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civil + structural ENGINEER

CELEBRATING THE DESIGN AND US

FROM KIGALI WITH LOVE

AVERY BANG,
BRIDGES TO PROSPERITY
INK LANDMARK DEAL
IN RWANDA

125 YEARS YOUNG
ACCURACY IN THE ALPINE
HORIZONTAL INFRASTRUCTURE,
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BRIDGES TO PROSPERITY

NEW FUNDING MODEL, NEW OPPORTUNITIES

Talk about the intersection of engineering and business. Avery Bang, the president & CEO of Bridges to Prosperity, has inked a deal with the Rwandan government to build 355 footbridges in remote areas throughout the country. The \$28-million program, expected to last five years, will ultimately benefit as many as 1.1 million people. In a place like Rwanda, where many people live in isolated villages, this counts as an important infrastructure play.

But, as Bang said, the real innovation in the Rwanda deal was the financing package, not the construction of bridges. Bridges to Prosperity, known as B2P, already knows how to cross a river or a gorge. Connecting people and places is what they do. But how do you scale a program from the community level to the national level, and in a country that is not bondable? Be creative and think big. Rwanda will pledge \$12 million, B2P will pledge \$5 million through a capital campaign, and the remainder will come from the nonprofit's partners. That's essentially a 40-60 split, with the 60 side on the shoulders of B2P. While there's certainly risk involved in a deal like that, the formula allows for lots of opportunity. For an organization that previously built footbridges by the handful, this represents a transformative step forward. If the program in Rwanda proves successful, B2P could use that business model in other countries.

While Bang is rightfully quick to credit her talented and passionate team, she's the president & CEO, so it goes without saying that her opinion, and her background, are influential in the direction the nonprofit takes. And that's where things get interesting. Bang has undergraduate and graduate degrees in engineering, but the real differentiator is her education in business. In 2016, Bang took a sabbatical to complete her MBA at the Saïd Business School at Oxford. In England, she served as the managing director for the Oxford Seed Fund, where she worked with other MBAs to oversee deal flow, due diligence, and term negotiation for Oxford-led startups. We're sure that experience, surrounded by some of the brightest minds in the world, came into full play as she and her team conceived of, and executed, the Rwanda plan.

According to its 2018 financials, B2P is a \$6.3 million operation, up from \$2.8 million in 2014, for an increase of 125 percent. For a nonprofit dedicated to helping people access markets, schools, and health clinics, those are astounding numbers. And think about the infrastructure that the nonprofit has built over the years. Kiewit, Parsons, Bechtel, Thornton Tomasetti, Balfour Beatty and Arup, among many others, are listed as partners. With firms like those in your corner, anything is possible, including a 355-bridge program in an east African country like Rwanda. With that said, the support from partners must be earned, and maintained, with ethically achieved results – something B2P can deliver.

As B2P has gone about its business building bridges, it's also honed its process for identifying where the structures will be built. Rather than rely on a static system, over the years B2P has developed a machine-assisted bridge identification tool used by its evaluators. The nonprofit wants to take this a few clicks further and create a fully automated process for remote assessments. Inside of every good engineering firm beats the heart of innovation, and that can certainly be said of B2P.

The nonprofit's team and its partners are going to install the bridges in Rwanda. Bang, meanwhile, is going to spearhead the fundraising campaign. Five million is a lot of cash, and there's a lot on the line. But if you've seen her TED Talk, you know Bang can hold the room and make her case. The money, and the bridges it will build, will be there.

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IT'S NOT THE PEOPLE, IT'S YOU

If you're not getting what you want or need out of your people, the problem is not likely with them but with you. When was the last time you truly looked at yourself in the mirror and questioned who you are? In an industry, or any industry, where we are reliant upon the relationships and trust that are formed, too few of our so-called leaders step up to the responsibility that comes along with leadership.

I travel around the U.S. and Canada helping to design strategies for AEC firms, speaking about project management and leadership, and coaching executives in any number of challenges. You hear various iterations of the same topics. I'm asked, "How do I get the best out of my people?" like they are trying to wring a towel. They say things like, "We just have to get the right people on the bus/team," like you can simply go about hiring and firing individuals to create the culture you are looking for. It's as if we are searching for that perfect person who will present themselves with exactly the right amount of work ethic, motivation, skillset, and attitude. Oh, and then there is the Millennial problem. Apparently, they are all unleadable. If we feel that way now, how will we react to the iGen? Maybe the problem isn't an entire generation. Maybe the problem is you.

I challenge us all to take ownership of this problem and what our responsibility is to our people. As a leader, you are less accountable for projects and clients and more responsible for the people who take care of those things. You are responsible for creating a culture and environment where those people can thrive. We should be asking the question, "What can I do to help my team perform at their natural best," or perhaps even better, simply, "How can I help?" Trust is of paramount importance, yet I still hear leaders discount this with their words and in their actions. You cannot possibly expect exceptional performance, innovation, or service without building trust. Why does it seem like everyone is clocking out as soon as they hit their 40 hours for the week? Again, look at yourself, the leadership you are modeling, and the environment you are creating.

So, where do you start? It can be difficult to take a true assessment of who you are and how you operate without bias or without coming up with a rationalization for why it had to happen that way. This is the first step. Luckily, there are many tools out there to help you with this, such as strengthsfinder2.0, 16personalities, or DISC. These can act as a good starting point for you and your team, but should not be utilized as a substitute for deep introspection. Once you've taken account of where you stand today, write down – yes, write, the qualities and skillsets that you are lacking so you can map out a plan on how to improve. There are a number of leadership styles and there is not a perfect one for every situation. I'm not talking about styles, though. I'm speaking of who you are at your core. That is something that is much harder to change, but it can be done. Start with qualities like trust, integrity, commitment, and empathy. Then, look at skillsets that affect environmental or behavioral things like communication, decision-making, inspiration, creativity, or accountability.

My final challenge to you is this. Elevate your thoughts and actions. Take the time to look inwardly and examine who you are and why you do what you do. With rare exceptions, everyone comes to work every day striving for success. Everyone wants to feel fulfilled and desires professional satisfaction. Let's challenge ourselves to buck the precepts of how things have always been done. We are the leaders now and it's up to us to define how we'd like to lead so that we can create a legacy where the industry, and more importantly the people within it, can serve at the highest level.

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WOMEN AND MEN

An engineering company that contracts with the federal government is in hot water. In a fraud suit filed by the United States, the defendant company is accused of presenting itself as a Woman Owned Small Business when in fact men were running the show.

The company allegedly hauled in as much as \$15 million in contracts directly from the government, or through working as a subcontractor on government jobs, from 2003 to 2015. Originally filed in US District Court for the Central District of California, the case has since been moved to the Southern District, where the defendants live and work.

According to the suit, neither of the women propped up as the bosses “were in control of the long-term decision making and the day-to-day management administration” of the company. Here’s the catch. According to the suit, when the company’s brass got wind of the investigation, the company “attempted to cover up its misrepresentations.” The company’s then-CEO, who was male, “abruptly retired from his position in late 2015,” and from that point on, the company changed its description “to indicate it was no longer a WOSB.” Instead, the company described itself as “Small Business Woman Owned,” a designation that does not exist as it pertains to federal contract preferences. Moreover, the company elevated two women to the business’ top spots – CEO and COO – when investigators started sniffing around.

But the female CEO, according to the suit, “did not have any technical background in Navy programs, NTDS, or prior experience with federal government contracting.” The female COO, meanwhile, is described as a “former file clerk.”

The whole ruse, according to the suit, was concocted because the defendants believed that “WOSB status provided a competitive advantage in obtaining these lucrative contracts and subcontracts.” The WOSB designation is in place to provide a level playing field for women-owned businesses by limiting competition for certain contracts.

The defendant firm and its management team deny the allegations, and in one defense describe the suit as “clearly frivolous, clearly vexatious, or brought primarily for purposes of harassment.”

The owners of the company are husband and wife, and both of them allegedly juggled job titles when investigators got involved. We can only imagine the conversations they’re having around the kitchen table.

TO NEW YORK

New York state has passed an aggressive climate bill aimed at all but eliminating the state’s greenhouse gas emissions by 2050. Hailed as one of the most ambitious pieces of environmental legislation in the world, the New York model would trade in fossil fuels for renewables, and do so on a grand scale, as the state is home to about 19.5 million people. The state plan is in addition to what’s going on in New York City, which is pushing for more energy-efficient skyscrapers.

The sprawling backdrop to all of this is twofold: less than a quarter of the state’s electricity currently comes from renewables; and in New York City, the Indian Point nuclear power plant, which supplies the city with about 25 percent of its electricity, is supposed to be shuttered in the next couple of years. In a nutshell, New York has a lot of work to do in a short amount of time if it wants to meet its goals. And it’s going to cost billions upon billions of dollars.

But, as always, out of chaos and crisis comes opportunity. Think about it. The market in renewables should enjoy an extended boom in the Empire State, and that boom will be powered by the engineering and tech industries. If you’re a young scientist or computer whiz, or a widget maker or an engineer in wind, water or solar, New York probably is, and probably will be, the place to hang your hat.

The environmental effort in New York is already underway, of course, and the competition, as it’s always been, is fierce. But the opportunity there is being measured in decades and in billions, so there’s probably enough innovation to go around. We can only imagine the tussle that’s up ahead. The lawsuits and heartache, the politics and permitting, the trial and error, the taxes and expenses, and the overall grind of transforming the sprawling, antiquated energy grid of the state and its teeming namesake city. But it’s the Big Apple, the home of turmoil. It could be no other way. If you’re a scientist or engineer looking to make your name, or at least your career, go to New York, and don’t forget to bring your coat!

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



...IT'S THE ANNIVERSARY OF THAT "QUICK
15-MINUTE PROJECT" WE'RE STILL WORKING
ON AFTER TWO YEARS!



Women in Rwanda cross a footbridge built by Bridges to Prosperity. Photo: Bridges to Prosperity

FROM KIGALI WITH LOVE

BRIDGES TO PROSPERITY MAKING BIG INFRASTRUCTURE PLAY IN RWANDA

By Richard Massey

RWANDA. For many, that one word is synonymous with civil war and genocide, and reminds them of the news snippets of human misery that flashed across American TV screens back in the 1990s. But that was over two decades ago. And since the end of the genocide, in 1994, the small, landlocked east African country has climbed the charts of economic development while plunging down the index of governmental corruption. Rwanda, emerging from ruin to embrace trade, is now considered a beacon of hope, even if many of its people still live in poverty.

Enter Avery Bang and Bridges to Prosperity, also known as B2P. The Denver-based nonprofit recently inked a memorandum of understanding with the Rwandan government for a five-year, \$28 million program for 355 footbridges that will serve an estimated 1.1 million people, or nine percent of the population. Rwanda is putting in \$12 million, B2P will provide \$5 million through a capital campaign, and the rest will come from the non-profit's foundational support as well as its industry partners like Balfour Beatty, Bechtel, Kiewit, and Parsons.

The deal was under negotiation for over a year, and to date represents the nonprofit's biggest agreement. While Bang, B2P's president and CEO, has a BA in Studio Art and a BS in Civil Engineering from the University of Iowa, and an MSc in Geotechnical Engineering from the

University of Colorado, it might have been her MBA from the Saïd Business School at Oxford that was the deciding factor in the Rwanda deal.

"This is as much a financial problem as it is a technical problem," Bang said, referring to the fact that in Rwanda, the real innovation was in the multi-pronged funding package. Having great technical people is one thing, but having the money, and knowing where to spend it, is another.

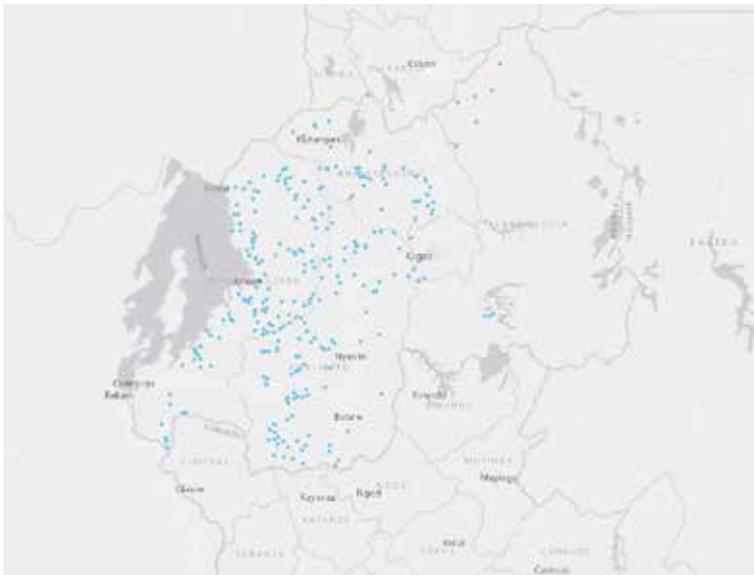
In terms of complexity, the list of stakeholders speaks for itself. The Ministry of Infrastructure, the Ministry of Local Government, the Ministry of Finance and Economic Planning, the Local Administrative Entities Development Agency, and the Rwanda Transportation Development Agency, are all involved. On the B2P side, key negotiators included COO Christina Barstow, Rwanda Program Director Hannis Whittam, and Partnership Development Advisor Jean Ntazinda.

B2P's big play takes place as Rwanda has emerged as a can-do country under the long-term presidency of Paul Kagame, who was re-elected in 2017 to another seven-year term. Kagame's growth strategies, forged in the wreckage of a war he himself helped to end, have been heralded by the international press. Last year, Forbes Africa reported that the "Made in Rwanda" campaign, launched in 2016, has reduced Rwanda's trade deficit by as much 36 percent and increased the value of exports by as much as 69 percent, from about \$558 million to \$943 million.

The same Forbes Africa piece cites the World Bank's 2018 Ease of Doing Business Report, which puts Rwanda 29th globally. For context, France, Poland, Portugal, Czech Republic, and The Netherlands were ranked 32 through 36, Somalia was ranked last, and New Zealand and



Access to education is a key reason why Bridges to Prosperity builds footbridges. Photo: Bridges to Prosperity



Bridges to Prosperity has mapped out the location of all the footbridges being built under the five-year program in Rwanda. Photo: Bridges to Prosperity

Singapore claimed spots one and two, respectively. In terms of the Corruption Perceptions Index, Rwanda is considered one of the least corrupt nations on the African continent.

While Bang's team and its partners will handle the boots-on-the-ground building of the footbridges, Bang will focus her efforts on the non-profit's \$5 million capital campaign, an essential element in the funding model. It's a serious challenge, but there's plenty of upside if all goes well.

"If we can prove it in Rwanda, we believe other countries are going to take notice," Bang said, referencing Uganda, Kenya, and Tanzania.

Even if the fundamentals of the financing have evolved, the mission of B2P has remained the same – serving isolated communities and giving them enhanced access to education, healthcare, and markets. A typical footbridge can cost as much as \$90,000 and take eight weeks to build.

According to B2P data, the expense and effort are warranted. A single span in an isolated community can increase income by 30 percent and increase school attendance by 12 percent.

While footbridges might not generate breathless international headlines, as they relate to the context of the areas in which they are built, they are monuments to practicality.

"It's a waste of resources thinking of infrastructure for vehicles," Bang said. "You need to reach [people] at their most basic level. It's an infrastructure play, but it's a human thing to do."

B2P has mapped 1,500 sites in Rwanda, and selected the 355 locations included in the current scaling program due to their suitability for the nonprofit's standard designs, which have been tailored to be cost-effective and extremely durable in remote areas. The nonprofit's geographic and operational data sets are housed in an integrated Salesforce database.

During the remote needs assessment phase, pre-existing information is gleaned from sources such as WorldPop, satellite imagery, and records created by governments and NGOs. B2P has also developed a machine-assisted bridge identification tool that can point evaluators to where a footbridge might need to be built. B2P has constructed over 300 bridges in more than 20 countries.

Operational field assessments are carried out on the ground with the use of tablets and TaroWorks. Those in the field, of course, also rely on local officials and the practical knowledge they have. In Rwanda, where B2P has operated since 2012, local knowledge was crucial for a program of such scale. For the most part built for the benefit of subsistence farmers, the footbridges serve their highest purpose when they link people to markets, healthcare, education, and even houses of worship.

Looking ahead, the nonprofit wants to create a fully automated evaluation process for remote assessments. Even with the tech innovations underway, the "why" of B2P is basic: Where do people need to go and what are their barriers?

Bang says she feels safe walking the streets of the Rwandan capital, Kigali, a city of hills situated over 5,000 feet above sea level, just like her home city of Denver. The weather is temperate year-round, and every morning a hazy fog hangs over the middle of the city, which makes for spectacular sunrises. She enjoys the international food scene – especially Indian – and appreciates the hotels and facilities, some of the best on the continent. From Kigali, visitors can venture out to B2P sites, or take a trip to see the gorillas.

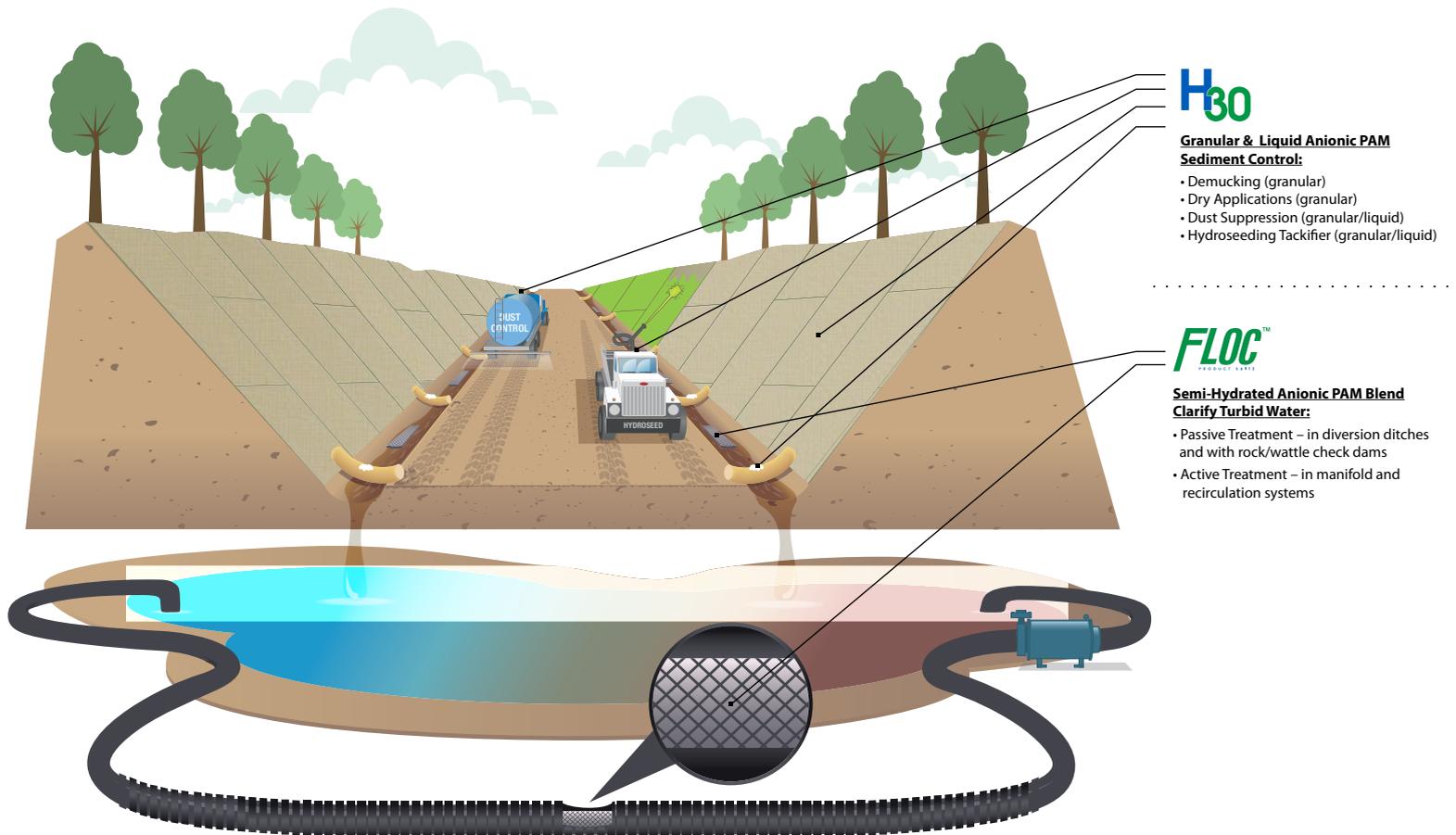
Something good is going on in Kigali and Rwanda, and B2P is playing its part.

"We're there and we're on it," Bang said.

RICHARD MASSEY is managing editor of Zweig Group publications. He can be reached at rmassey@zweiggroup.com.

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The Phyllis J. Tilley Memorial Pedestrian Bridge, which spans the Clear Fork of the Trinity River in view of downtown Fort Worth, was the first arch-supported stress ribbon bridge in the United States.

125 YEARS **YOUNG**

FORT WORTH-BASED FREESE AND NICHOLS GROUNDED IN HISTORY, INNOVATION

By Cindy Milrany

THE DAY THE CITY OF EDMOND, OKLAHOMA, raised the 2-million-gallon bowl of its newest water tower during the summer, dozens of residents arrived to set their lawn chairs out at sunrise, watch the action and chat with the Freese and Nichols engineers who designed and oversaw construction of the structure. It was like a community tailgating party, with company staff members handing out water bottles to visitors on a toasty July morning while celebrating this milestone with city leaders and staff.

This picture-perfect example of Freese and Nichols' immersion in the communities we serve illustrates a key component of how our firm has thrived over our 125-year history. Engineering firms have the chance to make people's lives better, and we take that challenge to heart. We've endured by adhering to a consistent philosophy defined by these main elements: take care of our employees, provide excellent service to our clients, invest in our communities, operate ethically and promote innovation.

Over that century-plus, we've diversified from a focus on water-related infrastructure to include broad-ranging services, such as major transportation projects, urban planning for cities large and small, and program management. Freese and Nichols' projects range from the oldest water treatment plant in Fort Worth (one of the fastest-growing cities

in the United States) to the newest renovations to DFW Airport (one of the world's largest and busiest airports).

Being headquartered in the Dallas-Fort Worth metroplex, we've spent decades delivering projects to meet the region's needs — from lakes created in the 1910s to support for growing cities' water supplies, to the Chisholm Trail Parkway, a key North Texas thoroughfare opened in 2014. But our work spans the state and beyond. Our long history in San Antonio, for instance, includes designing the Great Bend Cutoff Channel in the 1920s, which allowed for development of that city's iconic River Walk, as well as the recently opened San Antonio River Authority Martinez IV Wastewater Treatment Plant and Collection System, which was the first wastewater treatment plant in Texas to receive the Institute for Sustainable Infrastructure Envision Bronze Rating for sustainable design.

We are playing many roles in the development of Bois d'Arc Lake, a \$1.6 billion project that spans 70 miles across three Texas counties and includes a raw water pump station the size of a football field. We've also helped coastal clients across the Southeastern United States deal with natural disasters, such as Hurricanes Harvey in Texas, and Matthew and Florence in the Carolinas.

Business longevity and resilience require learning from innumerable, sometimes difficult, experiences over the years. Here are key lessons from our history that can prove invaluable to others in the engineering field:

Embrace innovation

John Hawley started the company that became Freese and Nichols



Simon Freese and John Hawley, early leaders of Freese and Nichols, conduct “hydraulic jump” experiments outside Fort Worth’s Holly pump station in 1924.

three years after he moved to Texas to design and build the City of Fort Worth’s first water treatment facility. His innovative approach to developing water supplies — he recommended water meters for all customers as early as 1894 — established a company mindset that continued under his successors, Simon Freese and Marvin Nichols, through to today.

One way we emphasize creative approaches is by funding groundbreaking research and development by our staff, which fosters an engaged workplace while yielding new solutions for clients. Our company also encourages innovative work with competitive awards that come with firmwide recognition and monetary prizes. These innovations might be a technically complex structure, forward-looking research or an internal company process improvement. Examples:

- The Phyllis J. Tilley Memorial Pedestrian Bridge, which spans the Clear Fork of the Trinity River in Fort Worth, was the first arch-supported stress ribbon bridge in the United States.
- At Rodney Cook Sr. Park in Atlanta, a large, multipurpose urban park that was designed to provide flood relief, protect a residential area from combined sewer overflows and use green infrastructure to improve water quality within a watershed.

Build relationships

How your business treats clients can influence their satisfaction with your performance as well as their willingness to partner with you again. That’s why we think in terms of relationships, not projects.

Building long-lasting client trust requires top-quality work but also responsiveness. Just as critical is providing solutions tailored to the client’s particular problem — instead of pushing a one-size-fits-all approach.

A good example of our specialized approach is a municipal bond program we were hired to manage. We helped the city streamline its processes and analyze delivery methods so that it could take over the

program management — a solution that was financially sustainable for the city, even though it reduced their need for our services. In another case, as Hurricane Florence approached in 2018, a Freese and Nichols team worked 40 hours straight to provide hydraulic forecast modeling to help South Carolina’s Department of Natural Resources decide where to strategically locate emergency resources.

We increasingly assist clients in securing state and federal funding for projects, especially for infrastructure and preparedness. And we regularly host clients at our in-house training classes on everything from professional ethics to dam safety to the latest modeling software. It’s no accident that more than 90 percent of our business comes from repeat clients.

We also devote time and effort to building relationships with and among our employees. We want to be their firm of choice, too. An annual survey helps us identify issues important to employee satisfaction and well-being and how we can improve. We have an open-door policy with management, encourage team-building events throughout the year in all our offices, and provide benefits including financial support for professional development and education, flexible work schedules, and an annual bonus based on company performance.

Look toward the horizon

Longevity doesn’t come without periodic hardship. In 1995, right after celebrating our centennial, we had our first — and still the only — unprofitable year in company history. That wakeup call brought about a more systematic approach to planning, management and business development. We adopted a “continuous improvement” approach that involves developing and executing a strategic plan: monitoring measures of success, making adjustments as needed, focusing on employees and clients, and holding people accountable for meeting their goals.

Those changes led to Freese and Nichols in 2010 becoming the first architecture/engineering firm to receive the Malcolm Baldrige National Quality Award. The award goes beyond recognizing past business excellence and provides feedback to continue the performance excellence journey.

A focus on continuous improvement also creates conditions that incubate innovation. That might lead to adoption of new efficiencies, such as when we initiated widespread use of tablets on project sites — years before that became standard practice. It also might mean planning for the long term, such as expanding our work on alternative approaches to developing water supplies, including conservation, reuse and desalination. For instance, we designed and managed construction for the first facility in North America to blend reclaimed water directly in a raw water distribution pipeline. Operated by the Colorado River Municipal Water District in Big Spring, Texas, it remains the only operating direct potable reuse facility in the U.S.

Looking toward the next 125 years means continuing to anticipate client and employee needs and adapt to address challenges — while adhering to the practices that have sustained us.

CINDY MILRANY is Chief Strategy Officer of Freese and Nichols, Inc.

RECORD KEEPING ROULETTE

By Lexi Selvig

SECURING AND PRESERVING PROFESSIONAL CREDENTIALS serves as the foundation for successful career development and effective practice management for architects, engineers, landscape architects, and all other licensed built environment professionals. Managing your professional credentials is an important priority.

The last few decades have seen an increase in the demands and challenges of staying current with varying state protocols and requirements. Some of these complexities include different renewal cycles, differing continuing education requirements, and inconsistent reporting processes. Additionally, states and professional organizations require different fees, payment options, and systems of record retention in the event of an audit.

What recordkeeping method are you using to stay on track with your license/s renewal, your continuing education and maybe even your professional memberships in ALA, AIA, NSPE, ASCE, ASLA, and IIDA among others? Are you shuffling spreadsheets and file folders? Do you as a Principal of your firm assume responsibility for credentials management, or do you delegate the task to an executive assistant? Is there an administrative assistant assigned to your project team? Or, maybe you rely on your membership benefits within a professional affiliation to record your continuing education on a transcript.

Typical methods of recordkeeping may have unlimited potential for failure and may result in serious repercussions. Among the many documented examples are, "My basement flooded and all my records were destroyed," or "I lost my job and I was forced to leave all my records behind and I have no access to the files," or "I didn't receive my renewal postcard because the state licensing board data base failed."

Tony Whitt, Continuing Education Coordinator at the Texas Board of Architectural Examiners quoted in his column, CE Documentation in the biannual Licensing News "A common problem I hear when I fail to get the proper documents is that: 'I went to a brown bag lunch-and-learn and they don't give out certificates.' To be blunt, if you can't provide the proof of attendance, then (from my auditing standpoint) you were not in attendance."

Staying current with your continuing education, license renewal and professional organization membership requirements is obviously best before negative issues and destructive consequences occur. Are you prepared to endure major financial losses for failed recordkeeping like fines in excess of \$20,000 and public exposure on a state licensing board website?

Violation, or the voiding of contracts due to an expiring license, is different from state to state. Some states have statutes that treat residential contracts different from commercial contracts – and hold the residential contract void for lack of a license.



It's best to know what the laws are in the states where you practice. Or better yet – don't let your licenses lapse!

Some states hold that the unlicensed contractor or professional can recover no fees for the services performed without a license.

The following excerpt taken from an article, "Architect Not Entitled to Recover Fee for Services on Foreign Embassy Because Not Licensed in Washington, D.C.," written by J Kent Holland, Jr, Atty. of Construction Risk Counsel, PLLC and the ConstructionRisk.com Report, Vol. 13, No. 7, demonstrates the severe consequences when credentials are not properly managed:

An architect licensed in the state of Maryland but not in Washington, D.C. entered into, and won, a competition for the architectural design of a new embassy and chauncery building in Washington, D.C. for the United Arab Emirates ("UAE"). Because she was not licensed in Washington, she was found by the court to have violated the licensing statute and therefore not entitled to recover any fee from the UAE for the services she had performed. The architect argued that she was not required to have a license as of the date she entered into the competition but that she would have obtained the license once she had a signed contract. In rejecting that argument, the court stated that the architect went beyond submitting bids and actually performed architectural services without a license. The court concluded: "District of Columbia law bars an architect from recovering (i) on a contract to perform architectural services in the District or (ii) in quantum meruit for architectural services rendered in the District, if the architect lacked a District of Columbia architect's license when he or she began negotiating the contract, entered into the contract, or performed the architectural services, even if the architect was licensed to practice architecture in another jurisdiction at such times.... There is no exception for international design competitions or the submission of bids to perform architectural services for foreign embassies (or public buildings or monuments) in the District.

The future of professional development for licensed professionals of the built environment includes additional challenges. For example the requirement of "proof of competency" upon completion of continu-



Lexi Selvig

ing education courses/credits. As the global economy draws us into practice internationally, licensing requirements and processes differ. Jurisdiction issues such as the recent statute changes in Kansas modifying the definition of engineering did not authorize an engineer to prepare or provide designs, drawings, specifications or other technical submissions were challenged and only through legislative action were revised. The interdisciplinary practice competition studied and temporarily enacted in Texas represent additional recent challenges.

The 21st century means consistent change and more vigilant attention to education and professional credentials management. To avoid some of the major consequences described plus the forthcoming challenges for licensing, the question is: Are you prepared?

LEXI SELVIG, President of LS Credentialing Services, provides a solution to A/E professionals and firms for organizing, maintaining and managing licenses and certifications, continuing education requirements, and professional affiliations. She can be reached at lexi@aecredentialing.com and you can check out her company's website at www.aecredentialing.com.

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THE DILLON IN RALEIGH

STEWART AND EATON TEAM FORGE CONTINUOUS UPTIME FOR HISTORIC MIXED-USE DEVELOPMENT

By Matthew Price and Sami Hussaini

IN 2017, Stewart, a design, engineering and planning firm located throughout North Carolina and South Carolina, was engaged to provide engineering and design services for The Dillon, the first mixed-use, high rise development of its kind in downtown Raleigh's rapidly expanding Warehouse District. Early in the process, Stewart wanted to preserve the historic value of The Dillon – originally a warehouse for the Dillon Supply Company built in 1914 – while renovating and modernizing the building to meet today's commercial and residential needs, as well as assume a monumental presence in downtown Raleigh's skyline.

The firm played a pivotal role in the construction of the new building, with almost all of its practice areas collaborating to bring the space to life, including Planning & Design, Structural Engineering, Geomatics, and Geotechnical & Construction Services. After working so diligently on the project, Stewart opted to relocate its own headquarters to The Dillon, taking over the entire eleventh floor as its first commercial occupant in June 2018.

Making backup plans

Even the smallest amount of downtime had the potential to cripple Stewart's operations in its new headquarters, which rely on a number of unique applications specific to engineering design and analysis. So, while Stewart was designing its innovative, open office space with areas for collaboration, discussion and team meetings, the firm's IT leaders were also focused on deploying a comprehensive power protection solution capable of safeguarding the company's servers and other critical devices.

High reliability, scalability and manageability were key elements that Stewart desired in an uninterruptible power system (UPS). In 2016, the firm had sought to standardize on a single UPS model and was attracted to the Eaton® brand for its reliability. As a result, prior to relocating its headquarters, the company had already rolled out Eaton 5PX UPSs at its other locations.

While Stewart was happy with its existing fleet of UPSs deployed across its offices and labs, the new facility at The Dillon required a more robust system to protect the additional lineup of equipment. Thankfully, the firm didn't have to look far to find the right solution.

Putting the pieces in place

To ensure critical servers and other equipment would remain protected at all times, Stewart stepped up to a larger Eaton UPS – the 9PX UPS – for operations in The Dillon. Available in models ranging from 700 VA to 11 kVA, the solution offers an ideal fit for both rackmount and



The server rooms at Stewart's office at The Dillon are equipped with Eaton solutions.
Photo: Eaton

stand-alone installations, delivering premium backup power and scalable battery runtimes. Since installing four 6 kVA units in the server room of the new facility, Stewart has experienced an unparalleled level of availability and uptime for its vital systems.

The reliability of both its 5PX and 9PX UPS units are enhanced by Advanced Battery Management technology, which uses sophisticated sensing circuitry and an innovative three-stage charging technique to extend the useful service life of batteries while optimizing recharge time. The technology provides up to 60 days' notice of the end of useful battery service life, allowing ample time for batteries to be replaced without ever having to shut down the connected equipment.

The 5PX and the 9PX UPSs are further bolstered with hot-swappable batteries, optional extended battery modules (EBMs) for scalable runtimes, and an exceptional power factor rating that provides up to 28 percent more wattage than comparable UPSs – enabling more devices to be connected.

Software for remote power management

Stewart leveraged Intelligent Power Manager (IPM) software in conjunction with its UPSs, allowing for the graceful shutdown of network devices during a prolonged power disruption to prevent data loss and save work-in-progress. With the software, IT staff can tier different components and prioritize the order in which they shutdown and startup during a power event. A network card enables the team to remotely and sequentially power down equipment, check server room temperatures and perform other key functions.

Stewart has gained additional protection and functionality by installing Environmental Monitoring Probes (EMPs) as part of the backup plan for all of its sites. The devices enable personnel to remotely collect temperature and humidity readings in rack enclosures and monitor environmental data. The EMPs came in especially handy during Stewart's first few weeks in The Dillon building, when some of the facility's HVAC issues were still being ironed out.



Stewart is headquartered on the 11th floor of The Dillon in downtown Raleigh.
Photo: Eaton

Complementing the ease of monitoring and management is the software's customizable alert feature. The capability allows Stewart to set up email alerts, so the team can be informed if there are power fluctuations at any offices.

Getting down to business

With The Dillon already making its name as an iconic property in downtown Raleigh, Stewart finds itself at the center of an entrepreneurial and pioneering atmosphere that matches its company culture.

Thanks to its commitment to power protection and forward-thinking approach, the firm can rest easy knowing its systems are protected as it continues to usher in a new era of economic development in the city. With its integrated power management solution, Stewart is now able to:

- Provide high availability and uptime to the servers and other critical devices at its headquarters and multiple office locations
- Maintain the highest level of reliability with features such as ABM technology
- Remotely monitor and manage the system using bundled power management software and connectivity
- Gain scalable runtimes with the addition of optional EBMs
- Protect more equipment with the UPS high power factor rating

While the new headquarters facility hasn't yet experienced any electrical cuts or serious power anomalies, some of Stewart's other locations aren't as fortunate. But thanks to its Eaton UPSs, even in the face of complete blackouts, all of the firm's critical equipment remains online — and completely unscathed. With the Eaton 9PX and 5PX UPSs safeguarding equipment at all of Stewart's facilities, the company is able to focus on its own business, without having to worry about downtime, equipment damage or data loss.

MATTHEW PRICE is Director of Technology at Stewart, and **SAMI HUSSAINI**, is UPS 9 Series Product Manager at Eaton.

ROAD RESURFACING SIMPLIFIED

CRITICAL DATA COLLECTED AT HIGHWAY SPEED

By Jeff Winke

TRADITIONALLY, HIGHWAY RESURFACING PROJECTS have been a challenge, not only for the contractor, but the inconvenienced community through which the road passes. Collecting the project data needed to perform the resurface typically required lane closures and a team of surveyors collecting data points from along the side of the road with diverted traffic whizzing past. It was a slow, cumbersome, and dangerous process, that affected the daily commuter flow and affected the contractor's project timeline.

But things are better.

Designed to work at the speed of highway traffic, the Topcon SmoothRide resurfacing system is intended to safely assist road resurfacing contractors without the need for road or lane closures. The system is fully automated with GNSS and sonic tracker control. It is designed to deliver accurate thickness boundaries while maintaining projected yield. It eliminates the need for survey strings, averaging skis, and lasers.



The SmoothRide system uses a Topcon RD-M1 (Realistic Dimension - Mapping One) Road Resurfacing Scanner that is attached to a vehicle, typically a pick-up truck.

Photo: Topcon

“In most situations, it's inconvenient or impossible, to shut down a road and map its surface using traditional point-to-point surveying methods,” says Murray Lodge, senior vice president and general manager of the Topcon Positioning Group Construction Business Unit. “We've developed a way to scan roads at highway speeds with no need for lane closures, crash trucks, escorts or any other typical road survey collection obstacles. With the new RD-M1 scanning unit, the system



The Topcon SmoothRide resurfacing system is intended to safely assist road resurfacing contractors without the need for road or lane closures. Photo: Topcon

maps the existing surface elevations – with many more points captured versus what can be expected with traditional tools – providing more accurate data needed to confidently estimate materials, as well as form the basis of the final design surface."

The SmoothRide system uses a Topcon RD-M1 (Realistic Dimension - Mapping One) Road Resurfacing Scanner that is attached to a vehicle, typically a pick-up truck. The downward facing laser scanner connects to a standard tow hitch or the front of any vehicle with standard tow hooks. With using standard tow hitches and hooks, the scanner is designed to be easy to remove and adapt to any vehicle, thus eliminating the need to have a dedicated vehicle to operate the RD-M1. The unit is designed to collect millions of points at scan rates of up to 100 times per second.

Cruising at normal highway speeds, the 3-D surface scanning can cover miles of road in a short time. The collected data is automatically timestamped and stored for the next step of data management and point cloud generation. The mounted scanner captures millions of data points that are collected safely from the cab of the truck or car. Topcon points out that the driver can begin a road-surface surveying session by simply clicking the start button on their laptop computer and go.

The RD-M1 employs Collect 2.0 graphical collection software, which features an interface status bar that indicates the optimum speed for collecting road information based on the project requirements. Capturing road details at proper speed helps enable SmoothRide to deliver the best possible results.

"I like that we can collect accurate topos while driving 50 miles per hour," stated Chris Smithson, project manager with Big Creek Construction, Lorena, TX. "We used it recently on a 3.5-mile section of Ranch Road 2838 in Mexai, TX where we were able to give the State more accurate cross sections and dirt quantities on the two-lane road and shoulders project we worked on. It saved us time and money."

Knowing the surface details in advance allows the contractor to successfully plan for an accurate material calculation, which can help with knowing how much asphalt or milling will be required for the project.

SmoothRide is considered to be especially appropriate for mainline paving or milling projects requiring long sections of road that need resurfacing.

A feature called Memos is designed to allow operators to create balloons with messages on the map. The collected data can also be made visible in the processing software — enabling specific site conditions to be noted for future reference.

A Manage Runs feature is designed to enable operation without necessitating an internet connection. The software display's large buttons which are intended to make using a tablet or laptop with touch screen easier. Operators can copy data collections to a USB drive, delete them from the hard drive, and add or remove them from the manager.

The RD-M1 Collect 2.0 software has a Plan Route feature that allows for the import of kml files of predetermined routes, designed to help ensure that nothing is missed during the data collection run.

"Using the map downloader, operators can be assured of having all map details visible while collecting data, without the need of an internet connection. Additionally, overlapping locations can be managed by creating areas where predefined overlaps are required for the project," said Kriss Maas, manager of machine control, Topcon. "The detailed road surface scanning can be used to create and manage large point cloud information with our intuitive 'Mobile Master Office' software. The data can then be seamlessly transferred into MAGNET Office software's 'Resurfacing' module to bring out the full array of software features needed to meet smoothness and cross slope requirements, while adhering to any minimum or maximum thickness specified for the job."

The SmoothRide system can assist contractors with variable depth milling and achieve uniform thickness in paving. The system is said to eliminate the time and costs of survey work and to benefit bid and spec jobs in advance by providing more accurate surface data.

"For rehabilitation and maintenance projects, the system simplifies scanning the existing roadway surface, which we can then use for building the model for automatic machine control of our cold planers," said Ryan Zenahlik, technology specialist for Pavement Recycling Systems, Inc., Jarupa Valley, CA.

In summary, the Topcon SmoothRide system is designed to offer 3D scanning collected while driving the job-site road, which is said to replace hours of surveyor-obtained cross-section measurements. The system's software is designed to deliver confidence throughout the paving and milling process by providing the key data needed to complete the job accurately to spec. As Topcon would phrase it, this resurfacing roadwork system fits squarely in the intersection of infrastructure and technology.

JEFF WINKE is a business and construction writer based in Milwaukee, Wis. He can be reached through jeff_winke@yahoo.com.

GRANT BARRACKS RENOVATION

WEST POINT BUILDING BEARING NAME OF CIVIL WAR
GENERAL BEING UPGRADED FOR CADETS

By JoAnne Castagna, Ed.D.

NEW JERSEY RESIDENT ULYSSES GRANT DIETZ is named after his great-great-grandfather, Army General Ulysses S. Grant, Civil War commander and the nation's 18th president.

He realized at a young age that bearing his name would be significant in his life.

"In 1968, at my grandfather's memorial service at the National Cathedral in Washington, D.C., I met his older sister who was born in the White House in 1876 and who married a Russian prince in 1899," Dietz said. "I suddenly became aware of my ignorance. I realized that my family was not like other families, and that somehow I had to do something about that. I was only 13, but I think a switch was flipped that day."

Since then, he has set out to preserve and share his family's history. He's done this by being on the board of the Ulysses S. Grant Association and speaking annually at the General Grant National Memorial, or "Grant's Tomb" on the General's birthday.

He's also made preservation his career and was the Chief Curator of the Newark Museum for many years.

So, when he heard that the U.S. Army Corps of Engineers, New York District, was to renovate and preserve Grant Barracks at the U.S. Military Academy at West Point, New York, he was pleased.

"Buildings like this are often not treated with historical sensitivity, which seems too bad," Dietz said. "The idea that the historic aspect of the building – even though it was built in 1931 – is being considered is a good thing."

The Army Corps is performing this work as part of the West Point Cadet Barracks Update Program. The purpose of the program is to provide additional modern living space for the Cadets.

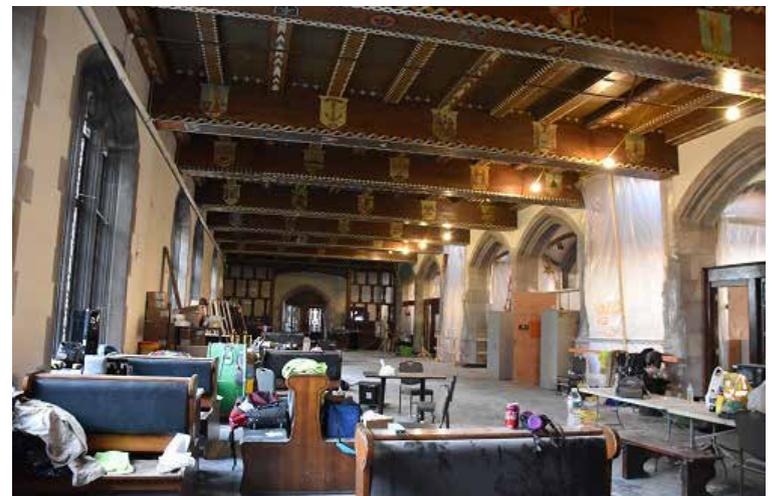
Grant Barracks – formerly named "Old South Barracks" – was constructed in 1931 and is the oldest Cadet barracks in use.

It was re-named after General Grant who commanded the victorious Union Army during the Civil War.

Grant graduated from the academy in 1843 and both his son and grandson would follow in his footsteps.



Renovation of Grant Barracks at the U.S. Military Academy at West Point, New York.
Photo: Dan Desmet, Public Affairs.



The Army Corps is performing preservation work inside and outside the building, including restoring the decorative wood work along the walls and ceilings of the dining hall, like these historic unit crests. To preserve these crests, plaster and terrazzo work will be performed. Photo: Dan Desmet, Public Affairs.

Today, the barracks is being modernized to meet the needs of today's Cadet.

"The renovation includes a complete gut and remodel of the existing structure and the floor plans will be optimized to utilize space in a more practical way," said Christopher Reinhardt, former Chief of New York District's Military Programs Branch.

The renovation is being accomplished by Army Corps contractors. STV Inc. of New York City is performing the design, and J. Kokolakis Contracting, Inc. of Bohemia, New York is doing the construction.

When completed, the multi-story barracks will have 162 modernized rooms.

To assist the Cadets with their academics, each Cadet company will



Ulysses Grant Dietz, the great-great-grandson of Army General Ulysses S. Grant.
Photo: Ulysses Grant Dietz.

have Collaboration Rooms that will allow them to meet in large numbers to work on group projects or participate in team building activities.

To help with this, it will be equipped with Wi-Fi and work stations will be equipped with cable connectors and USB ports.

In addition, the barracks will be outfitted with completely new mechanical, electrical and plumbing systems. The barracks will also get something that it didn't have before – air conditioning.

Many of these new and upgraded features will be energy-efficient making the barracks LEED Silver Certifiable.

Besides the renovations, preservation work is also underway.

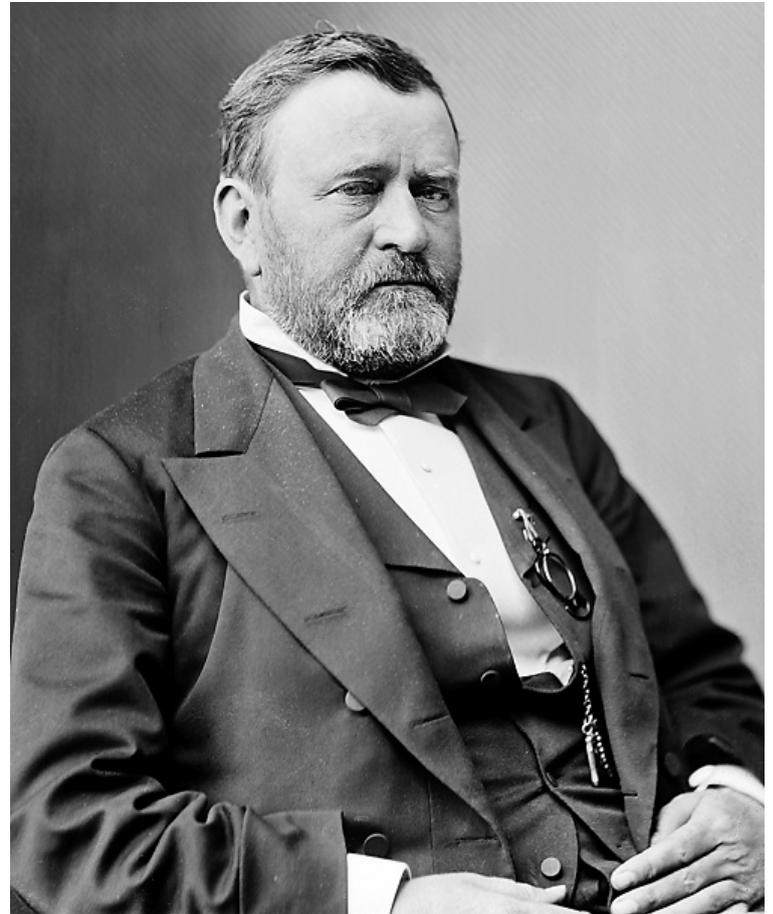
Dietz said that preserving old buildings is in his family's blood, and so is the Army Corps.

"My grandfather, Ulysses S. Grant III was a 1903 West Point graduate, who worked for the Army Corps and was also a founding trustee of the National Trust for Historic Preservation," Dietz said. "In the 1920s, his job in Washington, DC was to oversee all of the public buildings and parks, including the White House, which he altered for the Coolidges."

Dietz was also bitten by the preservation bug. "I've always loved old houses and the variety of things that went inside them," he said. "While I was Chief Curator of the Newark Museum, I was the keeper of a great 1885 beer baron's mansion that is part of the museum's complex. Interestingly, next door to this was the house of Marcus L. Ward, torn down to build the museum in 1922. It was a house that Ulysses S. Grant and his wife Julia visited, because Ward was a huge supporter of Grant, as both governor of New Jersey and a Republican congressman during and after the Civil War."

The Army Corps will be doing its own preservation work on Grant Barrack's both inside and outside the building.

Some of this preservation will take place in the Grant Hall that is con-



Army General Ulysses S. Grant. Photo: Wikipedia

nected to the east side of the barracks. The hall was built in 1852 and was the former Cadet mess hall, used to feed Cadets until 1923.

Today, Grant Hall is a kitchen and dining area separate from the mess hall and is a great gathering place to meet up with friends socially or discuss projects with professors in a more relaxed atmosphere.

Within the woodwork on the walls and ceiling of the dining hall is a rich history of unit crests decorating the interior. To preserve these crests, plaster and terrazzo work will be performed.

Grant Barracks' exterior military gothic revival architecture is also being restored in order to blend in with the rest of the historic 200-year old campus.

This involves delicate repointing work, pressure washing and re-grouting of the exterior granite stones. Besides the granite work, exterior historic items will be restored including decorative metal railings, stone masonry, and decorative metal and wood doors.

The barracks is expected to be available to the Cadets in the summer of 2020.

DR. JOANNE CASTAGNA is a Public Affairs Specialist and Writer for the U.S. Army Corps of Engineers, New York District. She can be reached at joanne.castagna@usace.army.mil.

Mass Timber Cost and Design Optimization Checklists

WoodWorks has developed a series of checklists to assist in the design and cost optimization of mass timber projects. The design optimization checklists are intended for building designers (architects and engineers), but many of the topics should also be discussed with the fabricators and builders. The cost optimization checklists will help guide coordination between designers and builders (general contractors, construction managers, estimators, fabricators, installers, etc.) as they are estimating and making cost-related decisions on a mass timber project.

The paper also includes links to a variety of mass timber design resources, most of which can be found on the WoodWorks website (www.woodworks.org).



First Tech Federal Credit Union in Hillsboro, OR. Architect: Hacker. Engineers: Kramer Gehlen & Associates, Equilibrium Consulting. Contractor: Swinerton. Photo: Jeremy Bittermann

Following is an excerpt from schematic design:

SD Design Optimization Checklist Material Optimization/Panel Sizes/Grids

- Identify options for mass timber fabricators and suppliers. o Maximize panel sizes to minimize machine cutting, material waste and costs. Unique geometries and varying slab edge conditions can increase costs; balance design with budget.
- Determine the thickness and grades of roof/floor panels based on preliminary loading. Minimize the thickness of floor/roof panels to control costs. Vibration often controls floor panel thickness rather than structural span capability.

- Approach mass timber design as a modular system. Start to think of your design on a module of 8 or 10 feet. For comparing material systems, the 8-foot module also works well for steel and concrete. The module can be refined early in the design development phase. For projects that include structured parking, consider modules that work well with the parking layout to minimize structural transfers.

- For panels sourced from overseas, shipping container size limits will govern maximum panel sizes. Actual panel size will be limited to a little less than 8 feet by 40 feet.

The checklists cover:

- Pre-design – including design and builder team coordination, cost estimating considerations, contractual considerations, and design goals
- Schematic design (SD) – including material optimization/panel sizes/grids, system coordination, structural systems, fire resistance, acoustics, finish quality, schedule savings, and cost optimization
- Design development (DD) – including additional considerations on material optimization/panel sizes/grids, hybrid considerations, system coordination, fire resistance, MEP systems, finish quality, specifications, and cost optimization

During pre-design, for example, the paper includes:

Design Goals

- Establish design goals through discussions among the owner, designer and builder, and use them as a guide in decision making throughout design and cost analysis. Consider the relative value of the following benefits based on the project’s objectives and constraints. Decide if these benefits are project goals or value-adds.

Potential Benefits	Project Goal ✓	Value Add ✓
Fast construction/shorter schedules; pre-fabricated and precise		
Exposed wood <ul style="list-style-type: none"> • Aesthetic value; potential for faster leasing and lease premiums; portfolio distinction • Biophilia; healthy indoor environment 		
Lightweight structure, especially beneficial on sites with poor soils		
Labor shortage solutions <ul style="list-style-type: none"> • Small crews for timber frame erection • Utilize more entry-level laborers when MEP and fire protection systems are fully designed, coordinated and pre-planned 		
Just-in-time delivery and small staging/lay-down areas; ideal for dense urban areas		
Natural, renewable material; environmentally friendly with a lighter carbon footprint		
Support healthy forests and rural economies <ul style="list-style-type: none"> • Mass timber can be made from relatively small-diameter trees and those affected by insects or disease; creates a market incentive for forest thinning and other landscape restoration efforts that reduce the risk of high-severity wildfires 		

Resources:

Ask an Expert: How can I create an efficient structural grid for a mass timber building (www.woodworks.org/experttip/2019-efficient-structural-grid/)

System Coordination

- Optimize structure, vibration, fire resistance and acoustics while minimizing the thickness of the floor/roof panels. These areas usually have the biggest influence on cost.
- Coordinate the structure, vibration, fire resistance and acoustic systems. Meet with the project's consultants/experts to discuss system options and how each impacts the others.
- Correlate acoustic and fire-resistance solutions. (They are interdependent.)

Structural Systems

- Determine where to use mass timber systems on the project. Consider: floor and roof systems, load-bearing walls, lateral force-resisting walls.
- Select the lateral system and consider how quickly it will be erected. Is the lateral system compatible with the fast speed of mass timber erection? Construction schedule savings can be significant with mass timber (and are a main driver for its use) and the choice of lateral system can greatly impact the construction schedule.
- Consider a mass timber core as an alternative to systems that have long cure times.
- Review the sequencing of erection. Do the lateral systems need to be installed prior to the mass timber?

Resources:

An Approach to CLT Diaphragm Modeling for Seismic Design with Application to a U.S. High-Rise Project (www.woodworks.org/wp-content/uploads/Approach-to-CLT-Diaphragm-Modeling-forSeismic-WoodWorks-Jan-2017.pdf)

Fire Resistance

- Optimize the construction type to minimize fire rating impacts.
- Consider fire protection approaches and what should be discussed with the Authority Having Jurisdiction (AHJ) during design. AHJs may be unfamiliar with mass timber systems. Early pre-application meetings can help to align expectations and mitigate concerns far in advance of permit application.

Resources:

Fire Design of Mass Timber Members – Code Applications, Construction Types and Fire Ratings (www.woodworks.org/wp-content/uploads/Wood_Solution_Paper-Fire-Design-of-MassTimber-Members-WoodWorks-Apr-2019.pdf)

Ask an Expert: When designing a mass timber building, what are the key design considerations related to fire ratings, panel thickness/member size and occupancy? (www.woodworks.org/experttip/designing-mass-timber-building-key-design-considerations-related-fire-ratings-panel-thickness-membersize-occupancy)

Acoustics

- Consider floor topping options and finishes.
- Determine how the wet vs. dry weight of toppings impacts schedule and mass of structure.
- Decide whether the mass timber floor/roof panels will be exposed on the ceiling side or concealed.
- Consider the minimum level of acoustical performance required by code and expected by the owner/occupant.

Resources:

Acoustics and Mass Timber: Room-to-Room Noise Control 5 } Inventory of Acoustically-Tested Mass Timber Assemblies (www.woodworks.org/wp-content/uploads/Acoustically-Tested-Mass-Timber-Assemblies-WoodWorks.pdf)



After completing the 7-story T3 Minneapolis, Hines switched from a concrete core to a steel brace frame for T3 Atlanta to keep up with the erection speed of the mass timber framing. HPA/DLR Group, Magnusson Klemencic Associates, StructureCraft, New South Construction. Photo: StructureCraft

Finish Quality

- Start to consider the appearance of exposed mass timber elements and the species available from different fabricators. Selecting species provided by local fabricators will typically yield shipping/transportation cost savings.
- Specify desired finish grades (architectural, industrial, etc.) for budgeting purposes. o Work with potential manufacturers to determine their appearance grade options and associated cost premiums in order to arrive at a solution that meets both aesthetic goals and budgetary constraints.

Resources:

Ask an Expert: How should desired appearance grades and characteristics be specified for CLT, NLT and glulam? (www.woodworks.org/experttip/desired-appearance-grades-characteristicspecified-clt-nlt-glulam)

SD Cost Optimization Checklist

Mass timber buildings are relatively new to the U.S. and, as such, not enough data is available to predict costs with the unit cost method. Cost estimating mass timber systems requires a holistic approach to compare costs and yield savings. This approach takes into account the considerations/ questions in these checklists, such as the financial benefits of a shorter construction schedule. A direct comparison of the price of a mass timber structural frame to the price of a steel/concrete frame will not provide an accurate overall project cost comparison.

Schedule Savings = Cost Savings

Example Timeframes for Mass Timber Projects

Project	Stories	Area	Type	Time to Erect the Mass Timber Structure	Overall Construction Schedule
First Tech Credit Union (Swinerton ⁸)	5	150,000 sf	Office	12 weeks	14 months
Candlewood Suites at Redstone Arsenal (Lendlease ⁹)	4	62,700 sf	Military hotel	16 weeks	12 months
Seattle Mass Timber Tower (DLR Group hypothetical case study ¹⁰)	12	305,000 sf	Mixed-use office and hotel	24 weeks	18 months

• Mass timber buildings are erected more quickly than buildings made from other materials. Consider the financial benefits of shorter construction schedule and earlier lease/occupancy.

• No cure times means follow-up trades can start working as soon as floor/roof panels are placed. According to Lendlease, Candlewood Suites at Redstone Arsenal was built 37% faster overall and with 40% fewer construction workers than a similar cold-formed steel military hotel. DLR Group projects that the Seattle Mass Timber Tower would be constructed 25% (5 months) faster than the baseline posttensioned concrete building in its case study.

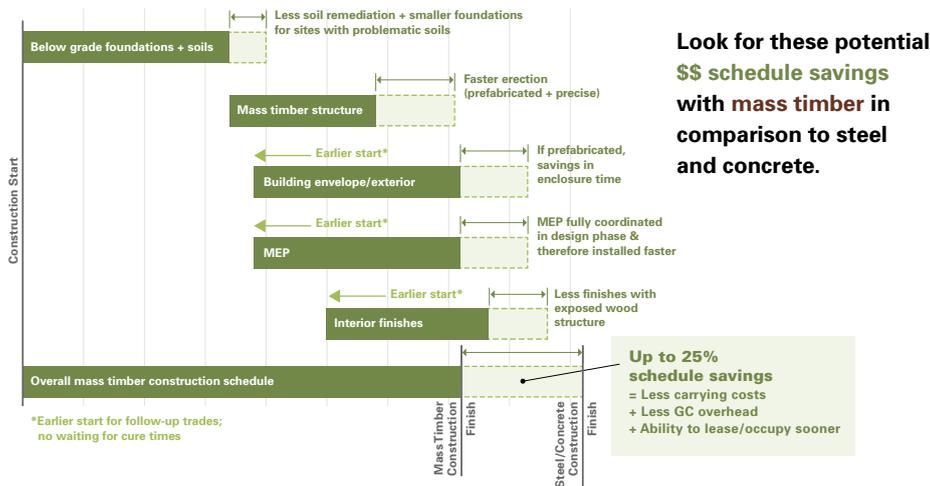
Resources:

Candlewood Suites Hotel at Redstone Arsenal (www.woodworks.org/wp-content/uploads/4-Story-CLT-HotelWoodWorks-Case-Study-Redstone-Arsenal-01-05-16.pdf)

Optimized Design, Efficient Construction: How One Company Successfully Constructed a Massive Timber Project (www.woodworks.org/wp-content/uploads/webinar_slides-EVANS-SILVA-OptimizedDesign-Efficient-Construction-Webinar-180613.pdf)

Tall with Timber: A Seattle Mass Timber Tower Case Study (www.fastep.com/wp-content/uploads/181109-Seattle-Mass-Timber-Tower-Book.pdf)

Compressing the Typical Construction Schedule



Aesthetic Value

- The unique aesthetic of an exposed wood structure can offer market distinction with potential profits from leasing velocity, less tenant turnover and/or higher leasing rates. 4,12,13

Less Weight = Cost Savings

- Mass timber buildings weigh less than concrete buildings and some steel buildings. The lighter mass requires smaller foundations and can result in lower seismic forces.

- For sites with problematic soils, significant savings are possible because of the lighter foundations, which can result in less soil remediation costs, and an earlier start to the above-grade structure.

Fabrication

- For a better estimate of panel fabrication costs:
 - o Include allowance for CNC fabrication of panels.
 - o Include allowance for finish of mass timber, if known. If unknown, either provide a range or include the assumed appearance grade that is factored in the quote (architectural, industrial, etc.).

Shipping/Trucking

- The cost of shipping can vary widely. Will material be shipped on standard trucks or will panels require oversized trucks? Can oversized trailers access the site?
- For overseas manufacturers, consider the cost of:
 - o Shipping containers and rail transit in addition to the typical manufacturing and trucking costs
 - o Storage in a warehouse or the extra room and logistics to store on site (climate-controlled storage may be needed depending on project location)

Installation & Labor

- Include allowance for installation/labor. Mass timber frames are usually installed with one team lead and 6 to 10 team members.
 - o Labor shortages are common and predicted to increase. Relatively small crews are needed to install prefabricated mass timber systems.
 - Lendlease trained unemployed veterans for the Redstone Arsenal project.
 - Swinerton was able to use entry-level electricians for the First Tech Federal Credit Union.
- Start thinking about who will install the mass timber, GC or subcontractor.
- Consider whether on-site training of crew by the manufacturer or an install specialist will be necessary.
- Capture savings from pre-fabrication. Installation costs of MEP elements can often be reduced.

To download the checklists in their entirety, visit the WoodWorks website at <https://www.woodworks.org/publications-media/solution-papers/>.

Contact WoodWorks for Free Project Support

WoodWorks – Wood Products Council provides education and free technical support related to the design, engineering and construction of commercial and multi-family wood buildings in the U.S. A non-profit organization staffed with architects, structural engineers and construction experts, WoodWorks has the expertise to assist with all aspects of wood building design, including (but not limited to): allowable heights and areas/construction types, structural detailing of wood and hybrid systems, fire resistance and acoustical-rated assemblies, efficient and code-compliant lateral system design, alternate means of code compliance, and energy-efficient detailing. For assistance with a project, visit www.woodworks.org/project-assistance or email help@woodworks.org. Visit our website at www.woodworks.org.



Aging infrastructure has led to a rise in pipe bursts. *Photo: Michael Baker International*

HORIZONTAL INFRASTRUCTURE, VERTICAL PRICE TAG

WITH WATER AND WASTEWATER SYSTEMS IN A STATE OF DECAY,
ENGINEERS MUST HAVE OPTIONS

By Suad Ciscic, P.E., John Harris, P.E., and Fred Muncy, P.E.

IT IS TIME TO PREPARE for future infrastructure needs now and an increasingly critical area is horizontal infrastructure – roads, bridges and most especially water and wastewater pipes. Leaks, bursting pipes and public health scares are now the norm as water infrastructure has declined. In the United States, the 2017 ASCE Infrastructure Report Card gave wastewater infrastructure a D+ grade, with drinking water earning a D. According to the American Water Works Association, an estimated \$1T is necessary to maintain and expand drinking water service to meet demands over the next 25 years, while the Environmental Protection Agency (EPA) estimates that the nation’s wastewater treatment facilities will need \$271B over the next 20 years to meet the Clean Water Act’s water quality objectives.

The issue isn’t limited to the United States, however. From November 2011 to February 2018, the city of London’s water pipes burst and leaked more than 36,000 times as the result of Victorian era-pipes that are just now being replaced. In Japan, much of the current water infrastructure was constructed during a period of rapid economic growth in the 1960s and as a result, approximately 38,000 kilometers of the nation’s water pipes have passed the statutory 40-year use life. This has contributed to more than 1,000 pipeline ruptures in the public water system and about 5,000 cave-in accidents annually.

An aging system and ever-increasing demands have put a strain on horizontal infrastructure. Many agencies recognize the need for programmatic replacement. Perhaps most problematic are cast iron pipes – these are susceptible to movement soil and pressure – and as our water systems expand, service outages with frequent start-stop can be rough

on pipes, causing more wear and tear. It is estimated that by 2020, the average age of the more than 1.6 million miles of water and sewer pipes in the U.S. will hit 45 years old. Currently, cast iron, steel and other traditional materials make up nearly two-thirds of the municipal pipes in horizontal water infrastructure.

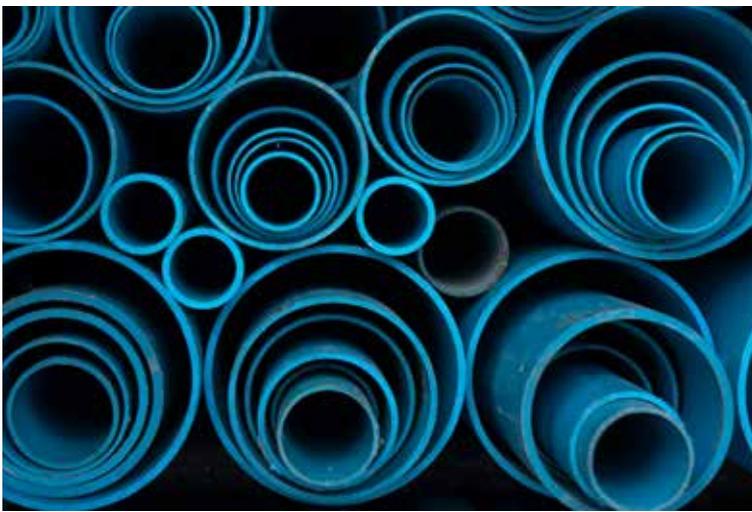
Horizontal Infrastructure Challenges

A key issue in horizontal infrastructure is simply the fact that when drinking and wastewater systems were originally designed, not a lot of thought was given to future replacements. The water and wastewater industry has roughly two-thirds of its assets in the ground and one-third “inside the fence” – reservoirs, treatment facilities or pumping stations. So, most assets are hidden and access to lines has become a major challenge when updating horizontal infrastructure. Throughout the years, development and utilities have encroached on pipelines. For example, it is quite common for fiber optic cables to be laid shallowly, making it challenging to access and repair or replace pipes. Narrow easements straddling property lines have also made access difficult. In addition, engineers must also try to plan for the least amount of disruption possible to continuous service and access to surrounding areas.

When considering horizontal infrastructure upgrades, there are only two choices: replace or rehab. Replacement is certainly more valuable over time in most cases. Pipe replacement costs can be approximately the same as rehab, but the benefit is that replacement can begin up to a new 100-year lifecycle, rather than adding approximately 25 years to an existing lifecycle through rehab.

Trends & New Methodologies

As we take on the challenge of updating horizontal infrastructure, new trends and methodologies are appearing that will help to facilitate the pipeline replacement. Government agencies typically employ one of three methods for horizontal infrastructure improvements: in-house replacement (typically used in straightforward water distribution or wastewater collection projects), design-bid-build with contractors and consultants (typically used in more complicated, high-traffic areas or challenging soil conditions) and design-build projects (also used in more complicated, high-traffic areas or challenging soil conditions).



Alternative pipe materials, like PVC, are increasing in popularity.
Photo: Michael Baker International

To effectively mitigate the risks associated with horizontal infrastructure needs, evaluation and planning are key. Today, we have innovative technologies that will help. Light Detection and Ranging (LiDAR) profiling can analyze the shape and condition of a pipeline. Unmanned aerial vehicles (UAVs) and robots can also be particularly useful when it comes to horizontal infrastructure and detecting leaks. These inspection vehicles can provide access to areas not easily reached by teams and can be deployed within the pipe itself. Some crawling drones even have the ability to cut pipes, weld seams and more. We are seeing more and more flying drones being used in confined spaces, like sewer tunnels and large-diameter pipes with air gaps. High-resolution and infrared cameras, as well as LEDs, are housed within protective barriers to allow the UAV to roll and bounce off obstacles to capture live footage and help engineers identify issues and determine the best course of action.

Big data is also becoming increasingly important in guiding pipeline replacements. We are combining artificial intelligence with machine learning with historic data on utility pipe breaks and information on environmental factors, including flow rate, soil chemistry and temperature, to identify which pipes may be at an elevated risk for failure. With the cost for replacing a single mile of pipeline typically being in the millions, big data helps us make well-informed decisions on what needs to be replaced and when.

Once the need for replacement has been determined, there are several new and emerging methodologies that can be particularly effective. Horizontal directional drilling (HDD) is a trenchless boring method that borrows from the oil drilling industry. This surface-to-surface method does not require excavation of an entry/launch shaft or exit/reception shaft and is known to reduce environmental impacts as HDD techniques require less earth disturbance, usually limited to the entry and exit points. It can also shorten planning, permitting and installation schedules and has been successfully used to install pipelines through environmentally-sensitive areas, long crossings and delineated corridor obstructions.

Another increasingly-popular trenchless boring method, microtunneling, involves using a remote-controlled tunneling machine, typically



Traditional trenched pipe replacement is time-consuming and invasive. New trenchless methodologies are more accurate, reliable and lower-maintenance.
Photo: Michael Baker International

with a laser-guided boring system. Microtunneling comes at a higher upfront cost than HDD, but is extremely precise, with an accuracy of ± 10 mm. This technique can be used with all types of materials, including various soils, sand, clay and even rock. The benefits here include the accuracy, reliability and lower maintenance for pipelines post-installation.

In looking to the future, we are also exploring alternative materials for pipelines themselves that not only improve durability but also provide longer life expectancy. It's more and more common for plastic pipes to be installed. PVC pipes are corrosion-resistant and light, making them easy to transport and handle. CPVC is similar to PVC, but its makeup allows it to withstand a wider range of temperatures. PEX (cross-linked polyethylene) pipes are the newest type of pipe material, but the benefits are clear – the material is extremely flexible and unlike PVC or copper pipes, it doesn't require elbow joints.

Real World Replacement

Modernizing horizontal infrastructure across the globe is a massive undertaking and one that will not be done overnight. At Michael Baker International, we have worked with Fairfax Water for more than 20 years on pipeline replacements, evolving replacement methodologies and incorporating emerging trends into everyday actions.

A key takeaway for our team is that collaboration across specialties is critical to overall success. To successfully and continually upgrade Virginia's horizontal infrastructure, our Water practice has incorporated colleagues across surveying, corrosion engineering, planning, construction management, design engineering (electrical, mechanical), stormwater (erosion/sediment control), park planning/landscaping and traffic control planning. Collaboration and adaptability are critical in developing innovative solutions as we all work to improve our water systems for future generations.

SUAD CISIC, P.E., National Water Practice Lead; **JOHN HARRIS, P.E.**, Water Department Manager; and **FRED MUNCY, P.E.**, Regional Water Practice Lead, all at Michael Baker International.

INFILTRATOR WATER TECHNOLOGIES

A HOLISTIC APPROACH TO WATER AND WASTEWATER MANAGEMENT

By Jonathan Kaiser

AS POPULATIONS CONTINUE TO GROW AND SHIFT, all aspects of the water cycle will need to be optimized for sustainability. Instead of simply continuing to bandage old or install new, costly centralized infrastructure, the goal should be to move toward a dependable, safe, and sustainable water cycle that includes wastewater. Implementing alternative cost effective, efficient, and environmentally friendly methods of water and wastewater management that reduce resource consumption has broad benefits including reduced power demands and aquifer recharge. In a 2014 study comparing resource consumption for centralized and decentralized wastewater treatment systems, it was determined that decentralized systems have a 75 percent reduction in consumed energy, 73 percent reduction in released carbon dioxide, and 68 percent reduction in cost during production and manufacturing compared to centralized systems. For communities, new approaches to improve infrastructure financing is critical to enable communities to implement next generation holistic water and wastewater treatment strategies. The value of preserving the world's water resource is recognized as one of the greatest challenges of our time.

The evolution of drinking water and wastewater management shifted toward a centralized scheme due to urbanization and the resulting increase of pollutant concentration. The centralized model became the “norm” and public perception followed that centralized management is superior. Meanwhile, globally there are trends of water tables dropping, saltwater intrusion, sewers polluting surface water, and stormwater systems failing to meet the demands of growing populations. The US Environmental Protection Agency's (EPA) Office of Water published, *The Clean Water and Drinking Water Infrastructure Gap Analysis*, which identified the potential gap in funding from the year 2000 through 2019 at approximately \$270 billion for wastewater infrastructure and \$263 billion for drinking water infrastructure.

Recharging the Diminishing Aquifer

Historically water scarcity was limited to the arid west. However, water resource concerns have been occurring in non-historical locations. In coastal areas where water tables are low and wells are beginning to run dry, saltwater is intruding inland, leaving an increasing number of people without a reliable source of life-sustaining water and damaging agricultural lands. One cause is centralized wastewater infrastructure; water is drawn from an aquifer, then consumed, and then discharged a great distance from the source, thus short circuiting the natural water cycle for aquifer replenishment. Also, each wastewater district may have thousands of miles of piping for collection and that piping system consisting of old and new pipes is far from watertight. The resulting inflow and infiltration further depletes the aquifer as does water supply wells for municipal water systems. Coupled with lean rainfall amounts



This engineered treatment wetland in Washington, Ind., has many different species of vegetation planted, all of which have taken nicely to the environment created.
Photo: Lochmueller Group, Inc.

and in some cases drought conditions these factors are extracting a water resource toll in unexpected areas.

Decentralized Treatment Systems Provide Land Use Options and Restore Local Aquifers

If developers and builders had to solely rely on centralized sewerage to dispose of wastewater from their projects, development in many areas would be unfeasible due to a lack of capacity to accommodate additional flows, the high unit cost of sewerage, or a lack of funding to expand the centralized wastewater treatment plant.

The decentralized model collects, treats, and discharges to the subsurface at or very close to the point of origin, recycling the original water resource to the local aquifer at a low energy cost. Properly designed, installed, and maintained decentralized wastewater treatment systems have the capacity to process large quantities of wastewater into the underlying soils, making this option a passive and sustainable form of aquifer recharge; providing both wastewater treatment and groundwater recharge in one step. Via this sustainable practice, the replenished aquifer can supply wells, recharge wetlands for wildlife, maintain base flow for streams, and counteract saltwater intrusion in coastal cities and towns.

Expanding acceptance of decentralized wastewater treatment systems is critical to environmentally and economically vulnerable areas. Replacing or rehabilitating outdated onsite systems such as cesspools, installing wastewater treatment where none previously existed, and eliminating surface discharge and nitrogen pollution have been leading initiatives. Finding less capital extensive solutions that can extend the life and expand the capacity of existing centralized systems is also a high priority in many communities open to smart sustainable development, but that have aging or undersized wastewater treatment plants.

Reducing Combined Sewer Overflows (CSOs) with Decentralized Strategies

In the United States, there are approximately 75,000 Sanitary Sewer



The treated water is re-aerated and disinfected using ultraviolet radiation, eliminating the discharge of bacteria. The community keeps the treated water aerated and stored for use at the stadium or elsewhere, if necessary. Excess water is discharged below the surface of the parking lot by a series of Infiltrator Chamber Beds, allowing recharge of the local aquifer. Photo: Lochmueller Group, Inc.

Overflows (SSOs) each year resulting in the discharge of an estimated 10 billion gallons of untreated and partially treated wastewater. The US EPA estimates that there are 5,500 annual illnesses due to exposures to contaminated recreational waters. Another source of watershed and surface water contamination is Combined Sewer Overflows (CSOs). In the city of New York alone there are 996 discharge points of untreated and partially treated wastewater and the US EPA estimates an astounding 1.2 trillion gallons of water from CSOs is discharged in the US each year, according to the [US EPA Report to Congress on Implementation and Enforcement of the CSO Control Policy](#).

Reusing Water and Wastewater to Boost Natural Resources

One holistic approach is to embrace water reuse including wastewater. While standards vary depending on the specified use of the reclaimed water, technologies are currently available to treat wastewater to acceptable standards prior to reuse. For example, irrigation water for landscaping may require lower levels of treatment as compared to reuse for non-potable indoor uses such as toilet flushing that requires higher levels of treatment.

Both public stigma and regulations can be barriers to the acceptance of water reuse. The perception of using wastewater as a potable water source seems unnerving and dangerous without proper education; in reality – we are continuously reusing water/wastewater! In fact, all municipal water systems that draw water downstream from a wastewater treatment plant are implementing de-facto water reuse. Decentralized water reuse simply offers a more direct and sustainable form of water reuse.

A still largely untapped water source is rainwater. From small residential rainwater harvesting systems to those designed for large-scale commercial applications, the technology in components, filtration, and controls is propelling this water supply alternative to the forefront. With little treatment, rainwater can be used for irrigation, toilet flushing, and cooling. With further treatment, rainwater becomes viable as a source of a potable water supply.

Project examples

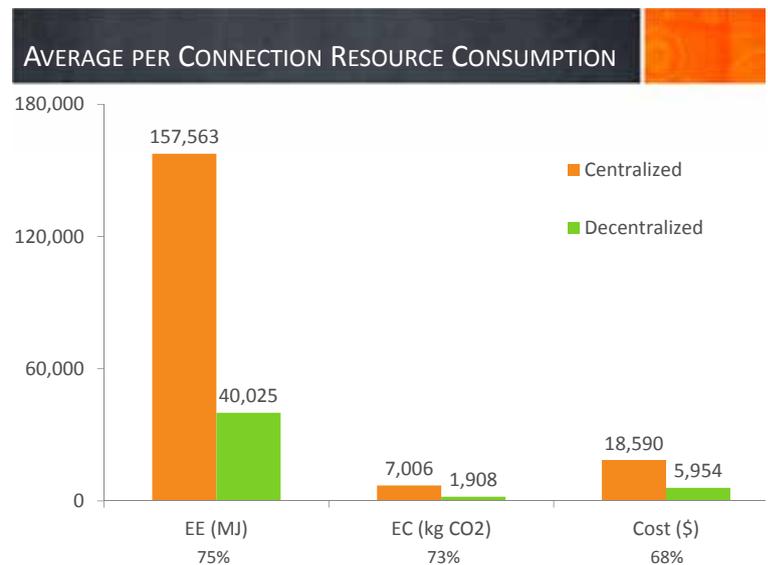
CSO Challenges in Washington, Indiana

The decentralized solution found by Washington, Indiana, cleaned up a polluted waterway, saved tens of millions of dollars in construction cost, and has lowered operating costs. Washington had problems with CSOs. Like many communities, the city's centralized infrastructure was old and decaying — most of it vintage 1930. Its storage capacity was minimal. As little as 2.5 mm (0.10 in.) of rain produced CSOs. To make matters worse, between rain events, the water pooled and then dried up, concentrating pollutants. The city struggled with this problem for decades. Early attempts to abate the pollution included enclosing drainage ditches and creeks in large pipes, but these fixes didn't address overall water quality. Facing federal mandates to clean up its water, the city was in a desperate situation.

The city hired various firms to study the problem and create a solution. The studies proposed conventional, centralized solutions with the most cost effective solution estimated to be in the \$53 million range. Given the average income of the city's 12,000 residents this cost was not a viable solution. The town knew they needed to find an alternative solution that the town's people could afford.

Water Reuse at Gillette Stadium, Foxboro, Massachusetts

The well-known stadium that serves as the home of the 2019 National Football League Champions, New England Patriots, also carries the record of having one of the largest recreational water reuse systems. When the Town of Foxboro advised the private developers that constructed the stadium that they could not furnish enough water or treat the wastewater from the planned 68,000-seat stadium, it became apparent that the reuse of reclaimed water was the only answer. To meet the



In a 2014 study comparing resource consumption for centralized and decentralized wastewater treatment systems, it was determined that decentralized systems have a 75 percent reduction in consumed energy, 73 percent reduction in released carbon dioxide, and 68 percent reduction in cost during production and manufacturing compared to centralized systems. Photo: Lochmueller Group, Inc.

demand for water, engineers proposed to incorporate a water reclamation scheme into the design. The design would allow wastewater from the stadium and the community to be collected, treated and reused for such purposes as toilet flushing, irrigation, cooling water and flushing of streets and sidewalks.

The solution to Foxboro's problem was to capture the wastewater from the stadium, treat it to a high degree, and store it for reuse when necessary. The treatment process is based upon the application of membrane bioreactor technology. These reactors allow the organic wastes (including ammonia) to be biologically degraded by microorganisms, minimizing the need for excess power or chemicals. The solids in the treated wastewater are separated from the liquid fraction by membranes whose pores are small enough to capture viruses. Additional treatment is provided to biologically convert the nitrates formed from the destruction of the ammonia to nitrogen gas. The treated water is re-aerated and disinfected using ultraviolet radiation, eliminating the discharge of bacteria. The community keeps the treated water aerated

and stored for use at the stadium or elsewhere, if necessary. Excess water is discharged below the surface of the parking lot by a series of Infiltrator Chamber Beds, allowing recharge of the local aquifer.

Conclusion

With aquifers rapidly becoming depleted and water tables dropping, minimizing the impacts to the water cycle that are under our control is critical for sustainability. Implementing next generation decentralized wastewater treatment, water reuse, and rainwater harvesting approaches are three potential solutions to move toward a dependable, safe and sustainable water cycle.

JONATHAN KAISER joined Infiltrator Water Technologies (Infiltrator) in 2016 as a Project Engineer after graduating with his B.S. in Environmental Engineering from the University of Vermont. Jonathan spends his time at Infiltrator working on septic system design, product regulation, and research and development initiatives. He can be reached at jkaiser@infiltratorwater.com.

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CASE STUDY

Addressing Chronic Flooding in El Paso, TX

Flygt high volume, low head propeller pumps combined with Formed Suction Intakes solve stormwater flooding issues for the Chihuahuita historic district

The city of El Paso, Texas lies on the tip of the Chihuahuan desert, and it is not uncommon for a year's worth of rain to occur in a matter of days during the summer. These rain events have caused serious damage throughout the city for years, and the flooding has always been particularly bad in the Chihuahuita historic district. In 2006, after a 100-year flood, Chihuahuita formed a stormwater utility to address the flooding issues and hired an engineering firm, CEA Group, to conduct a drainage study with the goal to reduce the impact of these storm events.

Scope

CEA Group determined that the flooding in El Paso was directly linked to high water levels in the Rio Grande River during heavy rains. Storm sewer inlets that were added in the past in an attempt to drain the area were connected to a system that drained a watershed at a higher elevation, causing the runoff from upstream storms to create a backup in the drainage system, flooding the Chihuahuita neighborhood.

A new pump station was determined to be the best solution to control the river water level and subsequently prevent the flooding. However, the solution would be difficult because the neighborhood did not have the footprint or the funding for a conventional stormwater pumping station.



Flygt pumps ready for installation at the Chihuahuita Storm Sewer Pump Station

The stormwater utility required the pump station to function both while the river is low (or at normal level) and also while the river is at the flood stage.

The design would need to be able to overcome these restrictions by utilizing a siphon when the river is low and the full pump horsepower while the river is at its normal level.

In 2012, a representative from Flygt distributor James, Cooke and Hobson, Inc. (JCH), contacted Flygt for assistance. With input from CEA Group, JCH and Flygt engineers, a pump station design was developed that could function properly when the space requirements were less than the recommended Hydraulic Institute Standards for high volume pump stations.

Solution

The project required the design of a pump station that would be able to efficiently transport the stormwater and utilize the smallest footprint possible. The Flygt axial flow propeller pumps PL7061 were selected due to their high efficiency and low power consumption. The design also utilized Flygt Formed Suction Intake (FSI) devices to ensure optimal pump inlet hydraulic conditions. In addition, this configuration allowed a more constant pumping condition regardless of the river level.



Completed pump station in El Paso, TX.

The Flygt FSI is an inlet device that provides optimal inflow to the axial flow propeller pump by gradually accelerating and redirecting the flow toward the pump inlet. Its primary function is to condition the incoming flow into a uniform profile and redirect it. By providing a reliable pump intake in limited space, the Flygt FSI is able to achieve a more economical pump station solution with a smaller footprint and better hydraulic performance than with standard inlet devices.

With a pumping capacity of 27,000 gallons per minute (GPM), the station can handle 100-year storm events. By utilizing siphoning methods, the city was able to accommodate the large swing in river elevations, allowing the station to operate at both high and low river levels.

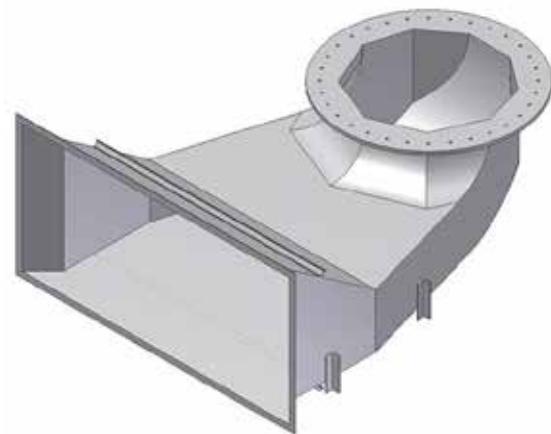
The pump station project included storm drain improvements and the relocation of numerous existing water and sewer lines serving the downtown area.

Result

In 2012, torrential rains hit the Chihuahuita historic district of El Paso, and this time the results were different. With the new pump station in place and functioning well, flooding was not an issue, bringing much-needed relief to this historic area.



Pump station model.



Flygt FSI device.



Work on the \$57 million biodigester began in 2018, and it is expected it will be fully operational by early 2020. *Photo: City of Grand Rapids*

MICHIGAN CITY HAS GRAND (RAPIDS) PLAN FOR RENEWABLE ENERGY

By Thomas Renner

THE MOVEMENT TOWARD USING RENEWABLE ENERGY is just beginning to evolve in many United States communities. According to a report in Fortune in 2018, 18 percent of all electricity in the United States was produced by renewable sources in 2017, an increase of three percent from the previous year. The share of renewable energy consumption doubled in the United States since 2008, according to the report.

The city of Grand Rapids, Michigan, has been far ahead of most other communities in the commitment to green. The city was named “America’s Greenest City” by Fast Company magazine, and has received worldwide recognition for its efforts. The city’s initiatives include the world’s first Community Sustainability Partnership – which was formed in 2005 – and it includes more than 270 local partners across various sectors working together to advance sustainability in Grand Rapids.

Rick Baker, President of the Grand Rapids Area Chamber of Commerce, said the entire community has shown commitment to environmental causes. “It is more of a conscious and intentional effort about what we should be doing and how we can contribute,” Baker said in a report on Groundworkcenter.org. “It is also an expectation from the workforce; our own employees insist on recycling.”

As part of its green initiative, the city is investing \$57 million in a biodigester that will convert food waste to energy. The goal is to develop 100 percent renewable energy to power city buildings by 2025. Construction on the biodigester began in 2018, and it is expected to be operational by November. The city expects gas produced by the project will generate 60 percent of electricity needs for the city’s wastewater

plant. “We looked at future demand and other options,” said Mike Lunn, Grand Rapids’ Utilities Director. “But those options would have been more than \$120 million. We calculated that this was going to be the best solution for future growth.”

How biodigesters work

Anaerobic digesters produce biogas, which is mostly made of methane and carbon dioxide plus small amounts of other gases. Biogas contains about 55-75 percent methane and 24-44 percent carbon dioxide.

The anaerobic digester is a large, air-tight container or tank that does not contain any oxygen. The tank is filled with organic material, such as wasted or spoiled food, plant clippings, animal manure, meat trimmings and sewage after it has been treated. The bacteria, which can only live in places where there is no air, break down organic, biodegradable material over time and converts it to biogas and an inorganic fertilizer.

The Grand Rapids system revolves around three tanks with a capacity of 1.4 million gallons. Two tanks will be used for municipal biosolids. The other tank is an anaerobic membrane bioreactor that will quickly reduce organic waste.

Concentrated food waste from city businesses will be carried through a 10-inch transmission pipe that was installed by the city in 2018. The next phase of the project is the building of the biodigester, which is expected to be fully operational next year. People who live in Grand Rapids can pay a surcharge to use the pipeline as well.

Electricity production from the biodigester is expected to offset the costs of the investment, and will help keep consumer rates steady. The sale of city-generated phosphorous recovery once the biodigester is fully operational could eventually add an additional revenue stream for the city. The project is being funded with tax-exempt municipal bonds.

Biodigesters are uncommon in the United States. According to the American Biogas Council, there are only 1,241 wastewater treatment plants in the United States using an aerobic digester, and fewer than 900 use the biogas they produce. High capital costs and risk to inves-



The doors from BILCO are made with stainless steel hardware and corrosion-resistant materials. They also include engineered lift assistance for one-hand operation. *Photo: Eric Sawatzki*

tors are primary reasons why biodigesters are not more common.

Building the system

Tetra Tech, a California firm, designed the project and The Christman Company, based in Lansing, Mich., is serving as the project's general contractor. When construction began in March 2018, Nicholson Construction and Menard Group USA – the companies developing the groundwork where the biodigester will be located – discovered some early challenges.

Nicholson started preparing the foundations for the biodigester, but almost immediately encountered unforeseen obstacles. “The combination of unsuitable soil, fill and the proposed structural loads required ground improvement to meet the settlement criteria,” the company said on its [website](#).

Workers also found onsite contamination from waste at a nearby railroad when the project began. “We had planned on some of that, but it was in excess of what we had planned,” Lunn said. “That was one of the biggest challenges.”

The system requires pumps and mechanical equipment to power the digester, and workers need access to that equipment for repair and inspection. Christman selected 19 products from The BILCO Company, including floor doors and roof hatches, that will allow workers access to equipment when the biodigester becomes operational. Architectural Building Products of Byron Center, Mich., provided the doors.

The project includes eight 4 x 4 roof hatches with safety railings on the roof exterior. There are also 11 floor doors of various sizes, including some with drainage. Some doors were also customized for the application. The doors are made with stainless steel hardware and corrosion-resistant materials. They also include engineered lift assistance for one-hand operation.

The safety grate provides a permanent means of fall protection. It includes a safety-yellow powder coat paint finish, and stainless steel hardware for corrosion resistance. BILCO, which has been manufacturing specialty access products for more than 90 years, can install

grates on doors prior to shipment. Retrofit kits are also available for field installation.

“BILCO provides a wide range of sizes that we need and could deliver to the project on time, including very large custom-built units,” said Eric Sawatzki, the assistant project manager for Christman, who led the company's team along with project manager Andy Brown. “A really appealing feature is the fall protection grating option for our standardized floor openings. This provides immediate protection from falls through the floor opening for construction personnel as well as users at the plant. It saves the expense of installing a rail system around every opening.”

Something's brewing

One of the key participants in Grand Rapids' biodigester is Founders Brewing, which has been in business since 1997. The brewery recently embarked on an aggressive expansion plan, and expects to produce 900,000 barrels per year when the project is complete.

Founders was ranked second in the nation by American Homebrewers Association's Top Breweries of 2018. But the Grand Rapids “King of Beers” has a lot of company. The city's “Ale Trail” boasts more than 80 breweries, and was awarded the title of “Best Beer Town” by USA Today. The city also has a rich brewing history. The first brewery in Michigan, City Brewery, opened its doors in 1836.

Beer brewing, however, strains water resources. Craft brewers produce an average of three gallons of wastewater for each gallon of beer produce. For large breweries, the average is seven gallons of wastewater per gallon of beer. With the expansion plans of Founders, the company looked at options to handle wastewater, but that would have required investing in more equipment and dedicating space to handling waste. It worked out a solution with the city to become one of the first contributors to the biodigester.

“This coming together of the public and private sectors in the name of sustainability will have a positive impact on the future of our brewery and our city,” said Brad Stevenson, Founder's chief production officer.

In her first State of the City address in 2017, Mayor Rosalynn Bliss said environmental sustainability was one of her top priorities. One of her projects is the Mayor's Greening Initiative, an environmental goal for a 40 percent tree canopy citywide. The city planted more than 2,000 trees in 2016 alone. The Water Environment Federation recognized Grand Rapids with a “Utility of the Future” award for its comprehensive plan in the recovery of resources, such as water, energy and nutrients. Clearly, the city takes its commitment to renewable energy seriously. The biodigester is one of its most notable examples.

“As energy recovery becomes more valuable, a lot of other communities will be looking at biodigesters,” Lunn said. “We've always been engaged in resource recovery. This is a project that could be a template for a lot of other communities.”

THOMAS RENNER writes on construction, manufacturing and other trade topics for United States trade publications. He can be reached at trenner@catalystmc.com.

Vegetated Geocellular Retaining Wall Designed as Flood Barrier for Reconstructed Levee



Flood Protection Plan

To meet federal requirements for flood mapping of levee-protected areas, a levee reconstruction project for the Indianapolis Southport Advanced Wastewater Treatment (AWT) plant along Little Buck Creek was part of a more extensive Deep Rock Tunnel Connector project—one of the largest combined sewer overflow projects for the City of Indianapolis.

To protect the Southport AWT plant and wastewater processing pond from a 500-year flood event from an adjacent creek and river, a wall system designed on the levee's creek side would maintain a narrow profile and allow opening up the creek's water capacity.

A Natural Erosion Protection Solution

The levee embankment along the north side of the wastewater treatment plant had received significant toe erosion resulting from flood events and high water flow from the adjacent creek. An erosion protection system to prevent future erosion from the creek's varying depths and flows was required. Little Buck Creek flows as low as a 1 foot depth with velocities of 3 feet per second (fps) to as high as 8 fps with a depth of 12 to 15 feet during a flooding event.

Project engineer, Christopher B. Burke Engineering, LLC, preferred a wall system that would incorporate native vegetation along the levee with enough sustainability to control erosive forces from the creek. The GEOWEB® vegetated wall system chosen would reduce environmental impacts, protect the levee from scour and erosion, and satisfy regulatory requirements.

Construction of the Levee Wall

The wall was designed as a gravity structure without reinforcement. Aggregate infill placed in the GEOWEB® wall's back cells facilitate drainage and a blend of topsoil and #2 stone in the front outer cells support vegetation as well as provide stability and resistance to soil loss during larger storm events.

Wall Dimensions & Attributes

- Wall length: 1,500 ft. Wall heights: 5 to 12 feet.
- Open fascia cells allow infiltration of stormwater.
- Flexible wall performs well in soft soil environments; conforms well to a waterway's geometry.
- HDPE material is unaffected by water contact.

Performance Update

Since installation seven years ago, the levee wall has performed well during several rain events. Significantly more economical than the U.S. Army Corps of Engineers' (USACE) conventional riprap solution, GEOWEB walls are a practical alternative for levee applications.



With native vegetation, the GEOWEB® levee wall proved to be an attractive solution that effectively minimized environmental and permitting impacts.

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A natural alternative to MSE block walls, 3D geocellular walls offer green aesthetics through living plantings—as well as flexibility of design for a variety of wall configurations (gravity, reinforced, steepened slopes) and conformance to native landscapes and change-in-grade construction. Their stormwater benefit is ideally suited for Low Impact Development (LID) and Green Infrastructure (GI) design.

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CTLThompson collects samples to test ground conditions for a satellite communication project on Diego Garcia, located just south of the equator in the British Indian Ocean Territory. *Photo: CTLThompson*

DIEGO GARCIA

STABILIZING GROUND IN THE MIDDLE OF THE OCEAN

By Spencer Schram

GETTING A TRACK-MOUNTED DRILLING RIG to the most remote U.S. military base in the world wasn't the only problem Spencer Schram and the team at geotechnical engineering firm CTL/Thompson had to overcome when the U.S. Navy hired them to provide geotechnical expertise and engineering solutions for a satellite communication project on Diego Garcia, located just south of the equator in the British Indian Ocean Territory. But it was a big one.

Schram, geotechnical department manager of CTL Fort Collins, also had to consider seismic activity, a jungle landscape that made it difficult to mobilize, and highly complex geological conditions that were markedly different than in his native Colorado.

“The location presents a work environment unlike anything in the world,” said Schram. “But with CTL’s experience on the island and our broad range of geotechnical expertise, we were able to design a winning solution.”

Schram and his team were uniquely qualified to overcome the geotechnical challenges presented by Diego Garcia, an atoll located 1,000 miles from the nearest continent, with soil that consists of hard fossilized or eroded coral. Nearly 20 years ago, CTL’s Jeffrey Groom had consulted with the U.S. Navy and contractor San Juan Construction to design and test materials for a new runway at the naval base, which supported military operations at the height of the war in Afghanistan in 2002.

This time around, Groom stayed stateside and helped Schram manage the logistics of getting the drill rig – and all other drilling equipment – to Diego Garcia. The trip involved a truck ride from Sacramento to Oakland, where the gear boarded a container ship to Singapore. Finally, the rig and other equipment were sealifted to Diego Garcia.



CTLThompson geotechnical department manager Spencer Schram stops for a break during the necessary clearing of Diego Garcia's coconut-tree-laden jungle. Photo: CTLThompson

Once the job site was established, Schram got to work with his soil testing. In some areas, the subsurface conditions are soft, liquefiable sand and gravel made predominantly from eroded coral. In others, they are fossilized coral, an extremely hard material. To accommodate these conditions, CTL employed a mud-rotary technique to log the subsurface conditions and collect samples for testing. Mud-rotary involves the use of a bentonite slurry mix that is pumped into a casing to help advance the drill bit and keep the hole from collapsing.

After clearing the coconut-tree-laden jungle, CTL teamed up with a local contractor to help lay down mud mats on the soft, saturated soils to allow access to the boring locations. Water was pumped as far as 100 yards to create the bentonite slurry mix.

CTL's investigation included evaluating eight locations as sites for 13-meter antennas and one site for a 34-meter antenna. The antennas will be covered with radomes – structural, weatherproof enclosures that protect the antennas without attenuating the signals. The radomes are constructed on 10-foot-high ring walls.

The foundation had to withstand a range of loads. Each 13-meter antenna will have a maximum deadload of approximately +50 kips with the radomes weighing approximately +21.7 kips. The 34-meter antenna will have a maximum deadload of approximately +1,072 kips, and the radome will weigh approximately +36 kips.

Due to the loads and liquefaction potential of the softer soils, CTL recommended deep foundation systems, including auger-cast piles, driven piles and Franki piles, which are high-capacity, cast-in-place deep foundations constructed using a drop weight and casing. These arrangements were not only the best for the geologic conditions, but also deep enough to help mitigate movements due to seismic activity. The last major earthquake near the island, back in 1983, registered magnitude 7.7.

“Success on this project was only possible due to the depth and breadth of experience on the CTL team and the support from our client, the U.S. Navy. While the island conditions are extraordinary, we truly enjoyed taking on the various challenges,” said Schram.

Before heading back to the U.S., the CTL team was asked to spearhead two additional projects: a wind farm that will produce electricity for the island and a pump station to extract cold ocean water, which will act as a coolant for the naval base. CTL may be back to drill, this time on a barge along the pipeline from the pump station to the ocean.

“We hope to explore new projects on Diego Garcia that rely on past experience but bring new questions to challenge our engineering chops,” said Schram.

CTL wrapped up its work in February 2019, about eight months after it began. Even when the job was finished, logistics were a factor – the drill rig and equipment took an additional four months to make their way back to Sacramento.



Photo: Google Maps

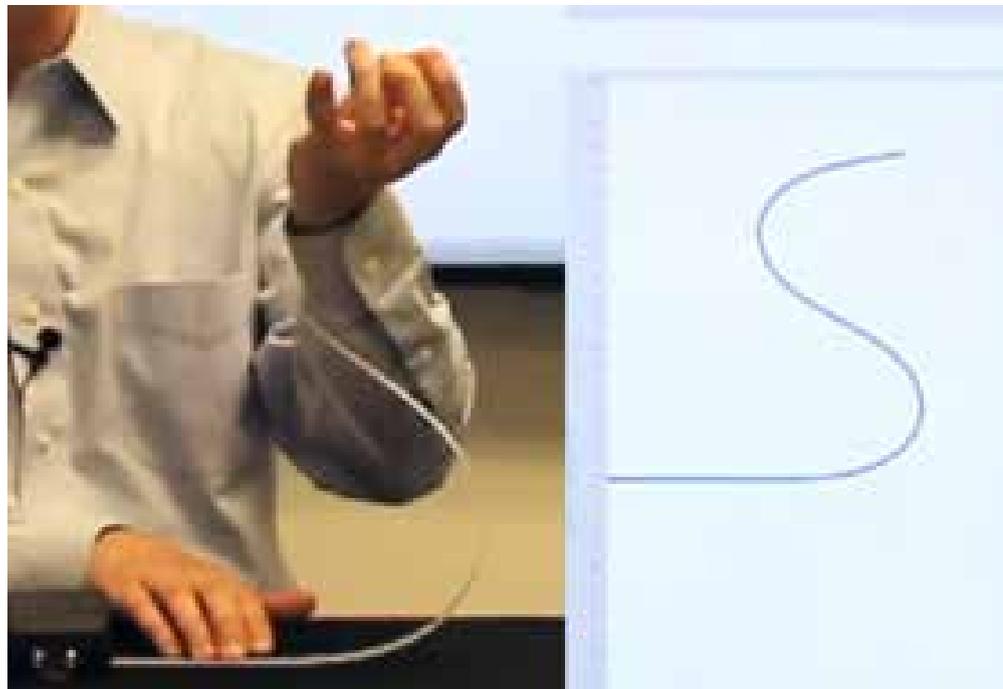
SPENCER SCHRAM is geotechnical department manager of CTL Fort Collins, one of CTLThompson's seven offices in the Rocky Mountain West. He is a Professional Engineer with expertise in foundation and pavement design, slope stability, heave estimates, seepage/permeability, and subsidence estimating. He has consulted for clients ranging from residential and commercial development, roadways, bridges, dams/reservoirs, landslides, onsite wastewater treatment systems, retaining walls, utilities, and more. In addition to his wide-reaching expertise, Schram helped CTLThompson become the first IAS accredited laboratory to test helical piles.

CASE STUDY: 2D SHAPE SENSING OF BORED TUNNEL SOIL SETTLEMENT

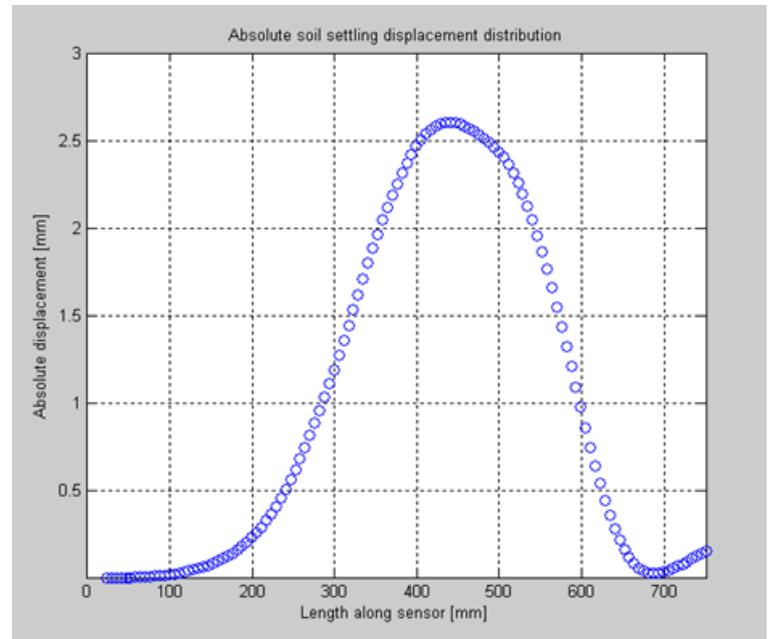
By Alex Tongue

THE WORLD'S UNDERGROUND INFRASTRUCTURE is ever growing. Subway and underground train networks are expanding. Mining, drilling, and fracking exploration is accelerating, and the vast land beneath us is being increasingly utilized as a safe storage space. These and many other subsurface engineering projects require dirt and rock to be bored and removed, resulting in large excavated voids in the Earth's crust. These trigger a redistribution of stress and settling of the surrounding soil. It is critical to understand the nature of this settling to confirm the short and long-term integrity of the underground project, to determine reinforcement requirements, and to ensure the safety of nearby underground and surface structures.

The Sensuron technology was recently utilized to measure the settling movement related to a metro boring project in Beijing, China. A 2D sensor was placed in a reduced scale boring test setup to measure the soil displacement resulting from a simulated excavation process. The existing methods of Digital Image Correlation (DIC) and electronic-based displacement sensors, due to their inherent limitations, are unable to produce the desired measurements within the test volume. The fiber-based 2D shape sensor acquired an accurate soil displacement distribution along a continuous line of the surrounding soil and provided sub-millimeter validation of their settling models.



Core capabilities 2D shape sensing



Displacement distribution

Testing was carried out using a 2D shape sensor that was approximately 3 meters long. A Sensuron 2D shape sensor consists of a thin, flexible beam with one or more optical fibers bonded to the beam's top or bottom surfaces. Depending on the length of the 2D sensor, each optical fiber is comprised of hundreds to thousands of fiber optic strain gauges. When the beam is flexed, the measured bending strain distributions are used to obtain a spatially continuous measurement of the beam's bending radius. Using these values, a 2D displacement profile is derived along the beams' entire length. The 2D sensor is constructed to be inherently self-compensating for temperature even if temperature gradients are present along the beam's length. A layer of heat shrink was applied around the beam to protect the fiber installation from damage.

To simulate the post-boring settling process, an acrylic chamber was filled with a sand, soil, and rock mixture which represented a scaled version of Beijing's underground material. The acrylic volume contained a cylindrical hole near the mid height of the container to allow for a variable-diameter cylinder to be inserted. The soil mixture was filled in around this cylinder to create the bored tunnel. Once the volume was entirely filled, the cylinder was slowly reduced in diameter and removed, thus creating a cylindrical void. The team of researchers utilized the Sensuron equipment to obtain a soil displacement profile along a horizontal line located 12 cm above the simulated tunnel. To accomplish this, the 2D beam sensor was buried within the soil volume and positioned at the desired height above the cylinder insert.



Experimental Setup

In this experiment, researchers were interested in the absolute displacement from the original state to the final state. This was calculated as the following:

$$d_i = \sqrt{(x_i^{\text{reference}} - x_i^{\text{measurement}})^2 + (y_i^{\text{reference}} - y_i^{\text{measurement}})^2} \quad (\text{Eq. 1})$$

$i = [1 \dots N]$ where $i = 1$ is the 2D sensor origin, $i = N$ is the distal end

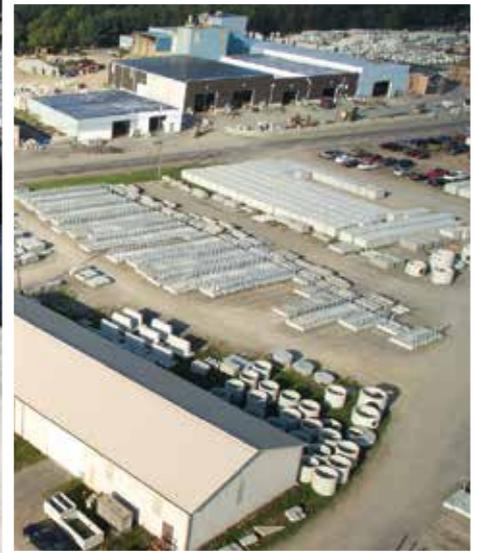
Bending strain distributions were measured using Sensuron's RTS125+, and were streamed over ethernet in real-time to a laboratory PC which calculated 2D shape. The 2D displacement profile was recorded and visualized throughout the experiment.

Sensuron's 2D shape sensing system enabled researchers in Beijing to measure soil settlement due to tunnel boring operations in a way not possible with any other technology. Shape and displacement were measured within a volume where the use of Digital Image Correlation (DIC) is not possible due to line of sight restrictions. The equipment also provided spatially continuous information, filling in the large gaps between LVDTs and other conventional techniques. Furthermore, the Sensuron solution provided bidirectional information as opposed to

displacements in only the vertical or horizontal planes. The measured displacement distributions agreed well with and validated the researchers' soil settling models, providing them confidence in using them for future work.

Sensuron's 2D shape sensing technology can be applied to a large variety of media or structures which are undergoing changes in their shape. Aircraft, automotive frames, boat masts, surfaces such as plates or shells, sand, soil, concrete, or many other structures and materials can all be instrumented with these sensors to understand the deformations or movement they see in testing and operation.

ALEX TONGUE is a Research Development and Applications Engineer at Sensuron, provider of distributed fiber optic sensing solutions for structural health monitoring, design optimization, thermal mapping, and 2D/3D shape sensing. Prior to Sensuron, Alex worked at NASA's Armstrong Flight Research Center as a Fiber Optics Aerospace Applications Engineer. He holds a Masters of Science in Engineering Mechanics from the University of Texas and is the recipient of the Sensors Expo Engineering Excellence Rising Star Award. For more information, please contact info@sensuron.com.



NPCA

PRECAST DAYS

precast.org/precastdays

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

In the last two weeks of October, NPCA plants are opening their doors to explain the precast manufacturing process and demonstrate the equipment, technology and engineering expertise that goes into making precast concrete products. Participating engineers can earn PDHs as part of this event.



Geolocation: Usable data for the future of construction

By Mike Landers

The concept of global positioning is not a new one. Launched by the US Department of Defense in 1973 and first made available for public and commercial use in the mid-90s, Global Positioning Systems (GPS) have become nearly ubiquitous in the era of smart phones and mobile technology. Now, most automobiles, smart watches and surveillance equipment carry GPS capabilities, and the advancement of rideshare apps has only increased the general population's acquaintance with the concept. In the last several years, the construction industry has also been making good use of geolocation to capture a variety of jobsite data to drive efficiency and information sharing among project stakeholders.



Geolocation provides a whole new way of looking at data on the jobsite, yielding more accurate and necessary data for project success.

"[Geolocation] in the construction sense involves [delivering] data to help people in the field make decisions they need to make," says Hensel Phelps VDC Manager Will Plato. "Whether this is from a phasing standpoint, different operations, all the way to safety factors, to me this is what 'geolocation' means. We can take this info and have it available on mobile devices and tablets so when we are standing out in the field we [know] what is around us." Plato's belief that this data can have a very positive effect on real-time decision-making is being echoed throughout industry as geolocation is becoming an applicable technology on a wider basis.

Laser scanning, drone and photo capture, and QA/QC are all different pieces of the geolocation puzzle; which is ultimately aimed at collecting big data and making it available on the jobsite. "Laser scanning has always been a huge factor in our coordination. We're getting more of that precise information and this allows the geolocation to happen on the [planning] side, where you're dealing with real-world data as you coordinate systems, validate installs, and recognize changes that you need to adapt to," says Plato.

Geolocated photos are another way GPS technology has made a huge impact on the jobsite. This allows the user to integrate the location of an image directly into the project plan. "In this last year, we've been able to take the technology of 3600 photos located on documents and models to employ artificial intelligence and machine learning to understand how our site is progressing," explains Plato. "We can establish positions throughout the life of the job and we can always go back and do a comparison. This offers a platform on mobile devices so your field can instantly look at the info in the 3D model and validate the progress in the field and get a feel for what's in that design."

Having the locations mapped out for the lifetime of a project is also a huge benefit when it comes to communication with clients or project designers, in the sense that real-time coordination can be visualized by owners. "That can be the handover deliverable we can push forward," says Plato. This is beneficial in the avenues of safety, materials tracking, and even site progress. "Quantities associated, being extracted and compared on the back end, materials tracking; it's a great way to act as a QA/QC concept when we are trending our progression. It is coming to the point where we can use it to go gut check ourselves."

The advent of geolocation capabilities and data is simply offering a new platform to send and receive more accurate and detailed information than previous data capture methods, yielding a more interactive and fluid result. "We aren't really changing our process, we are [just] able to do more with it," concludes Plato.

RESILIENCY WITH COLD-FORMED STEEL

WHEN LOOKING TO BUILD A STRUCTURE THAT WILL BOUNCE BACK FROM CATASTROPHE, CFS IS THE ANSWER

By Greg Ralph

RESILIENCY HAS BECOME an oft-used buzzword in the engineering and construction industries, as building professionals seek methods for countering increasingly intense hurricane activity, wildfires, flooding and other natural events. Natural disasters cost the U.S. \$91B in 2018, according to the National Oceanic and Atmospheric Administration, a sign that a growing number of extreme weather events are taking a significant economic toll.

But what defines a resilient building? Put simply, resilience refers to a building's ability to withstand, respond to and recover rapidly from extreme events in a cost-effective manner. Of course, fortifying a structure against hurricane force winds and minimizing loss from fire present entirely unique sets of design challenges. With so many potential forces at work against a building, it's important to take a holistic approach to resilient design.

A **joint report** from the U.S. Department of Homeland Security (DHS) and **National Institute of Building Sciences** lays out five key attributes that comprise resiliency: safety, security, durability, environment and energy conservation. These attributes are presented as basic requirements for addressing natural and man-made hazards, as well as the environmental conditions of the building's location. The resilience of the building corresponds directly to how well these attributes enable the building to meet these demands.

Among the numerous strategies for designing resilient buildings, material selection is of particular importance. When it comes to framing, there's no more resilient option than cold-formed steel. In this article we will analyze resiliency in the context of the built environment, explore the various attributes of a resilient structure, and make the case for why cold-formed steel performs best in each scenario.

Safety

The first attribute of a resilient building is whether it can protect occupants during a life-threatening event such as a hurricane or earthquake. Cold-formed steel has a number of inherent properties that help ensure a building remains intact during and following an extreme event.

1. It's highly ductile. Cold-formed steel can easily bend or stretch without breaking when force is applied, and later return to its original shape without losing its material properties. This gives it a higher degree of resistance to lateral loads, uplift and gravity loading, such as those imposed on a structure by seismic or high wind events.

2. It has the highest strength-to-weight ratio of all commonly used framing materials. When cold-formed steel is formed into a C-shape, like a stud, the



Because cold-formed steel is such a ductile material it provides a higher degree of resistance to lateral loads such as those imposed by seismic or high wind events. It also gives CFS framed wall and ceiling assemblies a higher resistance to uplift and gravity loading. *Photo: ClarkDietrich*

bends act as stiffeners and increase the strength of the steel dramatically, providing a strength-to-weight ratio that is significantly greater than that of dimensional lumber. This inherent strength, plus the fact cold-formed steel is such a relatively light material, also makes CFS-framed structures less susceptible to the forces of inertia that wreak havoc on buildings during seismic events.

3. Cold-formed steel is non-combustible. Because it won't burn, the material is eligible for use in Type 1 buildings where fire-resistance standards are most stringent. According to the Steel Framing Industry Association, both load-bearing and non-loadbearing CFS-framed assemblies are fireproof up to four hours when subjected to tests conforming to ASTM E119. Cold-formed steel has also displayed resilience against fire exposure in tests that follow rigorous NFPA 285 protocols.

4. It's consistent. Wood and concrete have a number of variables that can affect their performance, but once a steel stud has been formed it will remain straight with no change to the thickness, width or other dimensions, as well as strength and stiffness. Building professionals can be assured that CFS framing members, produced under a third-party certification program, will arrive at the jobsite certified to comply with all standards.

Security

Weather-related events aren't the only potential threats buildings must be prepared for. Many, such as terrorist attacks, are man-made. The DHS/NIBS report considers blast resistance and ballistics as measures of building resiliency when it comes to security.

Determining a building's level of protection against an explosive threat can be complicated. The U.S. Department of Defense (DoD) Unified Facilities Criteria (UFC) program developed **guidelines** to minimize the threat of mass casualties in the event of a terrorist attack on federal buildings, but these guidelines have also been adopted by many private sector projects. Mitigation strategies include maximizing standoff



For the AIT Barracks project in Monterey, California, the project team used cold-formed steel to ensure the building could resist seismic loading, as well as adhere to U.S. Department of Defense Unified Facilities Criteria (UFC) for blast loading applied to the exterior framing and progressive collapse requirements. *Photo: ClarkDietrich*

distance, preventing building collapse and minimizing hazardous flying debris. Recent [research](#) demonstrates that the overall stiffness and strength of cold-formed steel can be utilized to resist blast threats using conventional construction methods that add little cost to traditional designs.

Cold-formed steel's performance against progressive collapse was recently demonstrated in the [AIT Barracks](#) project in Monterey, California. The 110,000SF facility was commissioned by the U.S. Army Corps of Engineers to serve as a modernized, private-sector residence. In addition to seismic considerations, the structure was required to adhere to UFC 4-010-01 requirements for blast loading applied to the exterior framing, as well as UFC 4-023-03 progressive collapse requirements.

Progressive collapse is defined by the American Society of Civil Engineers as the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure, or a disproportionately large part of it. To meet the UFC progressive collapse requirement for the exterior walls of the AIT Barracks, the project team ran the CFS joist framing from demising wall to demising wall.

The end joists at the exterior wall were then designed to support the wall and roof loading above. This allowed for large sections of exterior wall framing to be removed, while still providing vertical support to the structure above. Additionally, structural steel tubes were designed in line with the joist framing at three end locations where the floor and roof were supported by the stud framing, allowing for progressive collapse requirements to be met if the bearing wall below were removed.

Durability

The third measure of a building material's resilience is its durability, or how long it can be exposed to outside elements with minimal wear or damage. A key component of a resilient building is one that is designed to have a long life. Particularly in areas where atmospheric moisture, flooding, or any other inadvertent exposure to water is a threat, cold-formed steel framing can be the difference between salvaging a structure or needing to completely gut and rebuild.

Cold-formed steel is corrosion resistant, doesn't retain moisture and won't harbor mold growth. When materials are underwater for any length of time, many are not salvageable when flood waters recede. Cold-formed steel utilizes zinc or similar coatings to boost durability



Cold-formed steel is non-combustible, making it eligible for use in Type 1 buildings where the fire-resistance standards are most stringent. Both load-bearing and non-loadbearing CFS-framed assemblies have been proven to be fireproof up to four hours under ASTM testing. *Photo: ClarkDietrich*

and will last hundreds of years before its corrosion resistance deteriorates.

Of course, any level of moisture within a wall cavity can quickly become a structural and a health problem. Cladding failure or plumbing leaks can also create significant problems within a structure. The EPA states that there is a 24- to 48-hour window to effectively reduce the potential for mold propagation following exposure to water. That time window can be even shorter if the materials used to build the wall absorb and hold water. This isn't a problem with cold-formed steel, which is inorganic and does not function as a food source for mold. Also, cold-formed steel is dimensionally stable in a moist environment and won't warp like lumber will when it gets wet, so walls and floors remain plumb and level.

Finally, cold-formed steel is one of the few building materials that is completely impervious to termites and other pests in any climate or

building type. According to [Orkin](#), termite damage in the U.S. results in more than \$5 billion annually. Not only are these infestations costly, but they can also compromise the integrity of the structure and limit its ability to respond to some of the more immediate events discussed previously in this article.

Environment & Energy Conservation

In addition to offering safety, security and durability, resilient buildings are also judged on their energy efficiency and impact on the environment. Air tightness, thermal transfer and the use of renewable energy all play a part. Environmental impact, which is often defined through Life Cycle Analysis and also encompasses issues such as acoustical performance, is another area where cold-formed steel can really make a difference.

Steel framing contains on average a minimum 25 percent recycled content and is 100 percent recyclable at the end of its life. [The Steel Recycling Institute](#) reports that steel is recycled more than paper, plastic, copper, lead and aluminum combined. When structures have to be renovated or rebuilt after a devastating event, using a material that can be reused or recycled is beneficial from a cost, convenience and sustainability standpoint.

The steel industry as a whole has made great strides to reduce the environmental impact of manufacturing CFS products. According to the [Steel Framing Industry Association](#), the U.S. steel industry has reduced energy intensity by 32% and CO2 emissions by 37% per ton of steel produced since 1990.

Engineering Resilience

Once you break down the concept of resiliency and the multiple attributes required to design a truly resilient building, it's clear that cold-formed steel is a superior framing material choice. Cold-formed steel is strong, durable and can contribute to a project's sustainability goals. It won't burn, corrode, or harbor mold growth. It is resistant to pests, offers consistent strength, and boasts ductility and strength-to-weight ratio that make it perfect for resisting seismic and high wind events.

Cold-formed steel has the characteristics to withstand, respond to and recover rapidly from nearly any extreme event. As the industry continues to embrace resiliency, it's certainly worth considering how you can incorporate this versatile material into your upcoming projects.

GREG RALPH is Vice President of Business Development for ClarkDietrich. He's actively involved with the Association of Walls and Ceilings International Construction Technology Council and also serves on the Standards Council for the American Iron and Steel Institute (AISI), the AISI Committee on Framing Standards and the AISI Committee on Specifications. In addition, he holds active memberships with the International Code Council and The American Society for Testing and Materials on committees C11, A05 and E06. He can be reached at Greg.Ralph@ClarkDietrich.com.

ABSOLUTE ACCURACY IN THE ALPINE

By Mary Jo Wagner

WHEN A CESSNA FIXED-WING AIRCRAFT took off over an Austrian alpine region on an early morning day in August 2016, it ascended carrying two crew, a large format digital camera, a bit of uncertainty and a whole lot of risk.

The plane's mission was part of an overall project to provide a precise, as-built survey of a 40-kilometer (24-mile), narrow stretch of railway in the Lower Inn Valley east of Innsbruck. Although this wasn't an unusual task for a surveying company, the required accuracy of the project was: 2-cm (0.8-in) horizontal and vertical accuracy for the entire area of interest (AOI).

"Airborne mapping surveys under 5-cm (2-in) accuracy are rare in alpine environments because the mountainous terrain is treacherous and unpredictable," says Klaus Legat, head of the photo-grammetry and aerial survey department at Vermessung AVT, a surveying company based in Imst, Austria. "To achieve 2-cm resolution we would have to fly about 500m above ground within a very narrow air space, making maneuvering tricky. And for this specific railway section, we'd need to supplement the aerial imagery with ground imagery, precise control points and software that could integrate all the data into an accurate, true-to-life map of the AOI. Neither we nor the client had ever taken on such a task before so this would be a proof of concept test to see whether modern surveying techniques could deliver such high accuracy over a large area. It was a risky proposition."

But, it proved to be a successful gamble.

Integrating GNSS technology, aerial imagery and Lidar data, mobile mapping technology and advanced image processing software, AVT proved not only that its multi-sensor, data fusion approach was a solid bet, it's given the company the confidence and experience to pursue similar high-precision alpine mapping projects, pioneer new business developments and reap the rewards of an expanded service area, project portfolio, and revenue stream.

Placing Their Bets

Based in Imst, about 50 km (30 miles) west of Innsbruck, the Alps are in AVT's backyard, making mapping and surveying mountainous environments a natural focus since the company's inception in 1970. With such a perfect testbed for researching methodologies and technologies, AVT has become quite comfortable and experienced in the notoriously difficult alpine regions, pushing their photogrammetric capabilities to the point where they routinely provide ground-resolution accuracies of 5 cm or better.

The Lower Inn Valley (LIV) railway project would push them further.



Designed for speeds up to 136MPH, the Kundi-Baumkirchen dual railway crosses the Alps and is the northern connection to the Brenner Base Tunnel.

Photo: Matt Tunjic, Pixabay

A double-track high-speed main line of the Austrian Federal Railways (ÖBB), the LIV railway is a core part of the Trans-European Transport Networks (TEN-T), a high-performance railroad that will eventually connect southern Italy with northern Europe.

AVT's target was the 40-km section between the Austrian towns of Kundi and Baumkirchen (KB), the first segment of the LIV that opened in November 2012. Designed for speeds up to 220 km/h (124 mph), the KB dual railway crosses the Alps and is the northern connection to the Brenner Base Tunnel, a 64-km-long (40-mile-long) tunnel between Austria and Italy scheduled for operation in 2026.

In 2016, ÖBB Infrastruktur AG issued a tender for a final as-built measurement of the above-ground areas of the new line, the converted sections of the existing line and any objects within 100 m (328 ft) of the tracks themselves. In addition to the 2-cm vertical and horizontal accuracy requirement, ÖBB specified that access to the tracks was prohibited so a purely terrestrial measurement technique wouldn't be possible. There was also another complexity: the tracks were lined by up to 6-m-high (19-ft-high) noise-prevention walls.

"Because we couldn't access the track, we had to choose aero photogrammetry," says Legat. "But the prevention walls and other obstacles would hide many along-track features from the plane's nadir-looking camera. So our approach was to pair an aerial survey with mobile mapping. The aerial data would give us both the railway detail and the area outside the walls and the mobile mapper would give us the ancillary features not visible from the plane."

Critical to the multi-sensor approach, however, was the ability to integrate the diverse data formats into one image processing software to create precise orthophotos and a seamless orthomosaic. AVT selected Trimble's Inpho Suite to process its data. Inpho is a set of photogrammetry modules for transforming aerial imagery into orthophoto mosaics, point clouds and other 3D datasets.

"Inpho can work with both analog and all brands of digital cameras," says Legat. "That flexibility and interoperability is quite important for



The Trimble MX7 mobile imaging system was mounted on the roof of a small van and pulled by a special locomotive of the ÖBB. The mobile mapper complemented the aerial campaign. *Photo: ÖBB-Infrastruktur AG*

us and saves us significant data processing time. It also is quite good at triangulating and multi-ray image matching which is the foundation for producing accurate results.”

Rolling the Dice

To achieve consistently high accuracy over such a long distance, AVT needed to first establish both a precise control network and a network of ground control points (GCPs). In an effort to minimize atmospheric disturbances, they chose to create the control network through a static observation, night survey. Using two permanent base stations situated near the center of the AOI, crews set out 30 GNSS receivers on predetermined locations and the units simultaneously collected measurements for 12 hours. The permanent survey established a base network precise to 0.5 cm (0.2 in).

For the GCPs, teams painted markers on concrete or other hard surfaces at 2-km (1-mile) intervals around the 40-km area and measured the center points of each with shorter, static observations of about two hours. They set five points at a time and laid out a total of 50 GCPs with a horizontal accuracy of 1 cm (0.4 in).

With the control networks set, AVT could dispatch their flight crew to

collect aerial imagery with a ground sample distance of 2 cm. Flying at an altitude of 450 m (1,476 ft) and an average speed of 200 km/h, they covered the entire AOI in two hours. They flew 21 flight paths in an east-west direction and collected 1,300 images with their Vexcel large-format digital camera. The images had a 60 percent overlap and the average lateral overlap between the flying segments was about 50 percent.

Per ÖBB’s request, they also carried out a secondary aerial Lidar mission to produce detailed point clouds to generate digital terrain and surface models. Reducing the altitude to 200 m, a crew collected Lidar data with a point density of 25 points per square meter and a side-overlap of 70 percent.

Completing the data collection campaign was a terrestrial survey using a Trimble MX7 mobile imaging system. A vehicle-mounted photogrammetric system, the MX7 is equipped with six, 5 megapixel cameras, and Trimble Applanix GNSS and inertial geo-referencing modules. The system was mounted on the roof of a small van that was placed on a truck-transport wagon which in turn was pulled by a special locomotive of the ÖBB. Maintaining an average driving speed of 50 km/h, the MX7 captured a 30MP panoramic image every 4 m (13 ft) along each of the KB tracks and acquired important features such as switching boxes, passenger benches and electrical housings that were not visible in the aerial photogrammetry. Along the railway there is a 600-m-long (1,698-ft) tunnel which required the AVT team to install six LED headlights to compensate for the low-light conditions and enable them to capture features inside the tunnel walls. In total, the MX7 system collected 20,000 images.

“This was our first experience with the MX7 so we weren’t sure how well it would perform,” says Legat. “It not only complimented our aerial campaign and captured the essential ground elements but it performed surprisingly well in the tunnel. We knew acquiring features with LED spotlights would be challenging, but the camera’s rapid exposure times enabled us to capture darkened features.”

Into the Ortho

After downloading and processing the aerial images and aircraft trajectory data, AVT personnel imported that data as well as the GCPs into the Match-AT georeferencing module of Inpho to automatically triangulate the images. Using an image pyramid process, the software analyzed the 1,300 images and automatically pinpointed 15,500 common features or tie points (TPs) across the images, with an average of 200 TPs per image. The precisely surveyed GCPs were measured in the images and the Match-AT module used a bundle-block adjustment process to automatically and precisely orient the imagery. The accuracy of the GCPs in the AT was around 1 cm in planimetry and altimetry.

“The triangulation needed to be done as precisely as possible to ensure we could achieve the vertical accuracy,” says Legat. “So investing in our ground control was crucial but we also needed image processing software that could deliver on the precision requirements. As a long-term user of Inpho, we haven’t found any software that can rival Match-AT’s triangulation abilities or its intuitiveness.”



The view from inside one of the new KB tunnels. Photo: ÖBB-Infrastruktur AG

With the OrthoMaster module, the software automatically orthorectified the individual images with a ground resolution of 2 cm. Switching to Inpho OrthoVista each orthophoto was then stitched together to create a 2D orthomosaic for the whole AOI. Experienced AVT operators used the OrthoVista Seam Edit tool to manually check the seam lines to ensure they didn't cross objects like bridges which would be distorted in the mosaic. Any imperfections were fixed to create a seamless, color-balanced and geometrically correct orthomosaic of the 40-km-corridor.

AVT personnel used the Inpho interface to export the aerial images into DAT/EM Summit Evolution (DSE) software to create a 3D vector map of all railway-related features. The map was customized and finalized in AutoCAD.

In parallel with the aerial mapping, a team processed and precisely georeferenced the MX7 imagery to map objects that couldn't be seen in the aerial images. They first determined the path of the MX7 using the accurate GNSS/INS data recorded during the ride. They manually selected several hundred 3D points that had been determined as multi-ray TPs (aerial GCPs) within Match-AT, and used them to orient the MX7 images to ensure the maximum consistency between the aerial and mobile-mapping data. They then extracted and mapped the mobile-mapping objects and exported the results to AutoCAD to produce the finalized 3D vector map showing the specific layers and symbols defined by the ÖBB.

To process the aerial Lidar data, personnel extracted approximately 300 horizontal patches, or surface sections, from the data and determined the mean height and standard deviation per patch. They imported this

data into Match-AT as vertical-only GCPs with a 2.5 cm standard deviation. The ground points were used to process a digital terrain model and to derive height iso-lines, the latter of which were integrated into the 3D vector map.

Both the 2D orthomosaic and 3D vector map were delivered to the ÖBB in August 2017 and the authority conducted several independent evaluations to assess the quality and accuracy of the datasets. AVT's results were given full approval.

"This was such a satisfying achievement," says Legat. "The project proved that with the right tools and approach, incredibly precise photogrammetry-based maps can be produced for the difficult alpine environment. More importantly, it has raised the profile of our multi-sensor fusion technique and given us the confidence to pursue similarly challenging projects."

The successful proof-of-concept has indeed led to further work with the ÖBB and piqued the interest of other organizations who service alpine communities. AVT is using the same flight data to support ÖBB's needs on the LIV railway. And an Austrian electricity provider wants the company to map its electrical network at a horizontal and vertical accuracy similar to the KB railway. It's a safe bet that for the next high-precision mapping project, AVT's plane and its crews won't be carrying the same amount of uncertainty or risk.

MARY JO WAGNER is a Freelance Writer, Editor, and Media Consultant based in Vancouver, BC. She can be reached at mj_wagner@shaw.ca.

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USING TWITTER TO EXPAND YOUR BRAND

By Heather Stegner

YOU'VE HEARD that social media is a way to position yourself as a thought leader or grow your business. But where do you start and how do you do it? One option: hosting or participating in a subject-specific discussion using a Twitter Q&A.

The American Wood Council (AWC) has been using Twitter Q&As to bring experts and partners together to discuss topics such as the building code development process, deck safety, resiliency and mass timber. In about 30 minutes, the duration of a typical AWC Q&A, our “chats” reach approximately 25,000 individual accounts.

What is a Twitter Q&A?

There are several ways to organize a “chat” on Twitter. The method AWC has used is to gather a panel of experts to discuss a given topic. For example, during National Forest Products Week last October, we hosted a Twitter Q&A using the #WoodBuildsOurWorld hashtag. Using a unique hashtag in posts, which is a word or phrase preceded by the pound sign, ensures that the group of messages are all seen together by viewers. Hashtags are used on many types of social media as a system of organization, gathering messages on a particular topic in one place. The AWC Twitter account, or “handle,” posed questions to the identified experts using the hashtag, who then posted their responses.

Hosting a Twitter Q&A

Interested in organizing your own Twitter Q&A? Here are a few tips:

- **Create a hashtag.** What is a catchy phrase that encompasses your topic and will garner interest? Plug it in to Twitter as a hashtag (meaning add a pound sign and delete spaces between the words) to research if it's been used before, and if so, how. Don't neglect this step. You don't want to start using a hashtag and find out there is an alternate meaning with which you wouldn't want your Twitter account associated. Examples of hashtags AWC has used for Q&As include #AWCResilienceChat, #SafeDeckChat, and #WoodBuildsOurWorld.
- **Draft questions in advance.** Once you have the topic you want to discuss, draft your questions. We have found that 10-15 questions, along with participant responses, are enough to span approximately 30 minutes. If you find you are running out of time during the Twitter Q&A, you can always skip questions.
- **Invite the experts.** Determine which of your partners who are qualified to discuss the topic are active on Twitter. Of those, choose three-to-five to participate in the Q&A as the expert panel.
- **Be prepared to offer support.** Your chosen panelists may not be familiar with a Twitter chat or Twitter Q&A. Be prepared to have (several) conversations beforehand to help the panelists understand the format, become comfortable and feel prepared.

- **Promote the Q&A.** Use various social media channels to promote the Q&A. Identify the panelists who will be participating and give the time, date and hashtag to participate in or follow the discussion. Ask your expert panel to help promote the Q&A by posting to their social media that they will be participating.

Recommendations for Participants

Similarly, here are some recommendations if you've been asked to participate as an expert during a Q&A:

- **Use the hashtag.** Make sure you include the hashtag in every response you post to ensure it's captured as part of the “conversation.” “Attendees” who are following the hashtag won't see your responses if it isn't included in your tweet.
- **Use gifs and images.** Social posts that include images generally get better engagement (likes or retweets) than those that are straight text. Add photos or animated gifs to your responses to liven up your posts.
- **Don't feel like you need to answer every question.** Some questions may be outside of your wheelhouse. It's ok to sit out some questions.
- **Engage with other experts.** If you see a response from another expert panelist that you agree with, like or retweet it. Engaging with the other responses encourages panelists to do the same with your posts, which helps your answers also reach their Twitter followers.



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Heather Stegner

Hosting or even participating in these types of social media events will help position you as a credible source in your topic area, as well as help you find relevant followers. Good luck and have fun getting involved in Twitter Q&As!

HEATHER STEGNER is vice president, communications, American Wood Council. She can be reached at HStegner@awc.org.

MAKING CONNECTIONS

EIGHT STRATEGIES FOR MORE SUCCESSFUL PRESENTATIONS

By Rich Friedman

IF YOUR FIRM has implemented a strategic business development process, then you're spending plenty of time identifying and researching prospective clients, pre-positioning work, and making thoughtful go-no-go decisions.

But what happens when you're in the room where the final decisions are made? Over many years of conducting client interviews, we've heard the horror stories and the success stories. If you want to impress your clients – and win more work – then it may be time to raise your shortlist and client presentation game.

As one client we spoke with recently put it: “Nine times out of ten, deals are made in the interviews. You think you have the front-runners selected from the proposals, and then they go in and bomb. It's all about how they connect with our group.”

While there is no cookie-cutter formula to a winning presentation, there's also not as much mystery as you might think. Here's what your clients want to see more of, and less of:

Give them the experience. Your number-one objective is to convey your client experience. We hear this repeatedly from clients in nearly all market sectors, public and private. They want to know what it will be like to work with your firm and your project team on this project. Successful teams are the ones that leave a positive lasting impression, not just as subject-matter experts but as collaborators and communicators. Clients value responsiveness and want a collaborative partner who is willing to understand their business. So unless it's been specifically asked for, be careful about coming in with a fully baked design or solution.

This is where an interactive, “show-don't-tell” approach can win the day. Think of presentations as an opportunity to demonstrate that you listen, ask intelligent questions, and model your collaboration and problem-solving processes. While they may not expect you to have all of the answers upfront, they do want to know that you've done your homework and that you have a clear process they can trust. Show them how you'll go about developing those answers, whether in the form of a design or a solution to a technical problem.

Skip what they already know. “I don't go out to 20 firms,” says one VP of facilities. “If I've gone out to three firms and you're one of them, you don't need to sell me or you wouldn't be there.” For example, instead of spending 30 minutes selling your firm and rushing through 15 minutes of project-related content, limit your sales pitch to around 5 minutes and be sure it's focused on the needs of the project. That

provides plenty of time for valuable content and discussion that showcases your understanding of the client, their needs and your solutions.

Tailor your format. It can be tempting to model your next presentation after your last one, but as you know, not all clients are the same. Even within a client organization, the winning formula can vary from project to project, and from decision-maker to decision-maker. If you've been chasing clients and not projects, you've already done the hard work in gathering intel and pre-positioning. Use this information to tailor your presentation accordingly. Things to think about include:

- How interactive can you be within the guidelines and culture of this client and this group of decision-makers?
- What are they most concerned with or likely to ask? How will you address this?
- What is most important to convey, and who will speak to each of these points?
- What questions do you need to (or strategically want to) ask the selection committee?

Invest in your people. If there is one expense that will deliver deep ROI for your BD efforts, training your people in presentation skills is it. An articulate, confident presenter who can think on their feet is more likely to connect with clients and be viewed as someone they can trust to deliver results. You don't want to be the team remembered for the PM who stared at the selection committee and stuttered or the principal who read to clients from a sheet of paper. One facilities director shared this insight: “My advice is to take some presentation courses. When lay people know nothing about construction or design, they select the best presenter.”

Do your due diligence. Before you walk into that room, you should know who you're meeting and what the competition looks like. This can set you apart before you even arrive. A surprising number of firms are reluctant to ask for the names and roles of the people they'll be meeting, the expected format of the meeting, or how many/which firms have been shortlisted. Having this information can inform your presentation content and allow you to research and make personal connections with committee members ahead of time on LinkedIn.

Focus on “why you, why now.” Use your five minutes of “sell” time wisely. What truly makes your firm different? Quality, service and modern technology are client expectations, not differentiators. If you want to get your clients' attention, show them what makes you the best choice for this project. If it's a repeat client, be sure to remind them of what you've previously done, the lessons you've learned and how you will apply them to the project at hand.

Build a strategic team. Selection committees, and even clients offering sole-source work, want to have a clear sense of who will be on the project and, ideally, hear from those doing the work. That includes the principal-in-charge and most especially, the project manager, but it may also include subject-matter specialists, key subs and partners, project architects and others. How will your team members seamlessly hand off or build off various pieces of the presentation? (Principals,



remember, this is not a solo show!). The makeup of your team should answer the questions on your client's mind:

- Which principal(s) will be involved and what will their level of involvement really be?
- Who will be doing the day-to-day work and are we comfortable with them?
- Do they bring the specialty expertise we believe is needed for this project?
- How well does this team understand our systems and/or requirements?

Rehearse! Even if you have stellar presenters, please don't wing it or try to cram for your preparation. The chemistry of your team and

ability to present cohesively is critical to your success. While it may be challenging to find time to rehearse, prioritize a few dry runs. After all, you're asking your prospective client to spend the next several months or years with you. A cohesive, confident and enthusiastic team will give them confidence that they're making the right choice.

What's the most successful strategy you've used to improve your client presentations? Tell me about it at rich@friedmanpartners.com or (508) 276-1101.

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THE ENVIRONMENTAL BENEFITS OF FABRIC STRUCTURES

By Nicholas St. Pierre

THE WORLD IS BECOMING INCREASINGLY CONSCIOUS of industry's effect on the environment. From manufacturing, to mining and everything in between, the global community is searching for ways to reduce its environmental impact. Focus has mostly been centered on lowering carbon emissions through renewable energy, but there remains a need for sustainable structures that are usable in a variety of applications.

While traditional buildings are capable of providing long-term usage, to manufacture, construct and operate them requires substantial energy. According to the U.S. Green Building Council, commercial, industrial and residential buildings account for nearly 40 percent of the nation's CO₂ emissions, using more than both the industrial and transportation sectors.

Traditional buildings require large amounts of raw materials, which increases the environmental impact on its own. Each raw material must also go through its own processing to be ready for use in construction. Once they are constructed, traditional buildings continue impacting the environment with high energy requirements, constantly drawing on the fossil-fuel powered energy grid for lighting, heating, cooling and many other utilities necessary for operation.

As the global community continues working towards implementing green technology to improve sustainability, industries across the world are beginning to shift towards sustainable buildings. Fabric structures are one option for companies looking to lower operating costs, while reducing their impact on the environment, without sacrificing functionality.

"There are countless industries that have benefitted from the installation of fabric structures," said Geoffrey Ching, Director of Sales for ClearSpan. "Among them are manufacturing, logistics, athletics, bulk storage, agriculture, recycling and waste management."

Fabric structures see widespread usage across so many industries mainly because of their versatility and lower operating expenses. However, their environmental benefits are becoming more important in an increasingly climate-conscious world.

Quality fabric structures offer several money-saving benefits that allow them to stand out among other building options, and additionally, these cost-effective features contribute to sustainability. In many instances, where customers are saving money, they are also reducing their effect on the environment. Some fabric structures have lower lighting, heating and cooling requirements than traditional buildings. Certain manufacturers also use more sustainable practices to reduce waste and carbon emissions.



Fabric structures require fewer raw materials and consume less energy during usage than traditional buildings. *Photo: ClearSpan*

Speaking of ClearSpan's manufacturing process, Ching said, "High-tech fabric welding equipment eliminates scrap, generating virtually no waste through manufacturing. Since all the raw fabrics are shipped to ClearSpan, then sent to customer sites directly from Northeast Iowa, transportation emissions are minimized."

In this case, building materials are not transported across the country, instead shipping from a centrally-located manufacturing facility in Iowa. Customers who work with a centrally-located manufacturer have the benefit of reducing carbon emissions, while also potentially saving money on freight and other transportation costs.

Aside from saving on transportation expenses, customers can also experience monthly savings from reduced energy usage for lighting.

"White fabric covers can reduce lighting costs by 50-75 percent over conventional construction, as a result of the incredible light transmission that brightens the interior naturally," Ching said. "The amount of natural light that penetrates the white cover is impressive."

Certain fabric structures take advantage of natural sunlight to create a comfortable, well-lit environment without using any electricity. This is achieved by using fabric covers that are translucent enough to let in an abundant amount of sunlight, preventing shadows and eliminating the need for expensive supplemental lighting.

These energy-efficient fabric covers simultaneously lower the structure's lighting expenses and dependency on the electrical grid. Because electricity consumption contributes the greatest amount to traditional buildings' carbon footprints, fabric structures that utilize these covers offer a level of sustainability that traditional buildings cannot. Customers wanting to maintain a functional interior without having to rely on fossil-fuel powered electricity for daytime lighting should work with a manufacturer who offers translucent fabric covers. Furthermore, some fabric structures don't require any lighting.

"Many of our industrial bulk storage buildings have no lights installed at all, further reducing construction costs by eliminating the need to run electrical," Ching said.

Customers who choose a manufacturer that offers fabric structures with no need for electrical work during construction will not only experience lower construction costs, but construction timelines will also be faster. After saving on the initial investment, owners of fabric structures without any lighting installed continue to experience monthly savings, while producing zero light pollution. Lighting isn't the only area where owners of fabric structures are able to save money and reduce their carbon footprint.

Traditional buildings require large heating and cooling systems to keep the interior climate comfortable, which consumes large amounts of energy. Customers looking to simultaneously reduce utility costs and environmental impact should opt for a structure with a polyethylene fabric cover. Polyethylene is used in climate-sensitive covers, which help regulate interior temperatures. In the summer, quality climate-sensitive covers can lower interior temperatures by up to twenty degrees. During the wintertime, these covers have the reverse effect, retaining heat and keeping interior temperatures up to twenty degrees higher. Climate-sensitive covers can save money and lessen the negative effects of heating and cooling systems.

Some fabric structure manufacturers also offer buildings that have natural ventilation, which lowers humidity levels and inhibits the growth of mold and bacteria without costly ventilation equipment. Not needing to use active ventilation helps to further decrease monthly operating expenses. By working with a manufacturer who offers designs that feature natural ventilation, customers can create a clean and healthy environment for inhabitants, while also saving money, all without using any energy or putting further strain on the environment.

Fabric structures can implement a long list of sustainable options, and with their wide range of suitable applications, they are finding usage across dozens of industries. Investors in these innovative structures applaud them for their superb functionality and reduced energy require-



ClearSpan's woven, rip-stop fabric covers allow natural light to filter inside during the daytime, reducing the need for expensive artificial lighting. Photo: ClearSpan

ments. Fabric structures can feature all of the above environmental benefits, and with drastically reduced construction and utility costs, they are the ideal structure for companies looking to go green without the expensive retrofitting of existing structures.

"Fabric structures have become the sustainable choice, because of their superior interior environment and energy cost reduction over time. We hear constantly that customers are impressed with the massive steel frame and the overall strength," Ching said. "Further positive impressions are noted by the high cathedral feel of the interior peak and the brightness offered by natural light transmission."

Keep an eye out for these buildings cropping up across the country as industries move to take green initiatives more seriously.

NICHOLAS ST. PIERRE is a Junior Copywriter for ClearSpan, which specializes in innovative building solutions. For more information, visit www.clearspan.com or call 1.866.643.1010 to speak with a ClearSpan specialist.

HY-TECH ENGINEERED SOLUTIONS ADDS ATP MAGNUM FORCE™ AIR IMPACT TOOLS

HY-TECH ENGINEERED SOLUTIONS adds magnum force line to atp air impact tools, for greater power, torque and durability in the 3/4" - 1-1/2" tool drive classes.

Hy-tech engineered solutions is pleased to announce the introduction of atp magnum force™ industrial air impact tools, featuring the high-

est torque outputs and power-to-weight ratios available today in the 3/4", 1", and 1-1/2" drive class of tools.

This completely new series of super duty industrial impact tools is designed specifically to deliver higher productivity in the most demanding environments, including refinery turnarounds, power generation outages, structural steel erection, mining and other similar bolting applications.

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twin hammer mechanism, mean atp magnum force™ tools will stay on the job, eliminating costly downtime. The atp magnum force™ tools are ce approved for global sales.

The atp magnum force™ series features:

- 16 standard models featuring twin hammer mechanisms
- Available square and spline drive anvils
- Both pistol grip and inline straight tools
- Available inside and outside trigger configurations

This new line further strengthens the hy-tech / atp product line, offering the world's broadest offering of industrial impact tools as well as over 20,000 replacement parts for many recognized leading oem brands.

Hy-tech's other current brands include flex-tech ozat, numatx, quality gear and thaxton. Hy-tech also provides engineered solutions and reverse engineering services to many original equipment manufacturers.



For additional information contact hy-tech engineered solutions at 800-245-1148, or visit us at www.hy-techinc.com.

MICROBES FOR HIRE: SNAPSHOTS OF BIONETIX® NATURAL WASTEWATER SOLUTIONS AROUND THE GLOBE

BIONETIX® INTERNATIONAL helps solve wastewater imbalances and odor problems around the world by supplying specially targeted microorganisms and nutrients to degrade waste with greater efficiency. Bionetix® International's full line of natural wastewater treatments ranges from solutions for starting new operations, to meeting wastewater discharge limits, to making biogas plants more productive.

Wastewater Startup Solutions

Starting a new wastewater operation requires “seeding” it with a healthy microbial population that can handle a heavy influx of contaminants. These beneficial microorganisms play a critical role in biodegradation by breaking down waste and essentially using it as food. If the waste outbalances the microbial population, treatment plant operators will have trouble keeping up with the overload. A shock dose of microorganisms and nutrients such as those in BCP50™ gives an important boost to the system, so it can handle the first sudden influx of waste.

For the last several years, Bionetix® International has been supplying BCP50™ to a local college in Quebec to seed the “pilot plant” students use to study wastewater treatment. The college successfully

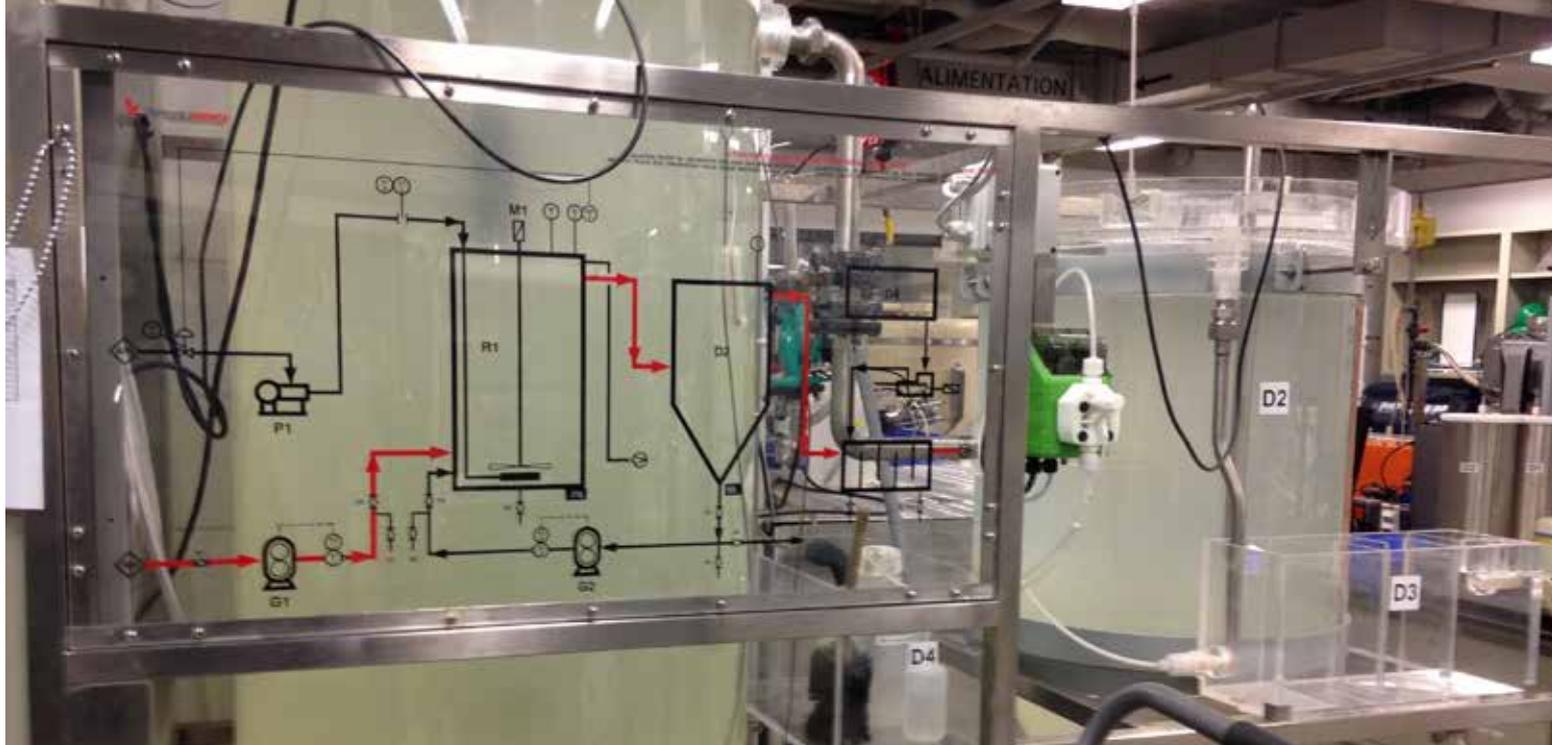


Bionetix® International's full line of natural wastewater treatments ranges from solutions for starting new operations, to meeting wastewater discharge limits, to making biogas plants more productive. *Photo: Bionetix International*

uses BCP50™ to create a new batch of sludge (or MLSS) every year to run the miniature aerobic tank for educational purposes. BCP50™ was recommended because of its use in municipal wastewater plants. It is an excellent choice for “seeding” new operations.

Meeting Wastewater Discharge Limits

Wastewater contaminant levels are often measured by BOD (biological oxygen demand) and COD (chemical oxygen demand). Industrial or municipal wastewater operations must meet certain BOD and COD limits before discharging effluent. Bioaugmentation is an excellent strategy for reducing contaminants in order to meet discharge limits



Starting a new wastewater operation requires “seeding” it with a healthy microbial population that can handle a heavy influx of contaminants. *Photo: Bionetix International*

and avoid extra fees. For greater effectiveness, Bionetix® doses specialized microbial and nutrient blends according to waste type. For example:

- BCP22™ targets high grease content
- BCP55™ targets high starch content
- BCP655™ targets high levels of ammonia, nitrate, and nitrite (together with organic waste)
- BCP57™ targets high cellulose content
- BCP80™ targets manure waste

In Spain, the wastewater lagoon effluent at a pig farm was marked by high levels of ammonium. A laboratory test conducted on effluent samples found that bioaugmentation with A55L™ successfully reduced ammonium levels, while BCP50™ reduced COD levels. In Mexico, a trial was done at an automotive factory using BCP50™ to maintain an 81% reduction in COD levels in the test tank. BCP50™ outperformed the global automaker’s standards and was approved for use in factories around the world.

Increasing Biogas, Reducing Odor

Bioaugmentation also has many side benefits related to waste treatment. In 2018, Bionetix® was able to help two biogas plants in Japan deal with inefficiency and bad odor problems. The plants dosed BCP12™ and STIMULUS™ at both locations, in addition to BCP80™ at the manure biogas plant and BCP57™ at the plant with high herbage content. The odor problem was resolved, methane production increased from 40% to the industrial norm of 60%, and power production rose from 100 kW/generator to reach full 300 kW/generator capacity.

These are just a few examples of what Bionetix® has accomplished with biological treatments that release powerful natural mechanisms. By tailoring the right microorganisms to the job, Bionetix® is able to maximize the efficiency of wastewater treatment systems and keep

operations in healthy balance for a variety of applications around the globe.

Learn more about Bionetix® biological solutions for municipal wastewater treatment here:

<http://www.bionetix-international.com/products/municipalwaste.html>



A miniature aerobic tank students in Quebec use to study wastewater treatment. *Photo: Bionetix International*

UNDERSLAB ANSWERS

TRUTH AND INSIGHT ON SPECIFYING UNDERSLAB INSULATIONS WITH STRUCTURAL IMPLICATIONS

By Sean O'Keefe

Dale Mullikin is used to answering questions. He gets a lot of them. He is a Sr. Product Representative for ACH Foam Technologies and for the last 20 years he has been answering questions of every sort from designers, engineers, contractors, field crews, owners, and inspectors about molded polystyrene foam products.

“Molded polystyrene foam is a very versatile material that solves a lot of common construction challenges, but it’s also a little misunderstood,” says Mullikin.

He works with designers and contractors across the Midwest to understand issues, answer questions, and provide proof of performance through technical data, and examples of past applications. From roofing and building envelope insulations to lightweight structural and precast panel fills – because molded polystyrene foam is often a surprisingly simple solution to very complex challenges – Mullikin must often overcome an initial sense of disbelief in client conversations.

“Molded polystyrene foam’s compressive strength is frankly incredible,” says Mullikin.

Foam-Control PLUS+ rigid foam insulation is manufactured in block form across a wide range of compressive strengths that begin at 15 pounds per square inch (psi) all the way up to 60 psi. “Even with the heaviest equipment structural loading is never really an issue, but occasionally proving it can be.”

Just such a question arose on a recent project for a protein-focused food company interested in building a large cold storage facility at a Midwestern distribution center. When Mullikin approached the potential customer about using Foam-Control PLUS+ insulation beneath the building’s cold storage slabs he got a little more than expected back from the owner’s engineer.

The engineer's reply by email, read in part:

I was forwarded some of your technical brochures regarding the properties of your Foam-Control PLUS+ insulation. I wanted to verify if you had technical information regarding the insulation foundation modulus (equivalent modulus of subgrade reaction) for your product. We are expecting very high point loads on the slab for this project, so I’d like to have that information available for verification, and for future reference.



Foam-Control Plus+ 400 molded polystyrene provides a dense, lightweight structural solution beneath a concrete slab intended to support large refrigeration units at a commercial processing plant.



Easy to maneuver and custom cut on-site, molded polystyrene foam provides thermal insulation and stability for a wide range of structural-fill applications in any climate or soil condition.

“This was a first for me,” says Mullikin with amusement. “The term modulus of subgrade reaction was not something I was familiar with.”

Fortunately, Mullikin had a reliable resource at the ready in Todd Bergstrom, Ph.D., of AFM Corporation. Bergstrom has a Doctorate in material science and engineering from Northwestern University and spent the last 22 years researching, developing, and testing molded polystyrene materials against variables of every sort. From proving R-values to conducting water absorption testing, and quantifying structural performance, Bergstrom has spent his career on the front lines of molded polystyrene material science.

“Modulus of subgrade reaction refers to the relative stiffness of the layers of support beneath a concrete slab,” says Bergstrom. Quantified, the modulus of subgrade reaction assists engineers in selecting the appropriate molded polystyrene foam to support the pressure of the loaded slab. “In this case, the engineering proved that Foam-Control PLUS+ molded polystyrene insulation would support the same loads as a subgrade composed using XPS.”

Foam-Control PLUS+ rigid foam insulation is available in four standardized compressive strengths ranging from 150, nominally rated at 15 pounds per square inch (psi) all the way up to 600 at 60 psi. The highest strength materials can be integrated into situations where structural requirements mean accommodating vehicles as heavy as fire trucks. As Bergstrom points out, some of the reason for the confusion surrounding rigid cellular polystyrene materials is that rigid cellular polystyrene can be used as both an insulation and a structural fill, known as geofoam. Though the materials are identical, within ASTM International standards there are two separate designations, ASTM C578 for insulation and ASTM D6817 for geofoam.

Rigid cellular polystyrene was first used in commercial construction more than 50 years ago as insulation throughout the building envelope. It was first tested by the ASTM and published in their standards under ASTM C578 “Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.” Rigid cellular polystyrene products include both extruded polystyrene and molded polystyrene materials whose practical purposes in commercial construction have grown well beyond the original thermal insulation objectives to now prominently include structural support.

“All rigid cellular polystyrene fell under C578 until 2002 when ASTM D6817 was introduced specifically to account for structural applications using geofoam,” says Bergstrom. “Many architects still think of these products exclusively as insulations and problematically, the original structural capacities listed in the insulation standard for XPS materials are inadequate without adjustment factors. Structural loading should always be specified using the structural capacities in ASTM D6817.”

ASTM D6817 “Standard Specification for Rigid Cellular Polystyrene Geofoam” determines the structural capacity of rigid cellular polystyrene by compressing the material until it is deformed by only one percent. Conversely, the insulation specification, ASTM C578, compresses the same material until it is deformed by 10 percent.

“C578 is meant to compare two types of materials against one another,” said Bergstrom. “D6817, however, defines the loading capacity the material can support indefinitely when used structurally.”

While both Foam-Control Plus+ molded polystyrene and extruded polystyrene materials are capable of supporting the intended structural load at the Midwestern cold storage facility, Foam-Control PLUS+ is much more efficient to build with. XPS insulation is manufactured in flat, rigid sheets a few inches thick and must be stacked. Foam-Control Plus+ is molded in blocks as large as 8' x 4' x 36"-thick. Despite their size, blocks this large can easily be moved by hand, allowing builders to quickly and easily install large sections of structural fill using only manual labor. Using hot wire cutters, the blocks are easy to customize to fit around obstacles like pipes or columns.

“Twenty-plus years of working with clients on insulations and structural solutions and they never run out of questions,” says Mullikin with a chuckle. “ACH Foam Technologies wants to make sure owners, engineers, architects, and contractors understand the incredible capacity, resiliency, and versatility of molded polystyrene foam and we’ll do it one project at a time.”

SEAN O'KEEFE writes design and construction industry stories based on 20 years of experience and a keen interest in the people who make projects happen. He can be reached at sean@sokpr.com.

U.S. BRIDGE CONSTRUCTION STARTS

SOURCE: DODGE DATA & ANALYTICS

Annual Bridge Starts			Monthly Bridge Starts	
	Bil \$	% Chg		Mil \$, unadjusted
2000	10.179		2018:01	1,503
2001	10.579	4%	2018:02	1,336
2002	10.962	4%	2018:03	1,871
2003	11.262	3%	2018:04	2,328
2004	9.981	-11%	2018:05	1,171
2005	11.386	14%	2018:06	1,720
2006	13.227	16%	2018:07	2,115
2007	14.632	11%	2018:08	2,025
2008	13.842	-5%	2018:09	1,125
2009	15.510	12%	2018:10	3,178
2010	15.697	1%	2018:11	1,119
2011	14.295	-9%	2018:12	1,073
2012	13.776	-4%	2019:01	1,519
2013	22.107	60%	2019:02	1,108
2014	15.643	-29%	2019:03	1,120
2015	18.238	17%	2019:04	1,827
2016	15.671	-14%		
2017	19.431	24%		
2018	20.563	6%	4 mos 2018	7,037
			4 mos 2019	5,574
			% Change	-21%



* In 2018, bridge construction starts had a very strong year with more than \$20.5 billion in projects breaking ground. This level was second only to 2013 when the Tappan Zee Bridge replacement broke ground.

* In 2019, starts were down 21% in the first four months of the year, suggesting that this year may not be quite as robust as last year. Still, five projects valued at over \$100 million broke ground in the first four months of the year. (See next page for list)

* What's a construction start? A general contractor has been hired for the projects, and the Dodge reporter has been told that the project is about to break ground (excavation for foundations has begun -- for buildings).

The full hard construction cost of the project is entered in the month the project breaks ground.

Project Title	Address	City	State	Started	Mil \$
Throgs Neck Bridge (Suspended Deck Span Replacement)	Bay Terrace	Bronx	NY	2019:04	253.0
MA/DOT: Chelsea Bridge Improvement	Route 1 over Various Streets	Chelsea	MA	2019:01	169.4
Bridge Deck Reconstruction & Misc Structural Improvements	Various locations	Newark	NJ	2019:04	138.8
TX/DOT IH 35 Widening improvement	12TH ST-N LP 340, N LP 340-	Waco	TX	2019:03	136.5
FL/DOT: Sr 429/Wekiva Parkway (Section 8)	Orange Boulevard		FL	2019:04	126.5
FL/DOT: First Coast Expressway Road Improvements (CO 001)	SR 23 (First Coast Expressway)		FL	2019:01	91.8
PA/DOT: SR 1 Roosevelt Expressway Rehabilitation	US 1 Roosevelt Blvd	Philadelphia	PA	2019:01	88.5
Southern Beltway Section 55C2-1	I-79 Interchange		PA	2019:03	87.2
WA/DOT I-5 Portland Avenue to Port of Tacoma Rd	Not Available		WA	2019:02	79.9
CA/DOT: HMA, Bridge & Drainage Improvements	South Of Oso Parkway	Mission Viejo	CA	2019:04	77.9
OH/DOT: Pavement and Drainage Improvement (Proj No: 173000)	IR 490/SR 010 (02.09/19.28)	Cleveland	OH	2019:04	75.4
AR/DOT I-30 Road Widening	Hwy. 70 - Sevier St	Benton	AR	2019:02	74.9
CA/DOT: Route 5/273 Bridge Replacements	South Of Churn Creek Road	Anderson	CA	2019:02	67.0
Durfee Avenue Grade Separation	Between West Blvd & Olympic	Pico Rivera	CA	2019:04	52.8
George Washington Bridge Center Avenue & Lemoine Avenue Bridge	George Washington Bridge	FL Lee	NJ	2019:01	51.5
KS/DOT I-235 Bridge Replacement (CO 259)	west Seneca St. over I-235	Wichita	KS	2019:03	51.3
OK/DOT: I-235 Grading & Drainage Improvements(CO 530)	Nw 50Th Interchange,	Oklahoma City	OK	2019:04	50.5

These are the largest projects that broke ground during the first four months of 2019 (all projects with a hard construction cost of \$50 million or more). The dollar value is the full hard construction cost of the project, which Dodge enters in the month the project breaks ground.

Pathway to Resilience

By Lionel Lemay, PE, SE, LEED AP. Executive Vice President, Structures and Sustainability, National Ready Mixed Concrete Association

James Bogdan, LEED AP, QEP. Senior Director, Sustainability Initiatives, National Ready Mixed Concrete Association

Tien Peng, Assoc AIA, LEED AP+, PMP. Vice President, Sustainability, Codes and Standards, National Ready Mixed Concrete Association

Credit: 1 LU/HSW

Course Number: ZG102019CS

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A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION

Build with Strength, a coalition of the National Ready Mixed Concrete Association, educates the building and design communities and policymakers on the benefits of concrete, and encourages its use as the building material of choice. No other material can replicate concrete's advantages in terms of strength, durability, safety and ease of use.

Course Overview:

Over the past several decades, there has been a continuous increase in human and economic loss from disaster events. The rise in disasters and their consequences is related to a rise in people's vulnerability, induced by human development. However, examples of resiliency planning and more stringent building code requirements still lag. This article will offer a view on emerging risks and opportunities as human and economic losses from disasters increase, with the overarching goal of supporting and advancing resilience in future construction of buildings and critical infrastructure.

Learning Objectives:

- 1. Recognize the increased risks from natural hazards and how resilient construction can support long-term sustainability.**
- 2. Identify approaches to mitigate the effects of natural hazards.**
- 3. Underpin a community's economic vitality and safety through natural hazard mitigation.**
- 4. Demonstrate the importance of incorporating resilient standards in construction.**

Introduction

For millions of people in the U.S., the consequences of natural disasters have become increasingly real, personal and devastating. According to the National Oceanic and Atmospheric Administration (NOAA), 2017 was the costliest year on record for natural disasters in the U.S., with a price tag of at least \$306 billion.

Hurricane Harvey broke a rainfall record for a single tropical storm with more than 4 feet of rain in southeast Texas matching Hurricane Katrina as the costliest tropical cyclone on record. Puerto Rico is still mired in recovery after Hurricane Maria in 2017, and nearly 3,000 are estimated to have died in the storm and its aftermath.



The Aftermath of a Hurricane. Photo: DEBOVE SOPHIE, iStock



The aftermath of Hurricane Harvey in Houston in August 2017.
Photo: AMFPhotography, Shutterstock



Flooding in Houston. Photo: Roschetzky/stockPhoto



Tornado Damage. Photo: ghonephoto, iStock

Requests for federal disaster aid increased tenfold in 2017 compared to 2016, with 4.7 million people registering with the Federal Emergency Management Agency (FEMA). These once-rare events are becoming more common and costlier according to NOAA. Hurricane Harvey's record flooding in Houston was the city's third 500-year flood event in as many years. It's time to rethink the way we build to meet the challenge of the next natural disaster.

CASE STUDY: Resilience to Hurricanes

While The Brickell was being designed, Miami was recovering from the impacts of Hurricane Wilma. Many high-rise buildings suffered extensive damage and were out of commission for extended periods in this hurricane-prone area. The developer was willing to increase construction costs to realize long-term operability of the building. The 35-story, 586,000-square-foot office tower was designed to withstand the force of large projectiles, wind speeds approaching 300 miles per hour and storm surge.

Integrating resilience was paramount and involved a reinforced concrete structural system that uses post-tensioned one-way slabs and beams, elevating portions of the ground floor above the floodplain, impact-resistant glazing systems, and multiple back-up generators to maintain business and continuity for tenants. It cost an extra 6 to 8 percent to implement these resiliency strategies which was immediately recouped with more competitive insurance rates and lower operating expenses that amounted to \$1 million in electricity savings. Additionally, with global companies concerned with business continuity across many time zones, high-profile tenants leased space in The Brickell faster than other nearby Class A office space. The Brickell also was awarded LEED Gold certification.

According to Verisk Insurance Solutions, 4.5 million U.S. homes are at high or extreme risk of wildfire, with more than two million in California alone. According to Munich Re, a reinsurer, there have been \$23.1 billion in losses to wildfires in the U.S. over the past five years. 2017 was by far the worst year with \$17 billion losses and that number will likely continue to grow due to climate change which is creating warmer and drier conditions.



The Brickell, Miami, Florida.

As we continue to build near fire prone areas, damages caused by wildfires will continue to increase. According to the Bloomberg Businessweek article *Why Is California Rebuilding in Fire Country? Because You're Paying for It*, the 1964 Hanley Fire in Sonoma County destroyed 100 homes whereas the 2017 Tubbs Fire, which covered nearly the same area, destroyed more than 5,000 homes and killed 22 people. The Tubbs Fire was one of 131 across California in October of 2017. By the end of 2017, more than 1 million acres and 10,000 buildings had been destroyed.

What is most surprising is that instead of building back to higher standards after the devastating fires, California policymakers are issuing permits to rebuild without updating building codes and even exempting residents from zoning rules so they can build even larger homes. State officials are even mandating that insurance companies not raise insurance rates for people in fire-prone areas thus passing the cost onto homeowners elsewhere in California.



Hurricane Irma heads toward South Florida in September 2017. Photo: lavizzara, Shutterstock

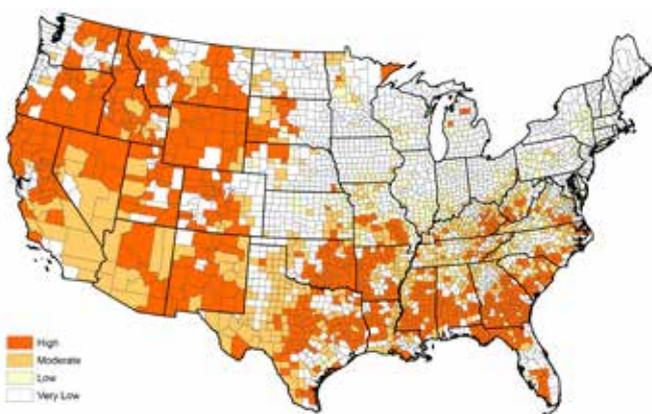


As development encroaches on fire prone areas, the cost of wildfires continues to grow. Photo: FrozenShutter, iStock



Aftermath of wildfire in California. Photo: Janos Rautonen, Shutterstock

The state paid nearly \$700 million in fire suppression in 2017 yet California Governor Jerry Brown suspended the fee homeowners in fire prone areas pay to offset the higher risk of wildfires. Although recent attention has been on California because of the major wildfires in 2017, there are wildfire risks in most states.



Counties with the greatest risk of wildfires characterized by the Counties characterized by higher-than-average annual area burned, structures lost, and homes exposed within the wildland urban interface.

Photo: www.forestandrangelands.gov

According to NFPA, there were 499,000 structure fires in 2017, causing 2,815 civilian deaths, 12,160 civilian injuries and \$23 billion in damages. NFPA estimates 262,500 fires occurred in homes resulting in 2290 deaths, 7,470 injuries and \$6.1 billion in damages, and 95,000 occurred in apartment buildings resulting in 340 deaths, 3,130 injuries and \$1.6 billion in damages. Property damages from fires have been increasing over time.

As a result of relaxed building codes, developers have increased the use of combustible wood-frame construction for multifamily construction (apartments, condominiums, hotels, dormitories and long-term care facilities) resulting in a rash of fires across the country that are reducing these buildings to ashes, putting lives and communities at risk. The recent spate of fires in low- and mid-rise structures throughout the country is raising questions and concerns about the safety of wood-frame buildings of this size.

Not only are these wood-frame building fires total losses, but they often cause considerable damage to surrounding buildings and property. Communities and surrounding businesses often don't survive. Not only must businesses and residents endure the



Property damage from structure fires is increasing over time according to NFPA. Photo: whiterabbit83, iStock.

disruption of construction of the original building, but then must endure further losses from business disruption and relocation while the new building is rebuilt after one of these devastating fire events.

Why are Disasters Costing More?

In the last several decades, population in the United States has increased and migrated toward the coasts, concentrating along the earthquake-wildfire-prone Pacific coast and the hurricane-prone Atlantic and Gulf coasts. Over 60% of the U.S. population lives within 50 miles of one of its coasts, including the Great Lakes. At the same time, wealth and the value of possessions have increased substantially.

For example, while California's Los Angeles County accounts for only 2.5% and Florida's Miami-Dade County accounts for only 14% of their respective states land area, they contain 30% of their state's property value. These changes in concentration of population and property values are significant contributors to the increased human and property loss.

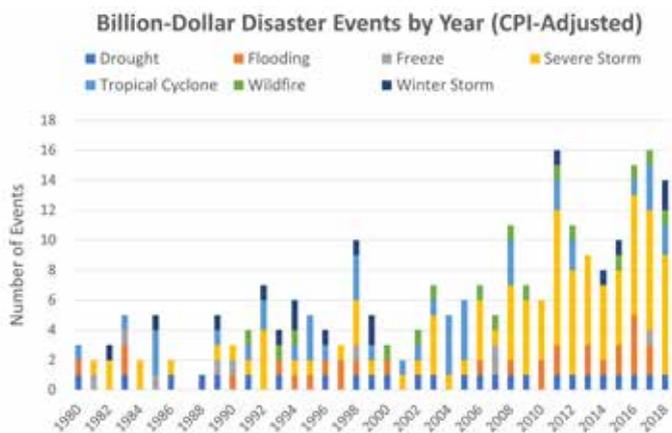


Massive structure fires in multifamily buildings built using wood-frame have become commonplace since the building codes have relaxed the requirements for passive fire protection. Photo: www.buildwithstrength.com/america-is-burning.

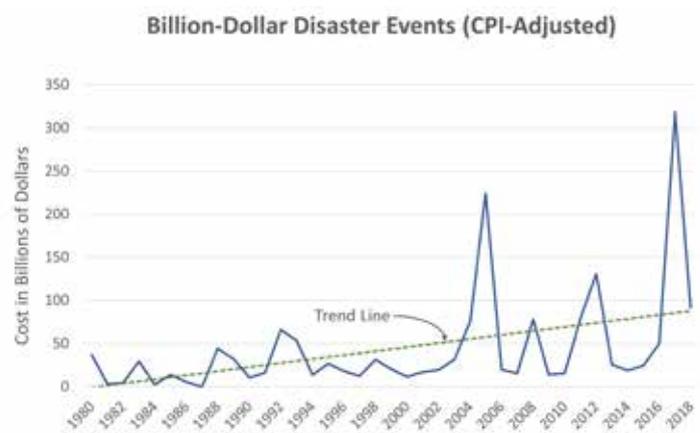
Disasters result not as much from the destructive agent itself but from the way in which communities are (or are not) prepared. Disasters happen when the natural systems are disrupted by human development. In fact, there is no such thing as a "natural" disaster in the sense that losses caused by a hazard event are greatly influenced by the degree to which society chooses to mitigate against the hazard. When a disaster occurs, lives, assets, products and crops are lost; livelihoods are cut off; economic growth is curtailed or sent into reverse. It is apparent that there needs to be significant shift in how we address natural disasters, moving away from the traditional focus on response and recovery toward emphasis on resiliency, that is, preventive actions to mitigate the effects of natural hazards.

What is Resilience?

There are several definitions of resilience. The Urban Land Institute (ULI) defines resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." Basically, addressing changes in the environment, whether the changes are natural or man-made, requires actions to mitigate their negative effects and adapt to those changes. **Read more here.**



Number of Billion-Dollar Disaster Events by Year. Adapted from NOAA.



Cost of Billion-Dollar Disaster Events by Year. Adapted from NOAA.

Concrete Innovations Quiz

BUILD WITH STRENGTH

A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION

1. 2017 was the costliest year on record for natural disasters in the U.S. with a total number of \$ billion dollar disasters of:

- a) 16
- b) 160
- c) 1600
- d) 5

2. Since 1980, According to NOAA, the number and cost of billion-dollar disasters in the U.S. each year is trending:

- a) Upward
- b) Downward
- c) Flat

3. What percentage of the U.S. population lives within 50 miles of one of its costs, including the Great Lakes, where natural hazards are the highest?

- a) 20%
- b) 40%
- c) 60%
- d) 80%

4. Which of the following is a program of the Insurance Institute for Business and Home Safety to enhance resilience of buildings?

- a) RELi
- b) LEED v4
- c) FORTIFIED
- d) USRC

5. Which resilience standard or rating system has been adopted by USGBC?

- a) RELi
- b) LEED v4
- c) FORTIFIED
- d) USRC

6. The following states have passed legislation requiring insurance companies to offer discounts to homeowners who build to the FORTIFIED standard:

- a) California, Oregon and Washington
- b) Alabama, Georgia, Mississippi and North Carolina
- c) New York and New Jersey
- d) Florida, Louisiana and Texas

7. The following cities have adopted Fire Districts to restrict combustible construction:

- a) Boston and Houston
- b) San Francisco and Oakland
- c) Denver and Salt Lake City
- d) Chicago and New York City

8. Which of the following hazards kills more Americans than all other natural hazards combined?

- a) Hurricanes
- b) Floods
- c) Fires
- d) Tornadoes

9. According to NIBS, the overall benefit-cost ratio for natural hazards such as floods, storm surge, wind, earthquake and wildfires is:

- a) 10:1
- b) 4:1
- c) 8:1
- d) 2:1

10. According to Verisk Insurance Solutions, how many U.S. homes are at high or extreme risk of wild-fire

- a) 500,000
- b) 1,000,000
- c) 4,500,000
- d) 10,000,000

11. Research into builder's risk insurance quotes found that a concrete building can be less costly to insure than a wood-frame building. For builder's risk insurance, the savings can be as great as:

- a) 2.3%
- b) 5.8%
- c) 88.8%
- d) 68.2%

Click Here to Take the Quiz!

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