the competition unfolded?

C+S: What was LandDesign’s prime responsibility on this contract?

KV&R: LandDesign was the prime consultant for landscape architecture and civil engineering services.

C+S: How did LandDesign and Gensler come to form a partnership for this project? Do you foresee the two firms doing more work at Kunshan? If so, what is in the pipeline, or at least on the radar?

KV&R: Gensler was brought on board under a separate client and project prior to LandDesign winning the design competition for the campus and being selected to lead the civil engineering and landscape architecture portions. The working relationship with Gensler was great! We have since worked together, and there are future phases of Duke Kunshan that may present another opportunity to collaborate together.

C+S: Water features, reflecting the environment in and around Kunshan, are an important piece of the campus design. What do you think LandDesign achieved with its landscape architecture and civil engineering, both technically and aesthetically?

KV&R: We were able to balance stormwater management with a beautiful landscape design that integrated with the building architecture and common open spaces on the campus. That region of China frequently floods and by incorporating stormwater management into the context of the urban hardscape and landscape we were able to ef-
fectively mitigate flooding, provide opportunities for stormwater reuse and enhanced the water quality on campus. Additionally, the campus was designed to foster diverse water habitats through the use of local flora and fauna. Today, the water gardens on campus are home to birds, amphibians and small mammals.

C+S: What was the most difficult aspect of this project, and what solution did you develop to overcome the challenge?

KV&RP: From a civil standpoint, meeting LEED requirements for water quality and quantity controls; mitigating flooding risks; incorporating a system that would continuously recirculate the water on campus to negate any stagnation; and integrating all of that into the design aesthetic for Duke Kunshan. Additionally, effectively communicating and collaborating with our local civil partner was a challenge from a language barrier standpoint, but also a unique and fun experience!

C+S: Mr. Petersheim, your bio says you specialize in building constituency. As it pertains to Kunshan, what did you have to do to get everyone on the same page, both internally within the team, and externally with the clients?

RP: I spent time with both Duke University and the City of Kunshan to listen to their concerns, goals and visions for the campus. That helped us come to a commonality on our design approach that would balance both the needs of the City and University.

C+S: Mr. Vogel, your bio says you specialize in the nuts-and-bolts aspect of projects – regulations, construction coordination, and permitting, etc. What stood out to you about Kunshan?

KV: Local regulations required a varied approach to stormwater managements and the LEED standards needed to manage runoff to higher levels of treatment and attention. We had to ensure we met both requirements and maintained the aesthetic of the project. The project was fast paced from a design and construction stand point.

C+S: Duke University. Wuhan University (One of the earliest comprehensive national universities in modern China). The People’s Republic of China. These are some pretty big names undertaking an ambitious program. What was the pressure like working for clients like this?

KV&RP: It was critical that we shepherded the values and opinions of both our client (City of Kunshan) and Duke University, who would ultimately operate the facilities. Working between the two entities at the same time was challenging but taking time to build consensus was critical for the project’s success.

C+S: These days, you hear a lot about the lifecycle of a project and long-term strategic asset management. What are a few of the central challenges a “sponge campus” like Kunshan presents, with its vast water features and abundance of environmental technology? In other words, what will need to be done, or what has already been done, to sustain the sustainability of the campus?

KV&RP: The University’s understanding of the operation of maintenance needs of the water management system was vital. A system with multiple and varying types of BMPs working in tandem requires that each piece of the puzzle is performing. The Sponge City initiative was developed during or after this phase of the campus was designed and built, but it represents the elements of the initiative. It is a prime
example of how to manage surface water flooding and water quality issues that arise with development, and how incorporating stormwater management into the urban environment can be a vital part of solving that challenge.

_C+S_: LandDesign President Rhett Crocker was recently quoted as saying, “It’s key to make it personal,” when talking about building clients and business. How did this type of mindset play out with Kunshan?

KV&RP: Duke University was a neighbor to our Charlotte office, and it was important that they be reflected well in China and were happy with the final product. LandDesign’s reputation was also important in that we were intimately involved with every aspect of our scope, and that the local team become an extension of LandDesign.

_C+S_: How was China? What did you learn about yourself and your profession?

KV&RP: Professionally, it was very rewarding to drive the design and work with professionals from around the world. Despite language barriers and cultural differences, we were able to collaborate and pull off a design that was technically complicated and have the end result be so successful.

---

**RICHARD PETERSHEIM, PLA** is a Partner and Senior Landscape Architect at LandDesign. Committed to creative and sustainable urban design, he is responsible for project development through construction, and directs a passionate urban design studio with focus on strategic urban planning, infill development, transit planning and station area design, higher education master planning, and retail development.

**KEVIN VOGEL, PE** is a Partner and Civil Engineer at LandDesign. He is responsible for design staff management of engineers, surveyors, and landscape architects. He is also responsible for full cycle project management, from contracts and administration through construction documentation. He is responsible for directing both public and private site development and infrastructure improvement projects both regionally and internationally.

---

**Key Phase II Stats**

**To view Phase II video, click here**

- **Groundbreaking:** Aug. 16
- **Scheduled completion:** End of 2021
- **Site area:** 189,334 square meters
- **Building coverage:** 19.98%
- **Green space area:** 66,268 square meters
- **Green ratio:** 35%

**Buildings in Phase II**

- Basement garage
- Employee center
- WHU-Duke Research Institute
- Visitor center
- Administration building
- Library
- Sports complex
- Community center
- Graduate student center
- Undergraduate student residence
- Service building

**Highlights**

- Once Phase II is complete, the university residence halls will have the capacity to accommodate 2,000 undergraduate students, 500-800 graduate students and 800 employees.
- All major buildings are within a three-minute walking distance.
- Phase II will include no fewer than 26 new classrooms and 18 to 22 laboratories.
- All major buildings are within a three-minute walking distance.
- Once complete, all of the buildings in Phase II are expected to receive LEED certifications – one platinum, four gold and the rest silver – from the U.S. Green Building Council as well as the equivalent qualifications from the China Green Building Council.

“We have built something unique at Duke Kunshan University. As with Phase I construction, these new buildings will be aesthetically impressive and distinctive, but more importantly they will serve our mission to create dynamic spaces for students, faculty and staff to interact, engage and innovate.”

–Youmei Feng, chancellor, Duke Kunshan University

**SOURCE:** Duke Kunshan University
NEW ERA OF DATA USE
EMERGING IN CONSTRUCTION
CONTRACTORS REPORT INCREASING ABILITY TO GATHER AND ANALYZE DATA HELPS IMPROVE PROJECT OUTCOMES LIKE BUDGET, PRODUCTIVITY AND PROFITABILITY

A NEW REPORT BY DODGE DATA & ANALYTICS, in collaboration with construction management software provider Viewpoint, a Trimble company, reveals a sea change in the way project data is gathered and analyzed across the construction industry – change that is poised to improve key project outcomes according to construction managers, specialty trade contractors and design/build firms surveyed. Tied to increased technology use and advancements, 64 percent of those who participated in the report said that their ability to gather and analyze data has improved or improved significantly.

The report, titled Improving Performance with Project Data Smart-Market Report: How Improved Collection and Analysis is Leading to the Digital Transformation of the Construction Industry, reveals that contractors believe improvements in field data collection will bring impactful change over the next three years, driving the industry’s digital transformation. If critical business data normalization can be accomplished, the results can increase key project outcomes such as budget, productivity and profitability.

The findings also reveal some important calls to action for continuous improvement in the industry:

• Contractors using commercial software to gather jobsite data report significantly higher satisfaction rates than those using paper forms or spreadsheets.
• Many contractors still have concerns about storing their data in the cloud, and in particular, around how secure their cloud-stored data will be. Both general contractors and specialty trades list security concerns as the top reason for not managing data in the cloud, and among those surveyed, 65 percent still use on-premise servers.
• While 86 percent of respondents are relying on anti-malware software to address data security, only 45 percent of those surveyed have implemented employee compliance training.

“Gathering siloed data from across their organization to analyze and improve project outcomes is a key challenge we work with clients to overcome daily,” said Viewpoint Chief Product & Strategy Officer Matt Harris. “Contractors are demanding easier, better and more consistent collection of data – from the office, across their extended teams and into the field – in order to enable better measurement of project performance and drive toward greater gains.”

The report also points to current and emerging means of gathering data via apps, cameras, sensors and wearables.

“We think this is a critical area to watch in the future,” says Steve Jones, Senior Director of Industry Insights Research at Dodge Data & Analytics. “The smarter jobsite will transform the industry, but companies need their data gathering and analytics fundamentals in place before they can fully profit from all of the exciting technology that is now emerging, funded by an influx of venture capital, and directly addressing industry needs to reduce risk, improve productivity and improve safety.”

A complimentary version of the full SmartMarket Report is available at: viewpoint.com/analyticsreport.

STEPHEN A. JONES served as executive editor for the report, and Donna Laquidara-Carr, Ph. D., LEED AP, served as managing editor.
HeliCAP® V3.0 – The Premier Tool for Confident Helical Engineering

Hubbell Power Systems, Inc (HPS), an international leader in earth anchoring, has released HeliCAP® Helical Capacity Design Software Version 3, a proprietary engineering software for confident helical engineering. It performs powerful calculations on site soil parameters to aid engineers designing foundations, tiebacks, soil nails, and heavy guyed loads. The software gives prompts to maintain control over essential criteria to affect the same process HPS application engineers employ daily to analyze problems and specify solutions.

Unlike previous versions of HeliCAP, version 3 is cloud-based and can be instantly accessed from any web-connected device. Users of previous versions of HeliCAP will notice some familiar tools have been enhanced. Improvements include:

• Allowing collaborators to view or edit shared jobs
• Ability to create up to 10 soil profiles in a single job
• Better correlation between blow count and soil profile

With the largest network in North America, local distributors of CHANCE® helical piles are available to assist engineers and installers with helical pile projects through their knowledge of local soil profiles, technical and engineering support, and reduced lead times with local, ready-to-ship inventory.

CHANCE helical piles are used worldwide to secure residential and commercial buildings, tower foundations, heavy equipment foundations and many other deep foundation applications. Engineered for dependability and long-term stability, HPS’ foundation solutions feature exclusive anchoring techniques, tools, designs and sizes to suit a broad range of applications.

The software is available to use instantly at no charge. Visit https://www.hpsapps.com/helicap to create an account.
Is advanced customization of soil profiles for greater engineering judgment and more accurate results. HeliCAP 3.0, online helical engineering software.

**CHANCE® THE CERTIFIED HELICAL PILE™**

HPSAPPS.COM/HELICAP
855-735-4824
The rate of change is moving at an increasing speed.

Technology continues to change the way we design, build and run projects and our firms. In this article, we’re telling a story that we hope will inspire you to decide what kind of culture you want to build and be bold about going after it. It’s the story of how one firm has gone all-in on creating a culture of learning and innovation. They’re doing it in a way that is sometimes at odds with conventional wisdom – and growing a profitable business at the same time.

The big why: innovation + a growth mindset

Turner Fleischer (Toronto, Canada), a 150-person architecture firm specializing in private-sector projects, is determined to be on the forefront of technology and education. This is their strategic priority, and over the past several years, they have been rewiring their firm culture from the inside out to achieve it.

As they’ve grown from 61 people to 150 in the last 10 years, Turner Fleischer has built a young and culturally diverse team. More than half of the firm’s staff is under 34, and many have received their professional degrees outside of Canada.

“You need young people if you want to be a technologically advanced firm,” says CEO Ellen Bensky. “These talented individuals know tech, but they don’t always know the ins-and-outs of the industry. And they don’t have the luxury of a gradual learning curve by moving from one project to the next, because we need them up and running sooner than that.”

Turner Fleischer decided the answer was to launch a robust in-house program that offers critical learning and professional development credits for free. Not only would this help younger staff upskill quickly, it would also provide opportunities to build teaching and presentation skills and develop internal subject-matter experts. Since its inception in 2015, TF Academy has exponentially grown and in its current Spring/Summer semester is offering a total of 60 individual teaching sessions, spread over 18 courses, 22 electives, and 7 workshops.

Encouraging teaching and learning

At TF Academy, internal and external teachers deliver courses that are vetted and refined through a 10-step committee approval and development process meant to support teachers and ensure that the courses are effective and engaging. The firm encourages staff, at all levels, to propose, teach and take courses. Participants are not graded. There are no exams. Courses are not required for advancement and do not define a set career path.

“We want presenters who want to teach and share their knowledge authentically,” says Bensky. “I want people who are there because they
want to learn. If we had requirements and grades and exams, it would change the whole dynamics of the Academy.”

Early on, the firm found that printed course materials were not as effective as active, hands-on, discussion-based learning. They evolved feedback systems to understand what was working and what was not. TF Academy now covers a variety of topics such as risk management, construction administration, condominium suite design, Photoshop, even a virtual reality class that prepares staff to understand and deliver VR experiences. The program also includes Partner-led architecture tours with external guest experts, which conclude with dinner, where the conversation continues. This year, at staff request, they’ve added a Health and Wellness stream with teachers sourced from the firm’s extended family.

Capturing and sharing wisdom

As a strategic priority, Turner Fleischer continues to roll out learning initiatives that are helping to build professional skills and personal connections, increase staff self-confidence, realize subject-matter experts, and help employees discover new interests.

The firm offers a three-month work shadow program three times per year to help employees better understand the work their colleagues do. Anyone can participate, and all levels of the firm are engaged. For example, one partner chose to shadow a seasoned REVIT expert to learn more about REVIT and gain hands-on experience. Technical staff have shadowed marketing staff and project managers have shadowed project accountants. After the shadow is complete, both parties present to the firm on what they’ve learned.

To tap into the valuable experience of the firm’s veterans, Turner Fleischer created a formal Practice Advisor role to provide coaching and insight for younger staff. Anyone can sign up for coaching sessions with one of the firm’s Practice Advisors, who also take staff on site visits to increase their understanding of projects and post relevant information on the company intranet, Newton.

“Practice Advisors are a way to give staff permission to have those vital interactions with senior staff, and to make it easy for them to do that,” says Bensky. “We’ve seen that drawings become very intentional once you go on site and can see how things are built.”

Members of a staff led development team “Automation Nation” lead drop-in software coding classes at lunchtime, while departmental teaching helps develop specific job-focused skills and knowledge. The firm has nine fulltime dedicated staff in a Digital Practice Department, which recently hired its first full-time programmer and has just completed the construction of a standalone technology lab for learning, complete with a 6-screen video wall for BIM coordination and a virtual reality space for client presentations.

Newton is a repository for more than 450 documents sharing knowledge on everything from drawing standards, the phases of a project, to how to lock up the office after hours. It is also a hub that includes a social media-style interface for posting and commenting on shared information. One popular feature is recorded video conversations with a Practice Advisor who recently retired. Anyone was able to request a conversation – topics included what makes good architecture, project coordination practices, and hand versus computer drafting – which are recorded and edited down to 15-minute clips.

Learning has become a marketable differentiator in recruiting and retaining staff. It’s also sorted out who is a good fit and who would be happier at another firm. “It’s the number-one reason that people leave,” says Bensky. “If you are someone who has a fixed mindset, working here is going to feel overwhelming. For people who love to learn, we are the perfect fit.”

Developing a true learning culture – like deploying any large-scale cultural change – requires leadership to be integrally involved and needs to engage staff from the bottom up. Here are a few other lessons you can take away from Turner Fleischer’s experiences:

• Don’t delegate it. Too many leaders delegate knowledge sharing or other culturally significant programs to HR, IT or marketing. At Turner Fleischer, principals are teaching and learning. They are job shadowing others, coaching and involved in deciding how learning programs are run and what is being offered.

• It’s not always about utilization. Turner Fleischer employees don’t worry about whether attending classes will hurt their utilization because the firm does not set utilization targets. “If you let go of control, you will still have the utilization,” Bensky insists. Even with unbilled learning hours on the books, staff productivity – and firm profitability – remain high.

• Be willing to invest in what matters. Successful learning programs require investment, and a well-managed budget. Turner Fleischer has streamlined the administration time and cost of TF Academy every year, moving from registration via business card and manual attendance to an automated registration system and QR-coded badges.

• Define your ROI appropriately. The success of learning initiatives is not always measured in numbers and reports. In some cases, that data will not be easy to track. At Turner Fleischer, more confident employees, higher quality deliverables and more effective client interactions are part of the ROI, says Bensky. “If you are attuned to your culture, you will know whether it’s working,” she says. “If you are aligned to the goals, you will know if you’re meeting them.”

What’s most important to the culture of your firm? Is it baked into your operation? Tell me what defines your firm’s culture and what you’re doing to cultivate that at rich@friedmanpartners.com or (508) 276-1101.

RICH FRIEDMAN, President of Friedman & Partners, has worked in and consulted for the A/E/C and environmental consulting industries for more than 25 years.
**Addressing the Need for Sharp Workers**

**Technology Training on Workflow Can Help**

By Jeff Winke

THE SCENE: A busy mid-size construction contractor office where owner-operator Bill plops into his desk chair while thinking that he and his incredible crew need relief ... need help.

"I'm gonna close my eyes for a minute," he promises, and dozes into a familiar dream where he's sifting through a stack of resumes of experienced, qualified workers all eager to work for him. He smiles contentedly until, "Bill! Bill! Are you sleeping? We need your help!"

It is a scary world out there. Construction contractors, like Bill, know that in spades. They struggle with tight deadlines, demands for regulatory-governed quality, better productivity, lower costs, more time in a day, and that ominous need for a competent workforce.

The Associated General Contractors of America released a study of construction firms in the United States. A few key statistics included in their Workforce Shortage Report include:

- 8 out of 10 construction firms cannot find sufficient qualified employees
- 19 percent are investing in labor saving equipment and tools that require smarter workers
- 82 percent believe that it will be more difficult to find qualified workers over the next 12 months

"As the U.S.-based construction workforce becomes increasingly thinly spread," the AGC report stated, "owners and managers of construction firms will be required to approach the problem of labor shortage creatively, in order to convert these problems into opportunities. A key to overcoming the labor shortage, in the construction industry, is to invest in current employees to increase their skills, knowledge and abilities, as well as to support existing employees with labor-saving tools and equipment."

Investing in existing employees has definite advantages, when compared to hiring new employees.

- Current employees know how the company operates and manages its project sites.
- Current employees are a known entity. Managers know their strengths and weaknesses and may be better able to manage and lead them than new hires.
- With new employees, there are start-up administrative costs, drug testing, equipment and safety training, and general acclimation to new managers, co-workers, and procedures.
- Current employees pose less risk. Studies have confirmed higher injury rates among workers who have been on the job for less than a year. Consider also that hiring new employees with less experience and then moving them quickly into the field to meet demands may create greater risk.

Clearly, on-going skills and technology training of existing employees can prove to be critical not only for retention but the success of the company.

"The penalty for not keeping current with technology is longer project timelines," stated Ron Oberlander, vice president, Global Professional Services, Topcon Positioning Systems, Inc., of Livermore, California. "Successful training focusses on the work process which yields greater efficiencies and better results."

With the training emphasis on workflow, employees can develop a broader perspective on construction projects and all that goes into the tasks that culminate in their completion. The emphasis on work processes demonstrates a respect for the intelligence of employees and invites them to think in a partner role, which can strengthen their commitment to the job and the company.

"I've completed a couple of training programs conducted by Topcon and am scheduled for another in the next six months," said John Poirier, project manager with Warman Excavating & Trenching Ltd., Waldheim, Saskatchewan, Canada. "It is well worth the time; and the cost is inconsequential compared to what I learn. I'm getting trained by unbelievable trainers – seasoned experts with 20 to 30 years of experience with the company. They know the products, the market, and understand the workflow."

"Technology changes too frequently," said Oberlander. "When we host attendees – distributors and end users – at our training sessions we focus on workflows and how the key features of our products and systems improve the productivity and efficiency of end users."

With the strong job economy today, it is sometimes difficult to find talent to fill open positions. A benefit of training and the power of easy-to-use technology means that construction contractors can hire less-skilled talent. They can either send them to instructor-led courses or put them through e-learning-based training. Either way, the knowledge and skills gap can be bridged.

Since every construction project is unique, and may require different technology and solutions, it is important – actually imperative – that workers at all experience levels engage in training regularly to remain up to date.

"Think about the advances in consumer technology … such as the Apple iPhone," Oberlander said. "The innovations and high-powered processors that upgrade the iPhone annually are being used in construction equipment. Look at the displays and systems inside of a new excavator, dozer, or other heavy equipment which now make them more productive to run and service; and in turn, makes the contractor more efficient and profitable."

Oberlander went on to describe how GPS machine control has evolved during the past 20 years from little adoption of machine automation to a market where some machine manufacturers are integrating machine control technology direct from the technology-provider’s factory floor into their machines or even wiring heavy equipment so that they are ca-
pable of later adding aftermarket systems. And how some government agencies are even specifying that contractors working on their projects must employ GPS machine control on their equipment.

An example of the interest and commitment to training occurring in the construction industry, is what Topcon Positioning Systems is currently doing. The company is investing by building state-of-the-art training facilities in the U.S., Italy, and Japan.

The new six-acre training facility in the U.S. is being constructed at the Topcon campus in Livermore, California and will cover training for construction, geo positioning, and paving. Vertical construction and layout training will include a half-built building for real-world demonstrations. Two state-of-the-art classrooms will be included. The training facilities in Italy and Japan are being built to the same parameters.

"Since we focus heavily on workflow training, our training will mimic live applications that take place at a typical construction site," Oberlander said. "The main difference is we can focus on the application and training without distractions of a contractor's live jobsite. We always offer on-location training at the contractor's jobsite or home office, but we believe that it is important to establish a baseline of education with a contained workflow at our training center. We also offer the students a tour of our manufacturing facility so they can see how the products they use are made."

Construction contractors struggle with the need to keep up to date on the latest technology and trends that make their projects more efficient, while attracting and keeping a full workforce in a tight labor market. The answers may be found in training both existing employees and new inexperienced workers on labor-saving technologies with a focus on the work process which yields greater efficiencies and better results.

What do you tell others considering training? Poirier said: "'Go for it!' There is 100 percent benefit to training; otherwise you're looking at your technology being the world's most expensive paperweight. Training gave me knowledge and confidence to feel comfortable with the technology. I recently set up a new excavator using a system I had mounted on a different machine. It works great and would have cost me $42,000 to have someone come in and set up and initialize the GPS system on the excavator – all work I did myself."

Clearly training can benefit contractors. It can add knowledge, skills, and the confidence to succeed.

JEFF WINKE is a business and construction writer based in Milwaukee. He can be reached through jeff_winke@yahoo.com.
DISCOVER PROFIS ENGINEERING SUITE

Live Webinar — Sept 17
Learn how to reduce your connection design time from 1 hour to 10 minutes

Register today!
bit.ly/webinarprofis

PROFIS Engineering Suite gives you a new way to work
• Easy-to-use excel interface for importing multiple load combinations
• BIM/CAD export
• Customizable report templates
• Productivity features such as favorites tab, responsive notifications, undo button
• Cloud-based sharing platform

START YOUR FREE 30-DAY TRIAL TODAY
www.hilti.com/profisengineering
It is hard to imagine a self-supporting structure made of fabric, which can last for over ten years in varying conditions around the world, but they do exist. The shelters can be erected anywhere from war zones to disaster areas. They were invented by two university students back in 2005.

William Crawford and Peter Brewin were studying Industrial Design Engineering at Imperial College London and Royal College of Arts when the two students came up with the idea of creating a fabric which could act like a plaster cast, creating a solid material which could be used to create inflatable, semi-permanent shelters for disaster relief. Having finished university, they continued to work on the concept and formed the company Concrete Canvas Ltd.

The idea behind the design was to provide a more secure alternative to traditional large-scale tents and shelters which are used by organisations such as NATO in humanitarian disasters.

When the shelter arrives on site, it is encased in a sealed polyethylene bag, which is airtight and waterproof to stop any rot affecting the product. To further protect the shelter, the polyethylene bag is encased within heat treated timber and ply panel crates.

Two sizes of the shelter are available, the smaller 25m² (CCS25) and the larger 50m² (CCS50). Should the situation require, multiple Concrete Canvas Shelters (CCS) can be joined together to form larger structures, as the shelters have been designed to work as part of a modular system.

Because the shelters were designed to be deployed in disaster areas, they needed to be set up quickly so they could be used as soon as possible. For that reason, both sizes of CCS can be set up by just two people. For the larger CCS50, a vehicle or winch is required to aid the unfolding of the shelter from its packaging.

The shelters are given their shape due to the innovate nature of their design – rather like a Nissen hut. Both sizes contain an inflatable inner which is bonded to the Concrete Canvas material on the outside. Using a blower, the inflatable inner pushes the outer material into shape. Once fully inflated, the shelters are pegged down to secure it to the ground, and they are ready to be sprayed with water.

The “Building in a Bag” can be deployed in a wide array of places and has an equally wide array of applications. Photo: Concrete Canvas Ltd.

**THE ‘BUILDING IN A BAG’**

INFLATABLE CONCRETE SHELTERS ARE A GOOD FIT ACROSS A BROAD SPECTRUM OF APPLICATIONS.

By Thomas Goodall
This may seem counter-intuitive, but this is where the speciality of the Concrete Canvas material comes into its own. As the material is a Geosynthetic Cementitious Composite Mat (GCCM), which contains a specially formulated dry concrete mixture, to harden the fabric you hydrate it and leave it to set. The shelters do not require fresh or bottled water to be used to hydrate the material; therefore, transported seawater or water from any local and sustainable watercourse can also be used without compromising the structural rigidity.

Within 24 hours, the material reaches 80 percent strength and the shelters are fully operational and ready to use. The inflated inner now functions as a sealed and sterile environment which can vastly increase the frontline medical capabilities of the shelters in disaster areas or war zones.

On the outside, the fully hardened concrete shell has several key benefits which make the shelter ideal for use in a number of challenging situations. Firstly, since the structure is fully self-supported, it can be covered in materials such as snow, sand or earth to enhance its thermal performance. Secondly, the outer layer of concrete fabric is fireproof due to being a ceramic. It also provides protection against small arms fire and shell fragments, making it ideal for medical operations in combat areas. These features are simply unattainable with traditional soft skin structures and fabrics. Furthermore, the lockable doors provide an added level of security not possible with conventional tents.

Concrete Canvas co-founder Peter Brewin also highlighted another advantage to the structures compared to traditional alternatives.

“Because it’s a hardened building just as you would in any conventional permanent building, you can drill holes, attach fixings and install services in exactly the same way,” he said.

As such services such as electricity can be installed, again increasing the capabilities of the shelter.

In developing the Shelter, Brewin and Crawford realised the potential of the Concrete Canvas fabric itself, and moved into commercial production of bulk rolls of the material in three thicknesses: 5mm (CC5TM), 8mm (CC8TM) and 13mm (CC13TM). The success of the material led to the development of a sister product: CC HydroTM (CH) for containment applications. Both materials have been used in a large variety of projects around the world from slope protection to channel lining and secondary containment. Concrete Canvas Ltd is now a multi-million-pound company and is growing year on year, with around 80-90% of all material produced being exported worldwide.

Concrete Canvas, however, have continued to be able to help those in difficult situations with their products. Co-founder Will Crawford said, “Recently (CC has been used) in developing countries to help reduce water loss in water transportation canals, which is increasingly becoming an area of global interest. Limiting water loss and looking after our water resources is increasingly important.”

However, getting the product specified for projects isn’t always easy. "The product is used generally for civil engineering applications,” Crawford said. “The biggest challenge is convincing what is traditionally a very conservative market – engineers and the construction sector – to use a completely new material. It’s about communicating first of all that this new product exists, and then persuading them that the benefits are worth them taking the risk to use the new material and that has been incredibly difficult, particularly in the market segment we are targeting.

Concrete Canvas Ltd. are currently on track to achieve another best ever year for sales, and hope to continue to grow in the coming years as a result of a growing client base, increasing export demand, and a brand-new manufacturing facility and HQ to support this demand.

THOMAS GOODALL is a graduate of Newcastle University who writes about a variety of topics, including technology and sustainability, and contributes work to a range of online publications.
GCP APPLIED TECHNOLOGIES’ ELIMINATOR® BRIDGE DECK WATERPROOFING MEMBRANE SAFEGUARDS OVER 12,000 ROAD & RAIL BRIDGES
SUPERIOR PROTECTION FOR BRIDGE DECKS, EXTENDING THE LIFE OF ROAD AND RAILWAY BRIDGES

GCP APPLIED TECHNOLOGIES’ ELIMINATOR® bridge deck waterproofing system, a cold, spray-applied solution, celebrates decades of protecting bridges across the globe. Developed in partnership with bridge engineers, this solution extends the life of road and railway bridges while reducing ongoing maintenance costs.

Steel and concrete bridges are vulnerable to damage from water, chloride and frost, leading to deterioration and even structural failures. Installing a high-performance waterproofing membrane is therefore an essential part of any bridge construction or refurbishment program.

Based on unique ESSELAC® advanced resin technology, the ELIMINATOR® system creates composite action between the deck, waterproof membrane, substrate and asphalt, ensuring that the membrane is fully bonded both downwards to the deck and upwards to the surfacing. The extremely high bond enables the membrane to stand up to punishing climate conditions and heavy traffic loads.

The ELIMINATOR® bridge waterproof membrane offers fast, simple and effective application. Unlike alternative solutions that are sensitive to moisture, the ELIMINATOR® membrane can be applied virtually year round, in any climate, preventing costly weather delays. It cures in just an hour, even in high humidity or low temperatures. In addition, the system can be applied to concrete substrates after just 14 days, and the paving can be completed on the same day as waterproofing application.

The ELIMINATOR® system also features on-the-spot QA capabilities, such as the two-color application system, that makes it easy to quickly verify that the membrane is applied properly.

The ELIMINATOR® bridge deck waterproofing system has an unparalleled track record safeguarding more than 12,000 road and rail bridges globally, including the Hong Kong-Zhuhai-Macau Bridge, Putney Bridge in London, the Governor Mario M. Cuomo Bridge and many other iconic structures. From small railroad bridges to some of the longest-span highway bridges in the world, the ELIMINATOR® system offers unsurpassed durability and performance, combined with a speed of application that makes it particularly appealing to contractors around the world looking to capitalize on fast project completion dates.

For more information on the ELIMINATOR® bridge deck waterproofing, visit product.gcpat.com/eliminator.

Since the ELIMINATOR system cures quickly, multiple trades could finish their work on the Governor Mario M. Cuomo Bridge in New York.

The ELIMINATOR® bridge waterproof membrane offers fast, simple and effective application. Unlike alternative solutions that are sensitive to moisture, the ELIMINATOR® membrane can be applied virtually year round, in any climate, preventing costly weather delays. It cures in just an hour, even in high humidity or low temperatures. In addition, the system can be applied to concrete substrates after just 14 days, and the paving can be completed on the same day as waterproofing application.

The ELIMINATOR® system also features on-the-spot QA capabilities, such as the two-color application system, that makes it easy to quickly verify that the membrane is applied properly.

The ELIMINATOR® bridge deck waterproofing system has an unparalleled track record safeguarding more than 12,000 road and rail bridges globally, including the Hong Kong-Zhuhai-Macau Bridge, Putney Bridge in London, the Governor Mario M. Cuomo Bridge and many other iconic structures. From small railroad bridges to some of the longest-span highway bridges in the world, the ELIMINATOR® system offers unsurpassed durability and performance, combined with a speed of application that makes it particularly appealing to contractors around the world looking to capitalize on fast project completion dates.

For more information on the ELIMINATOR® bridge deck waterproofing, visit product.gcpat.com/eliminator.

Since the ELIMINATOR system cures quickly, multiple trades could finish their work on the Governor Mario M. Cuomo Bridge in New York.

The ELIMINATOR® bridge waterproof membrane offers fast, simple and effective application. Unlike alternative solutions that are sensitive to moisture, the ELIMINATOR® membrane can be applied virtually year round, in any climate, preventing costly weather delays. It cures in just an hour, even in high humidity or low temperatures. In addition, the system can be applied to concrete substrates after just 14 days, and the paving can be completed on the same day as waterproofing application.

The ELIMINATOR® system also features on-the-spot QA capabilities, such as the two-color application system, that makes it easy to quickly verify that the membrane is applied properly.

The ELIMINATOR® bridge deck waterproofing system has an unparalleled track record safeguarding more than 12,000 road and rail bridges globally, including the Hong Kong-Zhuhai-Macau Bridge, Putney Bridge in London, the Governor Mario M. Cuomo Bridge and many other iconic structures. From small railroad bridges to some of the longest-span highway bridges in the world, the ELIMINATOR® system offers unsurpassed durability and performance, combined with a speed of application that makes it particularly appealing to contractors around the world looking to capitalize on fast project completion dates.

For more information on the ELIMINATOR® bridge deck waterproofing, visit product.gcpat.com/eliminator.
New Integrated Approaches Yield Improved Containment Design

Engineer Stacey Smith of Smith Gardner uses digital tools for landfill cover design

By Dorothea Olenska

Stacey Smith didn’t plan on building a lifelong career working with landfill cover, the layer of compressed, engineered soil designed to minimize waste’s interaction with the environment. “I would probably say I fell into it,” says Smith, president of the prominent North Carolina engineering firm Smith Gardner and member of the North Carolina Professional Engineering Board. Smith has been involved in the use of geosynthetic materials in cover design since working as the right-hand man of his mentor Greg Richardson in the early 1990s. When Smith got into the industry, the American recycling and waste system was in the midst of a transition from unlined to lined landfills (to prevent toxic materials from leeching into the soil), thanks to a new era of legislation that changed the way Americans think about and process the excesses of our consumption. “It was a time of a lot of change,” says Smith, “and the industry was different from what I had worked on.”

Smith says that one of the most rewarding aspects of working with waste processing and containment is the rapid evolution of science and legislation around the treatment of both consumer waste and the by-products of industrial activity. “It’s been so fascinating over the past several decades to see how we’ve evolved in the use of containment systems and how we remove waste or contain it,” says Smith. “When I started, we were very compartmental in the way we designed systems. But over time we’ve had to take responsibility for more of the containment design, learning how to manage liquid, landfill gas collection, trying to close and zip up the side with other geosynthetic materials. We’ve developed a master plan approach, looking at what the whole site looks like versus looking specifically at all the components.”

A critical component of designing this more comprehensive approach to waste management and containment is the use of digital imaging technologies and software. “We’ve seen 3D modeling technology evolve over the years,” says Smith, “And whenever we’re evaluating volume of waste materials or earthwork in trying to better optimize a site, that technology has become integral to what we do. I used to do cross sections by hand, which would take several days. With technology we’re able to do that work in half an hour.” Aside from the obvious benefits of saved time, digital technology has helped Smith and his colleagues present a more integrated approach to new designs, using software like Bluebeam Revu in order to track and communicate about projects across teams. “We’re able to display our designs in several types of illustrations, like gradients or layer models,” says Smith. “We do a lot of modeling to make sure we get the most out of an area. Our guys like Bluebeam software for its ability to bridge or extend our work, measuring areas or lengths and tracking projects.”

But for Smith, changes in the industry’s understanding of the nature of waste, reimagining potential new streams of storage, and reuse, are even more critical than developments in the underlying technology that supports landfill cover design. “Every year we advance our knowledge of potential contaminants within the world and then identity and mitigate their impact,” says Smith. “The most exciting work we do is trying to help our clients and the regulatory community discover how to apply the volumes of regulatory language that we have to navigate. What makes sense? What works the best? How can we do the best thing for the public and the environment? Every few years there’s a new topic and new things that we learn, and we try to put systems in place that can remediate issues as they arise.”

Waste processing is very much an economic issue. And with global market realities leading to a cessation in much of the international recycling markets the American waste community depended on, Smith says that now is the time to consider reuse and repurposing of waste as an increasingly critical issue. “I’m interested in how we can take advantage of the economy to recover waste that can be used in a different way,” says Smith, noting that reuse of waste products is central to his company’s practice. “Every time we’ve had an opportunity to pull out a waste stream and give a product a new use, we try it. If you assume that waste can still be a resource, you’ll think about it in an entirely different way. We’re continuing to find ways to streamline the process.”
BQE Launches Industry’s First Conversational AI Feature

BQE Software, Inc., a global leader in accounting and project management software for professional services firms, launched Core Intelligence, an Artificial Intelligence tool that allows users to have human-like conversations with their business software to gain actionable insights about their company and perform work-related tasks.

Core Intelligence is an extension of BQE Core, a cloud-based accounting and project management platform released to great acclaim in 2017. Since that time, BQE teams developed the AI and supporting technologies needed to bring Core Intelligence to life.

“We wanted it to be extremely robust and extremely prompt in getting answers,” said Shafat Qazi, founder and CEO of BQE Software. “If you have to wait a long time to receive an answer in a conversation, it doesn’t feel like a conversation. We also wanted this experience to be seamless, so imagine not even having to log into a computer to be in touch with your business, and forget shuffling through Excel spreadsheets to make sense of your data.”

BQE is the first company in the project management and accounting software industry to release an AI that goes beyond being a voice input and functions as an intelligent business analyst. Instead of just providing simple answers to a user’s questions, Core Intelligence looks deeply into a company’s data to make contextual connections that provide additional insights related to the questions that can be commonly overlooked. For example, while asking for your To-Dos for today, it will also remind you of the past-due To-Dos that need your attention.

“Core Intelligence will change the way we manage our business and make our business decisions,” Qazi said. “By simply talking to our software, Core users can be pro-actively informed about their company financials, project status, bottlenecks, and the rainmakers. This intelligence empowers users to make smarter business decisions and allows them to make the right decision.”

Core users can access Core Intelligence through any of their smart devices connected to Google Assistant, such as the Google Home app on their phones, a Google Home smart speaker, or a vehicle with Google Assistant connectivity. This allows them to use only their voices to get work done anywhere, instantly.

BQE will continue to update Core Intelligence every two weeks so that its functionality becomes deeper and wider. Or, as Qazi says, “We’re training it to do everything a human can do.”

Based in Torrance, California with offices in Sydney, Australia, BQE was founded by Qazi, oftentimes referred to as the “Pioneer of Professional Services,” in 1995. A structural engineer by trade, he had his own firm for eight years before founding the company. He understands the pain points associated with the engineering profession, and he and his team have created solutions tailored for AEC firms. In the process, BQE has become a place where people want to work. Earlier this year, the company won Comparably Awards for Best CEO for Women, Top 50 Best CEO for Diversity, and Best Company for Professional Development. BQE also made Inc. Magazine’s 2019 list of Best Places to Work.

With 25 years in the business, Qazi can look back at the evolution of computer technology, from mainframes to PCs, from DOS to Windows, from Desktop to Cloud, and now to mobile-first and AI, where BQE and its clients find themselves. If AEC firms want the competitive advantage from a business management perspective, they’ll have to keep an eye on the future, where they’ll find BQE’s Core Intelligence.

“You want to empower your staff with the right tools,” Qazi said.
CONGRATULATIONS 2019 HOT FIRM WINNERS!

<table>
<thead>
<tr>
<th>Rank</th>
<th>Firm Name</th>
<th>Rank</th>
<th>Firm Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>NV5 Global, Inc.</td>
<td>40th</td>
<td>Coffman Engineers, Inc.</td>
</tr>
<tr>
<td>2nd</td>
<td>NELSON Worldwide</td>
<td>41st</td>
<td>Humphreys &amp; Partners Architects</td>
</tr>
<tr>
<td>3rd</td>
<td>Dennis Group</td>
<td>42nd</td>
<td>Long Engineering</td>
</tr>
<tr>
<td>4th</td>
<td>Arduura</td>
<td>43rd</td>
<td>4 S.T.E.L. Engineering, Inc.</td>
</tr>
<tr>
<td>5th</td>
<td>Hargrove Engineers + Constructors</td>
<td>44th</td>
<td>IPS-Integrated Project Services, LLC</td>
</tr>
<tr>
<td>6th</td>
<td>Anser Advisory</td>
<td>45th</td>
<td>CORE Consultants</td>
</tr>
<tr>
<td>7th</td>
<td>VLK Architects</td>
<td>46th</td>
<td>ATI Architects + Engineers</td>
</tr>
<tr>
<td>8th</td>
<td>The Thrasher Group</td>
<td>47th</td>
<td>Lowe Engineers, LLC</td>
</tr>
<tr>
<td>9th</td>
<td>ISG</td>
<td>48th</td>
<td>SAM, LLC</td>
</tr>
<tr>
<td>10th</td>
<td>CMTA</td>
<td>49th</td>
<td>The Mannik &amp; Smith Group, Inc.</td>
</tr>
<tr>
<td>11th</td>
<td>RINCON CONSULTANTS, INC</td>
<td>50th</td>
<td>Westwood Professional Services</td>
</tr>
<tr>
<td>12th</td>
<td>Parametrix, Inc.</td>
<td>51st</td>
<td>GH2 Architects, LLC</td>
</tr>
<tr>
<td>13th</td>
<td>Parrish and Partners, LLC</td>
<td>52nd</td>
<td>CMBA Architects</td>
</tr>
<tr>
<td>14th</td>
<td>LJA Engineering</td>
<td>53rd</td>
<td>Environmental Partners Group, Inc.</td>
</tr>
<tr>
<td>15th</td>
<td>Maser Consulting P.A.</td>
<td>54th</td>
<td>Quality Engineering &amp; Surveying, LLC</td>
</tr>
<tr>
<td>16th</td>
<td>Ware Malcomb</td>
<td>55th</td>
<td>Sullivan Engineering</td>
</tr>
<tr>
<td>17th</td>
<td>SEPI Engineering &amp; Construction, Inc</td>
<td>56th</td>
<td>LeCraw Engineering, Inc.</td>
</tr>
<tr>
<td>18th</td>
<td>Halff Associates</td>
<td>57th</td>
<td>J2 Engineers</td>
</tr>
<tr>
<td>20th</td>
<td>HILGARTWILSON, LLC</td>
<td>59th</td>
<td>SCJ Alliance</td>
</tr>
<tr>
<td>21st</td>
<td>Binkley &amp; Barfield, Inc.</td>
<td>60th</td>
<td>Arora Engineers, Inc.</td>
</tr>
<tr>
<td>22nd</td>
<td>Ross &amp; Baruzzini, Inc.</td>
<td>61st</td>
<td>Traffic Planning and Design, Inc.</td>
</tr>
<tr>
<td>23rd</td>
<td>Hastings Architecture, LLC</td>
<td>62nd</td>
<td>TETER, LLP</td>
</tr>
<tr>
<td>24th</td>
<td>Woolpert</td>
<td>63rd</td>
<td>OHM Advisors</td>
</tr>
<tr>
<td>25th</td>
<td>Mead &amp; Hunt</td>
<td>64th</td>
<td>Bowers + Kubota Consulting, Inc.</td>
</tr>
<tr>
<td>26th</td>
<td>Cobb, Fendley &amp; Associates, Inc.</td>
<td>65th</td>
<td>DCI Engineers</td>
</tr>
<tr>
<td>27th</td>
<td>Patel, Greene and Associates, PLLC</td>
<td>66th</td>
<td>WSB</td>
</tr>
<tr>
<td>28th</td>
<td>P2S INC.</td>
<td>67th</td>
<td>G3 Quality, Inc.</td>
</tr>
<tr>
<td>29th</td>
<td>ECS</td>
<td>68th</td>
<td>Huckabee</td>
</tr>
<tr>
<td>30th</td>
<td>MCADAMS</td>
<td>69th</td>
<td>Harper Houl Peterson Righellis Inc.</td>
</tr>
<tr>
<td>31st</td>
<td>VHB</td>
<td>70th</td>
<td>Chen Moore and Associates</td>
</tr>
<tr>
<td>32nd</td>
<td>BFK Engineers</td>
<td>71st</td>
<td>GEI Consultants Inc.</td>
</tr>
<tr>
<td>33rd</td>
<td>Atwell, LLC</td>
<td>72nd</td>
<td>Harley Ellis Devereaux (HED)</td>
</tr>
<tr>
<td>34th</td>
<td>WestLAND Group, Inc.</td>
<td>73rd</td>
<td>The Vertex Companies, Inc.</td>
</tr>
<tr>
<td>35th</td>
<td>Garver</td>
<td>74th</td>
<td>SWCA Environmental Consultants</td>
</tr>
<tr>
<td>36th</td>
<td>Mabbett &amp; Associates, Inc.</td>
<td>75th</td>
<td>Langan</td>
</tr>
<tr>
<td>37th</td>
<td>Woodard &amp; Curran</td>
<td>76th</td>
<td>Wantman Group, Inc</td>
</tr>
<tr>
<td>38th</td>
<td>CRB</td>
<td>77th</td>
<td>Steelman Partners</td>
</tr>
<tr>
<td>39th</td>
<td>Ramey Kemp &amp; Associates, Inc.</td>
<td>78th</td>
<td>Gorrill Palmer</td>
</tr>
</tbody>
</table>

CONGRATULATIONS 2019 BEST FIRMS TO WORK FOR, MARKETING EXCELLENCE AWARD, AND TOP NEW VENTURE WINNERS!
Like our advertisers?
Visit their site and tell them we sent you!

**COMPANY NAME**  **URL & PAGE NUMBER**

ACI  www.concrete.org  2
Fenner & Esler Agency  www.insurance4structural.com  10
Hilti  www.hilti.com  56
Hubbell  www.hubbell.com  51
IAPMO  www.uniform-es.org  4
NCEES  www.ncees.org  35
NPCA  https://precast.org  39
Plastic Solutions, Inc.  www.plastic-solution.com  21
Sox Erosion Solutions  www.soxerosion.com  8
The Zweig Letter  www.thezweigletter.com/subscribe  64
Xypex  www.xypex.com  19

NOTICE: Articles and advertisements in this publication are often contributed by third parties. Owners and staff of this publication attempt to assure accuracy of content. In the publication process, it is possible that typographical, editorial, or other errors may occur. The reader is warned to make independent verification of any techniques, methods, or processes contained herein before implementation. Techniques, methods, or processes published in this magazine have not been independently verified or tested by the staff of this publication and are not endorsed or recommended by this publication, which disclaims any responsibility for results or consequences of their implementation. Reader assumes full risk of loss, damage, or injury to persons or property from the implementation. Anyone who purchased this publication under the mistaken impression that the contents herein had been independently tested or verified by this publication may submit a written request for a full refund of subscription price within thirty (30) days of date of purchase. The foregoing is the sole remedy hereunder against the publisher, its staff, and owners for any claim related to any techniques, methods, or processes set forth herein.

The digital subscription IS NOW FREE!

Sign up and receive the AEC industry’s leading management newsletter every Monday morning.

thezweigletter.com/subscribe/