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Pend Oreille County needed to remove a culvert on Indian Creek that was preventing Bull Trout from traveling upstream to spawn. The Bull Trout are a threatened species under the U.S. Endanger Species Act and the stream is considered environmentally sensitive. Additionally, the county needed to address the road’s aging condition. Its alignment was for a 35 mile per hour road, but the speed limit is 50 miles per hour. It was determined to realign the road and replace the culvert with a 58-foot, single-span bridge to allow the fish to more easily move upstream and to correct the road condition. Limited physical and right-of-way access dictated that the earth-fill embankment approaches required for the new bridge would need steep wing-walls.

The owner considered using steel sheet pile walls, but the cost quickly exceeded the project’s budget. Vinyl sheet pile walls were considered, but they did not meet the strength criteria. Another deciding factor was that residents and a local Indian tribe wanted a solution with a natural, vegetated look rather than a concrete wall along the wetland. PYRAWALL™ was selected because it is an engineered wrap-face, vegetated solution that costs less than a concrete retaining wall. The system combines the robust protection of PYRAMAT® High Performance Turf Reinforcement Mat with fiber-composite internal bracing to deliver permanent erosion control and mechanical slope stabilization.

In addition to offering long-term durability, PYRAWALL is a vegetated solution. It is designed with patented triolobal X3® Fiber Technology to promote rapid root mass development, yielding a fully vegetated installation. In addition to yielding a natural look, the system’s bracing is all internal creating a smaller footprint overall. PYRAWALL can also withstand animal loading expected from deer, antelope and moose in the area.

PYRAWALL was used to build an east-approach embankment that is 210 feet long and 14 feet tall, and the west-approach embankment that is around 340 feet long and 18 feet tall. On-site soil was used for infill, eliminating the cost and carbon footprint of importing soil. Seeds were planted within the wall to further establish vegetation. Within months of installation, vegetation was visible along the constructed wall, and within four years it is expected to be 85%-90% vegetated and will provide erosion control protection for up to 75 years.

In addition to creating wrapped-face mechanically stabilized earth structures, PYRAWALL can be used for reinforced soil slopes, stream bank stabilization, landslide remediation, vegetated facing for soil-nail or ground-anchored slopes, landscaping enhancements for residential and commercial properties, and wing walls for Geosynthetic Reinforced Soil – Integrated Bridge Systems (GRS-IBS). PYRAWALL features flexible setback and alignment, allowing it to be customized to unique site conditions. Plus, it is easy to transport, making it ideal for sites that are difficult to access.

For more information on how PYRAWALL can benefit your next project contact Propex GeoSolutions at 800 621-1273 or visit our website at www.PropexGlobal.com. Also, make sure to attend our webinar on PYRAWALL on May 30th at 1 p.m. (EST).
IF YOU KNOW ME, you know I get excited about my place in the AEC industry and the potential it represents. I’m President and CEO of Zweig Group, a strategic advisor, an analyst and researcher, and an educator. With The Zweig Letter and C+S Engineer magazine, I’m also a publisher. With all these positions rolled into one, it would be easy to let the opportunities overtake my bandwidth. Sometimes they do! But for the most part I’m able to focus by asking one simple question: Am I elevating the industry? If so, I’m in. If not, I’m out.

So, I take a look at the magazine and ask myself the same question, and these days the answer is a resounding yes. C+S just wrapped up the nominations for its Rising Stars, and the drone video contest, hosted by the magazine, has three finalists – among dozens of entrants – vying for a big trophy to be handed out this month. My team put in a lot of effort to make these programs possible. But for Rising Stars and the drone video contest to truly mean something, they need industry participation. Participation, after all, is a big part of the process of Elevating the Industry. To do it, you have to be part of it. And this year, we’re seeing increased participation in all that we do.

Nominations rolled in for Rising Stars, the annual celebration of the best and brightest in the fields of civil and structural engineering. Firms from across the country threw their hats into the ring. While the results of the judging, which is still ongoing, will not be announced in the magazine until August, I can tell you this: I took a sneak-peak at the nominees, and the Rising Stars candidates are all amazing! Professors, project managers, entrepreneurs and team leaders – all of them young, ultra-talented, and community-minded. They come from around the country and the world, men and women from firms large and small. Together, the 2019 Class of Rising Stars embodies Zweig Group’s aim to Diversify, one of the five tenets – Diversify, Celebrate, Change, Promote, Educate – of the Elevate mission. The top candidates will be featured in our August edition as well as at our Elevate AEC Conference in Las Vegas, October 2-4, at the Green Valley Ranch Resort and Spa. We hope to see you there.

Turning to the drone contest, I see another Elevate tenet in action – Change. Last year we tried something new. We sponsored a drone video contest. While participation was good, it was nothing compared to what happened this year, the second time around. There were many awesome examples of firms that are elevating the profession and the industry using this technology to differentiate their services. Differentiation fights against commoditization and is a key part of the change tenet of our mission. The number of submissions increased this year, as did the overall quality of the videos. In voting, people visited our website by the thousands. Instead of simply judging for ourselves and announcing the results, as we did last year, we took the top three vote-getting videos to the AUVSI XPONENTIAL conference in Chicago, where the audience determined the winner via live voting! You can see who won by checking out our Facebook page at @CSEngineerMag. How is that for Promoting and Celebrating achievements in our industry?

I think the whole drone setup was neat. But to get it done the way we did, my team had to change the way it did things. In other words, they had to practice what we preach here at Zweig Group by living up to the Elevate mission. This took outreach, partnerships, and a lot of extra work. And guess what? It worked.

Don’t ever be afraid to Elevate. It will always be in your best interests.

CHAD CLINEHENS, P.E., is Zweig Group’s president and CEO. Contact him at cclinehens@zweiggroup.com.
In late 2017, construction began on a new MSE wall to expand a portion of the waterfront at Point Defiance Marina. The site consists of hundreds of feet of loose slag mine tailings placed in the waterfront area as part of the ASARCO Lead and Copper Smelter operations, which took place for several decades in the 1900's. In addition to the surrounding area’s highly toxic soil, the adjacent sea water creates an electro-chemically aggressive environment.

The wall is about 430 feet long and reaches a height of more than 15 feet, with a geometry that includes eight inward and outward bends. Its foundation sits at a maximum depth of three feet below the extreme high tide elevation of 6 feet. Obstructions behind the wall face include drainage structures, an electrical vault, and an abutment for a 25-foot gangway extending to the boat docks.

Considering the corrosive environment and the need to skew soil reinforcements away from obstructions in the fill volume, GeoStrap® was chosen for it's advantage over galvanized steel and geogrid. Concrete facing panels were used for their durability against tide action and waves, ensuring that the shoreline will be protected in this location for years.

Frequent rainfall and high tides challenged the construction of the wall. At the time of placement of the bottom row of concrete panels, the water level was at the top of the leveling pad. Aggregate backfill with low fines eased construction in the rain, as it allowed water to freely flow through and did not require a high compaction effort. This type of fill is free-draining, which will also help prevent hydrostatic pressure from accumulating behind the wall during the life of the structure.
I AM STANDING AT 1,400 FEET HIGH looking down on the 88-story Petronas Twin Towers in Kuala Lumpur, once the highest in the world. The wind is blowing and storm clouds are forming along the skyline in the distance. I am at the construction site of The Exchange 106, now one of the tallest buildings in Asia. Engineering was started a mere three years ago. With amazing speed, it has now reached 106 stories. The skyscraper is a steel gravity system with a cast-in-place core system. Welding quality looks great. The design is a super simple but elegant solution engineered by Jason Louie and our San Francisco crew. Architect/Developer is Mulia Group. Yes, the developer is the architect. Mulia’s work is most fascinating and unique. The interior design features an exquisite finishing with Italian marble – directly procured from an Italian quarry.

Construction management is led by a man named Roland with a staff of half a dozen. They are long-term employees of Mulia and have been building game-changing high-rises throughout Southeast Asia for the past couple of decades. The general contractor is China State Construction. But Roland and his team are deeply involved in managing the construction, the general contractor and its subs. They are achieving such quality and speed by partnering. This means that his job is not top-down managing these contractors, but helping others achieve their objectives.

“We don’t follow a standard CM approach of assigning legal responsibility and work to hold them contractually accountable, but rather, we work alongside contractors as our partners,” Roland said. “Designers, engineers, developers and the contractor work in the same room and we troubleshoot and figure things out.”

Through this process, the team at The Exchange 106 continuously identifies waste, eliminates it and makes the process better. In contrast, the neighboring site – a high-rise currently at foundation level – is truly disastrous due to planning mistakes, delays and accusations of fault. It is run by an international contractor.

As Roland speaks about managing the construction at The Exchange 106 tower, it comes to me that his approach is very similar to the “Kaizen” system. This management system developed by Toyota Motors has been implemented by many U.S. companies such as Intel and Nike. It is known as the Lean process in the U.S. and is based on respect for people, maintaining a teamwork environment, eliminating waste and continuous improvement of the process. It is so interesting to see how Roland’s approach incidentally mirrors the philosophies of Lean and, when successfully applied, leads to the execution of such incredible projects.

As I write this article, I can’t stop thinking about John Taylor. J.T. has been working with our company for more than 55 years. When I joined the firm 30 years ago, he was already a senior-level guy. He has been a true mentor to me, teaching me through his actions to understand respect for people and teamwork. His health experienced a downturn recently and, now in his 80s, he’s decided to retire. To me, he is a true Kaizen guy and team player. I think he would be very proud of our involvement in such great projects and people. I will miss him.

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 non-profit Miyamoto Global Disaster Relief. He specializes in high-performance earthquake engineering and disaster mitigation, response, and reconstruction.
...AND YOU'RE GONNA LOVE OUR HALF-DAY FRIDAYS!
**DESIGN-BUILDING A LAWSUIT.** Well, Balfour Beatty Construction and HOK are duking it out in U.S. District Court for the Southern District of California. The lawsuit was originally filed in December in superior court in San Diego County, but has since been moved to the current location. Balfour Beatty is seeking at least $2.8 million in additional construction costs it says it incurred when it built a project, designed by HOK, that included a smoke control system allegedly in violation of the California Building Code. Fixing the problem, Balfour Beatty argues, cost it time and money. The project at issue was the Kern County Justice Facility, a $126-million jail that opened last spring in Bakersfield. While Balfour Beatty wants a jury trial, HOK has denied the allegations, has filed a counterclaim seeking $374,00 in retainage being held by Balfour Beatty, and has sued a subcontractor, Jensen Hughes Inc., blaming it for the shoddy smoke control system at the root of the conflict. In the greater scheme of things, and for firms that are so big, $2.8 million might not seem like a lot of money. But that amount, including the contested $374,000, comes out to about $3.1 million, or 67 percent of HOK’s original $4.6 million design fee. For HOK, if it loses the case, this would have to hurt. Both firms are mega-brands with international profiles, so they’re probably going to fight the good fight. No one knows how this will end, but one thing is certain – the lawyers will be busy.

**MODERN SLAVERY, REALLY.** Speaking of Balfour Beatty, a pretty interesting document lives on the company’s website. The Modern Slavery Statement, there in bold blue letters, outlines the concerns the firm has, and the stats that fuel that concern. According to the International Labor Organization, there are as many as 24.9 million people in forced labor, 16 million of whom are “exploited in the private sector such as domestic work, construction or agriculture.” According to the Balfour Beatty statement, “The vast majority of these people are in the supply chains of legitimate industries.” Balfour Beatty says that in its risk assessment, it found that the most significant risks for slavery occur in their “material and subcontract procurement.”

With more than 30,000 employees, Balfour Beatty is a leading international contracting company that had 2018 total revenue of £7.8 billion and an order book of £12.6 billion. The company operates principally in the UK, Ireland, the United States and Canada, and has a joint venture in Southeast Asia. The company has a Code of Conduct, and expects subcontractors, suppliers, and factories to comply with the code and other international standards. Kudos to Balfour Beatty, but it makes you wonder how many supply-chain companies don’t comply, and how many international companies don’t even address the issue of modern slavery.

**OIL & CRASS.** The sensationalism and delirium over Colorado’s SB 181, which overhauled the state’s regulation of the oil and gas industry by ceding oversight to cities and counties, got under Jack Hamlin’s skin. As owner and president of Englewood-based Summit Engineering Services, a 105-man firm that specializes in well pad facilities, he had a lot vested in the outcome of the bill, which was passed by the Colorado General Assembly in April. Hamlin was at a lot of public meetings, testified before the House Energy & Environment Committee, and was otherwise ever-present as the debate, framed along bitter party lines, unfolded in Denver. Disappointed by what he saw and heard, however, he penned an open letter to the public, one that was picked up by The Denver Post and that caught fire on LinkedIn.

“Instead of strong-arming and rushing through massive regulation overhauls, perhaps a more pragmatic discussion might be warranted. Let’s all put down our swords and bring people together to discuss the pros and cons of energy development of all kinds and the impacts it would have to all citizens and property owners,” he wrote.

And though his letter was well read, it’s not really what a lot of people wanted to hear. The bill’s supporters, the Democrats, said the world would collapse if the bill wasn’t passed, whereas Republicans, who opposed the bill, said the world would collapse if it did.

“Everyone’s a profit of doom,” Hamlin said during an interview with C+S. “I said, ‘Let’s have an armistice day,’ and it fell on deaf ears.”

Based in Weld County, ground zero for the Colorado oil and gas industry, the bill’s opponents have organized an effort to bring the issue to a vote of the people. Their aim? To repeal SB 181 and revert back to the rules and regs in place during former governor and current 2020 presidential candidate John Hickenlooper. Obviously, they may or may not succeed. Meanwhile, people like Hamlin, who make a living in the oil and gas industry, are worried about the health of their firms. Hamlin says he has already lost one employee due to fears over SB 181, and that he has put the kibosh on the hiring of two new people. He’s also looking harder at opportunities coming out of his Texas office in Midland.
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### MAY 2019

**WEF STORMWATER AND GREEN INFRASTRUCTURE SYMPOSIUM**  
**MAY 8-10 — FORT LAUDERDALE, FLA.**
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www.swan-2019.com

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National Conference for Public-Private Partnerships offers this event for public-sector officials and private-sector innovators focused on advancing public-private partnerships (P3s) nationwide.  
https://thep3connect.org

**INTRODUCTION TO STRUCTURAL DESIGN OF WOOD BUILDINGS PER THE 2018 NDS**  
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www.cpe.vt.edu/sdwns/index.html

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### JUNE 2019

**SECOND INTERNATIONAL INTERACTIVE SYMPOSIUM ON ULTRA-HIGH PERFORMANCE CONCRETE**  
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https://conferenceonarchitecture/?utm_source=Civil-Structural-Engineer&utm_medium=display&utm_campaign=Conf19-informa

**INTERNATIONAL BRIDGE CONFERENCE**  
**JUNE 10-13 — NATIONAL HARBOR, MD.**  
Presented by the Engineers’ Society of Western Pennsylvania, the IBC annually attracts more than 1,200 bridge owners and engineers, senior policy makers, government officials, bridge designers, construction executives, and suppliers from throughout the U.S. and abroad.  
https://eswp.com/bridge/bridge-home

**HxGN LIVE 2019**  
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Andrew Holt has been in the engineering business for 33 years, and 23 of them have been with Suburban Consulting Engineers. At 52, Holt said the time has come to make his mark, to experience the payoff for all that time spent in the trenches.

A graduate of Montana State University with a bachelor’s in civil engineering, and with a master’s in environmental engineering from the New Jersey Institute of Technology, it would seem that Holt’s school days are over. But that’s not the case. He’s currently enrolled in Centenary University, where he’s pursuing an MBA. During the course of his business studies, he wrote a personal mission statement which, Holt said, serves as a constant reminder to hold himself accountable to his ideals. The statement, he said, is working.

Suburban Consulting Engineers has just started an ambitious, five-year plan to double revenue, double the number of employees, and increase profitability by as much as two to three times the industry average. To implement this plan, Holt and the firm knew they had to bring more people into the fold rather than employ a narrow, top-down approach. The firm is focused on three areas: Growth/Profitability; Business Development; and Technology. SCE has doubled in size in the last five years, and Holt says the firm can do it again.

Out of a firm of about 110 people, only six are owners, or about five percent. And that’s about right. To become an owner, someone has to exceed expectations, not just a few times, but over a career. The litmus test is tough, but ownership awaits those who can deliver at the highest level year-in and year-out.

In terms of retained earnings, SCE is committed to driving profits back into the firm or, as Holt likes to say, taking care of the “golden goose.” Part and parcel of that effort is to make sure everyone is pulling their weight around the office.

“One thing we continually work to overcome is the feeling of entitlement that some develop after putting in the time without necessarily achieving the results,” Holt said. “We are a results-based organization, and advancing into management requires demonstrated results and teamwork, regardless of the amount of time spent learning at our firm.”

A Conversation with Andrew Holt

Do you tie compensation to performance for your top leaders?

Currently, compensation levels for top leaders is not directly tied to performance, but performance is one of the criteria we evaluate when considering compensation amounts and adjustments. Performance must be accurately and fairly measured and reported to the individual throughout each evaluation time period. As a growing company, we are continuing to perfect and improve on performance monitoring and reporting systems. Until such time, as these systems are reliably operating, we defer to a committee review process where the senior leadership compares and prioritizes the roles and responsibilities of each leader. Additionally, we invite top leaders to positions of ownership and as such, their compensation includes distribution of company profit. All top leaders have a direct influence on their total compensation through improved performance.

What actions do you take to address a geographic office or specific discipline in the event of non-performance?

Non-performance in any organization is an issue, especially when introducing the complexities of geographic distance or unique service disciplines. The critical action is to be aware of the non-performance issues through measurement and reporting (whether it be profitability, adherence to core values, or marketing and sales). Once identified, immediate dialogue must occur with those accountable for that area of performance or office, preferably in face-to-face meetings where corrective action plans can be developed, implemented and monitored. We typically find that serious performance issues require corrective action plans lasting up to one year. However, that level of investment and attention is warranted for the long-term health of the company.

Have you ever closed an under-performing office? If so, tell us about it.

The decision whether to close an underperforming office is not one that can be taken lightly. Earlier in my career, I was responsible for managing a regional office of 13 employees, and the corporate leadership decided to close the office due to the economic downturn and the higher than average overhead burden. In the end, it was the right decision as it realigned the corporate structure, facilitating a smooth
ownership transition, and many of the employee resources were transferred so the impact was minimal. In hindsight, a more thorough dialogue and action plan for the office closing would have offered less overall disruption, so as we move forward, similar significant decisions are being made with thoughtful review, risk mitigation, exploration of options, and with an eye towards employee satisfaction and care. Such decisions are through ownership and leadership consensus with the affected parties being made aware. Of course, our goal is to avoid having to make these types of decisions at all.

How many years of experience – or large enough book of business – is enough to become a Principal in your firm? Are you naming principals in their 20s or 30s?

Becoming a principal of the firm is not tied directly to years of service or a particular value of their book business. Cultivating principals has taken many different paths in our 33-year history, having undergone one complete ownership transition and preparing for the next. I think the point of this question is to understand what firms are doing today, and not necessarily what happened years ago, so our answer is yes, we are identifying and signing on new owners/principals who are in their early 30s, some of whom have only ever worked at this company. Their experience or book is secondary to their true value to the company, which is a demonstrated commitment to putting the needs of the company ahead of their own needs, as well as an ability to work well within the organization’s values while being successful in their area of study.

Internal transition is expensive. How do you “sell” this investment opportunity to your next generation of Principals? How do you prepare them for the next step?

Internal transition is all our firm has known, and the plan is to keep that the primary mode of ownership transition going forward, and this method of creating ownership is not as expensive as it might appear. While the candidate may look at the initial investment as prohibitive, we work with those candidates to arrive at compensation packages that sustain their quality of life, but provide an enhanced motivation for company success, which in turn, fuels their buy-in capabilities. All the while, investing in these new owners builds the long-lasting, trusting relationship needed to work together in advancing the company’s goals. We are fortunate to have several success stories and examples to show the newest owners that they are not taking extreme risk with buying into the company.

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?

Building our management team has probably been the biggest challenge we have faced through the years, and I would be crazy to think we have perfected it at this point. There have not been too many long-time leaders, more so the short-term hopes that unfortunately never really translated into the capable leaders and managers which was expected (or paid for). One thing we continually work to overcome is the feeling of entitlement that some develop after putting in the time without necessarily achieving the results. We are a results-based organization, and advancing into management requires demonstrated results and teamwork, regardless of the amount of time spent learning at our firm. Those who advance understand this principle and, fortunately, our management team consists of those individuals today.

How do you promote young and new leaders as the firm grows?

Our youngest and newest leaders are promoted on an achievement recognition basis. We have recently implemented a career track advancement template, so that all in the company have a general understanding of what it takes to reach the next level. It summarizes the requisite education, credentials, experience, and capabilities which an employee is being evaluated on. Of course, those exhibiting exceptional leadership are looked at frequently and promoted earlier in this track compared to others.

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

“Creating opportunity.” I also have a personal mission statement I created recently, which supports this statement.

What happens to the firm if you leave tomorrow?

During our last ownership transition, we strategically took the roles and responsibilities of the past president and assigned it to multiple leaders, based on their demonstrated strengths. Therefore, we inherently have resiliency in the leadership of the company, with the other senior most partner responsible for operations (COO), and a capable group of vice presidents and officers taking responsibility for other business operations. In my absence, I have no doubt our junior leaders and officers could quickly step in to serve in my capacity, taking responsible charge of the financial and strategic planning aspects of our business. As engineers, belts and suspenders are highly regarded in our business operations.

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

Pricing services we provide have always been, and will continue to be, a limiting factor in the development of our services and business planning. Technology gains in efficiency and overall progress are what we strive for every day, but covering those increased costs for development and implementation of those technologies is often not considered. One area in which we are finding success is presenting the options to our clients in terms of value-added proposals, whereby we educate the client on the available technologies and costs to achieve the desired outcome. More often than not, with societal demands for timely results, it can be shown that technological solutions at a higher cost is warranted. Let’s hope this trend continues and is maintained.

If the worker shortage continues, do you see wages increasing to encourage more talent to enter the AEC space, or will technology be used to counter the reduced workforce?
The number of capable resources required to deliver the wide range of services we provide has become the limiting resource to our growth and expansion. As we combat this constraint, we take a multi-faceted approach, including competitive salaries, enhanced benefits, and employee perks, designed to promote a desirable workplace for all levels. More important is the combined investment in technology to improve our delivery efficiency, as it also promotes a competitive and vibrant workplace environment. It is recognized that salaries are increasing to continue to attract and reward those in the industry, but the technology is also a factor in our delivery process.

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

This question is at the heart of SCE. We have always preached the fact that we are a for-profit business, and it so happens our business is primarily centered on engineering. At every level within the company, we train and empower employees to make decisions with the business success in mind. Our business management software is at the core of all aspects of the operation, including business development, finance, operations, and project management. Employees can understand the impact of their decisions based on the information and reporting available from our business management systems. The business culture is alive and well and makes setting and reaching goals that much more meaningful.

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

The AEC industry is notorious for a shortage of diversity and inclusion. Remarkably, we have a large number of women in leadership positions, and we expect that trend to continue based on the demographics of our current employee roster. As a firm based in a less diverse hiring area, we are continually pursuing the recruiting of a diverse employee base, simply because of the benefits the variety of experiences and cultures present in delivering results to our clients. While diversity and inclusion have become a priority in many of our clients’ procurement processes, we have explored the possibility of restructuring the company as a woman-owned disadvantaged business. To-date, this major corporate restructuring has not been determined to provide a great benefit, but it remains a topic of discussion as we consider future transition planning.

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

Longevity of the firm is an absolute necessity. We are continually intrigued by the success of firms that have existed for decades, recognizing that clients place an exceptional value on the reputation and less importance on the skill set or delivery capability of the current staff. I myself have worked for three firms in my career. From my experience, the most valued staff stick around simply because of the environment for opportunity and professional advancement offered. Employees that recognize this will stay the course and build SCE’s reputation in exceeding client expectations, rather than jump to other firms to advance. Don’t get me wrong, we lose our share of capable employee resources for a variety of reasons, but in every case, the choice to depart is in

Andrew Holt’s Personal Mission Statement:
“As a leader, I Andrew Holt, behave ethically, honorably and honestly in my personal and professional lives. I continually improve through education and experience and apply that enhanced knowledge in my mission to help to improve the lives of those around me. I will succeed by using my critical thinking and communication skills, along with my sense of humor in a continuous process that will surround me with people who are more capable than I will ever be.”

SCE Company Mission Statement:
Creating SOLUTIONS for client SUCCESS by delivering INNOVATIVE and practical professional services.

SCE Core Values:
WE WILL....
Anticipate our Clients’ needs and deliver results that EXCEED EXPECTATIONS.
Provide superior CLIENT SERVICE and thoughtful COMMUNICATION.
Exercise the highest PROFESSIONAL and ETHICAL RESPONSIBILITY supporting our positive reputation in the industry.
Advance the PROFESSIONAL DEVELOPMENT of our employees to enable them to achieve greater capabilities and rewards.
Deliver exceptional CLIENT CARE through exceptional EMPLOYEE CARE.
line with that employees’ ambitions. It is not reasonable to expect that we can create opportunities aligned with everyone’s ambitions and expectations, but what we do strive for is that employees leave better prepared and more experienced than when they arrived.

Benefits are evolving. Are you offering any new ones due to the changing demographic?

Benefit and compensation packages are evolving every year. Most notably, we have recently created an employee perks program, where employees are granted a number of points based on their level of employment status and number of years of experience. They can choose to use those points for a wide variety of perks, including team building activities like bowling and golf leagues, health options and gym memberships, family related activities, or entertainment/leisure activities. Also, SCE has created a company bonus program whereby if the company is successful in reaching its annual performance goals, the week between Christmas and New Year’s is granted as an additional week of vacation and our offices close for that time period. This has been a very popular motivator which also encourages personal and family time.

What scares you about the geopolitical environment today?

Today’s geopolitical environment poses significant challenges to the consistent growth and service categories we expect to achieve. While our services are less influenced by the international business climate, many of our clients’ needs are directly influenced by the world economy. Most prevalent today would be the threatening impacts of foreign trade tariffs. Materials and equipment availability and costs could have an adverse effect on projects we design and a client’s ability to fund infrastructure improvements. Stability in the government and international relations appeared to be at an all-time low under the current administration, and until that changes, we may be in for a bumpy ride.

Have the tax cuts impacted your firm’s valuation? Do you plan on doing another valuation due to the tax cuts?

Our firm valuation is relatively simple. In our shareholder agreement, we have agreed to adopt the Zweig Z-3 formula for all internal share transfers, and it is updated annually, based on updated Zweig variables. We have successfully relied upon that valuation for nearly a decade and conducted several ownership transfer transactions on that basis, without challenge or difficulty. Amazingly, our firm’s value has significantly gone up in recent years due to our growth and profitability, and our commitment to investing back into the company (retained earnings).

LIISA ANDREASSEN is a freelance writer who lives in Asheville, NC. She writes on a variety of topics including architecture and engineering, business management, HR, and technology. She can be reached at landreassen@zweiggroup.com.

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It’s no secret that global predictions for an unpredictable climate come with increased disaster risks. As the frequency and severity of weather events intensify and populations grow, the potential impact on governments, cities and businesses around the world is constantly increasing. But what if we showed you how Jacobs and NASA scientists are leveraging remotely-sensed data acquired by ISS’s orbital sensor systems and captivating images from 240 miles overhead to provide critical disaster response aid, and help communities recover and become more resilient?

Capturing the scene below, every 90 minutes
Traveling at a speed of five miles per second, the team of six astronauts living and working aboard the ISS orbit Earth every 90 minutes. This team has a unique vantage point to document Earth’s dynamic environment including its geology, meteorology, geography, oceanography and ecology.

90% of Earth’s population is covered by ISS orbit, with astronauts taking millions of images of the planet below.
58,319 images of lightning captured by ISS in 2018.
2,399 images documenting natural and human-made disasters used to aid in responses around the world since 2012.
Down on Earth, Jacobs’ team of scientists at the Johnson Space Center (JSC) in Houston help provide these specialized, remote-sensing, science operations and observation services to the ISS program, including guiding astronauts to produce scientific photography and enhancing the imagery’s educational impact.

The ISS-generated images – capturing everything from impact craters, glaciers, volcanoes and aerosols to cities, storms and lightning and natural disasters – give primary data on the state of the Earth and complement traditional automated sensor systems. In addition to the astronauts’ real-time observations using handheld cameras, the space station’s orbital sensor systems provide a vital tool to identify the extent of damage from natural disasters and can even provide mapping support to aid response efforts on the ground.

Understanding the bigger picture

Almost every day, new target image requests – a combination of scientific, educational, crew and public affairs needs – get added to the team database. The Jacobs team on ground checks the ISS orbit tracks alongside ground targets, the sun elevation angles for the target and weather conditions to ensure the crew can view the ground target requested. Once all checks are passed, the target will be included in the daily target capture list for the team aboard ISS.

When possible and applicable, the team at JSC will request the astronauts capture imagery before a natural disaster hits an area. This is primarily the case when a large tropical storm is forecasted to hit a specific area, as our team can keep up-to-date with when and where a storm will hit. Pre-storm and post-storm imagery is invaluable when assessing storm damage, including flooding, infrastructure damage, power outages and other factors.

In practice

Since 2012, we’ve delivered nearly 2,400 images in support of the U.S. Geological Survey/Disaster Program documenting natural and human-made disasters around the world, including Hurricane Florence and the California wildfires in 2018.

During Hurricane Florence, a Category 1 hurricane active from Sept. 11 to 21, teams captured nighttime imagery to document the widespread power outages, especially in North Carolina. As wildfires ravaged northern California in May, teams captured a total of 116 images to monitor and track the spread of the fires.

Gateway to Astronaut Photography of Earth, the entire library of images captured from ISS, provides an enthralling look at the world around us, especially in times of need.

Interested in learning more about how Jacobs transforms intangible ideas into intelligent solutions for a more connected, sustainable world? Visit www.jacobs.com/what-if.

LISA VANDERBLOEMEN is a PhD level scientist, specializing in remote sensing analysis. She currently serves as the manager of the Exploration Science/Earth Science & Remote Sensing Unit at Jacobs, leveraging extensive management experience as both a U.S. Navy Reserve Commander and civilian contractor working in the information technology discipline. Lisa’s technical expertise includes database management, temporal/spatial analysis of oceanographic and hydrographic data and algorithm development.
A Cool(ing) Company
Data Center Powerhouse ScaleMatrix Has a Message for the AEC Industry: Bring it On.

By Richard Massey

Foreseeing the Time

When AEC firms will face data management issues caused by the mainstream implementation of AI and machine learning, California-based ScaleMatrix says it will be ready.

Mark Ortenzi and Chris Orlando, the high-performing masterminds and co-founders of ScaleMatrix, have invented a hybrid air/liquid cooled cabinet built to house virtually any hardware needed for an organization’s computing needs. With built-in logic, the cabinets are efficient, high-density, closed-loop, and fully modular. And compared to the installation of a traditional data center, ScaleMatrix can reduce the deployment time by as much as 75 percent, a deployment that is measured in days, not months or even years. If this cabinet is the meteorite, the old data center systems are the dinosaurs.

The ScaleMatrix cabinet has the ability to scale from 1kW to 52kW of workload, and it can handle anything an AEC firm can produce, especially as the industry has yet to employ AI and other cognitive technologies on a meaningful scale. However, with AI technology expected to boom in the coming years, that will probably change as engineering firms follow the lead of more progressive segments of the economy.

In a nutshell, data growth leads to compute and density increases – more processors – which leads to more power outputs, and thus increased heat, which leads to heightened cooling requirements. In the old days, the raised floor, the wind tunnel, and the chilled room were sufficient. Ortenzi and Orlando know all about it, because it was in the data center industry where they cut their teeth and made their names. But even as they flourished in that industry, they also saw the need for disruption.

“I wanted to invent a better mousetrap,” Ortenzi said.

Or, as Orlando likes to say, “If you want a cold beer, you don’t put it into a cold room. You put it in the refrigerator.”

With important partnerships with leading companies like Hewlett Packard Enterprise and NVIDIA – ScaleMatrix is a select partner in NVIDIA’s DGX-ready data center program – and now with data centers in San Diego, Seattle, Houston, Charlotte, and Jacksonville, ScaleMatrix upped the ante with the recent acquisition of Instant Data Centers, a deal that adds ruggedized, micro-data centers that can function on the edge – near the action and in remote locations, like a mine.

Even though the technology behind what ScaleMatrix does is perhaps dizzying, the philosophy is quite simple.

“Everything we do in this business is power and cooling,” Ortenzi said. “Next to labor, power is the biggest expense. It takes so many amps to cool so many amps. It takes so many watts to cool so many watts.”

The cabinets have built-in logic that responds to usage requirements, making the variable system “one big, breathing animal that modulates based on requirements,” Ortenzi said. The ScaleMatrix design includes full cooling support, redundant power supply, fire suppression, and integrated network support. When one cabinet gets filled up, just add another one. While ScaleMatrix at first offered cloud and colocation services, it has since added another distinct business line, the DDC™ cabinet for companies that want them for their own data centers.

While the reaction from the market has certainly been favorable – ScaleMatrix had 2018 combined sales of about $20 million and employs 52 people – it wasn’t necessarily instant and overwhelming.

“That’s a great novelty, but who needs that?” Ortenzi said, referring to the initial reaction he and Orlando got when they introduced a system that could handle such a heavy workload.

But all that changed about two years ago, when AI and machine learning came in from the fringe and entered the mainstream. Seemingly overnight, companies were dealing with more data than ever, and ScaleMatrix started fielding calls from all across the country, and even the world.

“All of a sudden, two years ago, all hell breaks loose and no one knew what to do,” Ortenzi said. “We’ve set ourselves up to be in a position to help people. Where else are they going to go?”

The Industry

A recent M&A deal in the AEC industry, and leading research, says that the ScaleMatrix hunch is probably correct – engineering firms are...
going to embrace big data and the means to manage it, for themselves and for their clients.

Harley Ellis Devereaux, a 400-plus person engineering firm with offices in Chicago, Detroit, Los Angeles, San Diego, San Francisco, and Sacramento, just merged with Integrated Design Group, an architecture, engineering, and planning firm with an established reputation in the field of data center design. In the media surrounding the merger, HED leadership recognized the emerging importance of data center design and its relationship to mission-critical sectors like healthcare and higher education.

In Virginia, Gov. Ralph Northam recently announced that M.C. Dean, an electrical design-build and systems integration firm for mission-critical organizations, will invest $25.1 million to incorporate a new product line at its fabrication and distribution facility in Caroline County. The expansion, which opens this summer, will double the company’s manufacturing capacity to support high-growth, mission-critical customers such as airports, healthcare facilities, and data centers.

In 2017, McKinsey & Company, in its report, “The new age of engineering and construction technology,” announced that the engineering and construction industry “is at the cusp of a new era, with technology start-ups creating new applications and tools that are changing how companies design, plan, and execute projects.”

The report cited applications of cutting-edge technologies across the full gamut of the AEC cycle, from design to preconstruction, and from construction to operations and management. In a subsequent report, however, McKinsey & Company concluded that “adoption of AI solutions is quite low in E&C [Engineering & Construction], particularly compared with other industries.”

Last year, in “State of AI in the Enterprise, 2nd Edition,” Deloitte reported that the global market in cognitive technologies has already passed the $19 billion mark. Cybersecurity, according to the Deloitte study, remains a prime concern, as does the skills gap, among those employing cognitive systems. The study was based on the results of a survey of 1,100 IT and line-of-business executives from US-based companies in Q3 2018.

Deloitte’s conclusion, while general to all industries, could apply to any AEC firm that branches out into AI and machine learning.

“Our survey results clearly show that growing numbers of companies are becoming more sophisticated in their usage of AI technologies. Now is the time for organizations to start selecting the business use cases that can deliver measurable value through AI-powered capabilities.”

The Partnership
The partnership between Ortenzi and Orlando has stood the test of time, 18 years to be exact. Their tactic is fairly simple – divide and conquer. Ortenzi mans the “back of the house” with research and development, design and engineering, while Orlando works the “front of the house” with business development, sales, and marketing. Together, the two
The ScaleMatrix cabinet system at work at a Future-Proof data center.
*Photo: ScaleMatrix*

of them log about one million air miles per year. The hectic schedule means they don’t see each other too often.

“It’s been an interesting road,” Ortenzi jokingly said. “Whenever we’re together it’s either really good or really bad.”

Ortenzi dates his tech career back to the early 1980s – MS-DOS, 8088 processors, and the dawn of the “network or networks,” now known as the Internet. With a laugh, he guesses that he has built upwards of 4,000 servers in his day. A self-taught computer technician, Ortenzi has a degree in business administration from the University of Colorado.

Like Ortenzi, Orlando also traces his tech roots back to the early years, when he was just 18. He started out testing RFID in clothing, meat-packing, shoes, and other products. From RFID he came up through the data center scene in Southern California, crossing paths with Ortenzi in 2004. Orlando has a degree in international business from San Diego State University.

Orlando is always looking ahead to the next big thing. But he also understands the value of what happened in the past, specifically as it relates to his partnership with Ortenzi.

“We’ve been blessed,” he said. “We’ve had about two or three cross words [in the last 18 years].”

The results of the partnership speak for themselves.

“We now have one of the most complete and capable cabinet platforms in the world,” Orlando said. “We are able to serve a customer wherever their demands are.”

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**Richard Massey** is managing editor of Zweig Group publications. He can be reached at rmassey@zweigroup.com.
With nearly 20 years of experience on her resume, Emily Herndon is a recognized expert in the field of strategic asset management. Her job is to meet with a client, evaluate their facilities and, through an assortment of means, figure out how to make those facilities perform better. Easier said than done, of course. And when clients come calling, they do so in a state of distress. Since Herndon works with federal owners with enormous asset portfolios, the challenges are big and the solutions even bigger. But for Herndon, that’s what it’s all about.

“They’ve got a problem that they can’t solve,” Herndon said of her clients. “They end up liking us at the end of the day.”

Her specialty is federal clients, agencies that manage millions of square feet of facilities. Projects can take months, and even years, to complete. Her work can take her anywhere, and can involve almost anything, from locks and dams to an abandoned missile silo.

“You never know exactly what you’re going to find,” she said.

For over seven years she was at Booz Allen Hamilton, a mega-firm, and from there went to Jacobs, an even bigger mega-firm, for nearly 12. In May, she took a position at Woolpert, where, as a senior consultant, she helped found the firm’s Strategic Consulting group, which focuses on asset management in aviation, water, land management, and federal facilities.

“You never know exactly what you’re going to find,” she said.

Clients have a surplus of data and don’t know what to do with it. Moreover, clients are finding themselves at important crossroads, hence the need to contact people like Herndon. This, Herndon said, is what clients are saying about themselves: We need to manage ourselves more strategically. We can’t get by without a plan anymore.

Apparently this conversation is taking place a lot, because Herndon and her growing team are busy.

“There’s so much work out there,” she said. “Right now, we have more work than we can do.”

A Conversation with Emily Herndon

C+S: What will be your top priority as a board member of the NIBS Facility Maintenance and Operations Committee?

Emily Herndon: I’m really looking forward to bringing a fresh new perspective to the committee. My first priority is to work with the board to develop our strategic plan where we will outline the committee’s short- and long-term goals, what we plan to accomplish over the next 3-5 years and how we plan to get there. The Facility Maintenance and Operations Committee has an incredible purview that addresses over 75 percent of the building’s total cost of ownership and everything we can do to enhance life-cycle performance improves the overall industry.

EH: Asset management is inherently a practice in sustainability. By managing your portfolio in a strategic, comprehensive and holistic manner, your assets will operate more efficiently. I think we are challenged a bit in the perception that sustainability has fallen off the radar and is not generally made a priority by leadership. As sustainability professionals we need to understand that sustainability concepts should

"PART OF MY MESSAGE TO WOMEN WHO ARE THINKING ABOUT A PROFESSIONAL CAREER IN TECHNICAL DISCIPLINES IS TWO-FOLD: DON’T ACCEPT A SITUATION THAT SUGGESTS GENDER IS A FACTOR, AND SURROUND YOURSELF WITH MENTORS (MEN AND WOMEN) WHO SHARE THAT VIEW."
WOOLPERT SENIOR STRATEGIC CONSULTANT SELECTED TO SERVE ON BOARD OF NIBS FACILITIES COMMITTEE

Woolpert Senior Consultant Emily Herndon, LEED AP, has been selected to serve on the board for the National Institute of Building Sciences (NIBS), Facility Maintenance and Operations Committee (FMOC). NIBS is a group of industry, government and agency experts who identify and solve issues that would otherwise hamper the construction of safe, affordable structures throughout the U.S. The FMOC works to improve the performance and longevity of buildings through effective maintenance and operation, improved total cost of ownership and life-cycle strategies for the nation’s built environment.

NIBS was established by the U.S. Congress in 1974 as a nonprofit, non-governmental organization and is responsible for standards, including the Whole Building Design Guide, Integrated Resilient Design Program and buildingSMART Alliance. – Woolpert

be incorporated into every business plan and not be viewed as a stand-alone initiative. Perhaps one of the largest sustainability opportunities across an asset portfolio is to improve operations and maintenance performance, thereby reducing natural resource consumption, improving building life-cycle and, ultimately, improving the value of the investment.

C+S: You have worked with some large and important public-sector clients like the U.S. Army Corps of Engineers, the Federal Aviation Administration, the Centers for Disease Control, and the EPA, among others. What does it take to effectively manage a project with such cumbersome government agencies?

EH: While it may seem that large government agencies are challenging projects, I’ve found that our clients are passionate, creative and innovative. Our federal clients lead the nation in developing and implementing cutting edge asset management programs across some of the most complex and unique asset portfolios. I feel really privileged to have the opportunity to work on these projects. With a $264 billion portfolio, USACE Civil Works is a great example. Their efforts were recently identified by the Government Accountability Office (GAO) as a comprehensive and strategic approach to asset management and they represent one of the nation’s largest owners.

C+S: What motivates you to tackle such big projects?

I guess it’s all I’ve ever known. I began my career at Booz Allen Hamilton where my first client right out of college was the Environmental Protection Agency. From day one, I’ve been engaged with large clients who come to us with complex problems to solve. Every client engagement is a challenge, and while they are all tackling similar issues of aging portfolios and limited budgets, each client brings a unique set of circumstances and operating parameters.

C+S: You were at Jacobs for nearly 12 years before taking a position with Woolpert. While Woolpert is a large and influential firm with around 800 people, it’s not quite a mega-firm like Jacobs with nearly 80,000 employees. Why the change after 20 years in the business?

EH: As I mentioned above, I started my career at Booz Allen Hamilton, a large management consulting firm, followed by 12 years at Jacobs. Two very large firms with so much to offer their employees. I’m extremely grateful for the training I received at Booz and the exposure to some of the most interesting clients at Jacobs. I’ve also met and worked with some of the most talented people in the industry.

When I was approached with the opportunity to build a strategic consulting group from the ground up within Woolpert, I thought it was the perfect time in my career to do it. I’ve loved the entrepreneurial environment and really appreciate the fact that senior leadership sees the value that strategic consulting brings to the firm as a whole.

C+S: Woolpert CEO & President Scott Cattran recently said his top priority is firm longevity, shareholder value, and employee happiness. What’s the big cultural difference you are experiencing between Jacobs and Woolpert?

EH: Firms (large or small), are ultimately a collection of people and shared values. Woolpert presents an exciting opportunity to be immersed in an engaging and innovative culture that actually “walks the walk” with respect to employee engagement and career values.

C+S: When you were named to the NIBS Facilities Committee, you talked about the fact that you are not an architect, engineer or designer. How has this outside perspective shaped your career?

EH: This perspective has proved to be a strong asset within NIBS and more broadly across my career. Diversity in experience and training allows our team to bring a more comprehensive approach and solution to each problem. Individual disciplines or practice areas such as architecture or engineering bring a strength in that area, but not always a broader view of the economic, operational, environmental and social values. Integrating all those areas of expertise inherently provides a better outcome.

C+S: You have risen to the top in an AEC industry that is still dominated by men. As a woman, what were your greatest challenges and your greatest triumphs? What is your message to women who are thinking about a career in engineering?
EH: To be honest, I can’t think of challenges or triumphs in my career that I can specifically attribute to being a woman. Since day one I’ve been surrounded by very talented men and women and don’t feel like I’ve been treated any different because of my gender. So, perhaps as we participated in Women’s History Month in March, part of my message to women who are thinking about a professional career in technical disciplines is two-fold: don’t accept a situation that suggests gender is a factor, and surround yourself with mentors (men and women) who share that view. Beyond your immediate work environment, professional organizations such as the National Institute of Building Sciences offer fantastic opportunities to develop your professional network.

C+S: You have a BS in Environmental Science and Marine Biology from the University of New Hampshire. This is not the most popular degree in the collegiate world. What drew you to this field of study?

EH: As a child I wanted to swim with dolphins. I loved to SCUBA dive and snorkel and anything that had to do with the ocean. After a year or two of higher-level biology, physics and chemistry classes, I knew I was a better fit in the business world than the lab. At UNH, the environmental science curriculum included economics, business, writing, and public speaking courses. This well-rounded curriculum really set me up for success in the business world.

C+S: At some point you did FAA environmental work in Alaska. Did you see any bears? The Aurora Borealis? Mountain tops and salmon spawns?

EH: No bears or Aurora Borealis, but we did run into a very large moose on a midnight hike. Alaska is one of the many gorgeous locations this job has taken me to.

C+S: Any final thoughts?

EH: Work-life balance is possible. Both myself and my spouse, Jim, have professional careers and have managed to find a rhythm and tempo that fits our family – daughters Maddie and Caroline, and a rescue lab named Deacon – that allows us both to be engaged with our children, and to concurrently pursue individual passions such as traveling and running. Don’t give up on the idea that work-life balance is an achievable goal!

RICHARD MASSEY is managing editor of Zweig Group publications. He can be reached at massey@zweiggroup.com.
In January, the International Code Council (ICC) approved a set of proposals to allow tall wood buildings as part of the 2021 International Building Code (IBC). Based on these proposals, the 2021 IBC will include three new construction types—Type IV-A, IV-B and IV-C—allowing the use of mass timber or non-combustible materials. These new types are based on the previous Heavy Timber construction type (renamed Type IV-HT) but with additional fire-resistance ratings and levels of required noncombustible protection. The code will include provisions for up to 18 stories of Type IV-A construction for Business and Residential Occupancies.

This article is excerpted from a paper summarizing the proposals, including their background, technical research that supported their adoption, and resulting changes to the IBC and product-specific standards.

**IBC Definition of Mass Timber**

A relatively new category of wood products, mass timber can encompass well known and widely used products such as glue-laminated timber (glulam) framing as well as newer panelized products such as cross-laminated timber (CLT). The definition of mass timber adopted for the 2021 IBC is:

Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

In practice, mass timber as defined in the IBC has been an umbrella term that includes heavy timber elements, with heavy timber materials and sizes serving as the prerequisite to be considered mass timber. A subtle difference is that most mass timber utilized in Types IV-A, B and C have a minimum required Fire Resistance Rating (FRR) in addition to the intrinsic fire resistance due to the minimum prescriptive size requirements found in Type IV-HT.

Care should be taken to be clear when the minimum wood member size and detailing requirements of Type IV construction apply. When mass timber is used as one of the many current exceptions found in other construction types for “heavy timber” or “Type IV” construction, the heavy timber size and detailing requirements found in Section 2304.11 (IBC 2015 602.4) are applicable. Large format panelized wood products made from solid sawn laminations include: CLT, nail-laminated timber (NLT), dowel-laminated timber (DLT), and glue-laminated timber (GLT). Panelized products made from structural composite lumber include: LVL panels and a proprietary mass plywood panel (MPP) made from laminated plywood. While such products are sometimes called “mass timber,” they will only meet the 2021 IBC definition of mass timber when they meet the specific size and detailing requirements. When such products are used in Type III or Type V construction, as “any material permitted by this code” in Sections 602.4 and 602.5, the Type IV dimension and detailing requirements do not automatically apply.
Fire-Resistance Ratings: The table below contains the minimum FRR requirements for the new construction types found in IBC Table 601. Included for comparison are the requirements for Type I-A and I-B. The new Type IV-A has the same base FRR requirements as Type I-A. Type IV-B and IV-C have the same base FRR as Type I-B.

### Required Fire-Resistance Ratings by Construction Type (IBC Table 601)

<table>
<thead>
<tr>
<th>Building Element</th>
<th>I-A</th>
<th>I-B</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Structural Frame</td>
<td>3*</td>
<td>2*</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>HT</td>
</tr>
<tr>
<td>Ext. Bearing Walls</td>
<td>3*</td>
<td>2*</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Int. Bearing Walls</td>
<td>3*</td>
<td>2*</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1/HT</td>
</tr>
<tr>
<td>Floor Construction</td>
<td>2</td>
<td>2*</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>HT</td>
</tr>
<tr>
<td>Roof Construction</td>
<td>1½*</td>
<td>1*</td>
<td>1½</td>
<td>1</td>
<td>1</td>
<td>HT</td>
</tr>
</tbody>
</table>

*These values can be reduced based on certain conditions in IBC 403.2.1, which do not apply to Type IV buildings.

Noncombustible Protection: A requirement unique to the new construction types is noncombustible protection (for mass timber). This noncombustible material applied to the mass timber helps determine fire behavior by delaying the contribution of the mass timber structure in a fire and has an added benefit of increasing the fire-resistance rating of the mass timber element. The minimum contribution of noncombustible protection was set by the ICC Tall Wood Building Ad Hoc Committee to be no less than 2/3 of the Table 601 required FRR for mass timber elements. All mass timber in Type IV-A construction requires noncombustible protection. Most of the mass timber in Type IV-B requires noncombustible protection with limited exposed mass timber elements. Select mass timber elements in Type IV-C require noncombustible protection. A summary of the noncombustible protection required for building components in the different construction types is shown in the table below.

Three new types: Conceptually, Type IV-A is similar to type I-A with equal or greater FRR requirements and no exposed mass timber. Type IV-C is similar to Type IV-HT with almost all of the interior mass timber permitted to be exposed; however, most structural building components have a 2-hour FRR in addition to minimum heavy timber sizes. In surveying the existing and desired applications of mass timber in the U.S. and around the world, the committee determined that an intermediate construction type between IV-A and IV-C was needed, resulting in Type IV-B.

Type IV-B has similar FRR requirements as IV-C; however, all the mass timber requires noncombustible protection except the following:
- Area of ceilings not greater than 20% of the floor area
- Area of walls not greater than 40% of the floor area

### Required Noncombustible Protection on Mass Timber Elements by Construction Type

<table>
<thead>
<tr>
<th>Building Element</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Surface of Building Elements</td>
<td>Always required. 2/3 of FRR, 80 minutes minimum</td>
<td>Required with exceptions. 2/3 of FRR, 80 minutes minimum</td>
<td>Not required*</td>
<td>Not required*</td>
</tr>
<tr>
<td>Exterior Side of Exterior Walls</td>
<td>40 minutes</td>
<td>40 minutes</td>
<td>40 minutes</td>
<td>Not required*</td>
</tr>
<tr>
<td>Top of Floor (above Mass Timber)</td>
<td>1” minimum</td>
<td>1” minimum</td>
<td>Not required*</td>
<td>Not required*</td>
</tr>
<tr>
<td>Ceiling (below Mass Timber)</td>
<td>Per interior protection</td>
<td>Per interior protection</td>
<td>Not required*</td>
<td>Not required*</td>
</tr>
<tr>
<td>Shafts</td>
<td>2/3 of FRR, 80 minutes minimum, inside and outside</td>
<td>2/3 of FRR, 80 minutes minimum, inside and outside</td>
<td>40 minutes minimum, inside and outside</td>
<td>Not required*</td>
</tr>
</tbody>
</table>

*Not required by construction type. Other code requirements may apply. 5/8” Type X gypsum = 40 minutes.
A "sum of the ratios" type equation allows for a combination of the exposed ceilings and walls within a dwelling unit or fire area—e.g., area of exposed ceilings equal to 10% of the floor area plus area of exposed walls equal to 20% of the floor area. Unprotected areas of ceilings and walls also need be located with at least 15 feet horizontal separation. This requirement is to avoid re-radiation of heat between adjacent exposed mass timber elements which could extend the duration or severity of an uncontrolled fire. As an aside, the most frequent application of exposed mass timber in buildings to date is a portion of the ceiling alone.

**Common Requirements:** Additional requirements applicable to Type IV-A, IV-B and IV-C were included in the G108-18 proposal and include: No exposed mass timber in concealed spaces; concealed space permitted only with noncombustible protection as required for the interior mass timber • Exterior side of exterior walls protected by a non-combustible material—e.g., 5/8” Type X gypsum sheathing • No combustible exterior wall coverings except for certain water-resistant barriers • No exposed mass timber on the inside and outside surfaces of exit enclosures and elevator hoistways in high-rise buildings (occupied floor > 75 feet from lowest fire department access) • Noncombustible construction only for exit enclosures and elevator hoistways greater than 12 stories or 180 feet.

**Allowable Building Sizes**

As the ICC Tall Wood Building Ad Hoc Committee developed and tested requirements for the new construction types, the allowable heights and areas were developed with the following performance objectives as the basis:

- No collapse under reasonable scenarios of complete burnout of fuel without automatic sprinkler protection being considered
- No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios
- No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios
- No unusual fire department access issues
- Egress systems designed to protect building occupants during the design escape time, plus a factor of safety
- Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios; the degree of reliability should be proportional to evacuation time (building height) and risk of collapse

The comprehensive package of approved changes met these objectives, and allowable heights and areas for select occupancies in the 2021 IBC are shown in the table below.

**Select Height and Area Limits by Construction Type**

<table>
<thead>
<tr>
<th>Occupancies</th>
<th>I-A</th>
<th>I-B</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B, R</td>
<td>S</td>
<td>Unlimited</td>
<td>180</td>
<td>270</td>
<td>180</td>
<td>85</td>
</tr>
</tbody>
</table>

**Allowable Number of Stories above Grade Plane (IBC Table 505.4)**

<table>
<thead>
<tr>
<th>Occupancies</th>
<th>I-A</th>
<th>I-B</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-2, A-3, A-4</td>
<td>S</td>
<td>Unlimited</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>S</td>
<td>Unlimited</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>R-2</td>
<td>S</td>
<td>Unlimited</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

**Allowable Area Factor (At), Feet² (IBC Table 506.2)**

<table>
<thead>
<tr>
<th>Occupancies</th>
<th>I-A</th>
<th>I-B</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-2, A-3, A-4</td>
<td>SM</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>135,000</td>
<td>90,000</td>
<td>56,250</td>
</tr>
<tr>
<td>B</td>
<td>SM</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>324,000</td>
<td>216,000</td>
<td>135,000</td>
</tr>
<tr>
<td>R-2</td>
<td>SM</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>184,500</td>
<td>123,000</td>
<td>76,875</td>
</tr>
</tbody>
</table>

*S is sprinklered with NFPA 13 sprinklers. SM is the multi-story allowable area factor. Underlined entries are the new additions.*
To help visualize the building size associated with these tabular limits, the figure below shows representative buildings of equal area per floor with the maximum building sizes for a Business occupancy. As Business occupancies have the largest allowable areas and share the tallest height limits with other occupancies, these are the largest building sizes permitted by the new construction types, excluding minor additional area increases allowed by the frontage increase of IBC 506.3.

Note that in the current IBC, the use of NFPA 13 sprinklers is mandatory for all high-rise buildings defined with an occupied floor more than 75 feet above the lowest level of fire department access. For existing construction types, the use of NFPA 13 sprinklers typically provides for a one-story and 20-foot increase in the allowable building height but a substantial increase in allowable area. However, the new construction types are highly conservative when allowable area is compared with common A, B and R occupancy groups where unlimited area is allowed for existing Type I buildings.

Representative Building Sizes, Business Occupancy

<table>
<thead>
<tr>
<th>Stories</th>
<th>Height</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>270</td>
<td>972,000</td>
</tr>
<tr>
<td>12</td>
<td>180</td>
<td>648,000</td>
</tr>
<tr>
<td>9</td>
<td>85</td>
<td>405,000</td>
</tr>
</tbody>
</table>

**Conclusion**

The proposals from the ICC Tall Wood Building Ad Hoc Committee led to a comprehensive set of code changes developed using a rational performance-based approach to establish new size allowances for mass timber buildings in the IBC. The three new construction types have been crafted to support a variety of exposed and protected mass timber design systems which have been validated through fire testing.

The American Wood Council's 2018 National Design Specification® (NDS®) for Wood Construction and Technical Report 10 have been published and together include updated provisions for structural fire-resistance calculations and protection of connections, as well as a summary of prior and recent fire testing providing substantiation for the design criteria.

For more information, including a summary of the proposals, requirements for the new construction types, fire protection features, results of fire testing and other research, and an update to the CLT product standard, the complete paper can be found at [http://bit.ly/2IF8kB](http://bit.ly/2IF8kB).

WoodWorks–Wood Products Council provides free project support as well as education and resources related to the code-compliant design of commercial and multi-family wood buildings. For assistance with a project, visit [www.woodworks.org/project-assistance](http://www.woodworks.org/project-assistance) or email help@woodworks.org.
STRETCHING 415 MILES FROM NEAR FAIRBANKS, ALASKA, to the Prudhoe Bay oil fields on the Arctic Ocean, the Dalton Highway is one of America’s most remote roads. Originally called the North Slope Haul Road, the highway was built to support construction of the Trans-Alaska Pipeline. Today it continues to serve oil field traffic and is a crucial lifeline for Alaska communities above the Arctic Circle. The road faces such severe weather that it was featured on several seasons of the reality TV show “Ice Road Truckers.”

To keep the Dalton Highway operating year-around, the Alaska Dept. of Transportation (DOT) hired Cruz Construction to upgrade a 50-mile segment of the road south from Prudhoe Bay. A key part of the project is installing insulation in the roadbed to keep the permafrost frozen and to stabilize the road. The insulation does double duty:

1) Banking cold within the roadbed in winter to keep the permafrost frozen in summer, for a more stable and durable road
2) Providing lightweight structural infill to raise the roadbed above the flood level, without over-compressing the underlying soils

The project team is on schedule to finish this summer, and will be paving that same portion of the road after the last of the foam installed.

The project team designed the road in accordance with the strenuous specifications of AASHTO M230 – the American Association of State Highway and Transportation Officials “Standard Specification for Expanded and Extruded Foam Board (Polystyrene).” Traditionally, the only product that could meet this standard was extruded polystyrene (XPS) foam board, due to the standard’s thermal values, water absorption and compression values. However, because the Insulfoam Anchorage plant has specialized manufacturing equipment, the company was able to produce expanded polystyrene (EPS) boards that meet AASHTO M230.

Cruz construction is installing two layers of 2-inch-thick InsulFoam® 40 EPS as part of the road base, under a gravel road surface. InsulFoam 40 is a high-performance insulation consisting of a superior closed-cell, lightweight and resilient EPS, manufactured in a plank mold. Photo: Insulfoam

To supply the massive quantity of insulation needed for the Dalton Highway, Insulfoam’s Anchorage plant as of fall 2018 had produced 4 million cubic feet of InsulFoam 40 EPS (picture a football field stacked about 70 feet high with insulation). This required the plant to solve a range of production challenges needed to operate 24/7 for three years, while still also meeting other local demands for insulation products. Specifically, the plant ramped up production to supply three-and-a-half 52-foot long flatbed trucks of EPS every day to meet the Dalton Highway construction schedule, and worked with the contractor to ship the materials more than 500 miles to the jobsite.

DARYL SOBEK is the General Manager of Insulfoam’s Anchorage, Alaska location and oversees all sales and operations of the Anchorage facility.
Are you really saving with chemical stabilization?

When site work contractors run into bad soils, they want a solution that’s inexpensive, quick, easy to install, and effective. Chemical stabilization using materials like lime, cement, and fly ash is one option, but when you look at all the factors, it may not be the best choice. Let’s look at how chemical methods compare to mechanical stabilization with geogrids and discuss a few considerations that will lead you to the most effective solution.

**COST:** Does chemical stabilization cost less than mechanical stabilization with geogrid?

The factors that determine the costs of both methods are:

- Unit costs of the materials used
- Quantities of the materials used
- Cost of the labor and equipment needed for installation

For chemical stabilization, it is critical to look not just at the material cost, but to understand the potential uncertainty in the quantities required. What will happen if the expected application rate doesn’t achieve the required results? Beyond this, who is doing the installation? If you don’t have the required equipment and expertise, are you adding to the project costs by paying a markup to a specialty contractor? With mechanical stabilization, established design methods make quantities virtually certain, so you know up front what your total cost will be. And installation is simple – just roll out the geogrid, place granular fill, and compact.

**TIME:** How much is time worth on your project? Have you accounted for all the time your selected solution will take?

Chemical stabilization requires you to mobilize specialized labor and equipment, and application time increases as the depth of treatment goes up. What happens if the equipment is tied up on another job? In addition, all forms of chemical stabilization require cure time to achieve the desired strength. Is that built in to your project schedule?

These concerns go away when you use mechanical stabilization with geogrid. You’ll know up front what it will take to solve the problem, and the surface will be stable as soon as installation is complete.

**EASE OF INSTALLATION:** Which solution is the easiest to install?

There’s no contest when it comes to ease of installation between chemical stabilization and mechanical stabilization. Anybody can roll out geogrid, and placing the granular material on the grid and compacting it can be done with equipment you already have at the job site. Plus, there are no restrictions on the weather conditions when geogrid is used. With chemical stabilization, you can’t work if it’s below 40 degrees F, or if it’s raining.

**EFFECTIVENESS:** Which one works better?

Chemical stabilization can be an effective way to stabilize bad soils when conditions are right and the correct material is used. But even when it works as planned, it can deteriorate over time as precipitation and groundwater gradually leach the chemicals out of the soil. That might not matter if the fix is temporary or the area won’t be exposed to moisture long term. But in other cases, it could spell trouble. With mechanical stabilization, once it’s fixed, it’s fixed for good.

About Tensar International

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

DRONE EXPERT DAVID BARTON IS COLLECTING DATA AT A BIG CLIP, BUT WITH HIS VORACIOUS APPETITE FOR INFORMATION, IT’S NEVER ENOUGH.

By Richard Massey

GADGETS, GIZMOS, AND TECHNOLOGY are in David Barton’s blood. Growing up in southeastern Virginia, there was plenty of neat stuff around the house to spark his imagination. His father, Ray, worked as an electrical engineer at the GE television production facility in Hampton Roads, and he brought some of his work home with him. As a result, Barton learned to tinker at an early age.

“It was a unique experience that I grew up with, but it was normal for me,” he said.

But the GE plant closed down, so Barton’s dad went into government contracting. Barton’s older brother, Jason, did the same thing. So, when Barton graduated from high school, he knew a lot about technology, and had the background to easily gain security clearance. Instead of going to college, Barton went to work. As a defense contractor, he was either around, introduced to, developing, or chasing down the best technology of the day, and even founded, built and sold a multi-million dollar company – video sharing startup EchoStorm Inc. – in the process. At some point he came across drones, and while he didn’t fall in love at first sight, they ultimately cast their spell on him. An acknowledged expert in the field of unmanned systems, he is one of only a handful of people who can operate a drone inside the 14-mile Washington, D.C. Security Flight Restricted Zone.

In 2017, he was hired by engineering firm Draper Aden Associates where he is the manager of Aerial Services. A proud tech nerd who jokingly says he works 22 hours a day, Barton is determined to stay out in front of whatever’s coming next.

“My brain is always thinking about this stuff,” he said. “It’s addicting – you’re doing something that’s never been done before.”

A Conversation with David Barton

Civil +Structural Engineer: Part of your experience includes co-founding a company, growing the business, and then selling it to a Fortune 100 company. This is classic entrepreneurship. In a nutshell, tell me about the process from conception to sale.

David Barton: My brother and I had an idea and put it on a whiteboard in my condo back in 2001. The idea was lofty and novel. It took a lot of determination, commitment and even more hours to grow it into a company with revenue and a meaningful purpose. The eventual success of the company was clear, our unique product and services would become a commodity for the larger defense contractors. The larger firms were purchasing smaller firms with the goal of making our unique capabilities a value add versus a unique product or service. We ultimately explored the merger and acquisition process so that our idea could live on as part of another company’s existing product. The experience from start to finish pushed me and forced me to learn in ways I never imagined. It gave me a passion for entrepreneurship.

C+S: How does having the heart of an entrepreneur affect your current role with Draper Aden Associates?

DB: It’s been invaluable. I manage our Aerial Services at DAA like I’m building a start-up with a great angel investor. For me, the entrepreneurial spirit equals a round-the-clock drive and commitment to achieving our goals. Our leadership embraced my vision and strategy which translates into the resources (personnel and financial) to execute and deliver. Together we have had great success. I also leveraged software development and management concepts from Agile methodologies I’ve used in prior work into how I run our team so that it has a start-up mentality of lean and agile.

C+S: In regard to your standing as a UAS expert, where do you see yourself in 10 years?

DB: I love technology and solving hard problems. I will follow interesting or emerging technology wherever it leads me. If you told me 10 years ago I would be working in the civil engineering community I would not have been able to envision how my career path could lead there, yet it did. I’ve never known or aspired to be anything in particular when I grow up. I still don’t and I love that my future can be anything.

C+S: You have done plenty of work mapping landfills. What is the key issue with those types of facilities, and what problem does the UAS mapping of them solve?

DB: Landfills can be very dangerous environments with heavy equipment moving around or even landfill gasses from decomposition. Landfills have a number of use cases for drone mapping, the easiest is the topographic mapping which is used for volumetric calculations.
and regulatory compliance. By utilizing a drone we can reduce the
time needed to collect the data and reduce the time spent in potentially
hazardous sites. Drones do not eliminate the need for a survey crew,
but we can reduce and sometimes eliminate their time in the most haz-
ardous environments which reduces risk to our personnel. With sound
survey and drone methodologies, we are able to collect the necessary
data while minimizing risk.

C+S: Looking at your CV, it appears that UAS technology has various
applications – environmental, security, construction, marketing, and
charity, among others. Do you approach the different applications with
a different mindset, or do you undertake all projects in the same way?

DB: Yes, we approach each project based on the specific application
and product needed. One of the first things I talk about when giving a
presentation on UAS is the right tool for the job. Knowing the purpose
and product for a project should define the tools and methods used to
achieve the desired results. Knowing the kind of data you need also
defines the “how,” i.e., a multispectral, thermal and mapping payload/
camera can define the drone used, what altitude flown and speed for a
given flight. We have drones that excel at mapping, but would not be
the best choice for beauty photography or videography. Likewise, with
regard to the methods used to fly or collect the data. We analyze each
project’s needs before going to the field.

C+S: Has the UAS industry matured, or is there still room for growth,
both in the technology itself and in market share?

DB: The industry is one of the fastest growing and evolving I have
had the privilege to witness. The innovation of the small Unmanned
Aircraft cameras and software is fueled by Silicon Valley startups and
venture capitalist wanting to capitalize on a relatively new market. The
competitive landscape has seen many companies rise and fall with Chi-
na based DJI taking the majority of the drone hobby and commercial
market share. There is a lot of maturing ahead for the industry. Hobby
and Commercial technological improvements are coming. Rules and
regulations have evolved and will continue to evolve as well.

C+S: You are one of the very few people that the government has al-
lowed to conduct drone operations inside the 14-mile Washington DC
Security Flight Restricted Zone. What a big responsibility. What goes
through your mind while operating in such a sensitive area?

DB: Yes, it is a big responsibility and one of the more stressful things
I have done. The first time was a test of my nerves, but we had every-
ting planned, including a Crew Resource Management plan of who
was doing what and when before, during, and after the operation. We
did our pre-flight briefing as usual and executed the mission exactly
as we planned. We were very aware that we were operating in very
sensitive airspace, but we focused on the job at hand.

C+S: You currently serve as the Chair of the Unmanned Systems As-
sociation of Virginia. What are a few of the key issues this organization
is addressing? What’s the focus of the advocacy?

DB: USAV is focused on keeping Virginia legislatively friendly for
the Unmanned Systems industry. This is more than drones. We have
ground robots as well as above and below water systems. We want
to be the voice for the unmanned systems industry in Virginia and to
work with our legislators on ensuring Virginia is a place that supports
innovation, collaboration, and growth in the unmanned systems indus-
try. In recent years various bills have been introduced that could have
impacted unmanned systems, USAV worked to ensure the industry was
not negatively impacted by overly broad language. We also worked
to get a prohibition on localities and political subdivisions regulating
unmanned systems. Many localities outside of Virginia have enacted
laws regarding the operation of drones and that is something we really
did not want to happen in Virginia. A patchwork of rules and regula-
tions would hinder the unmanned system industry and economy.

C+S: Where is the center of the UAS industry in the United States, in
terms of UAS production, development of technology, policy, etc.? If
not in one place, are there scattered hotspots?

DB: I am biased; however, I would say Virginia is the center. Being
so close to Washington, D.C. helps with participation in federal policy
process and Virginia has a large industry of government and military
UAS firms as well as a significant amount of small UAS industry.
There are multiple hotspots around the country doing some really great
things in the small UAS industry. For example, the FAA awarded ten
UAS Integration Pilot Programs (IPP) to test and validate advanced
operations for drones in partnership with state and local governments
in select jurisdictions. One of the winners is Virginia’s Center for Inno-
vative Technology which is partnered with the Virginia Tech UAS Test
Site. Significant progress with Beyond Visual Line of Site and UAS
operation over non-involved people has come as a result of the VA IPP.

Production of small UAS is largely not in the United States. A few
domestic companies are designing and producing drones, but the vast
majority of the market share is with DJI and Parrot/senseFly, which are
based in China and Switzerland, respectively.

C+S: From a legislative/policy standpoint, what is the biggest problem
the UAS industry must overcome?

DB: I see two key legislative and policy issues that are equally impor-
tant that the industry needs to overcome:

– Patchwork legislation by localities. Some Counties and Cities across
the United States have enacted laws/legislation that restricts hobby or
commercial UAS flights. I believe federal preemption at some point
will be tested and the outcome, good or bad, will make a very large
impact on the industry. A positive result will help the industry grow
and a negative one could be disastrous for the UAS industry.

– The speed of innovation and federal regulations are not in sync.
Technological innovation and capabilities often outpace legislation.
The FAA was mandated to integrate UAS into the National Airspace
System, but I would not say the mandate came with adequate funding.
Before the automated Low Altitude Authorization and Notification
Capability (LAANC) was put in place we were seeing requests for
restricted airspace authorizations take six months or more. Things are
better now, but the challenge is real.

C+S: What will drone technology ultimately replace?

DB: I do not see a drone replacing anything. Sometimes it’s the best
option and sometimes it’s not. In the civil engineering community you
still need the knowledge and experience to make decisions on the data
the drone collects. There is potential for cost savings, efficiency and
safety gains with a drone, but we still need all the tools available and
the domain specific knowledge to do the job right.

C+S: If you were talking to a group of aspiring engineers, what would
you tell them about the opportunities available within the UAS indus-
try?

DB: The most important message I want to convey to aspiring engi-
neers is that the drone is not the job. Your engineering specialty is
your career. Drones are very exciting and have the potential to become
a critical tool for the engineering community. The unmanned system
is a tool in the toolbox which sometimes is the best tool for the job.
Sometimes it’s not. Domain expertise is needed to make sense of the
data the drone collects. The knowledge and experience the engineer
possesses is what makes the drone most useful. It also does not replace
ground truth. Oftentimes you will need to validate or verify what you
have observed with the drone.

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Project

As part of a coordinated development plan, Zhong-Guan-Cun will integrate the resources of Beijing, Tianjin, and Zhong-Guan-Cun to build a science and technology city. The CNY 2.2 billion project includes the design and construction of roads, utility pipelines, a 174,000-square-meter park, and green roadsides spanning 477,000 square meters. As the overall project consultant, CCCC Water Transportation Consultants Co., Ltd. (CCCC) needed to develop an innovative city model.

Solution

The team used the integrated BIM capabilities of Bentley’s OpenRoads and OpenBridge Modeler with ContextCapture to generate a comprehensive 3D model of the entire city. The team collected terrain data via unmanned aerial vehicles to integrate into ContextCapture, generating the reality mesh. Given the large geographic span, wide construction area, and tight construction timeline, CCCC’s project team also implemented a collaborative BIM process. The team used Bentley’s Connected Data Environment to coordinate with the many engineering disciplines and seamlessly deliver the new digital city.

Outcome

The 3D model of the city helped CCCC identify and remedy more than 200 collision points, optimizing design and reducing costly rework. The model also allowed the project team to perform construction simulation, facilitating construction management. The simulation streamlined the construction process, shortening it by 64 days to save CNY 6.6 million in costs. Using ContextCapture to generate the reality mesh also facilitated earthworks planning and saved approximately CNY 40 million.

Software

ContextCapture was used to create the 3D model of the new science and technology city. LumenRT and Navigator helped further visualize the model and conduct analyses. OpenRoads helped complete the creation of the road engineering model while OpenBridge Modeler helped create the bridge and culvert engineering models. Bentley’s Connected Data Environment based on ProjectWise streamlined workflows and improved design efficiency.
Graham Nasby is an industry-recognized leader in the water/wastewater community for his efforts with DCS/SCADA (distributed control systems/supervisory control and data acquisition) systems, standards development, raising cybersecurity awareness, and alarm management. Through his work with the International Society of Automation (ISA) and IEC, Nasby has co-authored international standards in alarm management, cyber security, and HMI (human machine interface) design. He has also worked with the ISA, American Water Works Association, Water Environment Federation, and other industry groups to author numerous articles on SCADA best practices, led the annual ISA Water/Wastewater and Automatic Controls Symposium, and contributed to other industry events.

Nasby is responsible for the long-term planning, design, construction/implementation, and commissioning of the automated control systems for the City of Guelph Water Services in Ontario, Canada. Before he joined Guelph, he worked for various consulting engineering firms where he provided project management and alarm management services for a variety of industries.

C+S Engineer magazine caught up with Nasby via phone and email this spring. This is what he had to say.

C+S: You have a background in cybersecurity awareness and alarm management. As it pertains to water/wastewater, what’s the issue?

Graham Nasby: Computerized systems are one of the ubiquitous realities in any modern water utility. We use computers for billing, customer management systems, work planning, reporting, and water plant control systems, not to mention day-to-day office applications such as Word, Excel and email. Without properly functioning computer systems, it is simply not possible to effectively operate. In many ways, looking after cybersecurity is like purchasing life insurance to protect your family. You don’t realize how much you need it until it’s too late. Water utilities need to do a better job of protecting the computer systems that enable them to keep the business operating and the water flowing.

Alarm management is all about using your plant control system to improve operational effectiveness and reducing overtime costs. Like any process industry, modern water plants have sophisticated automatic control systems that look after many details, so that operators can focus on more important tasks rather than just spinning valves and starting/stopping pumps. The purpose of an “alarm” is a notification that is supposed to interrupt an operator, in order to divert their attention to something that must be investigated and acted upon right away. Whether an alarm is used during the day shift or via an after-hours call out system, we need to take the time to properly design the alarm notifications so they only interrupt our plant staff in situations that truly need a timely response. Too many alarms lead to operator fatigue and higher overtime costs. Too many alarms are also a symptom of a plant or an automated control system that is not working well. Operators who get used to having to “ignore” a lot of alarms become complacent, and often won’t respond appropriately when a truly abnormal event is communicated using an alarm. Want to know more? Take a look at the ISA-18.2 alarm management standard and books by Bill Hollifield and D. H. Rothenberg.

C+S: Human/Machine Interface: In a nutshell, tell us about the future of this technology.

GN: The HMI, or Human Machine Interface, is the set of computer screens that operators and engineers use to interact with automatic control systems. In the old days, the HMI was usually located in a plant’s centralized room and the screens were hard to read. Old HMI technology was also expensive to install and difficult to update. Nowa-
days, we are starting to find HMI screens located throughout the plant, and operators using tablet and mobile devices to monitor and control the process control system. Where in the past HMIs usually had only single monitors, we are now also starting to see workstations with 2, 4, 6 or more LCD monitors that make it easier for operators to maintain situational awareness and monitor process trends before systems stray into abnormal and/or trip conditions. On the software side we are also starting to see better graphics and the use of better, more sophisticated, automatic control algorithms. Interestingly, a few years ago there was a movement to move to more photo-realistic and 3-D depictions of process data on screens, but industry research over the past 10 years has found that using more simplistic icons, built-in graphs, and reserving bright colors for alarms, actually makes systems easier to use and reduces operator fatigue. Further reading can be found in resources like the ISA-101 standard, the HMI Handbook, and publications by the ASM.

C+S: You have done just about everything someone can do within the water/wastewater industry. Tell us about your schedule. How many hours a week do you work, and how many miles do you travel in a year?

GN: I’ll be honest: I don’t watch much TV these days. I’m fortunate to have a very loving wife and a great team to work with at my day job. I am also fortunate to have a large network of contacts from around the world, which I keep in touch with through my work with non-profit technical associations and various international standards committees. Though I do try to attend a few conferences each year, a lot of my correspondence is done digitally these days. It’s incredible the sheer number of folks that one can keep in touch with using conference calls, Skype and email. I do travel to a few face-to-face meetings for ISA and IEC standards committees, but all of this has to be fit around the work I do at the water utility. Speaking of keeping the water on, I usually get up at 7am most mornings (I am not a morning person), walk to work, and then begin the adventure that comes every day with operations at a public drinking water utility. As I said, I have a great team to work with and that is what gets me up every morning.

C+S: Industry articles, technical articles, conference papers, newsletters, blogs, and standards reports. You are a prolific writer. When did you develop your love and talent for the written word? How has writing enhanced your career?

GN: Writing was not something that naturally came to me. It is something that I have had to work at over the years, but amusingly I have found that the more I write the easier it gets. I see my writing as a way I can give something back to the profession that I work in. From the many textbooks I own, magazines I read, and conference papers I’ve reviewed, I have been able to assemble a great deal of knowledge and experience that I bring to the water utility and can share with the people I work with. I see writing new material as a way to give something back in return for all the great resources that have helped me develop my career.

C+S: Presentations, webinars, seminars, panelist, and moderator. You obviously have no fear of crowds. How did you develop your ability to stand and deliver in front of your peers? Was this natural, or did you put a bit of work into it?

GN: Other than school presentations, the very first time I gave a technical talk was at an international water conference back in 2011. At the time I was working for a consulting engineering firm, and I had just finished my first control system upgrade project for a municipal client. I had never presented at a conference before but I had a feeling that my client at the time wouldn’t mind a trip to St. Louis, so he and I convinced our bosses to let us travel to the 2011 ISA Water/Wastewater and Automatic Controls Symposium. I can’t begin to tell you how many hours we spent practicing our talk and editing the paper. We must have done something right, for we actually won the prize for best paper. Since then I’ve never looked back. Ironically, it was that same co-presenter who hired me to come join him at the water utility four years later.

C+S: You serve as the Water SCADA & Security Specialist for the City of Guelph, and you also have your engineering and computer science degree from the University of Guelph. Located about 62 miles down the road from Toronto, Guelph is consistently ranked as one of the best places to live in Canada. Tell us something interesting about Guelph that only a local would know.

GN: Because I’m an engineer, I – of course – like trains. So, it’s only fitting that I live in a city that owns its own railway. Not only does Guelph own the Guelph Junction Railway, the railway is self-sustaining and turns a profit for the city every year.

C+S: You did a lot of the “dirty work” in the central IT department while a student at UofG. What did you take away from that experience?

GN: Yes, when I was doing my part-time engineering degree at the University of Guelph, I did a lot of work for the school’s central IT department. With over 37,000 user accounts and 100-plus supported software applications, the university’s central IT department was a big machine that required an army of professional staff, and several part-time employees like me, to keep it running. My main takeaway from IT was that keeping any type of large system up and running takes a lot of work, investment, and careful planning. I enjoyed my time working in IT, but as I got further into my engineering studies, it soon became apparent that the engineering and construction profession was a better fit for me. I do appreciate the work that the folks in IT do, I’m just happier when I can leave it them.

C+S: In addition to your work with water/wastewater, you also play the clarinet for several bands and orchestras. How long have you played the instrument, what’s the role of music in your life, and what style do you most like to play?

GN: I started playing clarinet back in Grade 7, as part of the local school board’s standard music program that required every student to give playing an instrument a try. Because my last name started with a letter later in the alphabet (“N”), this meant that most of the “cool” instruments (trumpet, saxophone, trombone, etc.) where already taken by the time I got to choose. I got what was left: the clarinet. However,
the clarinet soon turned out to be pretty cool too, after I found out about great players such as Benny Goodman, Artie Shaw, Avrahm Galper, Simeon Bellison, and the like. Over the years, I have been fortunate to have had several good teachers, both in school and via private lessons. Playing clarinet in community bands and orchestras is something that I continue to do to this day. In fact, I met my wife in an orchestra – she was the oboe player who sat in front of me in the university’s student orchestra.

C+S: You are a tour leader with MS Bike Ride for Multiple Sclerosis. What led you to support this organization?

GN: Growing up, I had an aunt who was diagnosed with MS in her early 30s. Over the next 30 years, I unfortunately got to see firsthand the progressive symptoms of the disease which ultimately led to her passing in 2012. At the time, the consulting firm I worked for had put together a team for the MS charity bike ride, so I thought it was only fitting that I get involved to help raise funds towards finding a cure. The ride is something that I try to do every year, rain or shine.

C+S: You are a recognized industry expert with all the accolades that come with it. What keeps you humble and hungry?

GN: I consider engineering to be a profession of service and collaboration. What engineers do is take science and technology and apply it to solve problems for the betterment of society. We also spend a lot of time talking with stakeholders and other professionals to learn about society’s needs, and develop potential solutions that can be built to address those needs.

Engineers like myself are always trying to think of how we can design things to be more efficient, cheaper to build, longer lasting, more robust, and easier to use. I see this as the never-ending engineering design problem, and one that provides many opportunities and rewards along the way. In my view, the mark of good engineering work is delivering projects that enhance the quality of life for the people around you. I get to do this every day. Why would I stop now?

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ON THE RIVER THAMES

POWERED BY WOMEN, LAND & POWER
ADMINISTERS AMBITIOUS WETLAND PROJECT

By Editorial Staff

LEADING CIVIL AND ENVIRONMENTAL ENGINEERING COMPANY, Land & Water, has gained consent for developing a Habitat Creation Scheme on the River Thames at Rainham Marshes, the largest habitat creation project ever constructed inside the M25. The project will involve creating a significant area of new wetland habitat from re-engineered spoils, coupled with a strategic investment in riverside infrastructure to support significant projects along the Thames Corridor for decades to come.

The scheme will see the importation of over six million tonnes of wet and dry spoil material which will form both the basis of a new landform and cover the site to collect rainwater to fuel the wetlands passively. The site sits between Veolia’s landfill site at Rainham and the RSPB’s Rainham reserve. With the new area creating 1,000,000m² of habitat, more than 5km² of continuous habitats will be formed, providing East London with an oasis of wildlife owned and managed by the Royal Society for the Protection of Birds. This is Land & Water’s most ambitious project to date.

James Maclean, Chief Executive at Land & Water and mastermind of the scheme comments: “Our involvement at Rainham can be cast back more than five years, to a time when we undertook an options appraisal on behalf of the Port of London Authority. We analysed ways in which the former dredging disposal lagoons alongside the A13 at Rainham Marshes, could be reinvigorated to support infrastructure projects along the Thames.

“In listening to the needs and desires of the stakeholders, we designed and developed a much bolder plan to turn our lagoons into the largest habitat creation project ever constructed inside the M25. We plan to deliver the project using dredged spoils and arisings from relevant construction projects to create varied habitats and engineer a considerable rainwater harvesting plan to feed sustainable wetlands to support the rare bird species in perpetuity.”

Empowered Women
As an industry leader, renowned for innovation and a forward thinking approach the company is continuing to lead the industry by providing an environment in which all staff can succeed. This includes employing 31 women in various roles across the business.

It is no secret that the construction industry is renowned for its low percentage of female workers. In fact, the latest research from the ONS highlighted that of the 2.3 million people working in the construction industry in 2016 only 13 percent of the workforce (296,000 individuals) were women.
Jayne Hornsby, Head of Estimating and Business Development at Land & Water Group, explains why the business is passionate about tackling the disproportionate employment figures in the industry: “I truly believe that we are at a turning point in the history of gender equality and as a values led, community focussed business it is vital that we actively engage with the issues affecting the communities in which we live and work. The #BalanceforBetter campaign is vital on both a societal and boardroom level with many businesses waking up to the idea that gender balance is vital in every aspect of our lives from work, to the media and beyond. Our businesses should be representative of the society and shared goals that we are working for and therefore reflect the individuals that make it up.

“This is why as a business we are extremely proud to have numerous talented women shaping and driving the Land & Water Group forward as well as fostering the next generation of talent through our apprenticeship programme.”

From its General Managers, Business Development team and Divisional Business Managers through to Contracts Managers and Environmental Scientists, women are fundamental to the continued success of Land & Water. In fact, female employees make up 50% of the senior services team. A diverse leadership team leads to greater diversity of thought which in turn improves problem-solving and allows the business to take a lead in the industry. Collaboration is a key factor contributing to the company’s success.

Land & Water is an award-winning inland waterway and coastal civil and environmental engineering company based in the UK.

Designing with Green Infrastructure
Reduce Stormwater Runoff with Green Walls & Permeable Pavements

There is more focus today on designing natural structures that offer stability as well as environmental benefits. As concern for runoff and flooding potential grows, engineers are rethinking how their designs can contribute to stormwater and mitigation initiatives without compromising their project’s performance.

Earth retention structures, commonly used in civil construction works, have spilled over onto sites with irregular topography, especially related to transportation upgrades. Retention walls are used in place of simple earth slopes, generally dictated by the severity of grade change and the availability or cost of land within the project site. Concrete cribs and steel sheet piles are typical wall structures, but they aren’t low environmental impact solutions and they don’t promote stormwater infiltration.

Living Retaining Walls Offer Design Versatility, Low Environmental Impact

A natural alternative is GEOWEB vegetated 3D geocellular walls. GEOWEB walls offer green aesthetics through living plantings—as well as flexibility of design for a variety of wall configurations (e.g. gravity, reinforced, steepened slopes) and conformance to native landscapes.

The unique feature of geocellular walls is their horizontal terraces and exposed outer fascia cells at the wall set-back. This open fascia creates a natural environment for selected sustainable vegetation to grow and is also highly permeable—acting as a multitude of planting pots where rainwater can infiltrate, rather than run off onto hard pavements. Their stormwater benefit is ideally suited for Low Impact Development (LID) and Green Infrastructure (GI) design.
Permeable Pavements Capture Stormwater at its Source

With increases in surface runoff from new construction and expanding hard pavements, the capacity of existing stormwater systems are being pushed beyond their limits. As a result, environmental regulations limiting runoff continue to increase the demand for access roads, parking areas, road shoulders and walkways that are porous.

Land development initiatives such as GI and LID are also helping to escalate the use of low environmental impact products to reduce stormwater naturally at its source. Porous and permeable pavements offer immediate infiltration at the point of contact—not only reducing runoff, but reducing the size/need for stormwater infrastructure. Gravel pavers contain open-graded aggregate for fast infiltration without any traffic restrictions. Even the pavement layer acts as stormwater detention. Grass pavers are designed to protect turf from damage caused by occasional traffic. Both can receive runoff from adjacent hard pavements, and store predicted stormwater in the base for natural percolation.

Design Support & Resources for Walls & Pavements

Selection of retaining wall type is influenced by a number of criteria (e.g. surcharge loadings, wall height and batter, soil conditions, space accessibility). A free project evaluation from the manufacturer helps determine design feasibility.

A downloadable porous pavement interactive tool is also available to help designers determine best options for site conditions, stormwater requirements, and expected use.
MAKING THE ASK

12 TIPS FOR SUCCESS.
By Doug Parker and Jen Newman

YOU HAVE SPENT countless business development hours and dollars developing relationships. You’ve put in the time to know anything and everything about the client and their project. So, now what? Make the ask!

Clients aren’t mind readers. Unless you let a client know that you want to work with them, they may not automatically think of you for future projects. Making the ask is a hallmark of a confident, proactive, and professional business developer; it represents a pivotal moment in the client relationship.

Asking for a project shifts the ownership of the situation to the client and empowers them with the responsibility to say “yes” or to give a good reason for saying “no.” Either way, you’ll gain valuable insight with a successful close or learn what else the client may need before making the final decision about a project. Making the ask establishes an open, honest tone of “you have a need, I have a solution. Let’s do business together.”

Here are 12 tips to prepare you to make a successful ask:

1. Be proactive. Don’t wait until an RFP has hit the street. As soon as you learn about a project, do the proper research, develop your project approach, assemble your team and then schedule a meeting with the client to discuss.

2. Choose the right time and place to talk to the client. Instead of cornering someone at a social gathering and giving them the hard sell, ask for their card and follow up in a more appropriate time and place. The right time and place are about the client’s right time and place, not what is convenient for you.

3. Treat every single client separately and distinctly.

4. Always use “we” instead of “I” when making an ask because “we” connotes that the ask is on behalf of the firm with the strength and backing of your organization.

5. Phrase your request in terms of the benefits to the client. Speak to “what’s in it for them.” Why will the client benefit from awarding your firm the project? If you’ve done a good job explaining the benefits of your service, you have every right to ask the prospect/client if they’d like the opportunity to enjoy those benefits by awarding you the project.

6. LISTEN to the issues and concerns of the client. Credible leaders are credible communicators. They use listening and probing skills to gain important information and to strengthen their bond with the client.

7. Give the client an appropriate amount of time to make an informed decision. Don’t pressure, manipulate, or overwhelm them in hopes of pressuring them to say “yes.” This tactic often backfires.

8. Accept the client’s answer whether they say “yes” or “no.” If you truly believe in what you’re selling, you’ll want to successfully meet the needs of as many prospects and clients as possible. Making the ask helps you do this by encountering concerns or objections to overcome, or by giving the client the right to say “no” and letting you move on to the next potential client.

9. Should they say “no,” consider proposing alternatives. For example, “If we are willing to sub civil engineering to someone you currently work with, would you be able to give us a project?”

10. Stay positive. If you are met with rejection, focus on what you have learned about the client or their project. And, consider that every ask you make is practice for the next.

11. Win or lose, thank the client either way for their time and willingness to consider you. By treating them with respect and care they are more likely to say “yes” in the future.

12. Follow up. If you lose a project and the client is important to your firm or practice, look for opportunities to build a stronger relationship with the client, learn more about their needs, and better position yourself for the next project.

Winning work in the AEC industry is all about relationships. And it often takes time and patience to build a new relationship and gain the trust and respect of potential clients. And, just like building relationships in our personal lives takes practice (remember your first boy/friend/girlfriend and what all you learned from that relationship) so does building business relationships.

Use the techniques above to make the ask. Listen to the client and get educated about them and their needs. Communicate your experience and passion for the project. Ask the client for the work. And, show your appreciation when you are awarded the project.

Exercise: For the next week, keep track of the number of times a salesperson actually asks you for the sale when you make a purchase. Take note of how they make the ask and how that played into your purchasing decision about the product or service.

Co-Authored by Jen Newman, CPSM, Managing Director and Doug Parker, FSMPS, CPSM, Managing Principal & COMO, Zweig Group.

As Managing Director at ZWEIG GROUP, Jen Newman, CPSM utilizes her 20+ years of AEC specific experience to help firms grow their people and profits while ELEVATING THE INDUSTRY.

Doug Parker, FSMPS, CPSM brings a unique combination of operations and marketing experience specializing in professional services firm management to his role as Managing Principal and COMO at ZWEIG GROUP. He has developed award-winning brand strategies to position firms and key stakeholders to gain market share and increase revenue.

Zweig Group is proud to offer in-house Doer-Seller Business Development Training. https://youtu.be/DVmRY_ga0GU. Contact Jen Newman for more information jnewman@zweiggroup.com.
IMPLEMENTATION OF BUILDING INFORMATION MODELING (BIM) in the transportation sector has seen dramatic growth in the last five years, as a recent Dodge study on The Business Value of BIM for Infrastructure demonstrates. In 2015, only about one quarter (27%) of U.S. engineers and contractors who use BIM deployed it on 50% or more of their projects, but by 2017, that percentage had doubled to 55%. The study also shows that in the U.S., engineers led the charge for high BIM implementation in 2015, but by 2017, over half of contractors (53%) were implementing BIM at that high level, nearly as many as the engineers (56%).

The findings also show a trend for more even implementation of BIM between two segments within transportation, bridges and tunnels. In 2015, only 26% of those using BIM for bridge projects reported that they were doing so on 50% or more of their projects, compared with 42% of those doing tunnel projects. By 2017, those percentages were nearly even, at 51% for bridges and 50% for tunnels.

So, what has led to that dramatic growth in the use of BIM in these sectors, and what does the future hold? To get answers to these questions, Dodge spoke to Cory Dippold, Vice President and Head of Special Project Applications at Mott MacDonald.

According to Dippold, the increased use of BIM is believed to be directly related to the improved ability of the tools to handle the massive amounts of data generated by many transportation projects. That experience in using BIM helps to overcome the challenge of, as he says, “how to apply the precision that BIM can deliver into the world of infrastructure that typically operates to different tolerances and levels of precision.” The biggest challenges to wider adoption of BIM now, he notes, are related to legacy workflows and the contracting models that still dominate infrastructure delivery. Dippold points to a successful bridge project conducted by Mott MacDonald in the UK that was one of the first model-only delivery projects in that country, which involved a very accurate model of the bridge and allowed them to make better use of off-site prefabrication. In fact, he believes that the ability of BIM to support Design for Manufactured Assembly (DFMA) will be a major factor for growth in its use in the bridge and tunnel sectors, given its ability to provide more rapid construction techniques and higher quality control.

Dippold warns against a simplistic understanding of the benefits of BIM. “I would caution that we shouldn’t be using BIM as a proxy for delivering jobs faster for less money. In a lot of cases, using BIM or using digital techniques to deliver the job offers a number of different benefits that the designer, builder or owner may choose to recover [such as] better constructability, less risk, higher safety, as well as a lower cost, or faster delivery. You have a nice range of different options to unlock value in different ways over time.”

Dippold also sees that list of options increasing in the future. He cites the value of a “digital twin,” which combines additional data with a model (such as non-graphical and sensor data) to provide a digital clone of the existing asset, as a critical part of the future value of BIM for these assets – especially for owners. We are now seeing the emergence of digital integrators who can help provide “a truly accurate, 3D digital representation of a physical asset that is kept current – this would provide significant benefits. We just need a little bit more time and experience as an industry to figure out how to make that happen and where all the value really gets unlocked.” Dippold ultimately envisions smart cities where “assets understand their performance relative to other assets, and you can begin to optimize the performance of your asset in the context of the other assets that are operating around it.”

For those who have not yet started using BIM in the bridge and tunnel sectors, he encourages them to dive in. And for those who are seeking to increase their level of implementation, it is essential to “understand your information structures because the way your information gets structured on a project can be the difference between success and failure.”

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Upcoming Webinars

**Design and BIM Managers:** How Industry Trends Are Changing How Projects are Delivered
Tuesday, May 7, 2019 12:00-1:00PM
https://register.gotowebinar.com/register/4530751365412085773

**5 Simple Steps to Modernize Your Firm - Moving your Project Management, Billing and Accounting to Mobile and Cloud**
Thursday, May 16, 2019 12:00-1:00PM
https://register.gotowebinar.com/register/2979052386707408652

**Pyrawall® - The Most Durable Vegetated Wall Solution**
Thursday, May 30, 2019 12:00-1:00PM