

July 2015 Vol. 2 Issue 4

civil + structural ENGINEER

CELEBRATING THE DESIGNERS OF THE WORLD AROUND US

STRUCTURAL GYMNASTICS

Restoring a treasure jumpstarts
economic redevelopment

David Gockel: The listening leader
Engineering P3 projects
Green infrastructure performance
Missouri seeks 'Road to Tomorrow'
A greener National Mall



More Than Just a Pretty Picture

Image courtesy of Touchstone Architecture



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ON THE COVER

A view from the interior side of Boston's historic Ferdinand Building façade after removal of all interior structure, with temporary supports coordinated with the incoming permanent structure — story on page 36.

Photo: © Arup/Jimmy Su



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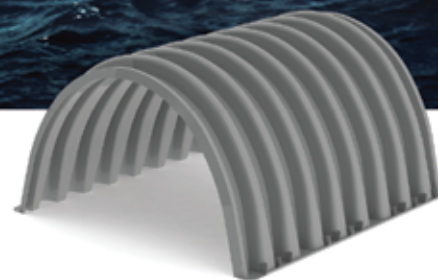


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LAND OF OPPORTUNITIES

HAPPY BIRTHDAY to the United States of America! With July 4, 2015, being the country's 239th birthday, it got me thinking about how lucky we are to live in this land of bounty and opportunity for all. In spite of our problems, there's still nowhere better to live.

Demand for civil and structural engineering provides good job opportunities — unless you are difficult to work with.

That said, we have a huge pent-up demand for infrastructure — both maintenance/repair and new construction — and the situation isn't going to get better any time soon. The local, state, and federal governments clearly cannot fund all the necessary expenditures. Thankfully, in some areas of the country, public-private partnerships and developer-led projects are filling in some of the gaps, but more needs to happen sooner.

The good news — if there is such a thing when talking about this problem — is that all of these needs create more demand for what civil and structural engineers in public and private organizations do. That looks like a pretty good indication of job security for the years to come.

But while we're talking about all the needs and opportunities that highly sought-out, skilled engineers have and should continue to have, let's look at some of the ways you could blow it:

- **Be difficult to work with** — Most everything we do is a team effort. The bigger and more complex the project, the more people have to be involved. Don't be one of those people everyone else hates to work with. Be nice, share the credit, don't treat people like they're stupid — or they won't want you on the job.
- **Let little things upset you too much** — Have you ever noticed that some people take umbrage at the slightest offense? They are overly sensitive to every comment, suggestion, or movement other people make. If you are one of these people, get over it. If you can't, they won't want you on the team.
- **Be unresponsive and less service oriented** — You have to be open to changing priorities and understand that other people are depending on your efforts. And you have to be responsive today. That means promptly returning calls and emails. I can tell you for a fact that I fire all professional service providers we deal with who can't respond in a timely fashion — I am not the only one who feels like this!

Yes indeed, it is a great time to be a civil or structural engineer. But you have to be someone other people want to work with. One way to ensure that happens is to keep learning and stay up with your profession! Enjoy this July 2015 issue of **CIVIL + STRUCTURAL ENGINEER** magazine. We're here to help make you more successful.

A handwritten signature in blue ink that reads "Mark C. Zweig".

MARK C. ZWEIG
mzweig@zweiggroup.com



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ARE YOU IN THE RIGHT PLACE?

RECENT CONSULTING ENGAGEMENTS with various architecture and engineering firms have left me with an appreciation for the contribution of so-called “Millennials.”

Your voice needs to be heard
to effect change.

I had the opportunity to meet with a group of these young professionals on a recent trip that was inspiring for me, in addition to allowing me to provide feedback to the firm’s leaders. The company, despite its problems, has done a great job creating a culture where people want to be. The frustration of this group of young professionals centered on the recent hiring of upper-level managers and the perception of an increasingly top-heavy organization. Their concerns were valid, and this strategic planning process was a vehicle to effect change in this area. For me, it was encouraging to see positive change result from input gained from employees lower on the organizational chart. It does not always turn out this way, thus reinforcing to me the importance of early career-building.

As young professionals, you do have a voice. Whether through a formal process, such as the one described above, or even through an informal open-door policy, you have the responsibility to communicate to firm leaders your concerns and aspirations. The early years of your career are especially important to position yourself for continual growth and improvement, and you have to make sure you are in the right place to build your career. It is the responsibility of firm leaders to listen to everyone and address concerns. If they do not do this, they will lose valuable people.

As the market becomes increasingly competitive for talent, everyone has more options than in recent years. It is important for everyone to communicate and to make sure they are in the right place. If you work in a firm that you believe in and see a good future with, you must communicate with firm leaders how you see your career path developing. If you are in a firm that is not listening, and you are not inspired, then maybe you should consider a change. Change is not always bad.

Regardless of where you are, you should always run your career like a business: Strategically plan your moves, have short-term and long-term goals, and constantly improve to make yourself relevant. Making your voice heard in the right place is Step 1 to effecting change.

CHAD CLINEHENS, P.E., is Zweig Group’s executive vice president. Contact him at cclinehens@zweiggroup.com.



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“Lead, follow or get out of the way.”

— THOMAS PAINE

“Men make history and not the other way around. In periods where there is no leadership, society stands still. Progress occurs when courageous, skillful leaders seize the opportunity to change things for the better.” — HARRY S TRUMAN

“Effective leadership is not about making speeches or being liked; leadership is defined by results, not attributes.” — PETER DRUCKER

“It is better to have a lion at the head of an army of sheep, than to have a sheep at the head of an army of lions.” — DANIEL DEFOE

LEADER LESSONS

WHEN THIS ISSUE hits the news stand, there will be about two more weeks before our incredible government again acts to keep our infrastructure construction crawling forward. It would be humorous if it wasn't so critically important to our nation to keep it from falling even farther behind the rest of the developed world.

I know I am sounding like a broken record (remember 78s and 45s) and my thoughts are not much consolation to those hoping for government to do something, but leadership is essential for all success.

For some helpful lessons on leadership for civil and structural engineers, direct your attention (and computer) to “Are You Easy to Follow? 10 Things Great Leaders Know and Do,” by Randy Conley, posted May 17, 2015 on SmartBrief (<http://leadingwithtrust.com/2015/05/17/are-you-easy-to-follow-10-great-things-great-leaders-know-and-do>).

If you haven't time to completely read Conley's “10 Things,” here's a summary list that will at least give you some help on your own roadway to leadership:

1. Be nice.
2. Give people your time.
3. Don't expect everyone to like you.
4. Solicit and incorporate people's ideas.
5. Be good at what you do.
6. Empower people.
7. Recognize and reward good performance.
8. Treat people with respect and create an environment of trust and safety.
9. Show a sense of humor; make work fun.
10. Maintain perspective on the most important priorities of life.

If these items don't make you a lion leading your team, well I tried!

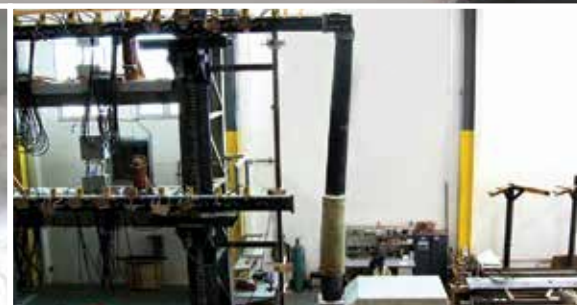
DAVID EVANS, P.E., PLS, FASCE, is the founder (1976) and a member of the board of David Evans Enterprises, Inc., the holding company for David Evans and Associates (www.deainc.com), and the author of “Achieving Zero,” a book on the life of the firm. He can be contacted at david.evans@zweiggroup.com.

Ten lessons for leading your firm to success.



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STRUCTURE MEETS ARCHITECTURE

MR. CRICKJ WILMATH wrote a very interesting piece about remarkable Structural Engineer Dr. August E. Komendant (“Structure meets architecture,” April 2015, page 60), but unfortunately committed a not unusual error in misspelling the name of the Kimbell Art Museum in Fort Worth, Texas, as “Kimball.”

I had the good fortune to know Dr. Komendant when I served as project manager for the firm of Preston M. Geren, Architects & Engineers, associate architect to Design Architect Louis I. Kahn on the museum, 1969-1972. Dr. Komendant mentioned me in his 1975 book: 18 Years with Architect Louis I. Kahn. The Geren firm produced all construction documents for and oversaw construction of the Kimbell Kahn building, which was supplemented by the addition of Renzo Piano’s separate handsome “Pavilion” in 2013.

Wilmath incorrectly attributes the finding of the Kimbell’s cycloid roof shape to the museum’s director, but it was actually found and proposed to Kahn by Kahn’s project architect, the late Marshall Meyers. However, Wilmath is totally correct in terming the cycloid shells of the Kimbell’s roof as beams. Komendant referred to them as being composed of two post-tensioned “curved beams” in his book.



August Komendant in the 1980s standing in front of Habitat 67. Photo courtesy of Merike Komendant

In the “small world” department, my long-time friend sculptress Ms. Miranda Leonard, originally of Fort Worth, conceived the design for a curvilinear house for herself overlooking San Francisco Bay. She developed a clay model of the shapes of the house, which was measured and converted to CAD drawings by her team of architects and engineers, one of which was Dr. Komendant’s son Juri Komendant, structural engineer in Berkeley, Calif.

Ms. Leonard sent me a video of the development and construction of the house in 2008. It is made of fiberglass reinforced plastic, fabricated in a plant by essentially the same techniques used to build fiberglass boat hulls. The sizes of the building’s curved elements were such that it was necessary to divide them into multiple components to suit restrictions of the California Department of Transportation for transporting them to the site, where they were meticulously assembled.

I have recently had the pleasure communicating with Juri Komendant, who is semi-retired as I am, but we both continue to do consulting work for long-time clients.

FRANK H. SHERWOOD, P.E. (RET.), FASCE
Aledo, Texas



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WEFTEC AND STORMWATER CONGRESS

CHICAGO HOSTS THE 88TH ANNUAL WATER QUALITY CONFERENCE.

By Bob Drake

THE WATER ENVIRONMENT Federation's 88th Annual Technical Exhibition and Conference — WEFTEC 2015 — returns to Chicago, Sept. 26-30, 2015. More than 20,000 attendees and 1,000 exhibiting companies support the organizer's claim of being "the largest conference of its kind in North America."

With 135 technical sessions, 29 workshops, and seven local facility tours, attendees can earn as many as 35 contact hours for continuing education units and nine professional development hours. Technical sessions and workshops address a diverse list of water and wastewater topics, including:

- Collection Systems — Management, operations and maintenance, infrastructure, overflow reduction, wet weather planning, watershed approaches, and regulations.
- Energy Conservation and Management — Resource recovery, combined heat and power, biogas optimization.
- Membrane Technologies — Application in wastewater and water reuse, innovations, enhanced performance, regulatory compliance.
- Plant Operations and Treatment — Innovations, technologies, processes, proven solutions in water and wastewater treatment, including nutrient removal and odor control.
- Regulations — CMOM/SSO rules, TMDL/watershed rules, nutrient trading, NPDES Phase II.
- Research — Leading-edge process applications in water and wastewater treatment.
- Residuals and Biosolids — Incineration, disposal, reuse through land application, research, regulations, politics, public perception.
- Stormwater — Treatment, green infrastructure, wet weather management, modeling.
- Utility Management — Asset management and financial planning for infrastructure, technology, regulatory compliance, security, including environmental management systems.
- Water Reuse/Recycling — Research, regulations, emerging technologies, proven processes.
- Water Quality and Watershed Management — Stormwater, wet weather, watershed issues.

The local facility tours offered during WEFTEC 2015 include:

- Metropolitan Water Reclamation District of Greater Chicago's Tunnel and Reservoir Project McCook Reservoir Stage 1
- Metropolitan Water Reclamation District of Greater Chicago's Stickney Water Reclamation Plant
- DuPage County's Woodridge-Greene Valley Wastewater Plant
- City of Chicago's Jardine Water Purification Plant
- Thorn Creek Basin Sanitary District

- John G. Shedd Aquarium's Environmental Quality Lab and Life Support Systems
- Stormwater Management Tour: Calumet Stormwater Collaborative Projects

Additional \$40 admission fees apply for each tour and participation is limited by the size of each facility.

Other WEFTEC conference highlights include the Water Leaders session; a Mix with Members reception; the annual community outreach project; special sessions for the oil and gas industry; a session featuring the new video-based educational format (Interactive Knowledge Exchange — IKE); poster sessions; the design competition; and the 28th annual Operations Challenge competition.

Stormwater Congress

Once again co-located with WEFTEC, the Stormwater Congress (included in the WEFTEC full-conference or one-day conference registration) will feature focused programming and provide access to all conference exhibitors, including those in the 5,000-square-foot Stormwater Pavilion. The Stormwater Pavilion — 25 percent larger than in 2014 — is a dedicated area on the exhibit floor that showcases stormwater treatment products and services, including a theater for programming.

More than 30 stormwater technical sessions and workshops include topics related to regulations and policies, flood impacts and mitigation, benefits of green infrastructure, stormwater and transportation systems, operations and maintenance, research in stormwater, stormwater financing and funding strategies, and more.

One stormwater-focused workshop is offered on Saturday, Sept. 26 and three workshops on Sunday, Sept. 27:

- Tools to quantify environmental benefits of trees for stormwater/green infrastructure projects (Saturday)
- Pollution load and volume-based urban stormwater modeling for meeting regulations
- Quantifying restoration for Clean Water Act compliance: Common ground for water quality trading and stormwater management
- WEF/WERF benefits of integrated modeling: Collection system, plant, and watershed and beyond

For more information about WEFTEC 2015 and the Stormwater Congress, visit www.weftec.com.

2015 HOT FIRM AND A/E INDUSTRY AWARDS CONFERENCE

FIRM LEADERS SHARE SUCCESS STORIES AND CELEBRATE ACCOMPLISHMENTS.

By Bob Drake

THE 2015 ZWEIF GROUP Hot Firm and A/E Industry Awards Conference, Sept. 3-4 in Boston, is a comprehensive business conference for leaders and aspiring leaders of AEC firms in the United States. The conference agenda includes topics on technology, leadership challenges, business planning, marketing methods, recruiting and retention, and growth strategies.

In addition to a variety of speakers from a range of industries, Zweig Group award winners will share the stories behind their success. A panel of Hot Firm/Best Firm winning CEOs will discuss “Five things we do that make us successful.”

Other scheduled speakers and topics include the following:

- Greg Bentley, CEO, Bentley Systems, Incorporated — Topic to be announced
- Langdon Morris, CEO, Innovation Labs — Agile innovation and the workplace
- Chris Doerschlag, CEO, WD Partners — How we made a small company into a large diversified one with less than 50 percent of revenue coming from traditional design services
- John Zweig, chairman, WPP — Topic to be announced
- Ozzie Nelson, chairman and CEO, NELSON Worldwide Inc. — Topic to be announced

- Scott Chappel, managing director, BDCA Adviser, LLC — Non-traditional sources of capital for A/E firms
- Tony Mirchandani, CEO, RTM — The challenges of integrating multiple cultures into one
- July Jewell, president, AEC Business Solutions — Holding employees accountable to increase profitability
- Randy Wilburn, director of Executive Search, Zweig Group — The real secrets recruiters use to find and hire the best people

An awards luncheon on the second day of the conference will celebrate the Zweig Group 2015 Marketing Excellence Award winners, and the conference will culminate with a black-tie awards banquet to present awards to and celebrate firms on the 2015 Hot Firm List, the 2015 Best Firms To Work For ranking, and the Jerry Allen Courage in Leadership Award winner.

CONFERENCE ATTENDEES CAN EARN AS MANY AS 15 CONTINUING EDUCATION CREDITS.

For more information about the 2015 Hot Firm and A/E Industry Awards Conference, visit www.hotfirm.com.

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JULY 15-17, 2015, WASHINGTON, D.C.

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www.artbap3.org

ESRI AEC SUMMIT

JULY 18-21, 2015, SAN DIEGO

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www.esri.com/events/aecsummit

ESRI USER CONFERENCE

JULY 20-24, 2015, SAN DIEGO

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www.esri.com/events/user-conference

AUGUST

STORMCON

AUG. 2-6, 2015, AUSTIN, TEXAS

The North American Surface Water Quality Conference and Expo offers certification courses and exams, workshops, technical sessions, technology exhibits, and networking events, plus an offsite tour to a local stormwater management project.

www.stormcon.com

FEDERAL PROJECT DELIVERY SYMPOSIUM

AUG. 18-20, 2015, WASHINGTON, D.C.

The Design-Build Institute of America and Society for American Military Engineers jointly hosted event will explore best practices and lessons learned, with perspectives provided from the federal agency/owner, designers, builders, and other members of the project delivery teams.

www.designbuildfederal.com

BUILD BUSINESS

AUG. 19-21, 2015, LOS ANGELES

The Society for Marketing Professional Services' annual conference brings together AEC marketers, business developers, principals, and firm owners for keynote presentations, educational tracks, client panels, and breakout sessions.

www.smpsbuildbusiness.org

APWA CONGRESS

AUG. 30-SEPT. 2, 2015, PHOENIX

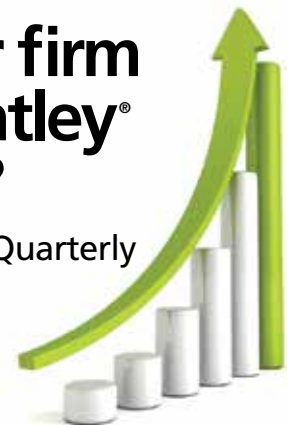
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SEPTEMBER

WHEN DISASTER STRIKES INSTITUTE

SEPT. 1-2, 2015, BILOXI, MISS.

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SEPT. 1-3, 2015, WASHINGTON, D.C.

Presented jointly by the National Center for Transit Research, Urban and Regional Information Systems Association, and the Transportation Research Board, this 9th national conference showcases how agencies of all sizes and budgets are managing GIS data and improving transit service.

www.urisa.org/education-events/gis-in-transit-conference

NATIONAL BROWNFIELDS TRAINING CONFERENCE

SEPT. 2-4, 2015, CHICAGO

An EPA event to promote public-private partnerships to stimulate community revitalization and sustainable brownfields redevelopment.

www.brownfieldsconference.org

HOT FIRM AND A/E INDUSTRY AWARDS CONFERENCE

SEPT. 3-4, 2015, BOSTON

Conference agenda includes topics on technology, leadership challenges, business planning, marketing methods, recruiting and retention, and growth strategies. An awards luncheon celebrates the Zweig Group 2015 Marketing Excellence Award winners, and in a black-tie awards banquet and ceremony, awards will be presented to firms on the 2015 Hot Firm List, the 2015 Best Firms To Work For ranking, and the Jerry Allen Courage in Leadership Award winner.

<https://zweiggroup.com/conference>

30TH ANNUAL WATEREUSE SYMPOSIUM

SEPT. 13-16, 2015, SEATTLE

Learn about the latest innovations in water reuse and find solutions to critical water supply issues.

www.watereuse.org/symposium

IHEEP 2015

SEPT. 13-17, 2015, PITTSBURGH

The International Highway Engineering Exchange Program (IHEEP) brings together transportation engineers, officials, leaders, and industry representatives from various countries, states, counties, cities, and consulting firms, from North America and Europe. This year's focus areas are 3D modeling, design/construction integration, and digital project delivery.

www.iheep2015.com

DAM SAFETY 2015

SEPT. 13-17, 2015, NEW ORLEANS

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www.damsafety.org

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SEPT. 15-17, 2015, LINCOLN, NEB.

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www.conservationfund.org/resources/courses-and-events/1036-epa-usda-national-workshop-on-water-quality-markets

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SEPT. 26-30, 2015, CHICAGO

The 2015 Stormwater Congress is a specialized educational opportunity included in the WEFTEC 2015 program. More than 30 stormwater technical sessions and workshops include Regulations and policies; Flood impacts and mitigation; Benefits of green infrastructure; Stormwater and transportation systems; Operations and maintenance; Research in stormwater; Stormwater financing and funding strategies, and more.

www.weftec.org/stormwatercongress

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www.weftec.org

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SEPT. 27-29, 2015, LONG BEACH, CALIF.

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www.iccsafe.org/conference

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www.cpe.vt.edu/sdwnds/index.html

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PROJECT PROFITABILITY: MENTORING PROJECT MANAGERS

By Howard Birnberg, Association for Project Managers.

ONE OF THE most effective devices to train and develop aspiring project managers — or any staff for that matter — is through a mentoring program. This device will likely achieve the fastest development of key staff and will enhance the performance of all who participate. However, depending on how extensively the program is developed, there can be sizable costs for staff time, administration, training fees, lost billable time, and many other items. Mentoring programs exist in many forms; however, they can be broadly classified into two major groupings: formal (with a four-step development process) and informal.

DIVERSIONS: NOISES IN THE NIGHT

By Jack Rueckheim

Jack Rueckheim fills in for Andy Sciarabba, P.E., this month with a story from his 30-year career with the Southern Cayuga Lake Intermunicipal Water Commission (known locally as the Bolton Point water system).

IT WAS A dark and stormy night. Okay, a cold and snowy night. Suddenly, a shot — I mean a phone — rang out. It was mine. I work for Bolton Point. I carry a license. A water system operator license, that is. All of these things happen at 2 a.m. in the middle of February when it's 10 degrees F, or so it seems. An elderly guy was letting me know that he had no water — at 2 a.m.



Find these web-exclusive articles with the July 2015 issue of **CIVIL + STRUCTURAL ENGINEER** at www.cenews.com.

AWARDS, PROMOTIONS, AND NEW HIRES

Ed Gannon, Ph.D., P.E., LEED AP, was appointed vice president and regional manager in Urban Engineers' State College, Pa., office. He is responsible for business development in all markets and services, overseeing and assuring the quality of the office's work product, and serving as a project manager and QA/QC supervisor for the firm's Vertical Markets Division.



Ed Gannon, Ph.D., P.E., LEED AP

Mark R. Hoague, P.E., joined Stanley Consultants as a project principal in the company's Federal Business Unit. Based in the company's Muscatine, Iowa, headquarters, he will focus on business development, client relations, and project oversight for U.S. Army Corps of Engineers Civil Works programs nationwide. The firm also appointed **Pete Stauch, P.E., S.E.**, as the company's director of technical development and training, and chair of the Technical Committee.



Mark R. Hoague, P.E.



Pete Stauch, P.E., S.E.

Dewberry announced the following promotions: **Anthony Fulco, P.E.**, to associate vice president in the firm's Bloomfield, N.J., office; **Craig Swengle, P.E.**, to business unit manager of Dewberry's Tulsa, Okla., engineering group; **Michael Rectanus, P.E.**, to associate in the firm's Baltimore office; **Mark Work, P.E., PMP**, to a senior associate in Dewberry's New York City, office; **Anand Seshadri, Ph.D., P.E.**, to senior associate in the firm's New Haven, Conn., office; and **Bryan Garbasz, P.E.**, to associate in the firm's Bloomfield, N.J., office. Dewberry also hired **Katherine Dewkett, P.E.**, as a senior transportation

project manager in the firm's New York City office. She has more than 30 years of experience as a civil and transportation engineer.



Anthony Fulco, P.E.



Craig Swengle, P.E.



Michael Rectanus, P.E.



Mark Work, P.E., PMP



Anand Seshadri,
Ph.D., P.E.



Bryan Garbasz, P.E.



Katherine Dewkett, P.E.

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Christina Grossenbacher, PMP, ENV SP, was named principal in Stantec's transportation practice group and vice president for the Women's Transportation Seminar (WTS) San Francisco Bay Area chapter. **Arya Rohani, P.E.**, joined Stantec as senior principal in its Irvine, Calif., office. He will assist in advancing the firm's Southern California transportation practice while supporting Stantec's international intelligent transportations systems practice. **Scott Bolton** joined the firm as community development manager based in its Salt Lake City office where he will be responsible for business development, strategic planning, and project management for the company's community development team spanning several offices in the Southwest.

ALTA Environmental hired **Garth Engelhorn, CPSWQ**, as a project manager in the Water Resources Division. Engelhorn will fill the role of senior consultant, utilizing his expertise in stormwater and TMDL compliance monitoring, design and development of watershed assessments, methodologies, and source identification studies.

Michael Baker International appointed **Spencer Patterson, P.E.**, as vice president and Air Force market manager. He has more than 30 years of professional engineering and program management experience with U.S. Air Force facility and installation operations and will be responsible for growing the firm's Air Force business. **Matthew C. Lamont, RA, NCARB, LEED AP**, was promoted to national practice lead for the firm's architecture and building engineering practice. He previously directed operations for Michael Baker's architectural practice in Arizona. Ray Balentine recently joined Michael Baker International as office executive for its Jackson, Miss., office. He has more than 37 years of engineering and planning experience and previously served as director of intermodal planning for the Mississippi Department of Transportation.

Arup's Americas Region board, which oversees operations in the United States, Canada, and Brazil, elevated six individuals to the position of principal: **Peter Alspach, P.E., LEED AP BD&C**, leads the Sustainability, Mechanical, and Plumbing teams in Arup's Seattle office and is the global skills leader for Environmental and Building Physics; **Will**

Baumgardner, P.E., leads the San Francisco Planning Practice; **Matt Carter, MEng, P.E., CEng**, leads the firm's Long Span Bridge Business in the Americas region; **Joanne Iddon, CEng**, is the Americas Programme and Project Management skills leader; **Seth Wolfe, P.E., LEED AP**, is leader of Arup's New Jersey office; **Josh Yacknowitz, P.E., LEED AP**, leads the Science and Industry Business in the Americas region.

Steven Nichols joined Davis, Bowen & Friedel, Inc., in its Salisbury, Md., office. He has more than eight years of experience in water and wastewater design implementation, site design, site layout, grading, utility layout/design, and development of construction documents.

JQ announced the following promotions: **Mark LeMay, AIA, LEED AP**, leader of JQ's Facility Performance Group to principal; **John Mischkot, P.E., LEED AP**, Infrastructure Group, to associate; and **Thomas Pickering, P.E.**, leader of JQ's Civil Engineering Group to associate.

Terry Gibson, P.E., CPM, joined Hatch Mott MacDonald as its East Unit Practice leader for Highways & Bridges based in the firm's office in Fuquay-Varina, N.C. He will also lead HMM's strategy to provide asset management services for all modes in the transportation sector.

HNTB Corporation added three new professionals to its multidisciplinary infrastructure team in Philadelphia: **Catherine Farrell, P.E.**, assistant manager of the highways department for HNTB's Pennsylvania offices; **Erik Kelechava**, electrical engineer; and **Amanda Havens**, who joined the firm's architecture practice

John Kastner, P.E., group manager with R.A. Smith National, received the 2014 Young Engineer of the Year Award by the Milwaukee Metro Chapter of the Wisconsin Society of Professional Engineers. **Kristian Nygaard** joined R.A. Smith National as a civil engineer in the land development services division.



Christina Grossenbacher, PMP, ENV SP



Arya Rohani, P.E.



Scott Bolton



Spencer Patterson, P.E.



Matthew C. Lamont, RA, NCARB, LEED AP



Peter Alspach, P.E., LEED AP BD&C



Will Baumgardner, P.E.



Matt Carter, MEng, P.E., CEng



Joanne Iddon, CEng



Seth Wolfe, P.E., LEED AP



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Headquarters: Elmwood Park, N.J.

Size: 1,000 employees in 20 offices

Ownership: Private

Website: www.langan.com

Primary Service: Site/civil, geotechnical, environmental, earthquake/seismic, demolition, traffic/transportation, surveying/3D scanning/BIM, information management, landscape architecture/planning, environmental planning, and natural resources/permitting.

Gockel is hands-on during a project for Paterson Habitat for Humanity, an organization with which Langan is actively involved.

DAVID GOCKEL: THE LISTENING LEADER

LANGAN ENGINEERING & ENVIRONMENTAL SERVICES PRESIDENT AND CEO HAS A STEADFAST DEDICATION TO QUALITY AND CONTINUAL IMPROVEMENT.

By Maureen Foody

ONE THING COMES to mind when following the career trajectory of David T. Gockel, P.E., PP, LEED AP — the importance of dedication. Instilled with the values of his earliest mentors — his parents — and driven by a hearty interest in math and science and to seeing things get built, Gockel has risen through the ranks at Langan Engineering & Environmental Services to become president and CEO. In the process, his personal dedication has translated to the firm, which has experienced remarkable growth and expansion under his leadership.

Although Gockel leads a global consulting firm and holds a Masters of Science in Civil Engineering from the University of California at Berkeley, where he studied under a Regents Fellowship, the start of his college years had a more humble beginning. His career aspiration in

high school was to be a carpenter because he enjoyed building things. Instead, he gravitated toward a commercial construction-related career and attended Middlesex County College where he earned an associate's degree in civil engineering technology. He then enrolled in a more challenging program at the New Jersey Institute of Technology (NJIT) to pursue a bachelor's degree in civil engineering. NJIT exposed Gockel to a variety of engineering disciplines, with the focal point being a soil mechanics course in his junior year that sparked his interest in geotechnical engineering.

"It's a blend of science and art because the subsurface conditions are highly variable," Gockel said. "You need to have good judgment because, unlike concrete or steel, soil and rock is not manufactured at a plant. We have to work with what mother nature has given us."

Taking the advice of another early mentor, Professor Edward Monahan, Ph.D., Gockel continued his education by pursuing a master's degree in civil engineering at Berkeley. Soon after emerging with this degree in 1982, he received a job offer back on the East Coast to begin his career at Langan with the initial position of staff engineer.

"Back then, our company only had about 36 people total," he recalled. "You were able to get your hands on a lot of different projects and take on a high



David Charette, Langan principal (left) and Christopher Hager, Langan senior principal (right) with Gockel accepting a National Recognition Award at the 2011 ACEC Engineering Excellence Awards event.



In 2014, two of the five ACEC Young Professionals of the Year were Langan engineers: Claudia Correa (center left) and Christian Roche (center right). They were both honored by Gockel and former Langan Chairman George Kelley (far left) at the firm's Annual Managers Forum.



At an Environmental Protection Agency event, Gockel met with John Mara, New York Giants' president and CEO. Langan provided a variety of geotechnical, site/civil, and environmental services for MetLife Stadium.

degree of responsibility. My decision to join Langan was about the work environment the firm offered and the people who I would be reporting to."

Recalling two important mentors at Langan, Gockel highlighted the tutorship of Dennis Leary and the importance not only of being a great, demanding leader but also of learning how to teach yourself through problems. "It's an essential skill everyone should know," Gockel said.

Then there was also Bernie Langan himself, an incredibly positive influence who helped Langan grow into the company that Gockel would eventually lead. "I was extremely fortunate to have both Dennis and Bernie as mentors. They both had a dramatic impact on my professional growth."

Gockel has had a role in many of the large projects that Langan has handled over the years, from construction of Metlife Stadium in East Rutherford, N.J., and the Prudential Center in Newark, N.J., to the Colgate Palmolive Waterfront Redevelopment in Jersey City, which helped transform a large industrial site into a dynamic commercial and residential opportunity on the bank of the Hudson River. He also worked overseas in Spain and Italy on projects for the Department of Defense.

Gockel is especially proud of Langan's work with the Franklin D. Roosevelt Four Freedoms Park on Roosevelt Island in New York City. Designed by Louis Kahn, the park contains green space and a plaza on the southern tip of the island with wide views of Brooklyn and Manhattan. It is one of only two of Louis Khan's designs that was built in the United States and is a tribute to FDR's famous four freedoms speech.

"After working on the project for 20 years, then being able to attend the formal dedication ceremony that was attended by President Bill Clinton, Governor Andrew Cuomo, Mayor Michael Bloomberg, and was officiated by Tom Brokaw was a fantastic experience," he said. "It's an inspiring monument and transformative place that will continue to pay homage to FDR and Kahn."

Even though most of his work within Langan currently is not technical, Gockel takes on new challenges by helping define the company goals and future. "I was deeply impacted by the Senior Executive Institute (SEI) program through the American Council of Engineering Companies. It changed the way I approached thinking, through a combination of a lot of reading, exploration, and dialogue with other leaders, and not just engineers. It's important to keep up interaction with a lot of different thinkers to keep yourself challenged intellectually.

"Most of our work as engineers is tangible. You can point to it and see why it matters," Gockel said. "When I started out, I certainly didn't expect to become the CEO, but I always wanted a leadership role, as I often took on those during my time as a student. Bernie Langan helped teach me the right standards to hold fast in order to become a capable leader."

It's through this leadership that Langan has emerged in the last decade as an incredibly fast-growing firm. In 2003, the company achieved \$50 million in revenue. "Four years later, we were at \$100 million but were quickly hit, like everyone was, by the recession," Gockel said. "So my first three years as president and CEO were full of growth, but then you get the true test of facing a crisis like



In 2012, Langan supported the American Red Cross' Superstorm Sandy relief efforts.

that. I learned more during that recession by facing those challenges though. We were able to emerge through careful planning and some bold moves by investing in newer markets."

Langan has a focus on remaining successful but also remaining flexible so evolution can take place and lead to continuous new growth. "I'm fortunate to be surrounded by so many talented partners and people who help drive this growth while our quality standards remain exceptionally high," Gockel said. "We are trying to plant the right seeds so everything can grow in the right directions, but to me, being a good leader is creating success for the people around you; everything else will fall into place after that."

Gockel is always quick to credit the other people who make Langan a true success story. "When you have good teammates, you're always there to pick each other up," he said. "It's an innate drive that exists within you as an engineer, but then you help each other, feed off each other's drive to keep going."

Gockel encourages young engineers to not just look for a *firm* for which you want to work but know *who* you'll be working under.

"You need to make sure your supervisor is the right fit for you," he said. "It's easy nowadays to get focused on the company, but you also have to know who are you working for and if they're going to be the right connection to become a mentor for you. The three most important people in your life will be your parents, your spouse, and your boss. You don't get to pick your parents, you and your spouse choose one another, but your boss is the only one that you get a chance to pick, so do so wisely."

Gockel also emphasized the importance of remaining curious throughout your career and never being afraid to ask questions.

He encouraged engineers to be mindful of the value of their services and work. "Right now, a lot of work is cost driven, and I question whether or not that's the best thing for the profession. It's certainly



Gockel and New Jersey Lieutenant Governor and Secretary of State Kim Guadagno.

important, but it often leads to engineers selling themselves short, which isn't good for us or our clients," he said.

"We as engineers contribute to the quality of life of every person that we touch. If you look at our basic needs — water, sewer, transportation — all of these come from us. We're continuously giving to society by making sure that quality of life we often take for granted in our day-to-day lives continues forward," Gockel said.

As part of that giving, Gockel serves as a governor for the NAIOP Research Foundation (www.naiop.org/en/Research/About-the-Foundation.aspx), "a think tank dedicated to conducting research assessing the trends, economic viability, and needs of the built environment."

"The revitalization of the American city is a tremendous thing that I get to witness by visiting our offices and projects," Gockel said. "The state of American cities today is fantastic. They're great places to work and even better places to explore."

Gockel, often quite busy visiting Langan's offices as regularly as possible, also enjoys spending time with his wife, Lynn, and their two sons. "I couldn't do anything without her support, so when I do get down time I often spend it with family and try to be outside as much as possible," he said.

Gockel stands as a strong example of a leader focused on quality work and with an adamant eye for detail. He has been able to bide through dark and bright with equal footing and bring people together to create a community that generates success after success.

MAUREEN FOODY, is a freelance writer and editor who lives and works in Chicago. She can be reached at maureen.t.f@gmail.com.

P3s: ENGINEERING THE DELIVERY OF PUBLIC PROJECTS

INNOVATIVE AND EFFICIENT DESIGNS CAN DRIVE PROJECT SUCCESS.

By Lee A. Weintraub



“PUBLIC-PRIVATE PARTNERSHIPS” (P3s) is one of the hottest buzz terms in public construction in the United States these days. A relatively new concept in America, but old and well established in many other parts of the world, P3s are starting to transform the face of public construction throughout the country. But just what are P3s and, more importantly, how can they change the business plan of an engineering firm seeking to capitalize on the opportunities they present?

In their purest form, P3s are exactly what they sound like: partnerships between private industry and the public sector to deliver projects for public use, whereby public and private participants share in the cost, risk, and benefits of the projects. In a typical P3, the private sector designs, builds, and finances the project then operates and maintains it over a multi-decade period. Though the private sector usually bears most of the design and construction costs, it gets paid during the prolonged period of operations and maintenance, which is where it can earn a healthy return, as long as the project remains available for public use.

P3s are seen throughout the country in a multitude of forms, some of them neatly fitting the model and others being more abstract forms of partnerships, humorously referred to as “P3-ish.” Regardless of their structure, P3 projects involve a partnership of some form between public- and private-sector participants in which they share the risks and rewards.

Furthermore, unlike the traditional design-bid-build process, where price and qualifications are the primary drivers in the selection of the private-sector participant, P3 procurement is often driven by factors such as ingenuity in design and financial returns to both the private and public sectors. A common saying is: “If you have seen one P3, you have seen one P3,” meaning there is opportunity for the design team participant to entice public sector buy-in through innovative design, and the design team can also impact the financial returns of their private-

sector participants through efficient designs, lowering operations and maintenance costs to the operators of the facilities. In this way, the design participant becomes integral to the project’s success.

P3s have been a preferred public project delivery method in Europe, Canada, and Australia for decades. The delay in P3 popularity in the U.S. stems from ours being a wealthy country that has been able to afford public projects without requesting private-sector investment. But, there is nothing like a good recession to lead to great ideas. P3s have emerged in America as a result of a number of factors, including the Great Recession of 2008 and the loss of corresponding tax revenue, the loss of public education capital outlay funds for the public education system, the need for new or upgraded facilities with no available capital, a reduction in internal public resources to manage facilities, and the increased risk of real estate investments.

The P3 model is a go-to solution for these issues because it allows the private sector to help defray some of the costs and risks in the delivery of public projects, thereby helping the public sector develop the projects it needs before the capital reserves returned. Many states have passed formal P3 statutes, and P3 activity has built momentum steadily over the last several years. Now is the time for engineers to catch the wave and familiarize themselves with the opportunities P3s present.

Engineering opportunities

P3s offer a unique opportunity for engineering firms to take a lead role in the delivery of public projects. Competition in P3s drives innovation. In a design-bid-build model, contractors find weaknesses in the plans on which bids are based so they can drive their bid price down, knowing future change orders will make up for the low margins. That dynamic is irrelevant in P3s, where the private-sector concessionaire does the design, construction, and financing themselves. Hence, there are rarely change orders and, if there are, the private sector absorbs the cost.

In P3s, ingenuity becomes the driving factor. Because of the transfer of risk from the public sector to the private sector, the rules of competition change. For instance, an engineering firm that can find ways to run utility lines in easements, instead of under roads, to minimize future maintenance costs can increase the private sector's return on investment. Therefore, an engineering firm has a big role to play in finding ways to reduce the costs of construction, operations, and maintenance in a manner that could increase efficient operations for the public sector and financial returns for the private sector. To the extent the public sector may share in some of those returns, depending on the project's financial model, such a design would make the private team's proposal more attractive during the competitive bidding process.

In design-build projects, the contractor usually controls the process from the private sector's perspective and the engineer usually works for the contractor on a service-fee basis. In P3s, however, the engineer takes control. In a traditional project, a contractor saves costs by cutting corners on the materials and systems specified in the design. Though such value engineering may increase construction profits, it often also increases future maintenance costs. That is not much of a concern to a design-build contractor, who completes and leaves the project long before the owner begins operating and maintaining the project.

In a P3 project, where the private sector must also operate and maintain the project, the engineer becomes a valuable commodity, challenging him- or herself to design efficient and innovative systems that can reduce operations and maintenance costs, thereby increasing

the returns to the private-sector team that operates the facility once construction is complete.

Though engineers are sometimes compensated a standard design fee for their services, on large P3 projects, the engineer may choose instead to be compensated by a share of the private team's profit, often determined by a percentage of savings achieved through innovative design. In this way, an engineer can increase its financial rewards on P3 projects by agreeing to a compensation model tied to a share of profits realized through, among other things, maintenance cost savings achieved through innovative and efficient design, a very different concept than value engineering or design-build.

Another interesting dynamic is that the private concessionaire team, usually consisting of a developer and one or more contractors, financial investors, design professionals, and operations firms, is often led by the developer, as opposed to the contractor. On traditional projects, there is often an inherent tension between a contractor and an engineer. When the developer leads the team instead of the contractor and all participants have skin in the game as teammates of the overall concessionaire team, the tension between the construction and design components is reduced or eliminated. The project can then be collaboratively structured so that most of the profit would be realized during the operations and maintenance period. Though engineers can be compensated for their initial designs on a service-fee basis, they can become among the most important participants in the private concession team through their ability to increase profits by reducing maintenance expenses.



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Getting started

P3s offer the promise of healthy profits and the opportunity to participate in unique, portfolio-building designs around which your company's reputation can be built. Many engineers would tell you that, for those reasons, participation in a private-sector team is the ultimate goal for an engineer engaged in P3s. But, if you are not a well-established large engineering firm walking in the circles of the big developers and contractors who build P3s, how can you get started? The answer is by beginning your P3 adventure working first for the public sector.

For a public entity to have a successful P3 program as part of its capital improvement plan, it is important that it have initial success on its first few projects. Failures will discourage private-sector participants from investing in expensive bids to work on the entity's P3 projects. The best private P3 teams gravitate toward public entities with either a successful P3 track record or who appear to have systems in place to ensure predictability and efficiency in the procurement and administration of P3 projects. Engineers play an important role in helping the public entity achieve success in that regard.

Opportunities abound for engineers to work with public entities on P3 projects, beginning with master plan studies. Engineers, in collaboration with financial consultants, can be retained by the public entity to determine which projects on the public entity's capital improvement plan are most ideal for P3s and which instead should be procured through more traditional delivery methods.

Once those projects are identified, the engineer can be pivotal to preparation of procurement documents and evaluation of bids received in response.

Most P3 bidders not only provide a bid fully responsive to the solicitation document, but also include alternatives for the public sector to consider. These alternatives can change the nature of the project, the financial model, and the engineering parameters in ways that could maximize efficiency, create more novel public uses, and drastically affect financial returns to both the public and private sectors. Engineers evaluating responsive bids can also advise their public-sector clients on these proposed alternatives. P3 procurement is a fluid and often unpredictable process in which engineers can provide stability through their consultation services.

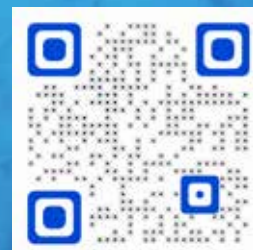
It is sometimes less competitive to get public engineering consultant work because most of the established engineers would be chasing the job as part of private teams and would therefore be conflicted from also pursuing it as a public-sector consultant. Public consultation is less risky than private-sector employment and, therefore, pays a correspondingly smaller profit, but it is a great way to cut your teeth and start building your reputation, which can later be parlayed into private-sector participation. Because of the lower competition and lower pay, it is sometimes easier to get started with public-sector employment.

If engineers new to P3s begin with public-sector consultation employment, their later marketability to the private sector increases



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accordingly. A public-sector consultation position helps the engineer learn the P3 process better and, more importantly, helps them understand how the public sector approaches the process. Engineers who fully understand what goes through the minds of public decision makers can translate that later to productive private-sector use as a future member of a private concession team.

Pedro “Pete” Hernandez, vice president and Metro-Dade executive for AECOM, said, “In a P3 world, engineers can bring innovation, new opportunities, and better performance at a lower cost. On the other side of the equation, the firm that wants to get started in P3s can work with the client, get experience in the technical and administrative side, and learn how the process works from the client perspective. That is critical and will help serve them well from the private-side perspective in the future.”

As Hernandez said, learn how the public-sector client views things and reacts to issues. It also does not hurt to develop political connections that can be leveraged in the future when you join a private concession team.


Another benefit of beginning your P3 experience by representing the public sector is that you will better understand its facilities needs

and be able to suggest ideas for new jobs not planned for imminent procurement. You can move those projects up on the capital improvement plan by identifying ways in which private innovation and funding can make the jobs more appropriate for procurement than the public entity may have believed.

As Michael Shehadeh, client and relationship manager at CH2M HILL, said, “The public sector should not be too restrictive in identifying projects. The best part of the P3 process is innovation. Bring in specialty designers to assist with the development of innovation and get a handle on the extent of risk.”

Simply put, P3s are the latest in the progression of public delivery methods: from design-bid-build, to design-build, and now to P3s. They are the wave of the future and will be as commonplace one day as design-build is now. Now is the time to familiarize yourself with the process the same way engineers did when design-build was novel. And get innovative. After all, that is what it is all about!

LEE A. WEINTRAUB, a shareholder at Becker & Poliakoff, is board certified in construction law by the Florida Bar and serves as vice chair of the firm’s Construction Law Practice Group. He can be reached at lweintraub@bplegal.com.



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EFFICIENT DESIGN DRAWINGS

IMPORTANT CHANGES IN THE NATIONAL CAD STANDARD VERSION 6 IMPROVE PROJECT DELIVERY.

By Ed Lowe

VERSION 6 of the United States National CAD Standard (NCS) has been released, and it contains important changes that will help reduce the costs of developing and maintaining individual office standards and of transferring building data from design applications to facility management applications. These changes are designed to help civil engineers, structural engineers, and other members of the building and construction industry improve project delivery.

NCS — which includes the Construction Specifications Institute's Uniform Drawing System, The American Institute of Architects' CAD Layer Guidelines, and the National Institute of Building Sciences' BIM Implementation and Plotting Guidelines — comprises interrelated standards, guidelines, and tools for uniformly organizing and presenting facility drawing information. It's the only comprehensive standard for facility planning, design, construction, and operation drawings. Simply stated, NCS offers greater efficiency in the design and construction process.

NCS only makes changes, when needed, through a consensus process. This process ensures that users and practitioners from all disciplines are represented and that any proposals made are properly vetted before being submitted to the Project Committee for a vote. The latest of these consensus ballots has been completed and several of the new and revised items are particularly relevant to civil and structural engineers.

A new BIM Implementation Guide is one example. The intent of this new section is to outline the use of the NCS in a building information modeling (BIM) workflow. It outlines the best way to incorporate

the 2D printed output of a CAD workflow with the 3D BIM output established by the National Building Information Modeling Standard-U.S. It goes module by module and explains the relationship between the NCS and what is considered the minimum BIM requirement.

We also saw major changes in the symbols library. Specifically, the Project Committee:

- replaced and updated all 1,300+ symbols in the NCS;
- properly categorized each symbol with an identifier to make them easier to find and store;
- converted the symbols, which were originally developed in millimeters, to inches and provided new insertion points, where needed; and
- updated the line type and pattern file definitions where appropriate and gave them better identifiers.

The committee approved 72 new symbols in a wide range of categories including Communications, Electronic Safety and Security, Fire Suppression, and General Division 1 symbols. The committee also created and approved new sections on how to create new symbols and how to use color in symbols, and provided a more complete explanation of approved fonts for use in the NCS. These new sections act as a template for understanding the use of the existing symbols library as well as a guide for future symbol creation and adoption into the NCS.

The CAD Layers Guidelines section saw many new major and minor groups added for civil disciplines:

- Airport items include airspace-related features, aprons, helipads, and decontamination zones.
- The committee also covered grading work, gray water systems, and plan and profile major group designations for civil-related work.
- New minor groups were also added to aid in clarifying details when line widths need to be identified in the layer names.
- We also added two new discipline designators this time — one for “Survey/Mapping Land” to use with ALTA surveys and one for “Survey/Mapping Boundary” for boundary survey clarification.

Most of the changes in the CAD Layers Guidelines section were civil engineering-related. We have seen an increased interest over the past years in the adoption and use of the NCS in those disciplines, as these updates demonstrated.

How to best adopt NCS in your workflow

Have you adopted the NCS yet to use in your workflow? If not and you’re not sure where to start, we recommend simply buying a copy and familiarizing yourself with the material. It’s now an online resource, so you can gain access and search specifically for what you need. A good place to start is “Appendix I – Implementation Guidelines.”

This appendix outlines the basics for adopting the NCS in phases, allowing you to customize how you rollout the NCS to your company. It gives tips on how to approach management, how long it takes to rollout different sections, and the benefits of using a nationally recognized CAD standard instead of one that is home grown. In easily digestible phases, it takes you through identifying a “first project” and building from there. Before you know it, all parts of the NCS will be adopted by your company.

What does the NCS have under the cover? Quite simply, the sections or modules cover all subjects pertinent to 2D drawing production and delivery:

- AIA CAD Layers Guidelines — outlines a layer/level naming process for CAD files.
- Drawing Setup Organization — establishes a hierarchy for sub-dividing the plan set into manageable sections via discipline designators.
- Sheet Organization — organizes individual sheets into a consistent, understandable structure.
- Schedules — establishes an effective way to communicate data via tables and schedules.
- Drafting Conventions — the mother lode of all things CAD, including line weights, scaling, hatching, dimensions, placement of details on sheets, title blocks, etc.
- Terms and Abbreviations — brings together the terms and abbreviations from a dozen-plus sources. It may not be the end all collection for these items, but rather establishes guidelines for use and brings together a searchable list of the more commonly used abbreviations.
- Notations — provides guidelines for creation and use of notes in drawings.
- Symbols — includes a full range of symbols covering all disciplines and establishes guidelines for creation of new symbols.
- Code Conventions — establishes guidelines for consistency in identifying regulatory information to be shown in construction drawings.
- BIM Implementation Guide (new section) — provides an explanation of the relationship between the 2D CAD workflow and the 3D BIM workflow.
- Plotting Guidelines — provides tables for both color-dependent and color-independent styles of plotting.

The NCS was established in 1999 and has become the most well-rounded CAD standard for today’s use. By continually updating this important standard, the National Institute of Building Sciences, Construction Specifications Institute, and other organizations help offer greater efficiency and cost savings in the building and design process.

ED LOWE, CAD coordinator for Burgess & Niple, Inc., is chair of the United States National CAD Standard Project Committee and a member of the National BIM Standard-United States Project Committee.

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GOING MOBILE

CAN RUGGED DEVICES BOOST ENGINEERS' PRODUCTIVITY?

By Theresa Cangialosi

FOR YEARS, THE U.S. labor industry has seen a steady decrease in productivity among workers, specifically those in construction. Paul Teicholz, Ph.D., civil and environmental engineering research Professor Emeritus at Stanford University, determined in a study that there has been an overall decrease in the U.S. construction industry's labor output, estimating a decline of about 0.32 percent each year from 1964 to 2012. Additionally, the study reported that from 2007 to 2012 there was a decrease in hours worked within the construction industry, estimating a drop of 11.4 billion hours, or a 26 percent decrease, from the previous years.

These data offer a basis for a much-needed conversation about the ways management and technology impact productivity in the construction and engineering industries.

Mobile solution to declining productivity

According to an AppsFreedom report (www.appsfreedom.com/mobile-workforce-increasing-productivity-manufacturing), 84 percent of all companies who view themselves as cutting-edge in mobility report an increase in overall productivity as a direct result of incorporating mobile apps into their business. Aberdeen Group published findings (www.aberdeen.com/research/10513/10513-RR-technician-future-service.aspx/content.aspx) stating that 82 percent of field service organizations acknowledged mobile capabilities as pertinent to their overall strategy. These mobile capabilities enable real-time intelligence that better aid workers with problem solving and decisions to ultimately benefit their customers.

Particularly for engineers — who face a wide range of job requirements, including surveying potential hazardous construction zones, inspecting offshore oil barges, and even managing projects from behind a desk — mobility can offer a way to seamlessly stay on top of demands, follow protocol, and log site information.

Furthermore, mobility offers the ability to connect workers with each other at a moment's notice and enables immediate communication in order to determine the best solutions to manage and fix problems instantaneously. For example, a civil engineer surveying and



Rugged smartphones maintain full functionality even in the most trying work conditions.
Photo: Cat Phones



Engineers, contractors, and construction workers demand high-quality technology that provides protection and efficiency to weather the elements on and off the job site.
Photo: Panasonic

monitoring the placement of pipelines along the sea floor needs to be in constant communication with the pipeline engineers and workers to follow strict guidelines and maintain a safe working environment.

In another scenario, contractors are required to manage and survey sites to accurately report back and determine next steps. It becomes imperative for workers to efficiently log and track daily tasks, whether it's from behind a desk or underneath a bridge calculating the appropriate data.

Mobile devices can track geological locations, snap photos of worksites, analyze material, and send essential files with a click of a button. These are just a few mobile capabilities that specifically assist contractors and engineers.

Go mobile, go rugged

The Bureau of Labor Statistics predicts civil engineering jobs will increase by 20 percent from 2012 to 2022, faster than the average for all professions. This prediction means more employees will be contracted to develop, structure, and rebuild infrastructure. As a result, we will need more tools and solutions to help them do their jobs better and faster.

Industry leaders are beginning to implement engineering-specific technology solutions that are built with rugged working environments in mind. Engineers, contractors, and construction workers demand high-quality technology that provides protection and efficiency to weather the elements on and off the job site. As a result of the job boom and demand for the proper technology for the job, the ruggedized mobile device market is projected to grow by a compound annual growth rate of 2 percent in just a few short years — from 1.5 million units to 1.6 million units shipped in 2018, according to a recent report from IDC Research.

Rugged smartphones, such as Cat Phones, and tablets, such as the Panasonic Toughpad, are designed for use in tough, outdoor environments. These devices can withstand drops and scratches, be exposed to high temperatures, are water resistant, and maintain high-quality performance in rough terrain on day-to-day tasks. They are built for a rugged, hands-on approach to work, yet maintain full functionality even in the most trying work conditions.

Businesses must prepare for growth within their companies while addressing challenges head on. As productivity in construction and engineering declines, more civil and structural engineering organizations are adopting guidelines that provide employees with mobile devices in order to maintain efficiency, boost communication with workers, and increase productivity in the workforce.

THERESA CANGIALOSI is the general manager and vice president of sales and marketing in North America at Bullitt Group, which designs, manufactures, markets, and sells mobile phones and consumer electronic products in partnership with global brands. Previously, Cangialosi was director of strategic accounts for Kyocera and prior to that spent two years at Huawei as director of sales and nine years at LG Electronics. For more information, visit www.catphones.com



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RESTRUCTURING BOSTON'S HISTORIC FERDINAND BUILDING

STRUCTURAL GYMNASTICS RESTORE HISTORIC TREASURE AND JUMPSTART ECONOMIC REDEVELOPMENT IN ROXBURY'S DUDLEY SQUARE NEIGHBORHOOD.

By Jimmy Su, P.E., LEED AP

ONCE HAILED AS BOSTON'S "other downtown," the Dudley Square neighborhood arose as the center of urban, commercial, and transit development in turn-of-the-century Roxbury, Mass. Surrounded by retail stores, hotels, movie theaters, and a bowling alley, New England's largest furniture store operated from the ornate Ferdinand Building, where intricate cornices, expansive copper-clad bay windows, and a terra-cotta skin were the welcome mat to a bustling urban economy.

Sadly, residents and businesses spread into suburban communities during the 1960s and '70s, and in 1987, the train station was removed. Boston chose to invest elsewhere, and the once majestic Ferdinand Building lost its luster, both physically and as a tie to the urban fabric. Then, along came the late Mayor Thomas M. Menino, whose vision, passion, and dedication to Boston spearheaded a major reinvestment in the neighborhood; and so began a powerful partnership with the Boston Redevelopment Authority to renovate the historic icon.

Newly dedicated as the Bruce C. Bolling Building, named for Boston City Council's first black president and long-time Roxbury champion, the former Ferdinand Building is now the permanent home of the Boston Public School Administration. An international design competition yielded a relationship with Dutch architect Mecanoo and local architect Sasaki, and the result is a bright, airy, and resonant reinvention of the hulking relic.

While the design is bright and airy, the engineering solutions required to achieve the vision are equally creative and unique. Structural gymnastics were necessary to ground the design, and integrated engineering techniques were developed to restore grandeur to the project.

Preserving the outer skin

The outward facing terra-cotta skin is part of what made the Ferdinand Building so recognizable, coupled with its unique triangular shape and prominent city-facing prow. In order to retain its historic status, the building envelope needed to be preserved. Working with several different parties, including the architects and the historic preservation consultant, Building Conservation Associates, and the contractor, Shawmut Design and Construction, we had to figure out a way to support the shell of the building when everything inside had been gutted and removed.



A view from the interior side of the Ferdinand façade after removal of all interior structure, with temporary supports installed by the contractor, coordinated with the incoming permanent structure. Photo: © Arup/Jimmy Su



Steel framing to resupport cantilevered bay windows at the Curtis and Waterman façade. Photo: © Arup/Jimmy Su

Very early in the process, Arup's structural engineers assessed the interior of the building to determine what could and could not be saved. Most concrete floors were so deteriorated that a hard footfall could stomp right through thinner remnants. Many of the steel beams and reinforcing in the arched and shallow vaulting system were severely corroded, and the floor levels didn't match up to the architect's ideal configuration and program demands. Although strategies to keep the existing steel in place were discussed, ultimately the architects felt keeping the steel beams and columns as they remained were too restrictive to move forward with their vision.

The decision was made to remove all of the interior elements in order to create new floor plates. Because of the unique shape of the Ferdinand building, the end result was a remaining, two-sided prow that rose five-stories and stood precariously on aged foundations. Because the terra

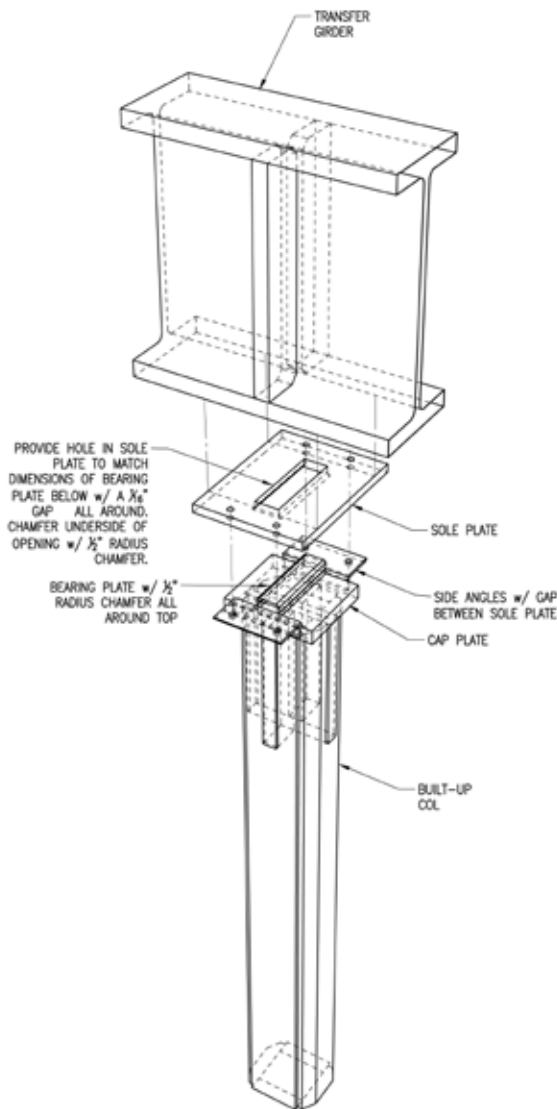


Figure 1: Pin condition bearing detail for heavy transfer girder at lobby onto slender custom column section.

cotta masonry was fragile, the contractor needed to devise a temporary support structure that could reach out and grab the existing façade from the backside and tie into the interwoven existing steel. As permanent foundations were poured and a new structure rose from behind the façades, accommodations were made so settlement wouldn't drag them down.

During the design phase, the city expanded the scope of the project by acquiring the adjoining Curtis and Waterman buildings, and it was similarly decided that only the façades of these two buildings would remain. This move initiated a more dynamic design process, where engineering solutions were adjusted to interweave the façades of these two buildings with the Ferdinand building, standing at the opposite end of the site.

In order to secure the existing skins, the engineering team developed a strategy for gripping the structure at discrete intervals using epoxy anchors with connections to supporting steel that allowed for differential

movement. Many adjustments were made in the field to accommodate the extremely complex existing conditions, such as cast iron columns coming down on large granite foundations, and a low mechanical basement — all at different elevations.

Significant thought went into determining how to best reuse the retained façades and what measures of reinforcement were necessary. Arup carefully choreographed the permanent support structures so as not to interfere with the exterior, and used extreme discretion to bolster the strength of what was already there.

Many of the ornate, copper-clad bay windows in the Curtis Waterman façade were cantilevered from heavy wood beams that reached back to create the former existing floor plates. When the floors were cut-back to renovate the interior, the windows were in danger of significant sagging. While Shawmut shored them up with scaffolding, Arup designed steel elements that could weave in and support the windows from behind, and used corner-points that mitigated intrusion to the aesthetic. A skilled copper worker ensured the windows achieved conservation standards, resulting in one facet of an award-winning preservation.

Achieving the architect's vision

Structural engineers are tasked with making architectural designs a reality. In the case of the Bolling Building, the grand vision went beyond achieving architectural success. In order to reach cultural victory, the building must invite the community into the resulting design. Instead of having an imposing municipal site, Mecanoo set out to create a building with dignity and weight that still allowed the community to come in and connect with its history. Retail establishments on the first floor encourage commerce, and the interior spaces are designed to run the public school administration. The design enforced open, column-free floor plates, striking views to Boston, and an air of encouragement, success, and achievement.

The lobby was a priority for the design team, and the intention of the open space was to bring the community together, provide transparency, and showcase the importance of culture and education. The creation of this open space presented the largest challenge on the project since it required a demanding, yet appealing, structural solution. Because the architectural design prescribed a more meticulous approach to column design, engineers slimmed down the columns that support the building and configured beam transfers to accommodate the force coming through these connections (see Figure 1). While transfers are fairly standard, engineers researched numerous applications to devise the best solution to accommodate both the slenderness of the column and the forces from above. Simultaneously, the sequencing and size of the column construction was taken into consideration in relation to the fragile façade located within the construction perimeter. With specially designed details and stringent planning, the caliber of execution mitigated risk of imprecision.

The floor plates were designed to step inward at select elevations, providing an opportunity to enjoy green roofs and terraces at different levels of the building, opening each floor to natural light and ventilation. As the building rose and rotated, many of the columns could not reach from the roof to the foundations. With no clear path to the ground,

engineers delicately balanced the design intent with the judicious use of transfers, carefully selecting the right opportunities for dramatic support of the building mass and structural interventions, and generating the open spaces in the design.

In the lobby, where the most powerful structural intervention needed to take place, engineers designed a span, akin to a highway bridge, to rise above the lobby roof and support five stories of the building above. Throughout the project, they allowed for more customized fabrications in order to deliver on the architect's vision, all while keeping a keen eye on the client's budget and the overall use of steel. The engineers achieved just over 11 pounds per square foot of steel, despite the numerous floor and expansive lobby transfers involved.

Integrated engineering

Throughout the project, Arup structural engineers collaborated with Arup MEP, fire, and life safety engineers to achieve the project outcome. Keeping the openness, sustainability, budget, schedule, and design in mind, all facets of systems integration were carefully coordinated to preserve the end result. This proved particularly useful when design changes occurred later in the process, and multiple penetrations needed to be carefully coordinated in the building's infrastructure to accommodate systems integration. Engineers from all disciplines were able to react quickly and devise solutions that caused little impact to the project schedule because of their close proximity to each other and general understanding of all facets of the project.

To illustrate the point, Arup's integrated engineering team developed stringers below the grand staircase in the lobby to accommodate sprinkler heads by building them into a two-sided (rather than enclosed) box that creates strong vertical fins while providing a serviceable sprinkler system. Additionally, a five-story masonry mural wall preserved from the original building was maintained as a centerpiece while a stair case intended for circulation and emergency egress was woven through it, interacting with a dramatic glass wall at the front of the lobby. Engineers designed penetrations and steel interchanges to accommodate these design elements while matching the stair landings with the existing geometry.

Dedication

In the true-sense spirit of the English language, the word dedication takes many forms, as does this historic renovation. The building, recently dedicated as the Bruce C. Bolling Municipal Building, is aptly named for a Roxbury figurehead, whose dedication to the city invokes a sense of pride, leadership, civic duty, and progress. Mayor Menino, the city's visionary, dedicated the last years of his life to creating a future for the city of Roxbury. And the design team, driven by a sense of honor and purpose, was dedicated to working together toward the common goal of revitalizing a historic and cultural icon, providing a transparent and fresh future for Boston education, and creating a place for area residents and local businesses to enjoy the culture of this rediscovered treasure.

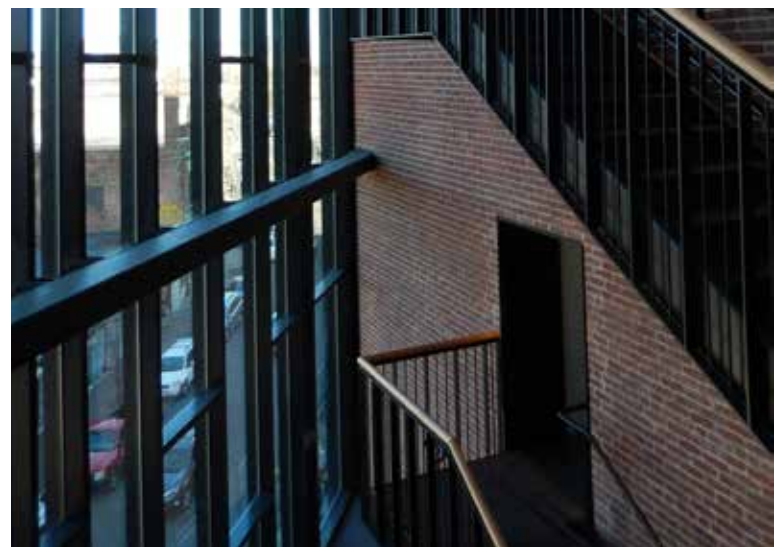
JIMMY SU, P.E., LEED AP, is an associate in Arup's Boston office. He can be reached at jimmy.su@arup.com.



Peek-a-boo sprinkler heads with pipelines integrated within a central double fin plate stair stringer. Photo: © Arup/Jimmy Su



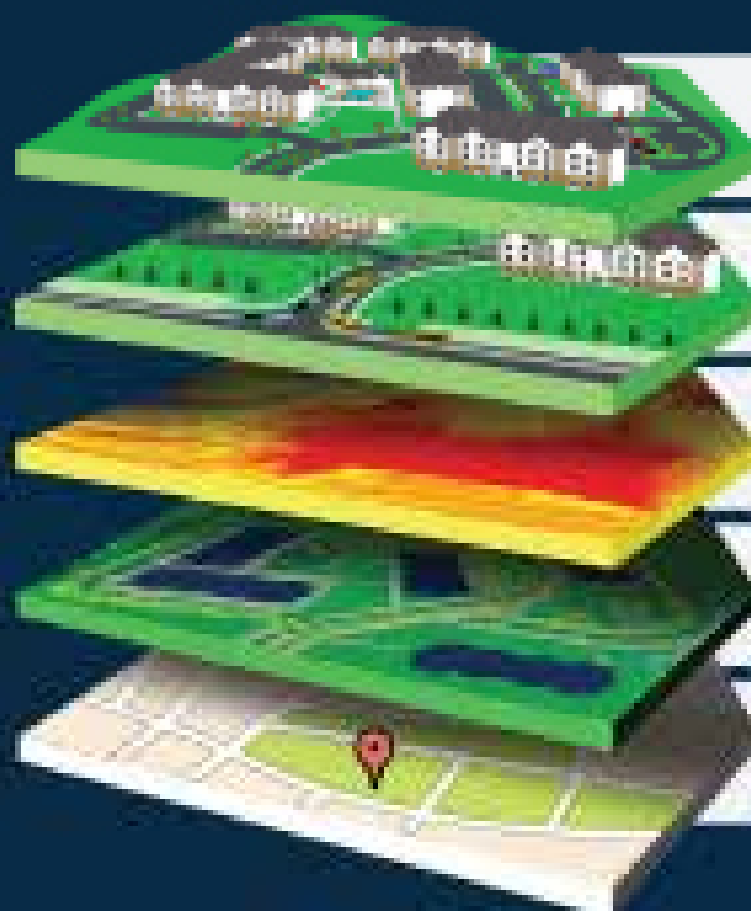
A third floor view from inside one of the building setbacks accommodating an exterior green roof. Photo: © Arup/Jimmy Su



Existing masonry wall extending from the Ferdinand façade, retained to support and interweave with a new circulating stair visible from the street through a multi-floor curtain wall. Photo: © Arup/Jimmy Su

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The Lundquist Tower's exterior skin is a combination of metal panel, precast concrete, plaster, and curtain wall. BIM 3D modeling aided in clash detection and coordination of the seismic bracing and exterior skin systems.

CONSTRUCTION WAS COMPLETED late last year on Torrance Memorial Medical Center's new \$480 million Melanie and Richard Lundquist Tower. Designed by HMC Architects, McCarthy Building Companies, Inc. served as general contractor of the hospital facility, which was delivered more than four-and-a-half months early and \$10 million under budget.

Located on an existing medical center site in Torrance, Calif., the Lundquist Tower replaced Torrance Memorial's original facility, built in 1971, which no longer met state seismic regulations for an acute care facility. The new tower utilizes a buckling restraint braced-frame structure, and meets California's strict seismic requirements for the structure and its contents.

The 390,000-square-foot patient tower features the latest medical technologies, 256 private patient rooms, and 18 surgical and interventional treatment rooms, including the South Bay's first hybrid operating room. The basement in the seven-level patient tower houses a central utility plant and a tunnel connection leading to the existing hospital facility.

"McCarthy Building Companies' commitment to partner with Torrance Memorial, focusing on the hospital's goals to deliver a well-built, compliant, functional, and beautiful health care facility to the community made it a pleasure to work with them on the Lundquist Tower Project," said Connie Senner, director of construction, Torrance Memorial Medical Center. "We had a premier team from McCarthy who were knowledgeable and communicative from start to finish. I take great pride in knowing that this facility is a legacy to the community and a stunning

one at that. It's been a pleasure to be involved with a building project that has been so highly complimented by the public, staff, volunteers, and physicians."

The replacement hospital serves as the new front door of the medical center and the centerpiece of the campus. A water feature greets patients at the tower's entrance and leads to a bright and expansive lobby. An indoor-outdoor cafeteria, gift shop, admittance services, and a spiritual room are easily accessible on the first floor.

In addition to providing state-of-the-art medical technology, the tower's patient-centered design addresses the comfort of visiting family members by incorporating family friendly lounges and overnight spaces. Expansive windows are located throughout the patient rooms, waiting rooms, and pre- and post-operation areas to take advantage of natural daylight and views, and outdoor gardens between the new and existing facility provide a serene and healing space for patients, visitors, and staff.

"The Lundquist Tower represents a state-of-the-art facility which supports an enriched patient-centered approach to the delivery of health care by staff and the enhanced continuum of care patients receive," said Chuck Eyberg, principal, HMC Architects. "The new tower's function is fully integrated with the existing facility on multiple levels through a network of strategically planned connectors, bridges, and corridors linking the new tower with the existing facility and the remainder of the campus."



A series of outdoor green spaces fills the void between the existing facility and the new Lundquist Tower, functioning as a healing garden and reducing the “heat island effect” from excessive use of hardscape.

The tower’s exterior skin is a combination of metal panel, precast concrete, plaster, and curtain wall. The variety of materials for the tower’s façade not only responds to the correct solar orientation to reduce energy consumption, but also gives the tower a contemporary and elegant aesthetic.

Sustainable features are equivalent to the standards required of a Leadership in Energy & Environmental Design (LEED) silver-certified structure. Some of the tower’s eco-sensitive design features include individual temperature controls to reduce energy, a white roof to minimize heat gain, low-level perimeter building lighting to reduce light pollution, recycled content, and environmentally friendly finishes, as well as the use of water-efficient landscaping and a healing garden to reduce the “heat island effect” from excessive use of hardscape. McCarthy implemented sustainable construction methods throughout the project, including recycling approximately 80 percent of construction waste, maintaining proper indoor air quality, and utilizing local labor.

“Built on an operational hospital campus in an urban site with limited access, construction was multi-phased to alleviate disruption to the operational facility,” said McCarthy Project Director Erik Chessmore. “McCarthy also created a detailed communication and logistics plan and closely coordinated with the hospital and subcontractors throughout the project.”

In order to provide the design team with constructability input efficiencies along with a progressive schedule and budgeting information, McCarthy used a combination of delivery systems to construct the new facility. Design-assist was incorporated to deliver the mechanical, electrical, and

plumbing (MEP) systems; structural steel; and framing. Design-build was used for the exterior skin, elevators, and fire protection system.

“The design-assist and design-build delivery methods aligned subcontractors and designers early in the design stage to identify project risks and develop solutions for issues that would normally surface in the field on a traditional design-bid-build project,” said Chessmore. “This early collaborative team approach combined with the use of virtual design and construction technology and common team goals resulted in building efficiencies contributing to the project’s overall success.”

Construction technology used on the Torrance Memorial project included BIM 3D project modeling, aiding in clash detection and coordination of the extensive overhead and in-wall MEP systems, as well as seismic bracing and exterior skin systems. The model was further leveraged to review upcoming work with the California Office of Statewide Health Planning and Development inspectors, to coordinate logistics with facility management, and to communicate the most cost-efficient methods of implementing design changes with the owner and designers.

McCarthy also developed a custom electronic plan room that hosted the BIM 3D model, contract documents, RFI responses, submittal information, in-wall coordination elevation, and closeout documents all hyperlinked to the building plans. This documentation was turned over to the hospital to assist with management of the building post construction.

Construction technology also aided in quality construction and ensured work was installed correctly the first time. For example, Trimble survey equipment loaded with coordinated design data was used to check work quickly, easily, and accurately as it was being installed, safeguarding compliance with construction tolerances and the coordinated model and eliminating rework due to human error.

“McCarthy’s self-performance of the structural concrete work further increased budget and schedule certainty by allowing for greater control through the first half of the project,” Chessmore said. “Aggressive schedule management, entailing daily schedule improvement reviews by our lead superintendent with project team support, was also a crucial strategy. This process ensured schedule advancement opportunities were constantly identified and captured, and ultimately the project was completed significantly ahead of schedule.”

Other project team members include Pfeiler & Associates, Chino Hills, Calif., civil engineer; KPFF Consulting Engineers, Irvine, Calif., structural engineer; and TMAD Taylor & Gaines of Anaheim, Calif., MEP engineer. Major subcontractors involved in the design-assist process include: Capparelli/KHS&S, Anaheim, Calif., drywall; Control Air, La Palma, Calif., HVAC; Morrow Meadows, City of Industry, Calif., electrical and low voltage; Murray Company, Rancho Dominguez, Calif., mechanical piping & plumbing; and Herrick, Stockton, Calif., structural steel.

Information provided by McCarthy Building Companies, Inc. (www.mccarthy.com) and HMC Architects (www.hmcarchitects.com).



In six months, the 70-meter-long section of bike path generated more than 3,000 kWh.

POWER PATH

BIKE ROADWAY PRODUCES MORE SOLAR ENERGY THAN EXPECTED DURING FIRST SIX MONTHS OF PILOT PHASE.

SOLAROAD, AN EXPERIMENTAL bicycle path in The Netherlands with embedded solar panels, opened in November 2014 and has generated more electricity than expected during its first six months of operation. It was developed by a consortium of research institutions, government, and industry: TNO (<https://www.tno.nl/en>); the Province of Noord-Holland (North Holland); Ooms Civil, a provider of infrastructure engineering and construction; and Imtech, a provider of electrical and mechanical solutions and automation.

Located in Krommenie, a town in the Dutch province of North Holland, Solaroad is a cycle path about 70 meters long constructed of concrete modules of 2.5 to 3.5 meters. In one lane, solar cells are fitted underneath a tempered glass top layer of approximately 1 cm thickness, covered by a transparent and skid-resistant coating. There are no solar cells embedded in the other lane; it is used for reference and to test various coatings. Solar electricity from the road is fed into the electric grid and can be used, for example, for street lighting, traffic systems, households, and (eventually) electric cars that drive over it, the developers said.

SOLAR ENERGY PROSPECTS

According to The Future of Solar Energy, a study released in May by The MIT Energy Initiative (MITEI), solar energy holds the best potential for meeting humanity's future long-term needs while cutting greenhouse gas emissions. However, realizing this potential will require increased emphasis on developing lower-cost technologies and more effective deployment policy.

"Our objective has been to assess solar energy's current and potential competitive position and to identify changes in U.S. government policies that could more efficiently and effectively support its massive deployment over the long term, which we view as necessary," said Robert Armstrong, director, MITEI.

The study's chair, Richard Schmalensee, Howard W. Johnson Professor of Economics and Management Emeritus at the MIT Sloan School of Management, added: "What the study shows is that our focus needs to shift toward new technologies and policies that have the potential to make solar a compelling economic option."

Among the study's major themes is the need to prepare electricity systems, both technically and from a regulatory standpoint, for very large-scale deployment of solar generation — which tends to vary unpredictably throughout the day. To this end, the study emphasizes the need for federal research and development support to advance low-cost, large-scale electricity storage technologies.

Information provided by MIT. Download a copy of The Future of Solar Energy study at <http://mitei.mit.edu/futureofsolar>.



SolaRoad consists of a cycle path constructed of concrete modules with solar cells fitted underneath a tempered glass top layer that is covered by a transparent and skid-resistant coating.

“We did not expect a yield as high as this so quickly,” said Sten de Wit, a SolaRoad spokesman. “The bike road opened half-a-year ago and already generated over 3,000 kWh. This can provide a single-person household with electricity for a year, or power an electric scooter to drive two and a half times around the world. If we translate this to an annual yield, we expect more than the 70 kWh per square meter per year, which we predicted as an upper limit in the laboratory stage. We can therefore conclude that it was a successful first half-year.”

SolaRoad is in a pilot phase for three years, during which various measurements and tests will be performed as input to further development.

One of the goals of the field test is to detect and cure “teething” issues at an early stage. At the end of December 2014 and in early spring 2015, a small section of coating on the SolaRoad cycle path delaminated. Research has shown that large temperature fluctuations can cause local delamination due to shrinkage in the coating. Repairs have been made and development of an improved top layer is now in an advanced stage.

Since its official opening, SolaRoad has attracted significant national and international interest — and more than 150,000 cyclists. Discussions about follow-up pilots are taking place with other provinces in The Netherlands. Additionally, the Province of Noord-Holland has signed a cooperation agreement with California that involves SolaRoad. Details of this agreement were not available at press time.

“We believe in the future of infrastructure as a means to generate energy,” said Arian de Bondt, director, Ooms Civiel on the SolaRoad website. “In the past, we have taken the initiative to extract heat/cold from road surfaces, now we are involved in the next step: electricity. It will be a matter of perseverance and patience in order to come to a marketable concept. The pilot is the first major step in that direction.”

Information provided by SolaRoad (www.solaroad.nl/en).

ELECTRICITY EXCELLENCE

USGBC OFFERS A NEW RATING SYSTEM FOR SUSTAINABLE POWER SYSTEMS.

IN APRIL, GREEN Business Certification Inc. (GBCI) launched Performance Excellence in Electricity Renewal (PEER), a rating system designed to measure and improve sustainable power system performance. Modeled after the U.S. Green Building Council’s (USGBC) LEED green building rating system, PEER evaluates power generation, transmission, and distribution systems through the lens of the customer, focusing on efficiency, quality, reliability, resiliency, and the environment.

GBCI will serve as an independent, third-party, global certification and credentialing body for PEER.

“Buildings don’t exist in a vacuum, so integration with other industries, such as energy and power, is crucial if we are to create a more sustainable built environment. PEER will be a transformative tool for power systems regulation, design, and operation,” said Rick Fedrizzi, CEO and founding chair, USGBC, and CEO of GBCI. “It is a great complement to

the array of rating systems already administered by GBCI, in particular LEED.”

According to its website: “PEER evaluates power generation, transmission, and distribution systems through the lens of the customer across desired outcomes that include efficiency, quality, reliability, resiliency, and the environment.”

The rating system and performance assessment program has three applications:

- stakeholder and professional education;
- power supply and microgrid performance design, rating, and certification; and
- development of better standards, tools, and guides to benchmark and continuously improve power grid design, construction, and operation.

“Through LEED, USGBC has created a common language, standard, and platform for advancing knowledge, technology, and innovation in green building. It now aims to do the same in the power sector with PEER,” said John Kelly, program lead of the PEER rating system, “and we anticipate similar transformative results.”

Information provided by the U.S. Green Building Council (www.usgbc.org). For more information about PEER, visit peer.usgbc.org.

GREEN INFRASTRUCTURE PERFORMANCE

CURBSIDE BIOSWALES IN NEW YORK CITY REDUCE STORMWATER RUNOFF BY MORE THAN 20 PERCENT.

THE NEW YORK City Department of Environmental Protection (DEP) released a detailed analysis of the performance of three neighborhood-scale green infrastructure projects in New York City, demonstrating that they absorbed more stormwater than anticipated and reduced runoff entering sewers by more than 20 percent. Located in the neighborhoods of Bushwick, East New York, and Edenwald, the three demonstration areas were chosen because the sewers drain to a single pipe where flow meters were installed to measure the amount of stormwater before and after construction of the green infrastructure.

Within these defined areas, DEP built 70 curbside gardens, or bioswales, that are specially designed to collect and absorb stormwater from the street and sidewalk and keep it out of the combined sewer system, where it can contribute to sewer overflows into local waterways. The work is part of the city's Green Infrastructure Plan, an alternative approach to improving harbor water quality that combines traditional infrastructure upgrades and the integration of more cost-effective green infrastructure, which captures and retains stormwater runoff naturally.

Across the three demonstration areas, the green infrastructure managed the first inch of stormwater that fell on more than 14 percent of the impervious area, which surpassed the goal of capturing the first inch that fell on 10 percent of the impervious area.

"New York City has aggressively built our Green Infrastructure program to help clean up our rivers, creeks, and coastal waters and the performance data demonstrates that these have been smart investments," said DEP Commissioner Emily Lloyd. "The findings in the report will guide us as we dramatically expand the program in the coming years and should serve to inform other cities across the country as they look for cost-effective ways to reduce pollution in local waterways."

Prior to installation of the bioswales, beginning in 2011, DEP installed depth- and flow-monitoring devices in the sewer pipes where they exit the demonstration areas and normal and peak flow levels were collected continuously for as long as 16 months to provide preconstruction (baseline) flow data.



On average, across all three demonstration areas during a typical rainstorm in New York City, the green infrastructure reduced the stormwater runoff entering the sewer system by at least 20 percent. Photo: New York City Department of Environmental Protection

Once the bioswales were built, the preconstruction findings were compared with the post-construction flow data. By taking into account the total rainfall for the area, estimates were made as to how much stormwater was being managed by the green infrastructure and never making it into the sewer system. On average, across all three demonstration areas during a typical rainstorm in New York City, the green infrastructure reduced the stormwater runoff entering the sewer system by at least 20 percent.

The report also found that inclusion of a stone gabion, which hydraulically connects the surface of the bioswale to the storage layer beneath the soil, helps to speed absorption of stormwater. The use of a stone gabion has now been added to the standard design for all bioswales in New York City.

In addition, information was also collected on the temperature in the vicinity of each bioswale, vegetation cover, and visits by pollinators and wildlife using sensors, infra-red, and time-lapse cameras, as well as human observation. This data is being compiled into a report on the



Bioswales resemble standard street tree pits, except that they vary in size, have curb cuts that allow stormwater to enter and overflow if it becomes saturated, and have been designed in a way that will allow them to manage between 1,100 and 2,200 gallons each during a storm. Photo: New York City Department of Environmental Protection

ancillary benefits of green infrastructure that will be made available soon.

Bioswales are built in city sidewalks and do not result in the loss of any parking spaces. They resemble standard street tree pits, except that they vary in size, have curb cuts that allow stormwater to enter and overflow if it becomes saturated, and have been designed in a way that will allow them to manage between 1,100 and 2,200 gallons each during a storm.

DEP has developed standard designs, specifications, and procedures for building green infrastructure in the streets and sidewalks of New York City. In partnership with the Departments of Transportation and Parks and Recreation, DEP conducts an extensive site-selection process that includes geotechnical investigations and surveys.

During construction, the bioswales are excavated to a depth of 5 feet and are then backfilled with layers of stone and engineered soil. These layers contain void spaces that store the stormwater and promote infiltration. The addition of hardy plants further encourages infiltration through root growth and increases the capacity of the bioswale through evapotranspiration.

The bioswales are designed so that all the stormwater is absorbed in less than 48 hours and dedicated maintenance crews ensure that they are functioning properly, including removing any trash that may have accumulated and pruning the trees and plants. The crews are active seven days a week and visit each bioswale approximately once a week; additional crews will continue to be added as the program expands.

To date, approximately 300 bioswales have been built throughout New York City with 1,300 currently under construction and thousands more planned for the next several years.

A 2012 modified consent order with the New York State Department of Environmental Conservation (DEC) included the ambitious goal of using green infrastructure to capture the first inch of rain that falls on 10 percent of the impervious surfaces within the city's combined sewer areas by 2030. The data collected from the three demonstration areas shows that the green infrastructure surpassed this goal and captured the first inch of rain that fell on more than 14 percent of the impervious surfaces.

In addition to the bioswales, DEP also built onsite green infrastructure at the New York City Housing Authority's Hope Gardens Houses in Bushwick and the Seth Low Houses in East New York. Designed to manage stormwater runoff from impervious surfaces within the developments, bioretention areas, permeable pavement, and subsurface detention systems collect stormwater that falls on the walkways and parking lots and keeps it out of the sewer system.

Since 2002, DEP has invested more than \$10 billion in upgrades to wastewater treatment plants and related efforts to reduce CSOs and the cleanliness and health of New York City harbor water continues to improve to levels not seen in more than a century. However, CSOs remain the city's major harbor water quality challenge. As further "grey" infrastructure upgrades became increasingly expensive, in 2010 the city launched the Green Infrastructure Plan, an alternative approach to improving water quality that combines traditional infrastructure upgrades and the integration of green infrastructure to capture and retain stormwater runoff before it ever enters the sewer system.

During the next 15 years, DEP is planning for \$2.4 billion in public and private funding for targeted green infrastructure installations, as well as \$2.9 billion in cost-effective grey infrastructure upgrades, to significantly reduce CSOs. The Edenwald and Bushwick projects were undertaken in connection with the settlement of an enforcement action taken by New York State for violations of New York State law and DEC regulations.

Information provided by the New York City Department of Environmental Protection (www.nyc.gov/dep).



Inclusion of a stone gabion, which hydraulically connects the surface of the bioswale to the storage layer beneath the soil, helps to speed absorption of stormwater. Photo: New York City Department of Environmental Protection

HUDSON RIVER DREDGING BEGINS FINAL SEASON

**GE EXPECTS TO COMPLETE REMOVAL OF PCB-CONTAMINATED
SEDIMENTS FROM A 40-MILE STRETCH OF THE RIVER.**

IN EARLY MAY, workers began the sixth, and final, season of dredging PCB-contaminated sediments from the bottom of the Hudson River. The historic dredging project — one of the largest and most complex cleanups in Superfund history — began in 2009. The U.S. Environmental Protection Agency is overseeing the dredging project, which is being conducted by General Electric Company (GE) under the terms of a 2006 legal agreement.

According to GE, the company has invested more than \$1 billion on the cleanup project to date. The EPA-mandated cleanup called for removal of an estimated 2.65 million cubic yards of PCB-contaminated sediment from a 40-mile stretch of the upper Hudson River between Fort Edward and Troy, N.Y. To date, approximately 2.5 million cubic yards of PCB-contaminated sediment have been removed. The dredging work is expected to be wrapped up this year, with habitat restoration to continue into 2016.

"The Hudson River has been damaged by a toxic legacy that this federal Superfund cleanup is addressing," said EPA Regional Administrator Judith A. Enck. "The massive amount of PCBs that have finally been removed from this treasured river is a tremendous accomplishment that will benefit the communities along the Hudson River for generations to come."

Several logistically challenging areas remain to be dredged this year, including those near dams and shallow waters around islands.

Dredging will also continue in a two-mile section of river near Fort Miller, located between the Thompson Island Dam and Fort Miller Dam, which is inaccessible by boat. Approximately 250,000 cubic yards of PCB-contaminated sediment is targeted for removal in 2015.

Between 1947 and 1977, an estimated 1.3 million pounds of PCBs were discharged into the river from two GE capacitor manufacturing plants located in Fort Edward and Hudson Falls. PCBs are potentially cancer-causing in people and build up in the fat of fish and wildlife, increasing in concentration as they move up the food chain.

Dredging is conducted when the Champlain Canal is open for the season, typically between May and November. Dredging occurs 24 hours a day, six days a week. Three to five mechanical dredges remove contaminated sediment from the river bottom. The dredges are mounted on deck barges and use environmental clamshell buckets to place the dredged sediment into separate barges.

In the land-locked section of river, where direct water-transport of loaded barges to the processing facility isn't possible due to the presence of dams at its north and south end, loaded barges will be pushed by tugboat to a loading station on a narrow section of land on the east shoreline of the river, south of the Thompson Island Dam. Once there, the material in the barge will be off-loaded into a bin on land and then re-loaded into another barge in the Champlain Canal channel. From there the barges will be pushed by tugboat upriver to GE's sediment dewatering and processing facility located on the Champlain Canal in Fort Edward.

Once the barges filled with dredged sediment arrive at the processing facility, the most contaminated sediment is first processed. Debris is removed and sediment is mechanically dewatered; the water is treated onsite and then returned to the Champlain Canal. The dewatered sediment and debris are loaded into railcars for transport to approved out-of-state disposal facilities.

During dredging operations, an extensive water quality monitoring program is in place to measure PCB levels at several downstream locations and to track the movement of dredged material downriver. Air quality is also measured around the dredge areas and near the processing facility while work is underway. Additional monitoring is required by the EPA to reduce the impacts of dredging and dewatering operations on surrounding communities.

In October 2014, the EPA announced that GE has agreed to conduct a comprehensive study of contamination in the shoreline areas of the upper Hudson River that are subject to flooding. Under the agreement, GE will investigate the PCB contamination in a 40-mile stretch of the Hudson River floodplain from Hudson Falls to Troy and will develop cleanup options. This investigation is expected to cost about \$20 million. The project area covers 6,000 acres of floodplain. More than 7,000 soil samples have already been collected.

Information provided by the U.S. Environmental Protection Agency. For more information about the Hudson River dredging project, visit www.epa.gov/hudson.

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Elan Westside is an eight-story building with 197 apartments and 11,000 square feet of retail space. Image: DSi Engineering

EXCELLENCE IN STRUCTURAL DESIGN

AWARD-WINNING PROJECTS HIGHLIGHT USE OF BIM
AND COLD-FORMED STEEL IN MID-RISE RESIDENTIAL
CONSTRUCTION.

THE COLD-FORMED Steel Engineers Institute (CFSEI) presented three Design Excellence Awards on May 19 during the 2015 CFSEI Expo held at the Rosen Centre Hotel in Orlando, Fla. Three residential structures earned the top honors: First place — ClarkDietrich Engineering for AQ Rittenhouse, Philadelphia; Second place — DSi Engineering, LLC for Elan Westside Apartments, Atlanta; and Third place — CEMCO for Plaza at Pearl City, Pearl City, Hawaii. The CFSEI Design Excellence Award recognizes small and large projects that exemplify excellence in the structural design of new or renovated structures utilizing cold-formed steel products.

“Congratulations to each of these companies for overcoming significant design challenges with innovative solutions utilizing cold-formed steel

framing,” said Maribeth Rizzuto, managing director of CFSEI. “There are so many creative ways to use cold-formed steel framing for mid-rise building projects, and we received many excellent submissions for this award. It was difficult to make the final selections. We greatly appreciate all of the entries that were sent in.”

All CFSEI award entries were judged by a panel of cold-formed steel professionals on demonstrated excellence and achievement in the use of cold-formed steel based on the following criteria: design creativity, technical innovation, system efficiency and economy, constructability, complexity of problems solved, and design integration.

First Place — AQ Rittenhouse, Philadelphia

2021 Chestnut Street was originally a four-story structure located in downtown Philadelphia that served as an annex to the Mid-City YWCA. Falling into disrepair, the structure was closed and remained abandoned for 23 years. Aquinas Realty Partners purchased the property in 2012 with the vision of razing the existing building and creating a new, 12-story, luxury apartment complex. This structure would be composed of a structural steel frame, concrete slabs, and exterior cold-formed steel framing. Today, that vision has been realized and 2021 Chestnut Street, now known as AQ Rittenhouse, stands as one of Philadelphia’s best residential complexes for upscale, urban living.

A number of factors made this project unique from a design and construction standpoint, including an unorthodox approach to the



The AQ Rittenhouse luxury apartment complex features a structural steel frame, concrete slabs, and exterior cold-formed steel framing. Photo: ClarkDietrich



To accommodate a short construction schedule and tight quarters, external framing was panelized offsite with exterior sheathing and finishes applied. Photo: ClarkDietrich

exterior connection design, panelization of the wall framing, and building information modeling (BIM). The smooth coordination between these processes allowed for many issues to be resolved prior to construction as well as an expedited construction timeline.

The cold-formed steel framing contractor, Clemens Construction, specifically faced several challenges in regard to installation of the exterior, cold-formed steel stud framing. They faced not only the usual issue of a short construction schedule, but also the challenge of installing the framing in tight quarters and within a high-traffic area. Clemens Construction chose ClarkDietrich as lead cold-formed steel specialty engineer to help address these issues through development of exterior framing details, engineering shop drawings, panelization drawings, and BIM modeling.

The exterior framing was panelized offsite to combat many of the job challenges at once. These panels consisted of the stud, track, and connection framing with the exterior sheathing and finishes applied. It was the design intent that these panels be constructed in a controlled environment, shipped to the job site, and fastened in place with no additional exterior finishing required. The design team also determined that stud infill framing would not be a good solution, as the slab edge would be exposed after the panels were installed. This would cost additional time and money to field frame and finish the strips around the structure where the slab edge was exposed.

In conjunction with Clemens Construction, the engineering team at ClarkDietrich developed details in which double 118-mil (50-ksi) bent angles were installed at each slab level. The top of the panels would then be field welded to the underside of these angles in order to support the lateral loads and the weight of the panels. The base of the panels would connect to these same angles, but also allow for vertical deflection between each level. This deflection at the base of the panels created another design issue. One of the custom bent angles would need to be manufactured with vertical slots at each stud and jamb. BIM allowed these slots be located and specified in order for the manufacturer to produce them.

Engineering technicians at ClarkDietrich modeled every stud and track on the exterior of the building. From this BIM model, panel drawings were created, which gave the exact location of every typical stud, jamb, header, etc. on the project. Clemens Construction then took these panel drawings and determined the length of angles that would be needed, as well as the location of the vertical slots. This information was then transferred back to the ClarkDietrich production team, which manufactured each custom piece.

The BIM model and panel drawings also allowed for creation of a material list of the typical track and stud products. This list included the size and length of every framing piece in every panel. Again, supplying this information back to the ClarkDietrich production team made the process of ordering and producing the material smooth and efficient.



The Elan Westside roof was made up of pre-engineered cold-formed steel trusses. Photo: DSi Engineering



The Elan Westside project combined welded, pre-panelized load-bearing cold-formed steel walls, structural steel, and dovetail composite deck supporting a floor slab. Photo: DSi Engineering

Creative thinking on the engineering side and a well-constructed BIM model on the technical side made 2021 Chestnut Street a unique and ultimately successful project for all parties involved. The finished structure turned what was once a vacant and uninhabitable eyesore into a 12-story, 110-unit luxury apartment complex that is now the jewel of the block.

Second Place — Elan Westside Apartments, Atlanta

Elan Westside, in the burgeoning West Midtown neighborhood at the corner of Howell Mill Road and 14th Street in Atlanta, is an eight-story building with 197 apartments and 11,000 square feet of retail space perfectly suited for cold-formed steel construction. Each apartment boasts state-of-the-art amenities. Residents of Elan Westside enjoy several amenities on the property, including a fitness center with virtual trainers, a first-class saltwater pool, an entertainment lounge and clubhouse with multiple high-definition televisions, and a bar and cyber café.

Elan Westside provides an example of the efficiencies and constructability of cold-formed steel construction. The building includes six stories of load-bearing cold-formed steel framing on top of two levels of concrete parking structure.

Construction was already well underway when cold-formed steel specialty engineer DSi Engineering was contacted about the project, so the contractor not only was concerned about costing, but also desired to provide a high-quality product for the customer in a short timeframe.

When the client learned about DSi's ability to create a single BIM that provided structural framing drawings, layout drawings, shop drawings, and material rolling information, he became intrigued. With little delay, DSi was selected to provide and build the entire cold-formed steel structural assembly above the concrete transfer slabs.

Within just six weeks, the structural design and drawings were nearing completion and materials were being prepped for order. Within 12 weeks, materials were being fabricated, and in less than four months, materials were being erected. The entire project only took 18 weeks to build, much of which involved installation of the complicated and large trussed roof.

This project required a combination of welded, pre-panelized load-bearing cold-formed steel walls, structural steel, and dovetail composite deck supporting a floor slab. The roof was made up of pre-engineered cold-formed steel trusses. To expedite the speed of construction, the project was divided into three phases per floor. This approach allowed walls to be erected in one phase, while flooring was installed in another, and shoring and concrete pours occurred in the third.

This project's unique use of integrated BIM modeling — which communicated from design to fabrication — coupled with the ease of fabricated cold-formed steel walls and truss panels, allowed speed to revenue for the owner.

Third Place — Plaza at Pearl City, Pearl City, Hawaii

Plaza at Pearl City is a 107,000-square-foot assisted living facility in Pearl City, Hawaii. The state-of-the-art, five-story facility creates 158 units for the elderly community in central Oahu.

The building structure is four levels of load-bearing cold-formed steel wall framing on a single level of concrete podium. The cold-formed steel walls are used in concert with cold-formed steel joist framing and SURE-BOARD laminated shear panels, all manufactured by CEMCO and supplied by GW Killebrew-AMS, the Honolulu branch of Allied Building Services. Other innovative products include ATS: Anchor Tiedown System by Simpson Strong-Tie and Structo-Crete structural concrete floor panels by USG. Steven Baldrige, Baldrige



A load-bearing cold-formed steel system in combination with a framed floor system with Structo-Crete panels reduced the dead load of the structure compared with traditional building materials while maintaining a noncombustible classification up to the roof line. Photo: CEMCO



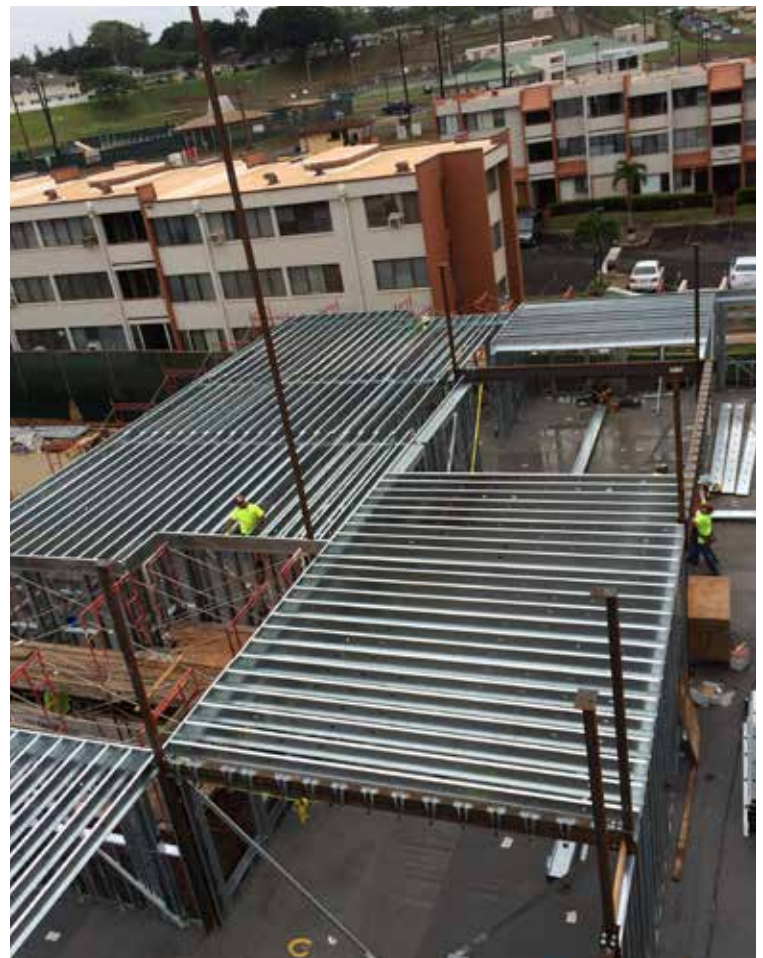
Plaza at Pearl City is a 107,000-square-foot assisted living facility in Pearl City, Hawaii. Photo: CEMCO

& Associates Structural Engineering, Inc., was the engineer of record and cold-formed steel specialty engineer.

These products were installed by Group Builders, with experience and expertise in load-bearing mid-rise construction. Group Builders' project scope ranges from the prefabrication of wall panels at the offsite panelization yard, installation of panels and joist framing, sheathing, roof truss framing, installation of ATS tiedowns and SURE-BOARD, drywall and exterior EIFS finishes, and acoustic ceilings. Group Builders delivered the project to the client on time and within budget.

The developer, MW Group, selected a load-bearing cold-formed steel structure for its fourth Plaza assisted living facility on Oahu. This structural system had not been used on the company's previous Plaza projects. Using the load-bearing cold-formed steel system in combination with a framed floor system with Structo-Crete panels, the builder was able to reduce the dead load of the structure compared with traditional building materials while maintaining a noncombustible classification up to the roof line.

There was a stringent quality tolerance on the wall panels for the project to ensure precision in the framed structure. There were concrete shafts that needed to match the settlement with the framed walls along with structural steel members in select areas of the building, putting greater emphasis on panelization consistency. SURE-BOARD shear panels allowed the designer to use lighter elements for lateral load resistance. The Simpson Strong-Tie ATS: Anchor Tiedown System provided an easy-to-install, high-capacity anchor restraint system with design flexibility for this multi-story building.



Cold-formed steel walls are used in concert with cold-formed steel joist framing and SURE-BOARD laminated shear panels. Photo: CEMCO

Information provided by the Cold-Formed Steel Engineers Institute (www.cfsei.org).

PREFABRICATION ACCELERATES CONSTRUCTION

ABC PROJECT AWARDED SPECIAL RECOGNITION FROM WISDOT.

A BRIDGE BUILT with prestressed concrete elements using an accelerated bridge construction (ABC) process earned special recognition from the Wisconsin Department of Transportation (WisDOT). The agency presented the Special Recognition Award to Lunda Construction

Company as part of the Excellence in Construction Awards held during the Wisconsin Transportation Builders Associations' annual Contractor-Engineer Conference in Madison.

The bridge spans Siggelkow Road in Dane County and is part of the I-39/90 Expansion Project currently underway to address safety and congestion concerns between Madison and the Wisconsin/Illinois border. Lunda Construction worked closely with precast concrete producer County Materials Corporation to complete the project. Precast bridge columns, girders, and pier caps allowed for faster bridge construction, which minimized road closures and saved time for commuters. ABC also reduced overall project costs.

County Materials supplied 20, 45W prestressed girders (each 110 feet to 116 feet long); five, 16-foot, 5-inch tall, 3-foot, 6-inch by 4-foot pier columns; and two 39-foot-long pier caps for the Siggelkow Road bridge project. The pier caps approached 100,000 pounds each and were hauled to the site with a specialized transporter.



The project required a great deal of cooperation between County Materials, Lunda Construction, and WisDOT. Lunda Construction did the formwork and fabricated the templates, and County Materials tied the rebar cages and executed the pour.

The Siggelkow Road Bridge is the first on the I-39 corridor to utilize ABC techniques. WisDOT expects ABC construction to benefit similar projects in the future.

“This project allowed us to gain an understanding of the constructability for these types of prefabrication and assembly techniques and demonstrates the department’s use of innovative construction methods used to accelerate bridge construction — that is, ABC concepts,” said Daniel Tyler with WisDOT’s Bureau of Project Development. “These techniques and practices will become increasingly valuable tools to help us manage schedule constraints, motorist delays, and fiscal demands.”

Information provided by County Materials Corporation
(www.countymaterials.com).



Precast bridge columns, girders, and pier caps allowed for faster bridge construction.

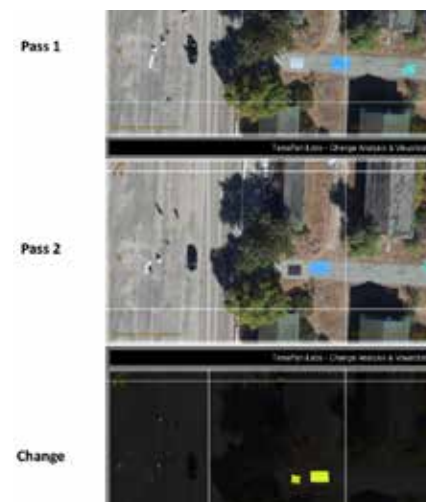
RAPID CHANGE DETECTION

UNM RESEARCHERS TAKE TO THE SKIES TO ASSESS INFRASTRUCTURE DAMAGE.

RESEARCHERS AT THE University of New Mexico (UNM), along with collaborators at San Diego State University and BAE Systems, are developing an operational prototype that will use remote sensing approaches and cameras mounted on low-cost aircraft or unmanned aerial vehicles (drones) to detect and map fine-scale transportation infrastructure damage such as cracks, deformations, and shifts immediately following natural disasters such as earthquakes, floods, and hurricanes.

A two-year, \$1.2 million grant from the U.S. Department of Transportation Office of the Assistant Secretary for Research & Technology Commercial Remote Sensing and Spatial Information Technologies Program, and additional support from the UNM College of Arts and Sciences and UNM School of Engineering, is supporting the project.

“We’ve been working on basic technology for really fast and precise change detection by aligning images to each other before a disaster and immediately after an event to detect anything that changed,” said Christopher Lippitt, Ph.D., an assistant professor in the Department of Geography and Environmental Studies. “We’ve been working on that in a number of applications for awhile, but this is the first time we’re fully operationalizing technology that myself and my collaborators at San Diego State have been developing for many years.”



Change detection example from repeat pass images from a multitemporal color digital camera (Pass 1 and 2) with automated change detection results in yellow. The image set was captured using the repeat station imaging approach as part of a RELIEF event at Camp Roberts, Calif.

One of the keys to infrastructure damage assessment is timeliness. Many natural disasters create dangerous situations that are time-sensitive in nature. The first 24 hours are oftentimes critical in terms of damage assessment, search, and rescue. Short time-frame damage assessments, sometimes over large urban areas, can be difficult with the current conventional, ground observations and sensor networks, researchers said.

The solution to this post-hazard information access challenge is to design flexible, ready-to-deploy, time-sensitive remote sensing systems based on a network of airborne platforms and digital cameras (manned aircraft in the short term and unmanned aircraft long term).

The project builds on previous research and patent pending technology to design a complete remote sensing system designed to meet the needs of agencies such as the New Mexico Department of Transportation (NMDOT) and U.S. DOT. Researchers aim to make available the latest in precision change detection and user-optimized remote sensing systems to U.S. DOT for operational assessment of damage to transportation infrastructure following hazard events.

The research team has already conducted extensive research and development on an image-based infrastructure assessment model that utilizes fast and precise data collection and processing within those critical time frames. Using an approach called repeat station imaging (RSI), researchers hope to rapidly align and analyze images for detection of fine-scale damage to infrastructure.

"I like to call it telemedicine for infrastructure," Lippitt said. "We're talking about being able to map every piece of critical infrastructure in minutes to hours as opposed to hours to days."

The researchers will use a GT500 aircraft made by Quicksilver for the project, while also working with corporate partner NEOS Ltd., which is supporting the research and development efforts. The information will eventually enable the U.S. DOT, the NMDOT, or any local DOT to better manage their assets by bringing much more data to the table than ever before.

"In the UNM School of Engineering's Department of Civil Engineering, the idea of infrastructure assessment, analysis, and management is really important to us," said Susan Bogus Halter, Ph.D., P.E., associate professor. "We have the skills to work with NMDOT or other agencies to better

manage their assessments. The new technology that Chris brings to the table allows us to provide much more information and data than we ever would before, much quicker than we could have ever before."

Whenever a natural disaster occurs — a storm or flood event, for example — the current practice is to send a handful of engineers out to the site to take a look, assess what's going on, and make a decision.

"We're talking about technologies that allow us to do that remotely," Halter said. "Let's say we can't access the site. Now we can have all this data that we wouldn't of had before or as fast. From the engineering side, that's very attractive new information and technology that we can use in our bread-and-butter type of field, which is infrastructure assessment and infrastructure management."

Operationally, the project involves interviewing transportation managers to determine how they do things now. That process will be followed by building the software and hardware capability using manned planes for all of the development phase.

"The long-term vision is to pre-deploy unmanned aircraft in a city that would fly around and map the damaged locations," Lippitt said. "The results of the changes or cracks would then be sent directly to any browser-based device — mobile phones, tablets, computers — that engineers around the country could quickly access to help evaluate the damage so emergency managers and transportation managers know how to respond."

"In terms of the telemedicine idea, it's not going to be something where we just ship the data to the DOT and they can do with it what they want," Halter said. "The data would also be available on a Web-based platform where the city of Albuquerque, the DOT, emergency medical services, or anyone could pull this data up and have access to it if they needed it."

A GT500 aircraft made by Quicksilver will be utilized initially during the development phase of the project. Eventually, drones will be used to map infrastructure.

"We envision routine flyovers and shots taken on a regular basis to detect changes in the infrastructure," Halter said. "Then, if there was some sort of special event — a flood, storm, hurricane, or earthquake, depending on where you live in the country — you could do a special flight and look at specific changes or damage to pieces of infrastructure."

"We think of natural disasters as pressure cooker situations," Lippitt said. "If you can do it after natural disasters, you can do it during any other time. I think the next steps after the demonstration include adapting this technology to everyday routine needs of infrastructure assessment and maybe prevent catastrophic accidents due to degrading infrastructure."

The idea was proposed to the U.S. DOT and adopted shortly thereafter. BAE Systems is implementing all the technology developed through the project. The technology will be incorporated into the SocketGXP line of desktop, server, and mobile applications for image exploitation and will culminate in 2016 with a demonstration in Bernalillo County, the test bed for the nation.

Information provided by the University of New Mexico (www.unm.edu).

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A GREENER NATIONAL MALL

ASSESSING THE BUSINESS CASE FOR
A MULTIPURPOSE INFRASTRUCTURE SOLUTION.

BY Lidia Berger, MEM, LEED Fellow, LEED AP BD+C, LEED O+M;
and Cody Pennetti, P.E.

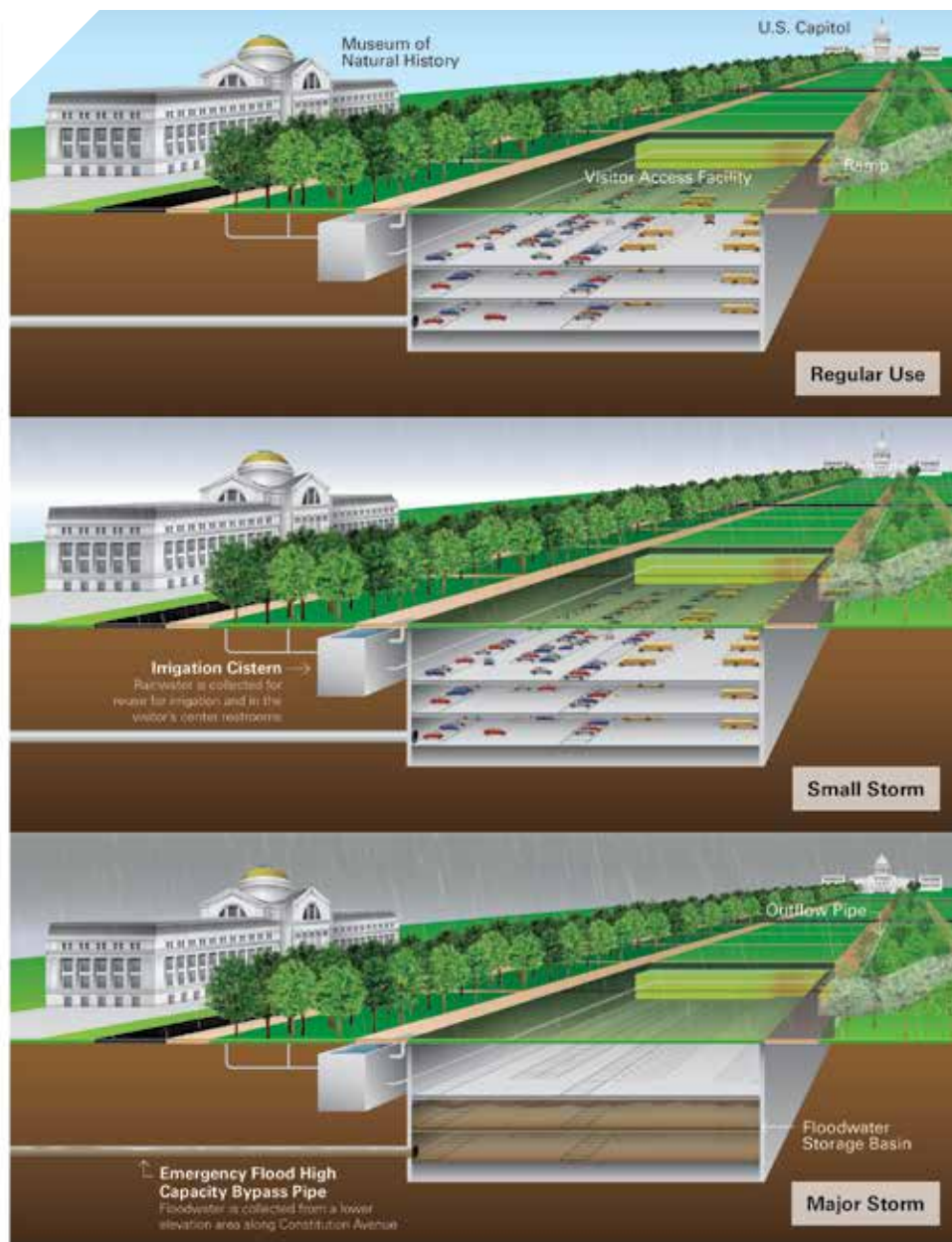


Figure 1: The proposed National Mall Underground is a subterranean parking structure that will also be designed to operate as a stormwater detention system during major storm events.

ONE OF THE most renowned civic spaces in the world, the National Mall in Washington, D.C., stretches roughly two miles from the U.S. Capitol to the Lincoln Memorial and Potomac River. This historic property attracts approximately 25 million visitors annually — more than Yellowstone, Yosemite, and Grand Canyon National Parks combined. The setting for many significant monuments, memorials, and museums, “America’s Front Yard” also hosts more than 3,000 festivals, performances, demonstrations, and other events each year.

However, the National Mall’s popularity creates a number of challenges in the capital city, including traffic congestion and parking shortages. Approximately 200,000 tour buses bring visitors to the mall each year.

Many of the buses idle along Constitution and Independence Avenues and side streets, clogging the road network, polluting the air, and blocking views of the mall’s iconic buildings.

In addition, the National Mall has been plagued with problems due to extensive flooding. In 2006, a major three-day storm overwhelmed the capacity of the city’s storm sewers and damaged many buildings within the mall and Federal Triangle area, including the Smithsonian’s Natural History and American History museums, the National Archives, and several federal agency headquarters. The flooding caused millions of dollars in damages.

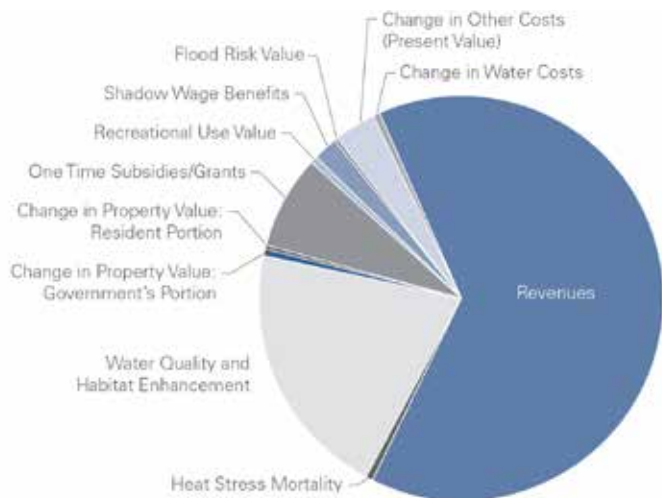


Figure 2: Attribution of benefits for the National Mall Underground; results are based on preliminary estimates.

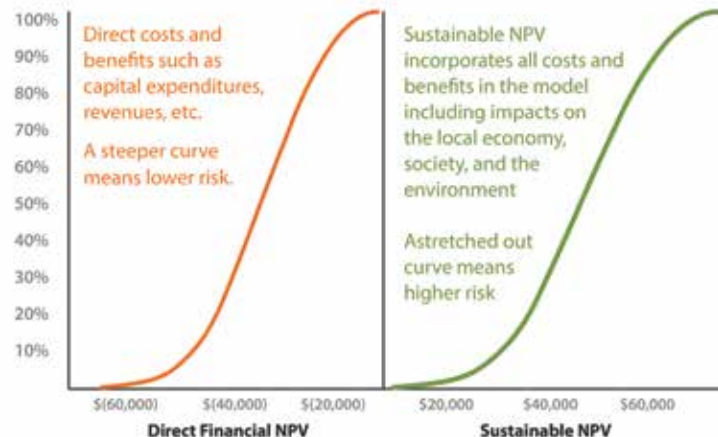


Figure 3: Attribution of benefits for the National Mall Underground; results are based on preliminary estimates. The difference between the curves is the (net) non-market or societal benefits (externalities) such as lower carbon emissions and less urban heat island effect.

Multipurpose infrastructure

An innovative and highly sustainable concept has been proposed to help remedy these persistent problems and provide a more enjoyable experience for visitors to the downtown area. Known as the National Mall Underground, this subterranean parking structure will also be designed to operate as a stormwater detention system during major storm events (see Figure 1). The multipurpose facility will address traffic, parking, air quality, flooding, and long-term sustainability issues while also providing venues for visitor information and amenities.

The National Mall Underground is the vision of Washington, D.C., real estate developer and philanthropist Albert H. Small and architect Arthur Cotton Moore, FAIA, working together with the nonprofit National Mall Coalition. Joined by the consulting firm of Dewberry for civil engineering and development of a business case evaluation for sustainability and functionality, the team has proposed a three-level underground structure that will offer approximately 1,000 parking spaces on the lower two levels for cars and buses. The top level will serve as a visitor center with amenities including food service, information on the National Mall and Memorial Parks, restrooms, and first aid. New turf grass will top the structure as a green roof.

During minor storm events (less than 50-year storms), large cisterns at the perimeter will collect rainwater and graywater flow from adjacent buildings for use in irrigation to reduce consumption of the city's drinking water supply. Prior to major storm events (50-plus-year storm events), the National Mall Underground would be closed, allowing the lower levels of the parking garage to operate as stormwater detention vaults.

As a multipurpose infrastructure concept, the National Mall Underground has no precedent in the United States. The design team

studied dual-purpose traffic and flood control projects in Rotterdam and the Kuala Lumpur Smart Tunnel as examples, as well as several underground parking facilities in the U.S. that serve to protect historic sites, but no project to date matches the National Mall Underground's complexity and scope. The project's versatility, however, is critical to its viability — ensuring that this unique infrastructure concept makes sense financially.

Making the case

The design team recognized that the National Mall Underground is poised to set an example for ambitious infrastructure projects moving forward through intelligent, multipurpose solutions. It was clear that an expensive flood protection system would not be viable without a vehicle for revenue. On the other hand, a large-scale underground parking structure was also untenable from a cost standpoint. Bring the solutions together, however, and the return on investment becomes much greater. The multipurpose design will allow the National Mall Underground to operate as a flood mitigation system at a fraction of the cost of a standalone system, and provide sustainability and resiliency benefits to the city. The District of Columbia, demonstrating its interest in the project, included the National Mall Underground in its recent submission to the U.S. Housing and Urban Development National Disaster Resilience Competition.

Throughout the planning phase, Dewberry developed business case analyses to help determine the benefits of various green and resiliency strategies. Valuation of the social and environmental impact was added to the analysis, helping to address the ecological impact of a decision or investment. This approach provided insight into the benefits of the National Mall Underground by evaluating direct financial performance as well as the project's benefits to society, the community, and the environment. A monetary value was assigned to features of the project

that provide benefits such as a reduction in water use, reduction in stormwater runoff, recreational use, water quality enhancement, and greenhouse gas reduction.

This approach led Dewberry's team to use the new Business Case Evaluator tool (BCE) for Stormwater Management, a companion tool for the Institute for Sustainable Infrastructure (ISI) Envision rating system. The BCE, developed by Impact Infrastructure (www.impactinfrastructure.com) in conjunction with the ISI's Economics Committee, incorporates research-based economic approaches to determine the monetized value of a project's economic, social, and environmental impact.

For example, the reuse of rainwater for irrigation can be evaluated against reuse toward potable water use reduction at the visitor center lavatories. The monetary value for both direct cash and non-cash costs and benefits provides a standardized metric that allows stakeholders to make informed design decisions. This process has revealed the full value of sustainability initiatives and enables project designs to be honed to achieve certain outcomes, such as maximizing total stakeholder value. Dewberry has also begun preliminary work to explore the benefits of an additional feature — geothermal rods beneath the facility — that would also enhance the project in terms of resiliency and value.

In a scenario such as the National Mall Underground where a project does not have an immediate positive return on investment through a direct financial analysis, a Triple Bottom Line business case approach identifies the equivalent financial benefits provided by sustainable or

resilience features. There are a number of advantages to using this process, including fully incorporating non-cash benefits and other factors into the decision-making process, and integrating risk and uncertainty analysis to help shape designs for optimal outcomes.

LIDIA BERGER, MEM, LEED FELLOW, LEED AP BD+C, LEED O+M, is national sustainability director for Dewberry. **CODY PENNETTI, P.E.**, is an associate and site/civil engineer for Dewberry.


TRIPLE BOTTOM LINE ANALYSIS TOOLS

The BCE for Stormwater uses a standard Cost-Benefit Analysis approach and research-based methodologies to monetize traditionally "intangible" benefits of projects. The BCE for Stormwater is a part of a family of tools that includes the BCE for Transit and AutoCASE, a cloud-based software application that integrates directly with Autodesk AutoCAD Civil 3D software to provide real-time feedback on a design's social and environmental value.

The BCE for Stormwater has been peer reviewed by members of the ISI and the ISI Economics Committee, and undergoes an annual update process to ensure that the tool uses the most up-to-date research in its methodologies. With a first release in 2013, this enhancement to the design process enables engineers and architects to create more sustainable and resilient designs while staying within tight budget requirements.

CIVIL + STRUCTURAL ENGINEER PROVIDES THE LATEST PRODUCTS AND SERVICES DESIGNED FOR THE ENGINEERING COMMUNITY

The screenshot displays the homepage of the 'civil + structural ENGINEER' website. At the top, a navigation bar includes links for CIVIL, STRUCTURAL, MAGAZINE, CONTINUING EDUCATION, CASE STUDIES & WHITEPAPERS, PRODUCTS & SERVICES, and RESOURCES. A prominent blue banner encourages visitors to 'VISIT www.cenews.com/products/services'. Below the navigation, a featured article titled 'ROBERT PENCE: LEADING THROUGH EVALUATION' is highlighted, accompanied by a photo of Robert Pence. The 'PRODUCTS & SERVICES' section is also visible, featuring 'FOUNDATIONS' and 'STRAIGHT-SEAM ERW ATLAS PIPE PILES'. A video player for 'PLAY PRECAST CONCRETE VIDEO' is shown on the right side of the page.



Unity College's two newest residence halls — Unity 1, now named Clifford Hall (right) and Unity 2 under construction (left) — are built to meet LEED Silver standards.

UNITY COLLEGE BUILDS 'LIVING LAB' SUSTAINABLE RESIDENCE HALLS

CELEBRATING ITS 50TH anniversary in 2015, Unity College, in Unity, Maine, will unveil a new residence hall that allows it to keep pace with peak enrollment while providing students a “living laboratory” in sustainable energy management. Constructed to meet LEED Silver standards, the approximately 18,000-square-foot residence hall was designed by SMRT Inc. of Portland, Maine.

The residence hall — expected to be completed in August — currently is named Unity 2 and is being built on the wooded campus next to Unity 1, the college's most recent residence hall. Unity 1, built in 2014 and renamed Clifford Hall, honoring the late Bert Clifford, a Unity College founder and local philanthropist, also was designed and built to LEED Silver standards.

Unity 1 design

Unity 1's location was chosen to minimize disturbance to the surrounding landscape. Nearby existing habitats, including vernal pools, were left untouched and unaffected. Existing vegetation, including some trees, was protected during construction. The project design included stormwater management thoroughly reviewed and approved by the Maine Department of Environmental Protection. The building was situated with southern exposure to accommodate a roof-mounted solar array, which the college is currently negotiating to install.

Sustainable construction methods were used whenever possible. The contractors were required to use an approved construction waste management program with separate containers for different waste materials. Regionally sourced products were used when available to minimize the amount of trucking required to bring the materials to the site. Whenever possible, construction materials containing recycled

content were used. Additionally, an emphasis was placed on using materials that are rapidly renewable.

All lumber used on the project was certified by the Forest Stewardship Council as having come from sustainably managed forests. Other construction materials used were specified to be low emitting, including adhesives, sealants, paints, flooring systems, and composite wood. The walls were insulated to R-30 and the roof was insulated to R-49.

All plumbing fixtures were specified as “low water usage,” using on average 20 percent less water than standard fixtures. All interior and exterior lighting consists of LED fixtures, greatly reducing the amount of electricity used. Exterior lighting was positioned to eliminate light pollution. Electricity consumed by the building — including during its construction — was purchased from green sources. The heating system consists of radiant in-slab heat fed by multiple wood pellet boilers to eliminate reliance on fossil fuels. During the design phase of the project, multiple heating systems were modeled and the wood pellet system was shown to have the lowest initial cost and the lowest life cycle cost.

Other features of the building that add to its sustainability include the following:

- Bicycle racks were installed to encourage non-motorized traffic on campus.
- The building contains adequate space for collection and storage of recyclable materials and waste to support ongoing recycling initiatives.
- Walk-off mats in the main entrance help minimize the amount of dirt brought into the building, thereby reducing the need for cleaning chemicals.
- Every resident room and common space has natural sunlight with large windows.
- All wooden furniture is made of environmentally farmed timber.



The Unity 2 residence hall will use 23 air-source heat pumps for heating and cooling.

Unity 2 design

Similar to Unity 1, Unity 2 will be fitted with advanced, yet different heating and cooling options. Unity 2 will take advantage of 23 air-source heat pumps, which provide both heating and cooling.

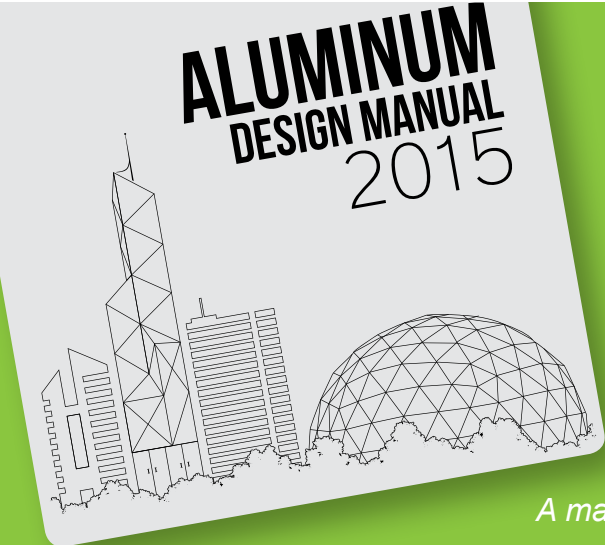
“Looking at our growth from a comprehensive point of view, the new residence hall will be a ‘living lab’ of energy management, in addition to fulfilling our need for residential space for our undergraduates and also for our expanding summer programs,” said Executive Vice President Melik Peter Khoury, Ph.D.

“Both buildings are part of our strategic plan for building a beacon and creating a national presence for Unity as America’s environmental college,” Khoury said, noting that students will be involved in energy management programs that compare and contrast energy use and efficiency throughout the two buildings.

Other notable aspects of Unity 2 include:

- roof positioning to support a solar array;
- furniture from a sustainable manufacturer that will match Unity 1;
- five-student suites, each with a kitchenette;
- a main common room with kitchenette across the hall;
- all LED lighting; and
- R-30-rated wall insulation and R-70 roof insulation.

Information provided by Unity College (www.unity.edu).




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A SHOT OF STRENGTH

RESEARCHERS ARE EVALUATING POLYURETHANE INJECTION TO STABILIZE RAILROAD BALLAST FOULED WITH FRAC SAND.

THE CRUSHED LIMESTONE or dolomite ballast that keeps railroad tracks in place appears to be a solid footing, even as freight cars rumble overhead. But temperature and vibration can destabilize ballast over time, keeping it from safely transferring the weight of a loaded train to the soil below, draining water, and preventing vegetation from crowding the tracks. In Wisconsin, a booming industry mining sand used by oil and gas drillers in hydraulic fracturing has presented a new challenge: Fine grains of sand can leak from rail cars, accumulate in rail bed ballast and, during a rainstorm, turn into mushy, track-loosening mud.

“Some of these tracks have deteriorated so much that the trains travel at about 10 mph,” said Dante Fratta, Ph.D., professor of civil and environmental engineering and geological engineering at the University of Wisconsin-Madison. “You have to lift up the track, remove the ballast, and put in new material. It’s very expensive. It’s also very expensive to have derailments.”

Fratta spent part of the spring examining these problems along a section of freight track in northern Illinois with colleagues Tuncer Edil, Ph.D., P.E., emeritus professor of geological engineering and civil and environmental engineering; and Jim Tinjum, Ph.D., professor of geological engineering. While frac sand poses a relatively new challenge in the Midwest, the three researchers hope to bolster the nation’s freight rail network against all manner of stresses that cause this particular problem, known as ballast fouling.

Fratta planned to install fiber optic cable in a section of track to monitor temperature, deformation, and vibration in the ballast, as well as any corresponding deformation in the tracks themselves. Damage and deformation often occur within a small area of the rail bed. Fratta wants operators to have a better handle on how problems arise, giving them a better idea of how to target repairs to rail infrastructure in more cost-effective ways.

Edil is partnering with the soil stabilization and pavement lifting company Uretek to devise a system to inject polyurethane to shore up damaged or potentially weak sections of ballast. Unlike cement, liquid polyurethane is great at seeping into the voids between rocks. And while cement can take weeks or even months to set properly, polyurethane injections can set within 15 minutes.



Fine grains of frac sand can leak from rail cars, accumulate in rail bed ballast and, during a rainstorm, turn into mushy, track-loosening mud.
Photo: Tuncer Edil/UW-Madison

The group still has to make sure polyurethane injection is the most cost-effective and energy-efficient approach. Producing less replacement ballast would mean using fewer fossil fuel resources, but making polyurethane also uses energy, so Edil and Uretek have conducted a life cycle analysis to determine whether, in the long run, their process actually reduces greenhouse gas emissions and energy consumption.

Tinjum is coordinating the academic and industry teams involved, ensuring that researchers have crucial access to railroad infrastructure. For obvious reasons, railroad companies don’t let just anyone experiment on their tracks, so building relationships and delivering results are important on a project like this.

“Whenever you do something for the first time, you want it to work because you need that experience and that trust for future development,” Tinjum said.

If the engineers’ pilot projects pay dividends on the tracks that carry freight out of Wisconsin, the group would like to apply its concepts to other vulnerable points in railway infrastructure.

Railroad tracks take a beating at bridge approaches — where the weight of a train is transferred between surfaces with differing physical properties — and at intersections with roads, where tracks deal with the stress of trains and the weight of other vehicles.

Since injection tools have been previously used to level runways and sidewalks, Tinjum thinks they can translate well into railways.

“The immediate huge application is the remediation or improvement of the capacity of these intersections for them to last longer,” he said.

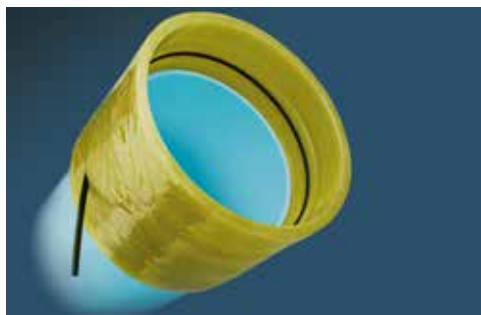
Information provided by University of Wisconsin-Madison College of Engineering (www.engr.wisc.edu).



01. BACKPACK REALITY CAPTURE

Leica Geosystems' Pegasus:Backpack combines five high-dynamic cameras, which work in a variety of light conditions, and a LiDAR profiler with an ultra-light and ergonomic carbon fiber chassis to capture 3D views indoors or outdoors. Accurate positioning is achieved in GNSS-restricted areas using Simultaneous Localization and Mapping (SLAM) technology. With full 360-spherical views and LiDAR together, plus a hardware light sensor, all images are usable while other functions are verifiable and adjustable over the operator's tablet device. The system uses multiple hot-swappable batteries. Leveraging Leica's Mapfactory extension, features can be extracted and datasets exported to CAD or BIM software.

LEICA GEOSYSTEMS
WWW.LEICA-GEOSYSTEMS.COM/PEGASUS_BACKPACK



03. RESTRAINED-JOINT PIPE

Certa-Lok C905/RJ Restrained Joint PVC pipe from North American Specialty Products (NASP) is a fully corrosion-resistant, segmented, restrained-joint PVC piping system in sizes 18 inches and larger. Certa-Lok pipe provides a restrained joint by utilizing precision-machined grooves on the pipe and in the coupling, which, when aligned, allow a spline to be inserted, resulting in a fully circumferential restrained joint. Available in cast-iron outside diameters up to 24 inches, it meets all performance requirements of AWWA C905, the company said.

NORTH AMERICAN SPECIALTY PRODUCTS
WWW.NASPECIALTYPRODUCTS.COM



04. CONCRETE WALL PANEL SYSTEM

Composite Insulated Concrete Systems LLC's THiN-Wall, a patented composite insulated concrete wall panel system, obtained a two-hour fire resistance rating according to ASTM E119 – 11A, Standard Test Methods for Fire Tests of Building Construction and Materials. The 10-foot by 10-foot specimens, which consisted of 4 inches of XPS insulation between two 3-inch layers of concrete, were tested under sustained flexural loading by the Fenestration Testing Laboratory. During the fire exposure for each test, no visual changes to the THiN-Wall specimens were observed.

COMPOSITE INSULATED CONCRETE SYSTEMS LLC
WWW.THIN-WALL.COM



02. POTABLE WATER GEOMEMBRANES

Seaman Corporation's XR Potable Water geomembranes are designed for containment of potable water. The high-strength, flexible geomembrane provides superior puncture, tear, and UV resistance, the company said, and is the only geomembrane with NSF 61 approval for potable water contact. The versatility of XR-PW geomembranes allows them to be used for applications including finished water baffles, raw water ponds, and floating covers. XR-5 PW is specifically engineered for floating cover applications.

SEAMAN CORPORATION
WWW.XR-TECHNOLOGY.COM



05. SEMI-RUGGED LAPTOP

Panasonic Toughbook 54 features an Intel Core i5 vPro processor, 11 hours of battery life — 18 hours with an optional hotswappable second battery — a full magnesium alloy case with handle, port covers, and a spill-resistant keyboard. The Toughbook 54 is available with discrete graphics, dual drives, up to 16 GB of memory, and a 1080p full HD 14-inch display and webcam. Semi-rugged, meeting MIL-STD-810G, the laptop was tested to survive 3-foot drops. A 10-point capacitive Gloved Multi Touch touchscreen model with stylus is available.

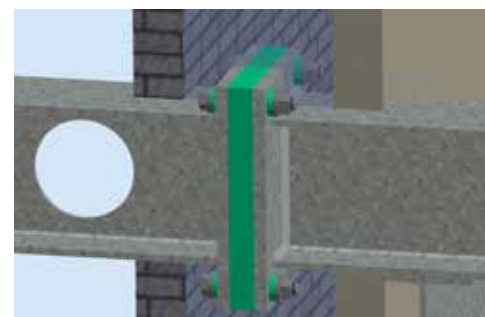
PANASONIC
WWW.US.PANASONIC.COM/TOUGHBOOK/54



06. POINT CLOUD PROCESSING

Topcon Positioning Group announced improved workflow compatibility for the GLS-2000 3D laser scanner and ScanMaster software with Autodesk solutions to collect, process, edit, and deliver 3D point cloud data from a laser scanner via the latest version of Autodesk ReCap. Autodesk ReCap and ReCap 360 have the new capability to read the Topcon CL3 format as a scan file in addition to a standard point cloud. The scan file allows for the use of individual scan positions for additional options in registration workflows.

TOPCON POSITIONING GROUP
WWW.TOPCONPOSITIONING.COM



07. STRUCTURAL THERMAL BREAK

Fabreeka International introduced Fabreeka-TIM, structural thermal break material, in a new green color. Fabreeka-TIM is a load-bearing thermal break that maintains structural integrity while reducing energy loss, the company said. It is available in several thicknesses, including 1/4 inch, 1/2 inch, and 1 inch. It can be supplied with Fabreeka-TIM washers, and Fabreeka bushings, which when used together in a structural connection, greatly reduce the energy loss rate through conduction, the company said.

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Additional information available online at

lane-enterprises.com/StormKeeper



08. UNDERGROUND STORMWATER SYSTEM DESIGN TOOL

Advanced Drainage Systems, Inc.'s online ADS StormTech Design Tool enables engineers to design and estimate the cost of customizable underground stormwater management systems constructed with ADS StormTech Chambers. Available for free on the company website, the tool provides the ability for site-specific applications and can be accessed and used through multiple platforms, including smartphones, tablets, and other mobile devices. System designs are produced in PDF and CAD formats, with data for estimating total installed cost.

ADVANCED DRAINAGE SYSTEMS, INC.
WWW.ADS-PIPE.COM



09. MOBILE VIEWER FOR 3D MODELS

Trimble introduced a new version of SketchUp Mobile Viewer, an onsite presentation app that provides SketchUp users with a convenient way to view, explore, and share models on-the-go. The app allows users to view their own 3D models as well as browse, download, and orbit their way through the universe of SketchUp (.skp) files found in Trimble's 3D Warehouse. In addition to iOS and Android tablets, SketchUp Mobile Viewer now also supports iOS and Android mobile phones. Through integration with Dropbox, SketchUp Mobile Viewer now offers additional cloud-based file transfer options.

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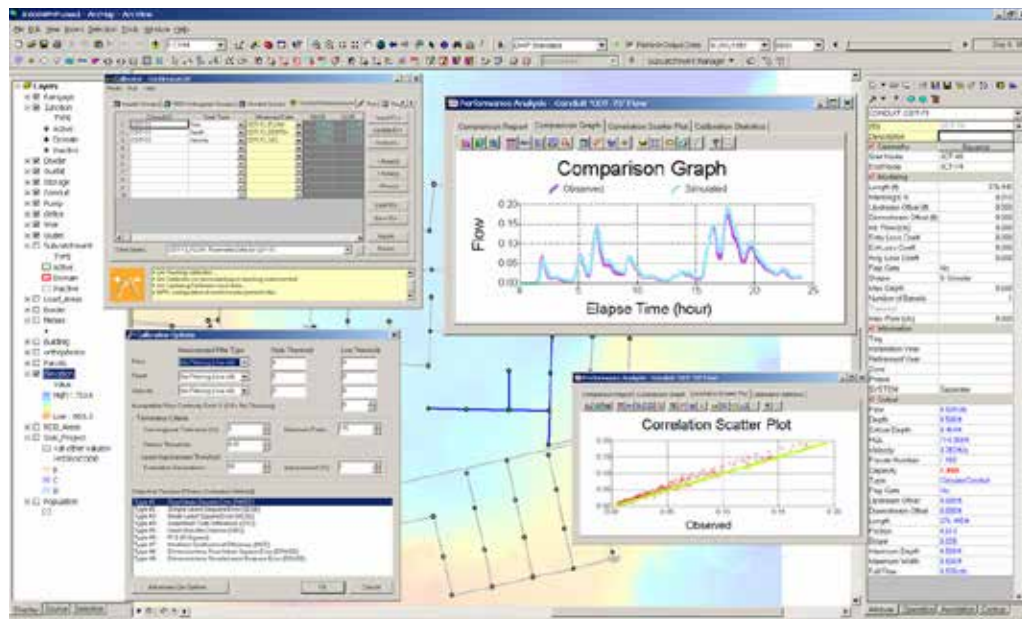
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CLIMATE CHANGE AND STORMWATER SIMULATION MODELING

By Bob Drake



Built atop ArcGIS, the InfoSWMM analysis and design program addresses all operations of a typical sewer system.

EPA TOOLS

- EPA Storm Water Management Model Climate Adjustment Tool — <http://www2.epa.gov/water-research/storm-water-management-model-swmm>
- EPA Stormwater Calculator for Low Impact Development — <http://www2.epa.gov/water-research/national-stormwater-calculator>

IN JULY, INNOVYZE, a provider of wet infrastructure business analytics software, announced that its InfoSWMM and H2OMAP SWMM programs now fully support the recently released U.S. Environmental Protection Agency Storm Water Management Model Climate Adjustment Tool (SWMM-CAT). This capability allows InfoSWMM and H2OMAP SWMM users to directly estimate future changes in temperature, evaporation, and rainfall for simulation modeling.

The SWMM-CAT tool provides a set of location-specific adjustments derived from global climate change models run as part of the World Climate Research Programme Coupled Model Intercomparison Project Phase 3 archive. These are the same climate change simulations that helped inform the United Nations Intergovernmental Panel on Climate Change in preparing its Fourth Assessment report. SWMM-CAT and the EPA Stormwater Calculator for Low Impact Development simulation are both part of the president's Climate Action Plan (www.whitehouse.gov/share/climate-action-plan).

Built atop ArcGIS, the InfoSWMM analysis and design program addresses all operations of a typical sewer system — from analysis and design to management functions such as water quality assessment, pollution prediction, sediment transport and deposition, urban flooding, real-time control, and record keeping — in a single, fully integrated geoengineering environment. The program's hydraulic and water quality computational engine is based on the latest SWMM 5.1 version, which is endorsed by the EPA and certified by the Federal Emergency Management Agency.

InfoSWMM also serves as a base platform for advanced modeling, operational, short-term and long-range planning, capital planning, urban stormwater treatment and analysis, and analytics-driven asset management extensions. Some of these applications include InfoSWMM 2D (two-dimensional surface flood modeling), CapPlan (risk-based capital planning and asset performance modeling), InfoSWMM Sustain (optimal selection and placement of LIDs/BMPs), InfoSWMM SFEM (dynamic sewer flow estimation model), InfoMaster (GIS-centric analytics-driven asset management), and RDII Analyst (rainfall-dependent inflow and infiltration planning and analysis).

“Our priorities have always been to advance the frontiers of smart network modeling technology and support our customers’ successes by helping them better prepare for climate impacts and build safer, better water infrastructures,” said Paul F. Boulous, Ph.D., BCEEM, Hon.D.WRE, Dist.D.NE, Dist.M.ASCE, NAE, president, COO, and chief technical officer of Innovyze. “This direct support to the EPA Storm Water Management Model Climate Adjustment Tool delivers on our promise to equip our customers with the ultimate geospatial decision support tool for evaluating, addressing, and managing climate change risks for more resilient, sustainable sewer collection and urban drainage systems.”

Information provided by Innovyze (www.innovyze.com).



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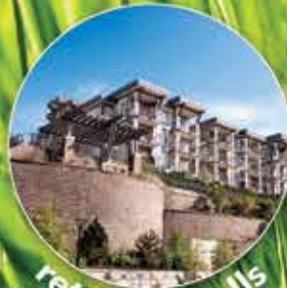
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