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POSTMASTER: Send address changes to Ascent, 200 W. Adams St., Suite 2100, Chicago, IL 60606.

Periodical postage paid at Chicago, IL and additional mailing offices.

Ascent (Vol. 28, No. 1, ISSN 10796983) is published quarterly by the Precast/Prestressed Concrete Institute, 200 W. Adams St., Suite 2100, Chicago, IL 60606.

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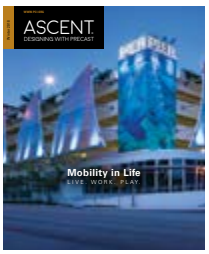

On the cover: Pompano Beach Pier Parking Structure.
Photo: Dan Forer.

FEATURES

"The Z" parking structure. Photo: Bedrock.

DEPARTMENTS

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The Parking is Dead! Long Live the Parking!

Data point #1: My dad, a likely-never-to-retire civil engineer and former mining engineer, still has the sky-blue 1967 Chevrolet pickup truck he bought when I was only six months old. In fact, with over 650,000 miles on it, it is still his primary vehicle. (His other cars are a 1931 Model A and a 1941 Willy's Jeep, both still road ready, registered, and regularly driven.) While not everyone drives their cars for over half a century, according to R.L. Polk, an automotive marketing firm, the average age of cars on the street is 11.4 years.

Data point #2: In the U.S. in 2016, 17.6 million new vehicles were sold and the total number of vehicle registrations was 263.6 million.

Data point #3: China, India, the U.K., France, and Norway are developing plans to ban fossil-fuel cars by 2040, presumably spurring further research and a market move to electric vehicles. Within 10 to 20 years, all the automakers will (at long last, some will say) have full lines of electric vehicles to sell to an apparently insatiable market.

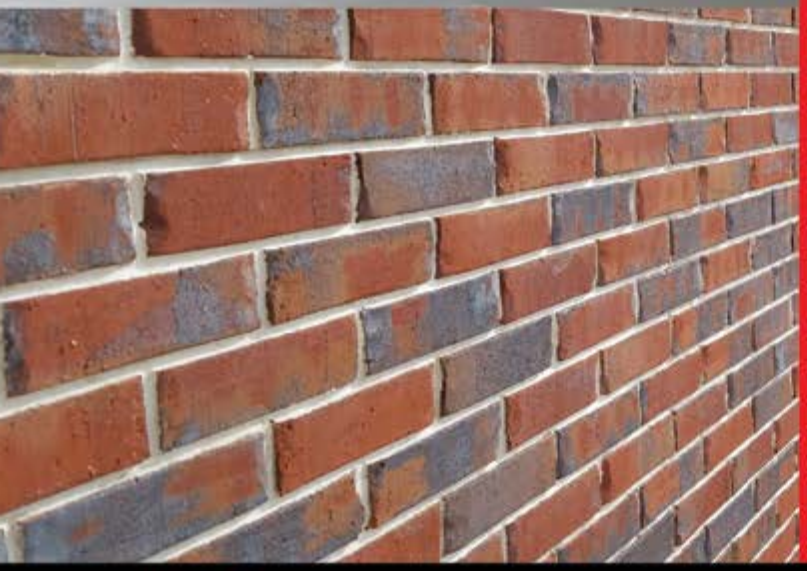
Data point #4: According to primary research conducted by Dale Denda of the Parking Market Research Company and delivered at the National Parking Association convention this past October, although research and development of autonomous vehicles continue apace and artificial intelligence technology in vehicles advances, we will likely not see truly driverless, autonomous vehicles on the roads for at least another 60 years. His conclusion: the parking demands of our growing population will continue to drive the need for the design and construction of parking structures across the U.S. for the foreseeable future.

Data point #5: Today's parking structures, depending on geography and maintenance requirements, are expected to last 30 to 40 years, according to K. Nam Shiu of Walker Parking Consultants.

What does all this mean? Despite the air being taken out of the room with the promised future of autonomous vehicles, parking structures, even as we know them today, are not likely to go away for at least another two or three generations. We will continue to build parking structures to answer the demands of our ever-growing population, but build them differently to accommodate the higher proportion of electric vehicles being driven by the workforce, tenants, visitors, or customers using the structures.

And during the transition to a (probably) driverless future, adaptive reuse options need to be further explored and introduced to the parking structure market, especially for owners such as government and various institutions who expect better performance and longer service lives for their buildings. For owners who need parking right now and would prefer not to worry about future-proofing, don't worry about it. All indications are that you will continue to have workers, customers, and tenants who will want to park there for years to come, including my dad and the other 222 million licensed drivers who enjoy their little piece of personal autonomy behind the wheel.

INSIGHT



Old World, Meet New World

By combining structural and architectural prefabricated elements, the design team was able to blend a new eight-story 485,000 square foot, parking structure into the University of Mississippi's predominately Georgian-style campus architecture.

Gate Precast's structural exterior precast features an architectural finish with embedded old world, wood-mold bricks which helped bridge the gap between traditional building methods and modern prefabricated techniques.

The structural precast concrete frame is comprised of long-span, double tees spanning from perimeter spandrels to interior lite walls, along with inverted tee and L-beams.

These prefabricated components worked together to solve aesthetic challenges, a compressed schedule, site congestion, and high seismic requirements. Total precast construction allowed for an open design with 12-foot floor-to-foot heights which accommodate large vehicles and maximize lighting.

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Precast Panels Clad Westchester Medical Center Addition

VALHALLA, NEW YORK

To ease congestion on a tight site, speed construction, and provide a strong appearance for the new Westchester Medical Center Ambulatory Care Pavilion in Valhalla, N.Y., designers specified architectural precast concrete panels for the exterior in various shapes and finishes.

The $230-million, 280,000-ft^2 facility represents the largest health-care construction project in Westchester County in decades, according to Lohud.com, a *USA Today* regional website. The eight-story structure, adjacent to the existing medical center, includes 185,000 ft^2 of ambulatory care space with a surgery center, advanced imaging center, and heart and vascular services. Also included are a 20,000-ft^2 private room expansion and 75,000 ft^2 of doctors' offices, Lohud.com reported.

The project was designed by Perkins Eastman in Stamford, Conn., with Skanska USA Building Inc. in New York, N.Y., serving as general contractor. John Smolen & Associates in North Haven, Conn., is the structural engineer.

About 250 precast concrete panels were cast, covering 55,000 ft^2 of cladding area. They feature two finishes along with a tight reveal pattern that was custom-made with polyurethane formliners. The precaster also cast 400 ft of radiused panels with preinstalled granite to achieve the appearance designers sought. Coreslab Structures (CONN) Inc. in Thomaston, Conn., fabricated the components.

The project was built in two phases. Phase one was completed in October 2017 and phase two is scheduled to complete erection in early 2018, with occupancy planned for later that year.

Hollow-Core, Panels Add Efficiencies for Harlo

BOSTON, MASSACHUSETTS

The Harlo mixed-use development in the Fenway neighborhood of Boston, Mass., features architectural precast concrete panels and precast concrete hollow-core flooring in its 17-story structure, which created efficiencies and sped up construction.

The 183,000-ft^2 tower, which completed construction late in 2017, was developed and built by Skanska. It rests on a four-story podium base that provides a set-back to break up the building's mass. The building consists of two masses of slightly different heights, with one façade featuring metal panels and a sloping façade, while the other consists of textured precast concrete panels. Stantec/ADD Inc. in Boston served as architect of record.

Both the hollow-core slabs and panels are supported by a steel frame. All of the components were erected by the same erector to create efficiency, reduce logistics, and shorten the schedule, according to Darrin Ball, senior project manager at Skanska. Hollow-core was chosen to provide the desired ceiling heights, reduce sound transmission between floors, and speed construction of the flooring system, enclosing the building quicker.

The structural system relies on the hollow-core slabs to transfer horizontal diaphragm chord and shear forces via additional prestressing strands and heavy embed plate assemblies to the steel framing system. The framing and hollow-core slabs were nearly erected before installation of the exterior panels began. The total erection time for steel/slab beat the schedule by two weeks. The vertical precast concrete erection, including detailing, took about 30 days.

The 8-in.-thick slabs, 8 ft wide and 26 ft long, were fabricated by J.P. Carrara and Sons Inc. in Middlebury, Vt. Architectural precast concrete panels were manufactured by Precast Specialties Corp. of Abington, Mass., and Bétons Préfabriqués Du Lac Inc. (BPDL) based in Alma, Quebec, Canada. Each producer coordinated their deliveries with the erector.

The panels feature a combination of sandblasted, exposed aggregate, and smooth finish banding, which has a deliberately random pattern. The panels included punched openings for the window system. Accent panels with peaks and valleys to add depth are adjacent to each window opening. Varied coloration is designed to match the color palette of the project. Panels are tied to the structural steel skeleton.

The project is seeking LEED-NC gold certification and the use of precast concrete components contributed in a variety of ways, including being locally produced, using local materials, contributing little to construction waste, and not emitting volatile organic compound chemicals.

Submit your headline news for consideration in a future issue of Ascent to Becky King at bking@pci.org.

Correction Facilities Use Precast Components

TELFORD, PENNSYLVANIA

Two new correctional facilities are using modular precast concrete cells to create cost-effective and quickly constructed structures. Oldcastle Precast in Telford, Pa., is supplying the precast concrete components for both projects.

In Monticello, N.Y., Sullivan County lawmakers have approved construction for a 155,000-ft^2 facility with 256 single cells and more than 300 beds in all. The $79-million, two-story structure will feature precast concrete front-chase cells with integral precast concrete bunks.

Oldcastle is supplying 164 70-ft^2 cells and 92 100-ft^2 cells. The units were outfitted with all furnishings and system tie-ins, including heating, ventilation, air conditioning, plumbing, and electrical fixtures, as well as doors, windows, and frames.

LaBella Associates in Rochester, N.Y., is the design consultant while The Pike Company in Rochester is the general contractor. Pennoni in Coplay, Pa., is the structural engineer.

The expedited product delivery and fast erection of the precast concrete cells shortened the construction timeline. Construction began in October and is scheduled for completion in September 2018.

In Cape May County, N.J., the new $37.3-million correctional center will feature 96 two-person precast concrete, rear-chase cell modules and 16 eight-person, dormitory-style cell modules. The cells will aid quality control and scheduling, according to the facilities director.

The 85,000-ft^2 correctional center will include a medical area that can house inmates, plus a laundry service that will do laundry for other facilities, reducing costs.

The modular units are delivered with plumbing and interior fixtures in place, allowing the cells to be ready to be stacked and construction to continue around them. The rear-chase configuration was chosen to allow maintenance personnel to have access to mechanical systems without disrupting the prison population's daily routines.

Construction is being performed by Hall Construction Co. in Farmingdale, N.J., while Hill International in Philadelphia, Pa., is overseeing the project for the county. The project began construction in August 2016 and is scheduled for completion in August 2018.

Gate Adds New Plant

HILLSBORO, TEXAS

Gate Precast has begun constructing a fully enclosed structural concrete plant near its existing Hillsboro, Tex., architectural precast concrete operation. The plant, featuring a 45,000-ft^2 manufacturing facility, will be operational by January 2018. About 50% of the site will remain open for future expansion.

Submit your headline news for consideration in a future issue of Ascent to Becky King at bking@pci.org.

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Clemson Students Gain Hands-On Experience at Tindall

SPARTANBURG, SOUTH CAROLINA

As part of their PCI Foundation Precast Studio classes at Clemson University in Clemson, S.C., students built and finished a precast concrete panel at Tindall Corp.'s Spartanburg, S.C., plant.

The class is conducted by Carlos Barrios, recently tenured associate professor in the School of Architecture. The Tindall program, designed to give students hands-on experience with the material, was hosted by Tindall's vice president, David Britt. After receiving instruction about precast concrete, the students built forms with a variety of finishes, placed the concrete, and, once the concrete cured, stripped the panels.

PCI Forms Architectural Certification Sub-committee

CHICAGO, ILLINOIS

PCI has formed an Architectural Certification Sub-committee to finalize specific levels of architectural precast concrete certification and take advantage of the PCI Erector Certification Program. The sub-committee was formed on the recommendation of a PCI task group of Architectural and Plant Certification Committee members working with five leading design architects.

Three Schools Receive Foundation Support

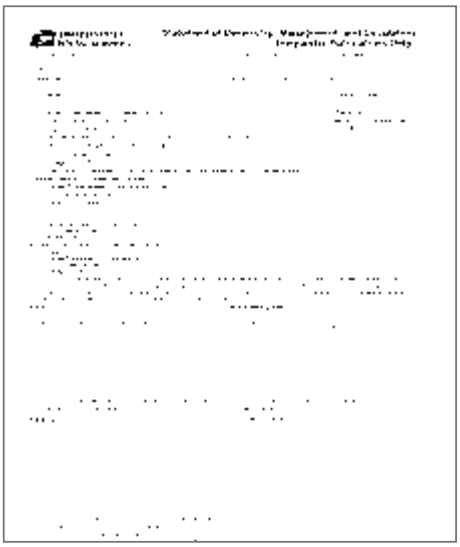
CHICAGO, ILLINOIS

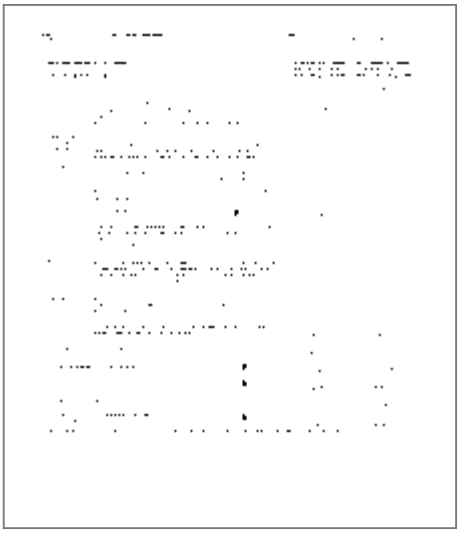
The University of Arizona (UA) in Tucson, Ariz., and the University of Minnesota Duluth (UMD) have created programs supported by the PCI Foundation that will begin operating in early 2018. In addition, Georgia Institute of Technology in Atlanta, Ga., was approved for a four-year grant to run a Precast School that began this fall.

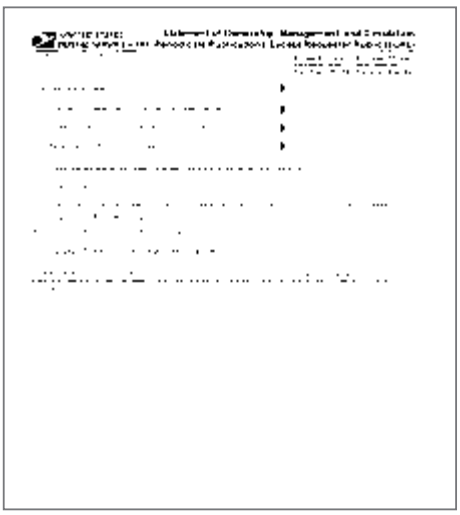
The UA program will be coordinated by Robert Fleischman, civil engineering professor, in conjunction with the College of Architecture, Planning, and Landscape Design. It will create precast concrete-related content integrated across the civil engineering, architecture, and architectural engineering degree programs. Dawn Rogers of Coreslab Structures (ARIZ) will coordinate the industry involvement.

The UMD program will focus on resilient precast concrete. Ben Dymond, assistant professor in the Department of Engineering, will coordinate the program in conjunction with the Department of Civil Engineering, the Department of Mechanical and Industrial Engineering, and the MBA program. John Saccoman of Molin Concrete Products will be the industry champion. It will combine traditional concrete engineering education with cutting-edge knowledge related to sustainability and business management.

The Georgia Tech program, funded by a grant and run by Professor Tristan Al-Haddad, will focus on computational tools and machines to examine how mature material systems such as precast concrete can continue to evolve. The program will run for two consecutive semesters each year.







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Photos courtesy of Lombard Precast and Advanced Formliners

Colors, Finishes and Blends **to Fit any Design**

More than a parking structure, the Main Street Triangle parking garage is central to accessing downtown businesses, entertainment, and medical offices in Orland Park, Illinois. The building includes more than 540 parking spaces and 12,000 square feet of additional commercial space. METROBRICK Schoolhouse Red in modular size and wire cut finish was used throughout the project. Lombard Architectural Precast Products Company was the precaster.

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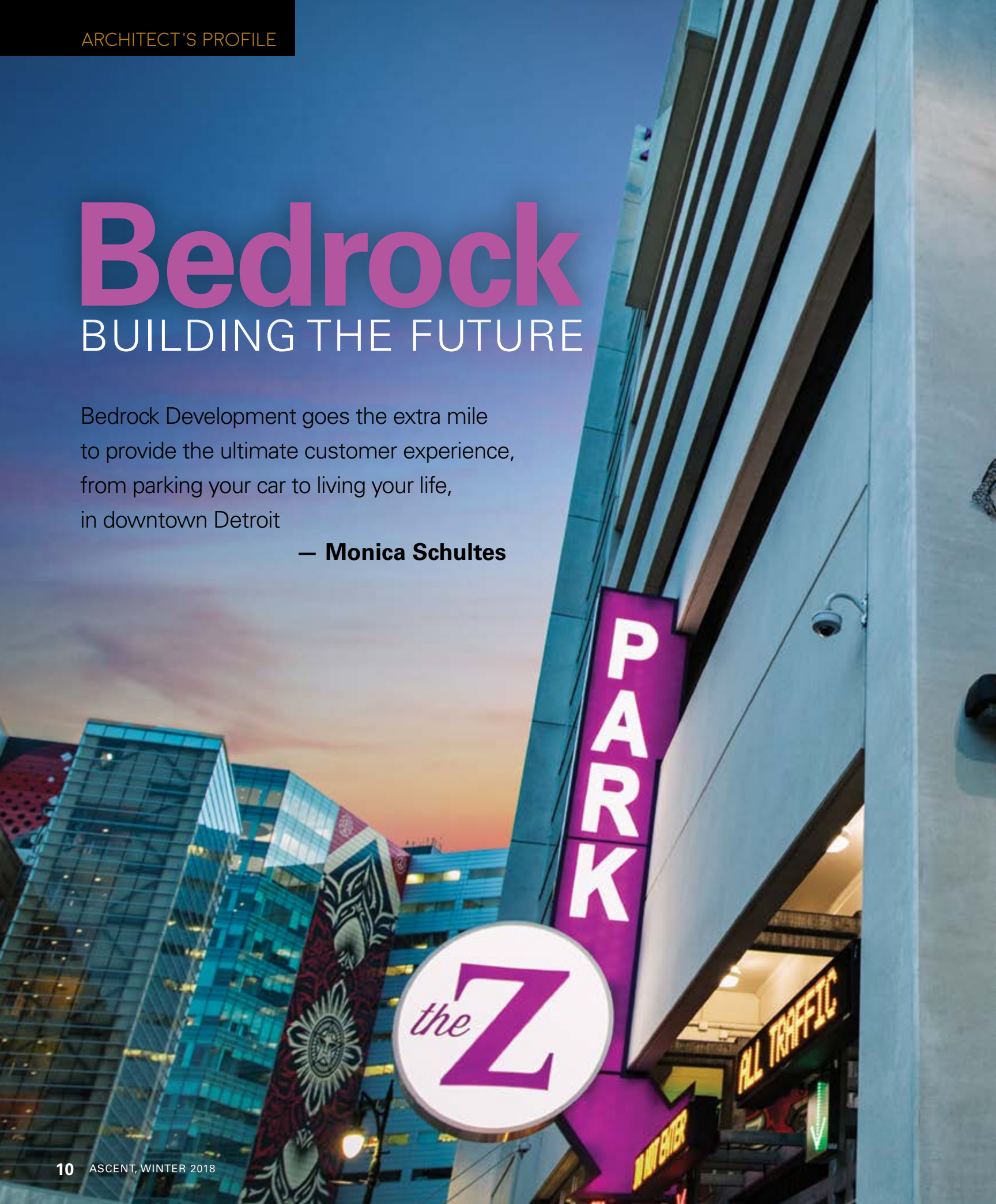

In six short years, Bedrock, a full-service real estate development firm, has built a portfolio of more than 90 properties in Detroit, Mich. Using the latest technology and a top-notch team, Bedrock aims to create unique experiences, from parking to shopping to living in the city.

Founded in 2011 and based in Detroit, Bedrock Real Estate Services LLC has already made a name for itself. They strive to be more than just a landlord by investing not only in real estate but also in public art and place-making. Their portfolio includes diverse properties that range from multifamily residential, office, commercial, and parking structures, all centered in the downtown business district of Detroit.

Cofounders Dan Gilbert and Jim Ketai launched the company with a single acquisition, a former movie theater that is now a hotbed of entrepreneurship, with several tech startups on the upper floors and a homegrown coffee roaster and local restauranteur on the street level. The purchase followed Gilbert's decision to move his Quicken Loans mortgage operation from suburban Detroit to the urban core. In the years since, Bedrock has invested millions in acquiring and developing downtown properties, in many cases taking painstaking measures to restore iconic architectural treasures designed by the likes of Albert Kahn and Minoru Yamasaki.

The first years were dedicated solely to this work, until Bedrock completed its first new construction project in 2013: "the Z" parking structure. This precast concrete structure is not your average parking deck.

MOTOR CITY MAKEOVER

While it goes about the business of uncovering, acquiring, developing, and managing undiscovered real estate opportunities, Bedrock is changing the face of downtown Detroit. The company understands that the architecture and the very structure itself, even a parking structure, is part of the user experience.

THE FUTURE OF PARKING

"The Z" represents what a parking structure could be. This ten-story structure with a three-dimensional style façade features custom artwork on every floor, retail and entertainment destinations, and an alley repositioned as a popular public space, complete with a beer garden, art gallery, and speakeasy craft cocktail bar. The 1282-car parking structure features 33,000 ft^2 of grade-level retail, restaurant, and office space facing Broadway and Library Streets. It is called "the Z" because the site is Z-shaped and straddles an alley surrounded by seven existing buildings. All photos: Bedrock.

'We want everyone, whether a visitor or resident, to begin and end their day with a positive experience.'

Kevin Bopp, Bedrock's vice president of parking operations, has been tasked with making parking downtown a memorable experience. "When we talk about parking, we make sure that all of our assets have clear, obvious signage, the facilities are clean, and there is a high level of security and awareness. We want everyone, whether a visitor or resident, to begin and end their day with a positive experience. For a commuter, a typical work day frequently begins and ends in a car."

"The Z," a parking structure constructed from precast concrete, was Bedrock's first ground-up construction project and the company's first parking-centric property. The challenge was to build a structure in an oddly shaped in-fill lot in a dense urban area, and to make it aesthetically pleasing. Bopp explains, "As we continue to grow from an aesthetic standpoint, without question, anything we design, develop, and build will be integrated into the cityscape. 'The Z' deck is a great example of that approach. Wherever there is parking, we take the 360-degree approach to fit into the landscape." Beyond its unique shape, the parking structure contains original floor-to-ceiling murals by nearly 30

PRECAST FAÇADE
The structure features a precast concrete façade with white cement and aggregates. Its bold geometric "picture frame" design is intended to reduce the scale of this 10-story structure. The precast concrete façade uses repetitive formwork to create the faceted picture frame panels. Shear walls to brace the walls for wind were strategically placed.

artists from around the world. As motorists wind their way up the structure in search of a parking space, they are essentially driving through an art gallery. (For more on "the Z," see the article on page 16 of the winter 2015 issue of *Ascent*.)

"We incorporate different textures and colors and utilize how light filters through. People don't want to see a gray box, and that is not what we plan to build," states Bopp. "When it comes to physical buildings, we do everything possible to preserve and protect the beautiful architecture that preceded us in the city. As it pertains to the parking, we do everything to augment existing properties." (For more on parking structure aesthetics, see the Aesthetic Showcase article on page 30.)

With respect to adaptive design, Bedrock believes in the benefits of planning for eventual reuse. In Bopp's opinion, "I don't think everyone will give up their cars in the next 20 years, but it is naïve to think change is not coming. Particularly in urban environments, car ownership is definitely going to change."

Unlike most cities and municipalities, Detroit does not have minimum requirements for parking. Parking minimums typically mandate a certain amount of parking spaces for specific uses, for example, three spaces per 1000 ft^2 of retail, or two spots per apartment unit. The absence of this ordinance allows Bedrock to give more thought and have more control when considering the importance of parking in the management of their assets.

FACE TIME

The sharing of real-time information with tenants is woven into the corporate culture at Bedrock. Bopp describes their dedication to communicating with their tenants. "The company has a social media platform that works in sync to keep tenants informed in real time. This is part of what makes Bedrock so special. It is not just one person. There is an entire team of individuals whose sole responsibility is to curate and deliver experiences to tenants, whether it is someone who rents 250,000 ft^2 or a 250-ft^2 micro-loft."

'There is an entire team of individuals whose sole responsibility is to curate and deliver experiences to tenants.'

Bedrock recently completed the construction of micro-lofts in Detroit's Capitol Park neighborhood. The 28 Grand project exemplifies the evolution of downtown Detroit from the vacant buildings of 20 years ago to today's youth-oriented market.

Designed for young residents, the new micro-lofts average 260 ft^2 and represent a trend in the rental market for hassle-free living space. The tiny apartments, which opened on September 1, 2017, feature large communal living spaces on the second floor and offer bicycle storage but no on-site parking.

The 13-story, 101,000-ft^2 building features 218 units, of which 133 will be rented at market rates and 85 reserved for residents who qualify for low-income housing credits as part of a program with the Michigan State Housing Development Authority. Kraemer Design Group worked with Kerkstra Precast to maximize the site limitations of the L-shaped parcel. The result is a total–precast concrete system with a contemporary feel. The façade features a thin brick veneer on the lower levels; the upper floors complement that finish with buff and gray concrete. The multifamily project is sited on a cast-in-place concrete podium with precast concrete hollow-core slab as the floor and roof system above. The wall on the north end of the building serves as both a fire wall and shear wall as the structure extends out to the property line.

PARK AND TECH

Bedrock does not use way-finding technology in parking structures yet. But they are vetting those ideas for future development projects. They do maximize parking structure lighting and other security features to improve safety and comfort in the structures. The electric vehicle charging station in the downtown "Z" deck is one of the most consistently used in the United States with ChargePoint technology. They are early adopters of technology and that makes the facilities stand out.

Like many forward-thinking companies, Bedrock is investigating autonomous parking, and plans to include it in their portfolio. Bopp is paying attention to the innovations that are shaping the parking industry. "Globally, people are paying attention to and will design more for adaptive reuse. For example, placing ramps

on the exterior and using level floor plates to optimize space for autonomous parking. This arrangement allows you to park more cars in a smaller footprint. There will also be better technology for charging stations or vehicles that can be used as batteries." (For more on adaptive reuse, see the Perspective article on page 62.)

"Existing structures probably are not a good fit for autonomous parking technology due to slopes on ramps and other challenges. We are exploring stacking systems and puzzle sliders of autonomous parking for new construction projects. We are actively exploring many different options for upcoming major development projects," says Bopp.

There are so many more options now as people become connected to ride-share services like Uber or Lyft. Even in the Motor City, major automakers and suppliers are investing in automation technology and shared-fleet services like Maven. Vehicles and parking structures will still be needed, but the landscape will be very different.

A lifelong Detroit resident, Bopp cites the changes occurring in the downtown area. "Woodward Avenue, once a major thoroughfare for vehicles, has been slowly converted to a walkable promenade. For communities to be healthy and thrive—especially urban cores—people have to be comfortable walking around, and that shapes our approach. The car has been part of the fabric of this city, but that is changing." Bedrock has impacted the commute with their involvement in extending the QLINE transit system. As the city grows and prospers and experiences a resurgence, mobility solutions are going to be integral to its long-term health and to creating neighborhoods and safe spaces.

As Bedrock looks to further redefine the experience of living, working, and playing in the City of Detroit, it will continue to consider precast concrete systems. Malek Eljizi, Bedrock's construction project director, explains, "The Detroit parking

28 GRAND

Micro-apartments are popular in other big cities, but a fairly new concept in Detroit. 28 Grand is an impressive 101,000-ft^2, 13-story, total–precast concrete apartment complex. This modern structure has been designed for retail and restaurants to be hosted on the first two floors, with residential above.

Bedrock Stats

- Over $2.2 billion invested in Detroit
- Over 15 million ft^2
- Over 8000 jobs created in Detroit
- Over 95 properties owned
- Over 15,000 Bedrock team members working in Detroit
- Over 160 tenants recruited to Detroit

SMALL SPACE, BIG PICTURE

The development may be large, but the units inside are not. The micro-lofts or tiny apartments are roughly 260 ft² and feature 9-ft ceilings and large picture windows that are 6 ft high and 10 ft long.

system consists of a majority of precast garages. It makes sense as a building system given the winter conditions we face. Precast gives us the flexibility of off-site production so that casting can take place simultaneously with site work."

While the benefits of precast concrete construction are not unique to Detroit, it will likely make use of the design flexibility and speed of construction as it redefines itself. Precasters have a powerful influence on the construction of these projects and will find themselves involved in the changing face of the Motor City. Incorporating the aesthetics that have become so vital to transforming parking structures into works of art starts at the precast concrete plant. In addition to the architectural contribution, the service life of these precast concrete structures can reflect the resiliency of its surrounding neighborhood.

MISSION ACCOMPLISHED

Detroit has been known as the poster child of abandonment, but around the city, vacant properties are being cleaned up, and that is just one of the ways the city is evolving. Bedrock is curating a new contemporary downtown experience. Having acquired or constructed an impressive stock of architecturally significant buildings, Bedrock looks to the future of the city. Their signature projects will leave a mark on the central business district and define it for decades to come.

Bedrock's investment in properties delivers a uniquely forward-thinking experience. Whether it is office, residential, retail, or parking, everything is done from a redevelopment standpoint to create world-class spaces. Bedrock's debut "Z" parking showed what attention to detail could do for a parking structure. Their next project is sure to elevate parking in Detroit to a new level.

Bedrock Moving Forward

Bedrock has announced that they plan to start on the Hudson's site, which will be the largest new construction in Detroit. Renderings reveal a tower that soars 800 ft high, complete with an observation deck. The 52-story, 1.2-million-ft² building will be the tallest building in Detroit to date and will contain apartments, office, retail, and entertainment space. The project is estimated to break ground in December 2017 and be completed by the end of 2020.

Bedrock has also unveiled plans for the "Monroe Blocks" development project, a plan to turn two vacant blocks east of Campus Martius Park into more than 800,000 ft² of new office and residential space. This project proposes a 35-story office tower along with residential and retail components. Construction is slated to start in early 2018.

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SHOREWOOD METRO MARKET

LOCATION
Shorewood, Wis.

PROJECT TYPE
Parking structure (and grocery store)

SIZE
265,000 ft²

COST
$22.4 million

DESIGN/BUILDER
Briohn Building Corp., Brookfield, Wis.

OWNER
General Capital Group, Fox Point, Wis.

STRUCTURAL ENGINEER
Pierce Engineers, Milwaukee, Wis.

PCI-CERTIFIED PRECAST PRODUCER
Spancrete, Waukesha, Wis.

PRECAST COMPONENTS
139,000 ft² of double tees, along with more than 45,000 ft² of columns, beams, and hollow-core, plus 63,000 ft² of architectural and structural wall panels and 21,000 ft² of solid wall panels

BLENDING STRUCTURES
The precast concrete helps the two structures blend together to create a unified appearance. Photo: Spancrete.

PRECAST PARKING OFFERS

Versatile Solution

Parking needs vary due to many factors, but precast concrete's flexibility, speed, economy, and other attributes make it the best choice

— Craig A. Shutt

Building types of every kind require parking, but the specifics of those support structures vary dramatically based on many factors: footprint, budget, location, and the demands of the structures they support. Designers find that precast concrete systems (often referred to as total–precast concrete structures) provide the design and construction versatility that makes them their first choice on many challenging projects.

The ability of precast concrete double tees and other structural framing to create long-span, open bays creates flexibility, and its ability to be erected quickly aids the schedule and ensures it's ready when the project's other facilities come online. Its aesthetic versatility allows any desired appearance to be created, while its high durability ensures it maintains its look while lowering maintenance costs. (For more on the benefits provided to parking structures, see the sidebar.)

The following examples show some of the various ways designers around the country have taken advantage of total–precast concrete structural systems and architectural precast concrete panels to meet a variety of challenges across different types of building functions.

SHOREWOOD MARKET

Aesthetics played a key role in the design of the parking structure built to support the Shorewood Metro Market in Shorewood, Wis., the first two-story Roundy's supermarket in the state. To alleviate congestion in the downtown district, executives commissioned a four-story, 265,000-ft^2 parking structure adjacent to the 90,000-ft^2 grocery. To blend the two structures, the parking structure was cast with spandrels featuring inset thin brick to match the brick used on the supermarket, which also was clad with precast concrete panels once it was value-engineered to create a consistent, efficient overall design.

"Parking has always been a challenge in this urban community, so the development team wanted to ensure accessibility and parking availability were at the top of the priority list," explains Clinton Krell, business development for Spancrete, the precast concrete producer that fabricated the components. "The accelerated construction and erection schedules provided an ideal opportunity for precast to demonstrate its versatility."

Precast concrete was chosen for the parking structure due to its speed of construction and ability to match the look of the brick-clad supermarket, which was constructed at the same time, says Dominic Ferrante, project manager for Briohn Building Corp., the design-build company on the project. "The total–precast concrete structural framing system gave us open spaces. The columns were larger, but it provided better flexibility for layouts." The precast concrete components comprised double tees, columns, beams, hollow-core, and architectural, structural, and solid wall panels.

The framing concept provided such an efficient design that, once Spancrete won the project, the two-story grocery store was value-engineered into a total–precast concrete structure as well.

'The accelerated construction and erection schedules provided an ideal opportunity for precast to demonstrate its versatility.'

"Casting components for both structures had to work together from schedule, design, and engineering perspectives," says Krell. That approach made it much easier to match the brick façades and create a unified appearance.

TIGHT PROJECT SITE WAS NO PROBLEM

Because of the busy downtown environment and the simultaneous construction of the store, no staging area was available on the narrow, restrictive site. "The precast concrete design allowed us to bring in pieces as needed by truck and pick and erect them immediately," Ferrante says. The design-builder worked closely with Spancrete early in the process to value-engineer the original design to reduce the number of panels and optimize their sizes to save time and piece count.

"Working with the brick panelized modules helped speed up construction compared to what would have taken place using masons," Ferrante says. "That was especially important since the supermarket was already under construction during the erection of the parking structure, so there was little room to maneuver." The complete erection took about one month.

Designers took advantage of precast concrete's inherent fire resistance to meet the fire rating requirements for the parking structure, which connects to the supermarket on the first level and on the third parking level (which corresponds to the grocery store's second level). Additional parking was provided on the roof.

THIN BRICK COMPLEMENTS STORE

The panels feature embedded thin brick and spandrels finished with an acid etch and sandblast finish. "Our goal was to create a look that was comparable and complementary, but not identical," explains Ferrante. "We didn't want to hide the function, which could confuse shoppers and others using the building. The tenant liked the use of brick, so we went over several choices for the colors to use on the parking structure and agreed on a final look."

The result was a finished design that provided durability and an attractive appearance that complements the adjacent supermarket. "The developer saw the value that could be provided in low maintenance and structural integrity with a precast concrete structure," says Krell. "It also showed the design capabilities that allowed us to match the surrounding community aesthetics."

The design created a unified look for the two very different structures. "The urban environment for this project created an ideal opportunity to showcase the prefabrication benefits of precast: no staging, immediate installation, and minimal site disturbance," says Krell. "These precast attributes resulted in an accelerated construction schedule and reduced the congestion and disruption to the community on a complex and vital project for the Milwaukee area."

'Our goal was to create a look that was comparable and complementary, but not identical.'

CONNECTIONS MADE
The parking structure connects to the supermarket on the first level and on the third parking level, which corresponds to the grocery store's second level. Additional parking is located on the roof. Photos: Spancrete.

COLORS CONTRAST
Several colors of brick were used to create contrasts and break up the visual scale of the buildings.

COMBINED FOOTPRINT
To fit office and parking needs onto a tight footprint for Celgene's new offices in Summit, N.J., designers created a four-story total–precast concrete parking structure that supports two levels of steel-framed office space. Photo: Highland Associates.

CELGENE OFFICE

Precast concrete performed double duty for a new office building on the Summit, N.J., campus of pharmaceutical company Celgene. Officials wanted to double the size of their campus by adding a 540,000-ft^2 building, but a limited footprint on a sloping hillside precluded allotting any additional space for parking.

Designers resolved that issue by building a four-story total–precast concrete parking structure that supports two levels of steel-framed office space. The 400,000-ft^2 building provides space for 948 cars without dominating the company's campus.

"The client was doubling the size of the campus in one new building, and with that quantity of employees, there needed to be adequate parking," explains Ross Rosen, project engineer at Turner Construction Co., the general contractor. "Because the site was developed to the max, the only solution was to put the parking underneath the building."

Designers exploited the large grade slope to allow parking to be accessed at grade on one side and the offices to be entered from the other side at higher grade. "The sloping site and adjacent wooded area played heavily into the design," says Eric Scott, senior associate and project manager for Highland Architects, the architectural firm on the project.

'Because the site was developed to the max, the only solution was to put the parking underneath the building.'

A 50-ft-tall modular-block retaining wall was constructed into grade to hide the parking levels from the pedestrian entry, reducing the building's profile. The retaining wall also provided ventilation and allowed the structure to be constructed without temporary shoring.

CELGENE CORPORATE HEADQUARTERS

LOCATION
Summit, N.J.

PROJECT TYPE
Parking structure with office building above

SIZE
400,000-ft^2 four-story parking structure supporting 140,000-ft^2, two story office building

DESIGNER:
Highland Associates, New York, N.Y.

OWNER
Celgene Corp., Summit, N.J.

STRUCTURAL ENGINEER
Innovative Engineering Services, Fort Wayne, Ind.

CONTRACTOR
Turner Construction Co., Somerset, N.J.

PCI-CERTIFIED PRECAST PRODUCER
Dailey Precast, Shaftsbury, Vt.

PCI-CERTIFIED ERECTOR
JEMCO Erectors Inc., Shamong, N.J.

PRECAST COMPONENTS
823 pieces, comprising double tees, columns, beams, lite walls, shear walls, stair and elevator walls, and spandrels

PRECAST SPEEDS CONSTRUCTION

Precast concrete was chosen for the parking levels to prefabricate as many components as possible. This work sped up construction, as fabrication could begin while site preparation was completed, and it removed congestion and additional trades from the busy campus. Dailey Precast fabricated the precast concrete components, which were erected by JEMCO Erectors.

The parking levels were designed to contrast with and enhance the office floors above. "Since the office portion was going to be above the precast concrete parking, it was very important for the parking design to complement the building," says Eric Scott, managing architect at Highland Associates. "We wanted the precast to act as a light base for the solid-looking office levels." The parking levels feature an open design with bright spandrels cladding the exterior. White cement with color pigments was used on the exterior pieces, while a gray mixture was used on the inside.

> 'We wanted the precast to act as a light base for the solid-looking office levels.'

The mixtures were custom-batched in Dailey's automated mix plant. "Although the garage primarily uses structural precast concrete to support the building, we understood finish was important to the team and client," says Eric Subik, senior project manager at Dailey. "Therefore, each piece received a project-specific sandblast to match the control that was established by Highland Architects during the plant tour."

LOWER COSTS
On-site construction costs were lowered by providing pretopped double tees with drain frames already cast in. Photo: JEMCO Erectors.

Speed was also a driving factor, he adds. "We understood the importance of schedule to the project team and the desire to minimize cast-in-place toppings, particularly as the garage erection was completed just before winter. Our total–precast solution increased quality and lowered on-site construction costs by providing pretopped double tees with drain frames cast in under factory conditions at the plant."

SUPPORTING OFFICE LEVELS

Determining the best way to support the office levels created the most difficult challenge for the project. Due to city height restrictions, a transfer deck couldn't be added between the parking structure and offices to help handle the load. Instead, the offices' steel column loads were transferred to footings via additional precast concrete columns, shear walls, and lite walls added into the parking structure's levels. Additional attention was paid to separating the parking levels from the office floors to deaden acoustics.

"We spent a good amount of time with our consultants, design team, and steel and precast concrete subcontractors discussing issues," says Scott. The team ultimately decided to drill and epoxy anchor bolts into the precast concrete columns for the office's structural steel. That eliminated the issue of differing tolerances between the structural steel and the precast concrete.

Designers made use of the sloping site, allowing the office building to sit on the highest grade, which conceals the parking base. Traffic is directed down the hill to the parking entry, providing a natural division between pedestrian and vehicular arrivals.

"It was a logistical challenge to work around the hill, which restricted our maneuverability," says Matthew Mozitis, JEMCO owner. "There was a major amount of earth excavated before we could begin, but the retaining wall helped us get in closer." The erectors started against the hill and worked outward.

The added columns erected in the precast concrete structure to create the office levels' support grid created challenges for maneuvering the crane into the proper position. The precast concrete was erected with a 2250 crane, while the later steel

LOWER COSTS
On-site construction costs were lowered by providing pretopped double tees with drain frames already cast in. Photo: JEMCO Erectors.

erection was completed with a Link-Belt crane. A handful of precast concrete columns were erected with a mainframe crane due to the long reach needed to place them.

Delivery to the site was also difficult, he adds. "Staging was a nightmare," says Mozitis. Drivers had to negotiate a hairpin curve down the 15% grade and maneuver around a large oak tree that had to remain in place. The erectors cut into the hill's bank behind the tree to provide sufficient room to maneuver into position. The trucks then backed down the hill to position the truck bed so components could be picked and set. "It wasn't an easy process, but everyone bought in, and it moved well once we set up the system."

LEED CERTIFICATION ACHIEVED

The precast concrete helped the building achieve LEED certification, especially through the use of local materials and local manufacturing, as well as reductions in construction waste and other measures. "Material and proximity played a large role in helping us achieve certain credits," Scott says.

Attention to detail ensured the project reached its goals, both functionally and aesthetically. "There was a working relationship to get the ideal final product from a design and cost standpoint," says Scott. "Designers went to the precast facility and watched the sandblaster rough up surfaces to select the exact right amount for the finish and overall aesthetic."

The result was a compact, two-function building on a tight footprint on the only available campus space. "The building design minimized massing by using existing grades as well as a creative mix of glass, curtain wall, and brick," says Scott. "It maximized views to the outdoors while flooding interior spaces with daylight."

UNIVERSITY OF MISSISSIPPI

Site logistics were a key concern for the design and construction team on the massive new parking structure at the University of Mississippi in Oxford, Miss., where previously eliminated spaces and a need for expansion led officials to create an eight-story, 485,000-ft^2 facility.

The site's sloping grade not only had to be excavated so the structure could be fit into the side of the hill, but the location was in a high seismic zone, requiring a flexible structure able to withstand a seismic event. Designers created a total–precast concrete structural system and clad it with architectural spandrels that had the university's classic brick color integrally cast in to help it blend with other buildings.

"It was a very challenging site," says Rob McConnell, vice president in the Parking Solutions division of Carl Walker Inc., a division of WGI. Stepping the lower two levels of the 1532-car facility into the hillside created various challenges, but it also helped reduce the perceived mass of the building and disguise its horizontal nature.

"The hill, along with the architectural design, helped downplay the robust size of the building and its horizontal lines of openings," McConnell says. The design also helped maximize daylight and natural ventilation, avoiding the need for mechanical systems. Ramping was placed in the center bay to balance required earthwork, structurally separate the earth retention from the superstructure, and preserve the shape of the perimeter façade. Ramping on the second level had to be shifted to the end, however, to allow more punched openings on that floor where it was open to daylight.

"We had to be a little creative on the lowest two floors to ensure enough natural ventilation despite the barriers and the need to balance architectural design with the need to create openings," says McConnell.

LONG-SPAN TEES USED

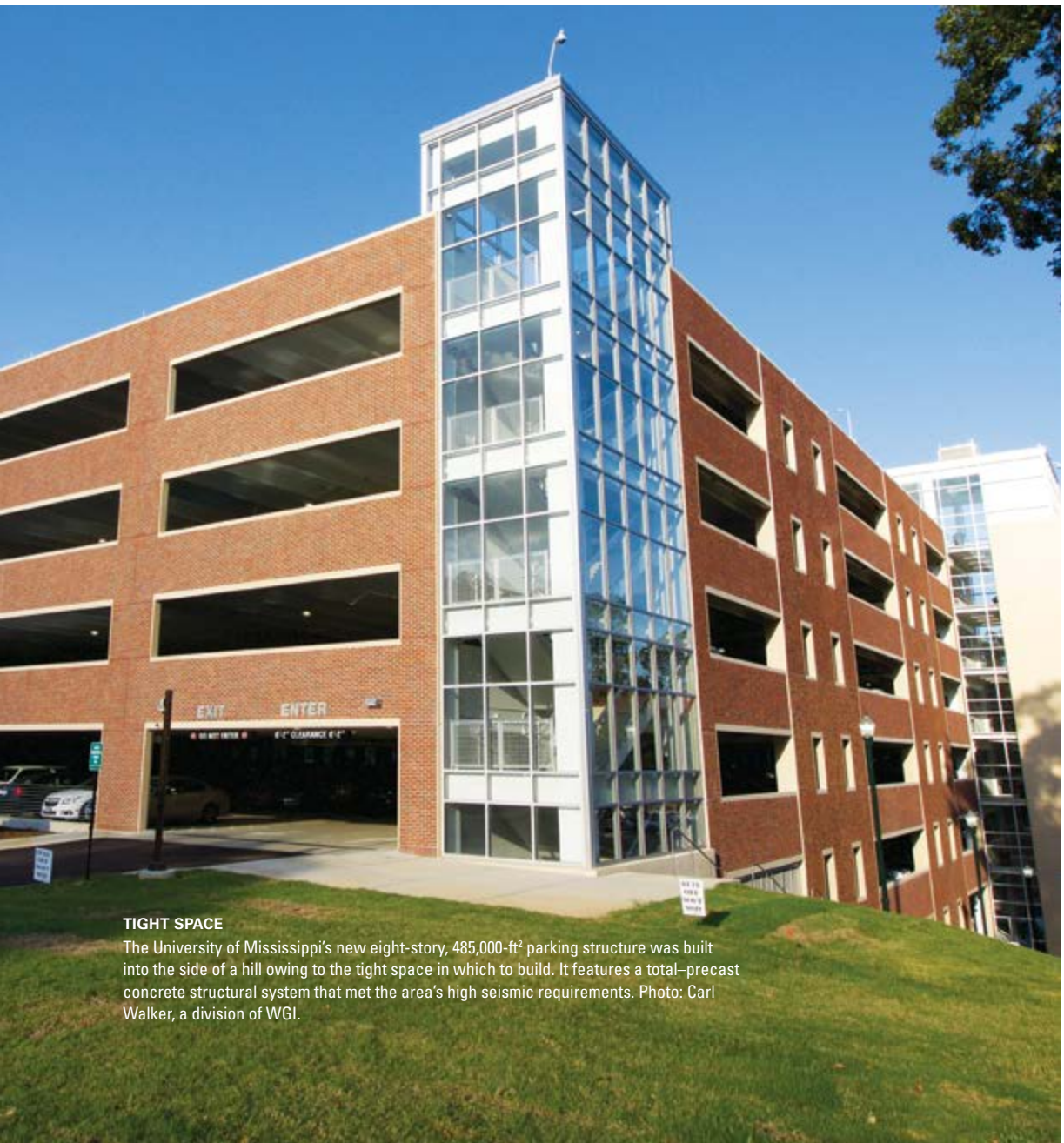
The structural frame consists of precast concrete components, comprising long-span, field-topped double tees spanning from perimeter spandrels to interior lite walls, along with inverted-tee beam and L beams. Gate Precast Co. fabricated the precast concrete components. The structure is supported on a deep foundation system consisting of augured, cast-in-place concrete piles and pile caps that support both the cast-in-place concrete retaining walls and the precast concrete superstructure.

"The precast detailing allowed superstructure erection to proceed with only a nominal two-inch gap between the precast and the adjacent walls in place," McConnell notes. "Having the earth-retention system separated from the superstructure allowed us to create standard precast connections, using economical anchor bolts and bars/grout splice sleeves."

In addition to its precision, precast concrete was specified due to the aggressive schedule. "We had one year from assignment to completion," McConnell reports. "We looked at cast-in-place, post-tensioned options, but precast concrete offered the best choice."

A key benefit came from precast concrete's ability to combine structural and architectural elements into one component, saving casting and erection time as well as material costs. "Once we understood that precast concrete presented the most appropriate façade treatment to meet the university's needs, it became obvious that a precast concrete structure would be the most economical and fastest."

'We looked at cast-in-place, post-tensioned options, but precast concrete offered the best choice.'



TIGHT SPACE
The University of Mississippi's new eight-story, 485,000-ft² parking structure was built into the side of a hill owing to the tight space in which to build. It features a total–precast concrete structural system that met the area's high seismic requirements. Photo: Carl Walker, a division of WGI.

UNIVERSITY OF MISSISSIPPI PARKING STRUCTURE

LOCATION
Oxford, Miss.

PROJECT TYPE
Parking structure

SIZE
485,000 ft²

COST
$29.5 million

DESIGNER
Eley Guild Hardy Architects, Jacksonville, Miss.

OWNER
University of Mississippi, Oxford, Miss.

STRUCTURAL ENGINEER
Carl Walker Inc., a division of WGI

CONTRACTOR
BL Harbert International, Birmingham, Ala.

PCI-CERTIFIED PRECAST PRODUCER
Gate Precast Co., Monroeville, Ala.

PRECAST SPECIALTY ENGINEER
Midwest Structure Engineering, Inc., West Allis, Wis.

PRECAST COMPONENTS
329 pieces, comprising long-span, field-topped double tees spanning from perimeter spandrels to interior lite walls, plus inverted-T and L beams, shear walls, lite walls, stair components, and load-bearing and nonload-bearing spandrels

HIGHER HEIGHTS
The 12-ft floor-to-floor heights accommodate large vehicles and help maximize lighting levels, creating a feeling of openness. Photos: Carl Walker, a division of WGI.

It also reduced site congestion, which was critical as there was no available staging area. The site was virtually blocked by the hillside at its back and existing landscape that had to be preserved, providing little room for maneuvering. "Between the site restrictions, the schedule, and other factors, it was apparent that cast-in-place concrete wouldn't have been able to meet our needs."

REDUCED CONGESTION
The precast concrete design reduced site congestion, which was complicated by the tight site and landscaping that had to be preserved.

SEISMIC NEEDS MET

To meet the high seismic zone requirements, special precast concrete shear walls were used to resist seismic loading and limit lateral deflections under design loads. Openings in the shear walls were located just above slab level in the ramped and flat bays. Gate Precast's crews alternated the openings in the shear walls, depending on the wall's ultimate location. The lowest panels had the greatest quantity of bars or grouted splice sleeves, gradually reducing with height up the wall. Four shear walls were used in each half of each floor's short dimension, with two used in each half in the long direction. An expansion joint was placed at the structure's center due to the floors' length.

Stair towers were constructed at each corner, but they were not structurally isolated from the main structure. "Tying the stairs to the main structure eliminated the need for expensive expansion joints, but it increased the risk of undesirable structural restraint during volume-change displacements," McConnell explains. To resolve this issue, stairs were stick-framed with precast concrete beams and columns rather than solid walls. "It provided a relatively flexible structure to accommodate volume change

displacements and keep the stairs visibly open, maximizing user comfort and passive security."

Openness was a key ingredient in the design, with generous 12-ft floor-to-floor heights used throughout to accommodate large vehicles and help maximize lighting levels. "They provided a uniformity that offers users an enhanced feeling of openness and comfort," says McConnell. The interior was painted white to further enhance light distribution.

Openness was a key ingredient in the design.

Extensive coordination between the design team and the precast concrete detailers was required to achieve the desired university architecture. Brick coursing, panel size, location and detailing of sills, concrete colors, and sandblasting levels were among issues addressed in the design phase with Gate's team. Key issues focused on the length of the sandblasted bands at the top and bottom of spandrels on each level and planning when the spandrel ends, and column covers would have brick cast in, which affected the start and end of the chamfers in the face and back.

The façade design incorporated modern precast concrete construction techniques to provide a historic look consistent with the overall Georgian-style campus architecture. Architectural spandrels were cast integrally with cut versions of the campus standard brick with a limestone-colored face mixture and sandblast finish to match the surrounding campus style. The spandrels are supported on the exterior face of the perimeter columns with brick-clad column covers provided above and below the spandrels.

SEISMIC NEEDS
Stair towers were stick-framed with precast concrete beams and columns rather than solid walls to create a relatively flexible structure to accommodate volume-change displacements and keep the stairs visibly open. Photo: Carl Walker, a division of WGI.

SMOOTH ERECTION
Erection of the structure began with the crane in the center-bay location working from the south end northward. Components were delivered by truck and picked from them using just-in-time delivery methods due to the tight site. Photo: Carl Walker, a division of WGI.

CONSTRUCTION MOVED SMOOTHLY

Erection of the structure began with the crane in the center-bay location working from the south end northward. Components were delivered by truck and picked from them using just-in-time delivery methods due to the tight site.

The site was so restrictive that the university constructed an access road behind the building.

The site was so restrictive that the university constructed an access road behind the building to alleviate the need to deliver through steep grade changes and tight curves. "The university really helped by creating that road," McConnell says. Now, university officials are considering leaving the road in place and making it the first leg of a ring road to provide better access throughout campus. "They built a legitimate roadway that may have long-term benefits."

Certainly, the parking structure itself will provide benefits for many years to come. Although no parking spaces compliant with Americans with Disabilities Act (ADA) standards are currently located in the structure, designers ensured the floor slopes and structural clearances allow for future ADA-compliant parking. "The structure's vehicle and pedestrian access points on three floors, along with its interior geometry, can provide ADA pedestrian routing through the structure," says McConnell. "That can allow the structure to connect areas of the campus that would otherwise not have an ADA-accessible route."

These projects show some of the ways designers are using total–precast concrete structural systems and architectural panels to create attractive, economical, and efficient designs. Whether challenges are structural, aesthetic, schedule- or budget-based, or site- or time-restricted, precast concrete producers can help meet any need.

Total–Precast Concrete Benefits

A total–precast concrete structural system and architectural façade provides a variety of benefits to owners, designers, engineers, contractors, and users of all types. These benefits include:

- **Open interior spaces** that maximize parking layouts and provide secure environment. Double tees can span long distances to eliminate columns. Moment frames, K frames, lite walls, and other structural supports can further open interiors and smooth traffic flow.
- **Fast occupancy** ensures readiness when other buildings are completed. Component casting begins when the shop drawings are complete, ensuring erection begins when the site is prepared. Year-round, all-weather construction ensures schedules are met.
- **Maximized green space.** Building precast concrete parking levels beneath levels for other functions limits the building footprint, leaving more space for plazas. Resilient double tees can provide sufficient support for landscaping and other green elements on roofs.
- **High durability.** Concrete mixtures and high-quality, plant-produced components ensure resistance to chloride penetration from deicing chemicals. High-quality façades require little cleaning or maintenance to retain their aesthetic appeal, while panelized, cast-in brick never requires tuckpointing, as laid-up brick does.
- **Easily planned drainage.** Precast concrete producers align joint placement and drainage in floors to meet the needs of each unique design.
- **Easy long-term maintenance.** Maintenance is minimized via annual inspections of key joints and routine recaulking at long-term intervals. Bonded prestressing strand positioned deep in the double tee, beam, and spandrel sections provide maximum protection and performance over the life of a parking structure.
- **Minimized congestion and safety concerns** on the site and in the general vicinity during construction. Precast concrete components are cast off-site to alleviate activity while other on-site construction is under way, and they can be brought to the site as needed for that day's erection.
- **Meet seismic needs.** Precast concrete systems use proven connection technology that allows precast concrete components to be used in all seismic zones.
- **Reduction in visual scale** to avoid overwhelming or dominating the landscape. Precast concrete's aesthetic versatility allows designers to create the appropriate aesthetic look, whether historic or contemporary.

AN INTEGRATED SOLUTION FOR

Insulated Precast

Photos courtesy of U.S. Department of Energy

About Thermomass

We manufacture a complete line of insulation systems for use in precast concrete projects. Throughout our 35-year history, we have worked hand-in-hand with clients on thousands of projects to create buildings noted for their energy-efficiency, durability, and performance. We are the industry leader in high-performance concrete sandwich wall technology because we believe in offering three key advantages:

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SPOTLIGHT

NREL Energy Systems Integration Facility

The Energy Systems Integration Facility (ESIF) at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) is a state-of-the-art facility for the research, development, and demonstration of advanced strategies and components in modern, clean energy technologies.

The ESIF's LEED™ Platinum certified design includes energy saving features like natural ventilation, enhanced daylighting, radiant heating and cooling, and Thermomass-insulated precast concrete panels.

Using edge-to-edge System NC insulation, Thermomass helped the ESIF project meets its goal of a 40 percent greater performance efficiency than the baseline ASHRAE 90.1 building standard. The integral insulation also provides for a strong, durable building envelope, ideal for use in areas where new, unproven, or potentially hazardous equipment and processes are under evaluation.

thermomass®

CONRAC SAN DIEGO
Photo: Pablo Mason Photography.

Precast Parking Façades

SHOWCASE FORM and FUNCTION

Precast concrete aesthetics are essential for a sense of architectural continuity, creating a positive image for a parking structure

— Monica Schultes

Parking structures have an important architectural function. They are the gateway through which customers, visitors, commuters, or employees pass before entering a building. The approach to designing parking structures establishes the tone for a place and gives the first impression of the space.

When real estate costs or site limitations necessitate an elevated parking structure, owners and developers look for cost-effective, engaging, beautiful solutions to support all types of commercial, residential, and municipal parking needs. The increased emphasis on aesthetics is at the forefront of design requirements. The days of plain, gray boxes for cars are over.

Innovative owners and designers are taking advantage of the unlimited design freedom of precast concrete. Colors, textures, and finishes that are available to clad a high-end structure can also be rendered onto the façade of a parking structure. The aggregates, colors, and finishing techniques translate into almost any color, form, or texture specified by the designer.

In today's high-resolution, touch-screen environment, color and texture are paramount to the end user. Texture can express the inherent beauty of natural materials (such as sand and aggregate) or accentuate the relationship to light to create a range of exposure to the sun. Whether subtle or dramatic, these façades capture the desired appearance and design intent.

If a parking structure's location demands the use of brick, stone, or formliners, they can be easily incorporated into a precast concrete panel system to enclose the structure while also serving as a vehicular barrier.

The following parking structure examples feature designs that avoid the flat, heavy spandrels traditionally associated with parking structures, replacing them with a variety of options that provide both exciting form and efficient function.

BLENDED PARKING: HILL CENTER BRENTWOOD PARKING STRUCTURE

A suburb of Nashville, Tenn., Brentwood is one of the wealthiest cities in the United States. So it is no surprise that aesthetics were of preeminent importance in the design of the Hill Center Brentwood mixed-use campus comprising retail and office buildings. Hill Center Brentwood features office space, retail, and dining options in a one-stop shop, work, and play destination.

This first parking structure in the development had to complement the urban/suburban feel of the upscale, mixed-use development. The owner wanted to reimagine and refurbish the existing configuration and incorporate walkability and connectivity to adjacent properties with the new construction.

"Inlaid brick is a favorite in the Brentwood area, so it was used to give a modern feel to the design," describes JP Cowan, associate principal with TMPartners PLLC. "The owner was open to ideas that would create an attractive garage. We suggested a cascading corbel brick to provide interest to the façade and worked closely with the brick manufacturer and Gate Precast to make sure our design was economically feasible and within budget."

The parking deck is a six-tier, 873-space, cast-in-place concrete structure clad with precast concrete panels.

Four brick types were used along with three varying precast concrete thicknesses. The varying thickness allowed the architect to create depth along the façade and break up the long elevations. The protruding brick detail features a random pattern that increases in density from the bottom to top of the panels.

HILL CENTER BRENTWOOD PHASE 1.1, GARAGE "D"

LOCATION
Brentwood, Tenn.

DESIGNER
TMPartners, Brentwood, Tenn.; Cooper Carry, Atlanta, Ga. (associate architect)

OWNER
H.G. Hill Realty Company, Nashville, Tenn.

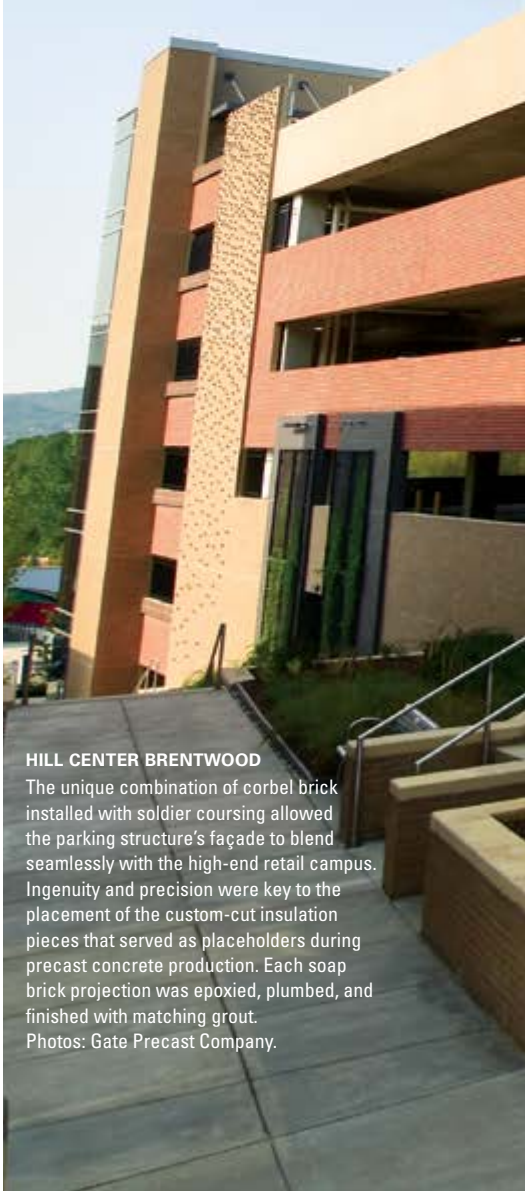
ENGINEER
EMC Structural Engineers, Nashville, Tenn.

CONTRACTOR
Turner Construction, Nashville, Tenn.

PCI-CERTIFIED PRECASTER
Gate Precast, Ashland City, Tenn.

PCI-CERTIFIED ERECTOR
Ben Hur Construction, Indianapolis, Ind.

PRECAST COMPONENTS
Architectural precast: 27,560 ft² brick, four unique projected (corbel) brick panels



HILL CENTER BRENTWOOD
The unique combination of corbel brick installed with soldier coursing allowed the parking structure's façade to blend seamlessly with the high-end retail campus. Ingenuity and precision were key to the placement of the custom-cut insulation pieces that served as placeholders during precast concrete production. Each soap brick projection was epoxied, plumbed, and finished with matching grout.
Photos: Gate Precast Company.

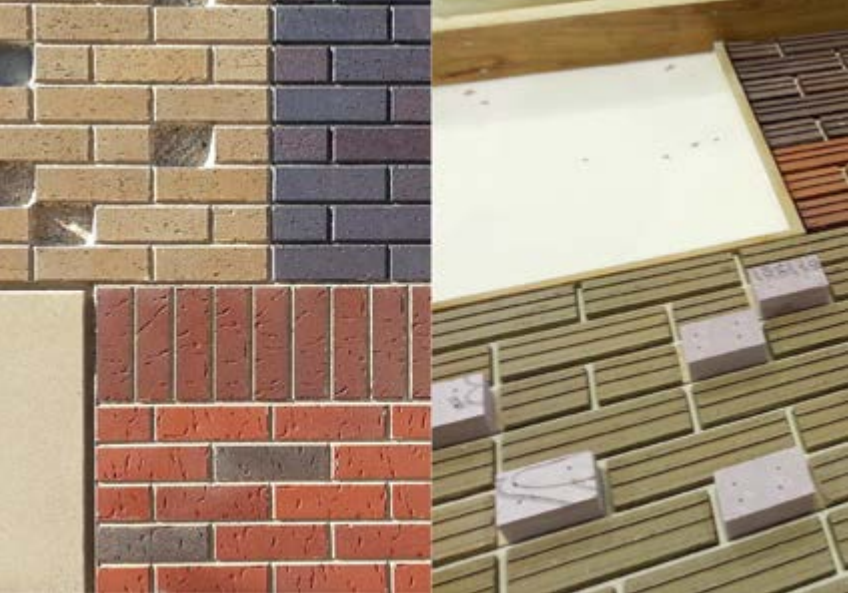


Photo: Gate Precast Company.

In addition to the unique corbeled brick, each elevation includes precast concrete panels that display soldier coursing for headers and contrasting light and dark brick. Highly detailed precast concrete elevation drawings via building information modeling were paramount in accurately achieving the architect's vision.

One side of the parking structure is adjacent to the office building. Stairs connect the anchor tenants to a landscaped elevated plaza. Cowan explains, "We knew the upper paseo would be a very pedestrian-intensive space and as such we wanted to provide an attractive visual and not just a plain spandrel on that side. We also collaborated with a landscape architect to incorporate a green screen with vines growing up the panels."

"There is variation to the brick with a light stipple that differs from top to bottom. TMPartners brought their idea to Gate Precast and they developed shop drawings that detailed how they would fabricate it," says Cowan. "They took the idea of the random pattern and ran with it."

A lighting designer was consulted to highlight the three feature panels, including two along the adjacent city street. A large light fixture was installed below and shines upward. The combination of the stipple effect and light fixtures creates unique shadow patterns.

The three glass stair towers were designed to add plenty of light and improve the safety and ease of use. They are also very prominent, promoting the use of stairs as a healthy alternative to taking the elevator.

The response has been favorable and the parking structure blends seamlessly with the high-end shops. The City of Brentwood Planning Commission had to approve the elevations prior to construction. "They would not have agreed to a plain concrete structure, so we knew we would have to provide a fabulous façade," reflects Cowan.

SCENIC VIEW: HIGHWAY 610 AND NOBLE PARKWAY PARK & RIDE

The design of the Park & Ride facility in Brooklyn Park, Minn., creates a striking statement along the Minnesota State Highway 610 corridor. The stark white precast concrete finish was selected because the project is situated next to a highway with high-volume, fast-moving traffic. "We wanted to create a nice-looking parking garage," recalls Tyson McElvain, senior associate/architect at Snow Kreilich Architects. "We wanted to craft something simple, yet bold enough to create a statement along the road."

To reduce headlight glare and deflect light away from adjacent properties, all parking ramps in the region require headlight stops. Given the size of the project, precast concrete was the economical choice. "The precast was economical for its panelized construction, timing, sequence, and potential range of finishes that allowed us to create a unique façade for this garage," explains McElvain.

The design reflects the scale and the view from the highway as well as the horizontal nature of the site. The prairie grass and snow drifts that are commonplace in south central Minnesota were the inspiration for the undulating precast concrete façade panels. "We like to use white; the faceted façade gets a lot of shadow play during the day and throughout the changing seasons. It looks different set against the prairie grasses and fields during the summer and the windswept snow in the winter," describes McElvain.

The subtle transformation of a flat precast concrete panel was achieved by simply pulling two points along the panel's surface.

The pattern is mirrored and rotated so that each panel is different from its neighbor across the random façade. The white was chosen after a lengthy selection process to find the right combination of aggregate and pigment with a light acid etch.

Black precast concrete panels hide the mechanical and storage elements of the parking structure and form the base of the facility, creating a sharp contrast. The dark precast concrete panels are often overlooked, yet they set off the white and create two distinct stripes of snowy ripples. The black panels were achieved using both aggregate and pigment with a heavy acid etch finish.

The two vertical circulation towers are pulled out from the ramp and create beacons along the western façade. "The ramps are separated from circulation of the garage for a few reasons. First is safety: the additional glass provides a passive deterrent against crime and feels more open. Second, the towers help to orient pedestrians and drivers around the garage anywhere on the site. The ramps pulled out from the structure allowed for a cleaner footprint to maximize parking," clarifies McElvain.

Benches, native plantings, and trees create a public plaza near the bus stop for users to gather around the facility and softens the edges of the site. The north stair tower is slightly enlarged to provide shelter for travelers while they wait for the bus. The combination of real-time signage in the enclosure creates a small community space. The precast concrete benches and planters used in the plaza match the dark color from the parking structure.

McElvain muses that in the future they would like to take advantage of building information modeling software and three-dimensional modeling to push the limits and increase the customization of precast concrete panels. "Rhino or Grasshopper [software] can be quickly programmed to develop iterations and be exported to a robotic arm for fabrication. That is the future of precast concrete façades."

HIGHWAY 610 AND NOBLE PARKWAY PARK & RIDE FACILITY

LOCATION
Brooklyn Park, Minn.

OWNER
Metropolitan Council (Metro Transit), Minneapolis, Minn.

ARCHITECT
Snow Kreilich Architects, Minneapolis, Minn.

ENGINEER
Stantec, St. Paul, Minn.

CONTRACTOR
Knutson Construction, Minneapolis, Minn.

PCI-CERTIFIED PRECASTER
Gage Brothers, Sioux Falls, S.D.

PCI-CERTIFIED ERECTOR
Amerect Inc., Newport, Minn.

PRECAST COMPONENTS
Architectural precast: 64 spandrels, 54 stair tower panels, 41 base panels and infills, 6 seat walls

PARK & RIDE
The parking structure off Minnesota Highway 610 is a subtle alteration of an otherwise straightforward layout. White precast concrete panels were transformed by pulling two points along the surface, converting an otherwise static façade into one that changes with light and shadows throughout the day and the year. Black precast concrete panels form the base of the facility and are a sharp contrast against the white panels. Photos: Gage Brothers.

CONRAC SAN DIEGO
The San Diego airport's consolidated rental car center drive ramps are clad in white helix architectural panels and follow the trajectory of the ramp's corkscrew shape. Panels are trapezoidal in shape and have vertical and horizontal ribs at the back to connect to the spandrels above and below. The panels provide the sculptural look the architect intended, helping to break up the quarter-mile-long structure. Photo: Pablo Mason Photography.

CALIFORNIA COOL: RENTAL CAR FACILITY AT SAN DIEGO INTERNATIONAL AIRPORT

The new 2,000,000-ft^2 consolidated rental car center (ConRAC) at the San Diego, Calif., international airport is a facility that can house up to 19 rental car companies and 5400 cars. This high-profile project represented a major milestone for the city and its residents. Precast concrete played a key role with its unique cladding solution that satisfied both the public and the airport authority's expectations.

"Our challenge was to take an enormous utilitarian concrete structure—the façade is one quarter mile long—and elevate its typical concrete parking structure appearance by applying architectural treatment to achieve a higher level of aesthetics," says Tony Demattei, president of Demattei Wong Architecture. "The airport was instrumental in pushing for a higher level of exterior finish to represent their perceived result: to provide a state of the art ConRAC facility and to reflect the retail rental car functions within the structure itself."

"The precast offered a high quality of finish and added a consistency that was not achievable with other materials" explains Demattei. "The faceted design itself reflects light which varies during the day and adds a sense of movement to the overall appearance. In addition, LED lighting adds a complementary accent at night and is programmable to achieve any color desired. The lighting accentuates the faceted aspects of the precast façade and gives the overall structure the visual interest and relief that it needs."

The sheer size and scope of the ConRAC piqued public and political attention from the early stages, as a project of this magnitude had not previously been attempted in San Diego.

SAN DIEGO INTERNATIONAL AIRPORT CONSOLIDATED RENTAL CAR CENTER

LOCATION
San Diego, Calif.

OWNER
San Diego County Regional Airport, San Diego, Calif.

ARCHITECT
Demattei Wong Architecture, Burlingame, Calif.

ENGINEER
Parsons Brinkerhoff with Kleinfelder Inc., San Diego, Calif.

CONTRACTOR
Austin Sundt Joint Venture, San Diego, Calif.

PCI-CERTIFIED PRECASTER
Clark Pacific, West Sacramento, Calif.

PRECAST COMPONENTS
Architectural precast: 850 total panels, 300 plant assemblies for a total of 1150 pieces

Furthering the public interest was the rental center's highly visible east border on the airport campus, which increased the rigorous scrutiny.

"The folded panel creates a three-dimensional appearance and avoids the typical flat spandrel, especially because of the length of the building," explains Dematteі. The typical spandrel panels are almost 9 ft tall and have a triangular cross-sectional shape. Most of these spandrels also received gray crash-wall panels that were plant-assembled before being transported to the jobsite. Clark Pacific also manufactured 80 diamond-shaped infill column cover panels that were attached at the top and bottom to the adjacent spandrel panels. Vehicles enter and exit the parking structure by way of two helical drive ramps that service all four floors of the building. These cast-in-place concrete drive ramps are also clad in white architectural precast concrete spandrel panels.

The ramp panels have a cross section similar to those on the main building; however, these spandrels have to follow the trajectory of the ramp's corkscrew shape. Thus, the helix spandrels have a triangular section that follows a radius with a "twist" built into the profile to follow the ramp as it climbs from floor to floor. The infill wall panels that clad the stair towers and building corners around the perimeter are very complex: trapezoidal in shape with vertical and horizontal ribs at the back to connect to the spandrels above and below.

The helical ramps are cantilevered slabs to accentuate the movement of the cars through the facility. At night, the headlight patterns are visible: you see the cars entering on the east side and exiting on the west side. The cantilevered slabs with the folded spandrel panels soften the edges.

Photo: Clark Pacific.

Says Dematteі, "With the inherent quality of the precast we came up with a fairly simple façade that had a level of sophistication that provided visual interest, as opposed to a monotonous repetitive structure. Translucent fabric canopies over the arrival and departure plaza tie back to the terminal and relate to the whole airport architecture. The white color precast [white aggregate and heavy sandblast finish] is a contemporary finish mostly designed to refract light."

The articulated precast concrete façade, curved glass storefront entry, tensile fabric canopies, and public art installations provide a striking yet cohesive element at the east border of the airport campus. Additionally, the precast concrete components contributed to the facility's LEED gold certification.

Photo: Pablo Mason Photography.

GO TRANSIT
Precast concrete was used throughout the West Harbour GO Transit station's elevated parking deck, and in areas subject to high pedestrian traffic, to minimize risk of damage to the building. By using varying pigments, finishes, and reveal patterns in the precast concrete, the desired architectural language was achieved. The station serves as a landmark for the community, while fitting contextually within the neighborhood. Photos: Studio Shai Gil.

TRANSIT BEAUTY: WEST HARBOUR GO TRANSIT STATION

To kick off the 2015 Pan Am Games and create a gateway to the City of Hamilton, Ontario, Canada, the West Harbour GO Transit station showcases style and substance. The transit project incorporates an urban plaza embellished with landscaped gardens as well as a parking structure. The site is designed as a series of sloped roads, stairways, and gardens punctuated by two tower and bridge structures that connect the streets directly to the platforms. A two-story parking deck clad in precast concrete links the towers, with 140 parking spaces and a "Kiss & Ride" passenger drop-off area.

"Rail stations are founded on passenger flow, so the facility is all about movement," explains Arthur Briggs, manager of architecture with the IBI Group. "We didn't want anything flat or static, and to celebrate movement we used different textures of precast to create animation and poetic repetition in the cladding."

There were concerns about the noise that would be created by buses using the plaza bus lane. To alleviate these concerns, a 7-ft-high precast concrete sound barrier was installed along the south perimeter of the plaza. Rather than using the simple

WEST HARBOUR GO TRANSIT STATION

LOCATION
Hamilton, Ontario, Canada

OWNER
Metrolinx, Toronto, Ontario, Canada

ARCHITECT
IBI Group, Toronto, Ontario, Canada

ENGINEER
IBI Group, Toronto, Ontario, Canada

CONTRACTOR
Kenaidan, Mississauga, Ontario, Canada

PCI-CERTIFIED PRECASTER
Armtec, Hamilton, Ontario, Canada
(sound walls at plaza)

Advanced Precast Inc., Ontario, Canada
(parking deck panels)

Castle Precast, Ontario, Canada
(precast planter boxes)

PRECAST COMPONENTS
Architectural precast panels and sound walls

precast concrete sound barrier panels typically seen on highways, a custom articulated panel face was used, with overlapping rectilinear forms at various face depths. Staggered linear LED strip lights were recessed within these panels, animating the wall and providing a sense of movement to what could have been a static and utilitarian element of the project.

"We used precast sound walls to line the edge of the project and to delineate the residential portion of the plaza," explains Briggs. "The LED lights embedded in that wall provide animation to that area and soften the impact to the area residents."

"Given the grade difference, several retaining walls were integrated into the station design. They serve as multifunctional structures cohesive with the project design, rather than solely utilitarian. Retaining walls from plaza level to platform level were terraced, and serve as planters. A retaining wall between nearby streets provided the opportunity for a stacked parking solution, with the structure serving as the south wall of a two-level parking deck. This concrete retaining wall was clad in charcoal precast panels, alternating between a smooth, sandblast finish and a ribbed panel with 3-in.-deep reveals, mimicking the waterfalls that the city is known for. Precast planter boxes were provided at the top of this concrete retaining wall, creating an extension of the landscaped boulevard along the street to the south of the project site."

"Precast concrete was used on the station's parking deck and in areas subject to high pedestrian traffic to minimize risk of damage to the building. By using varying concrete pigments, finishes and reveal patterns, the desired architectural language was achieved by using this cost-effective and resilient material. The station serves as a landmark for the community, while still fitting contextually within the surrounding neighborhood," recalls Briggs.

Precast concrete is synonymous with parking structures. Parking structure aesthetics are essential to the sense of architectural continuity critical to the success of a project. Just as architectural panels can benefit an office or residential building, so too can they create a positive identity for a parking structure. These examples illustrate how architectural precast concrete can provide the "wow" factor to complement high-end retail or mixed-use projects, introducing color and texture that transform parking into an architectural statement.

GO TRANSIT
Photo: Studio Shai Gil.

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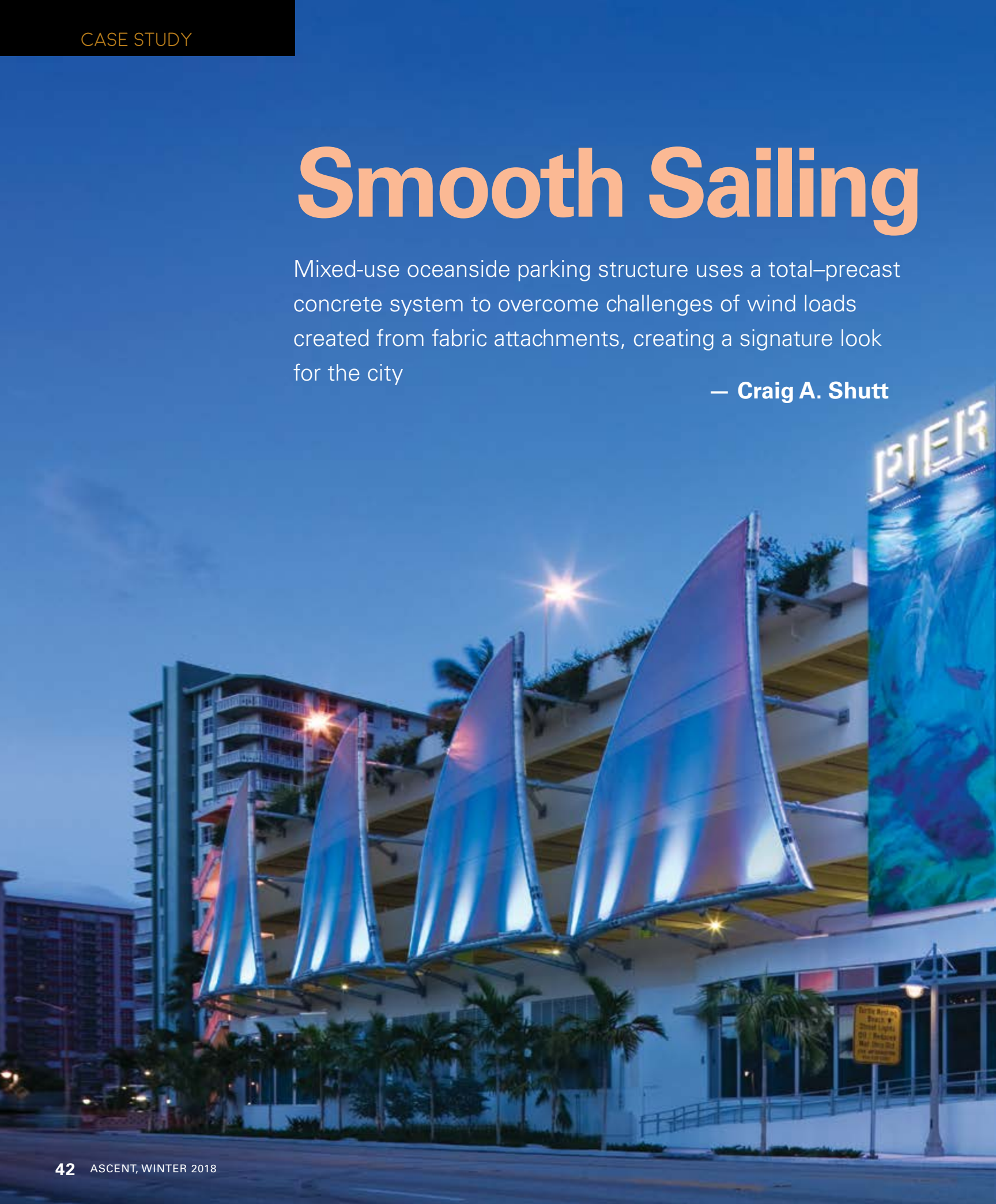
Smooth Sailing

Mixed-use oceanside parking structure uses a total–precast concrete system to overcome challenges of wind loads created from fabric attachments, creating a signature look for the city

— Craig A. Shutt



A number of challenging goals confronted the design-build team commissioned to create the city-owned Pompano Beach Pier parking structure in Pompano Beach, Fla. City officials wanted a building that would project an "iconic" appearance for the city. They also wanted to include first-floor restaurant, retail, and office space that would generate activity and excitement. The structure had to meet stringent hurricane-level wind loads and provide protection against corrosive saltwater, as the ocean was only 300 ft away.

To achieve these goals on a tight schedule and with a limited budget, the team at general contractor Kaufman Lynn Construction and Currie Sowards Aguila (CSA) Architects created a bright white, total–precast concrete structure that features tensile-fabric "sails" attached to the perimeter. The 16 triangular sails, made of PTFE (polytetrafluoroethylene) fiberglass, comprise more than 27,000 ft^2 of surface area and weigh more than 25,000 lb.

DESIGN-BUILD
The project's design-build delivery method allowed quick decisions to be made on constructability and engineering, as well as on functionality. Photo: Dan Forer.

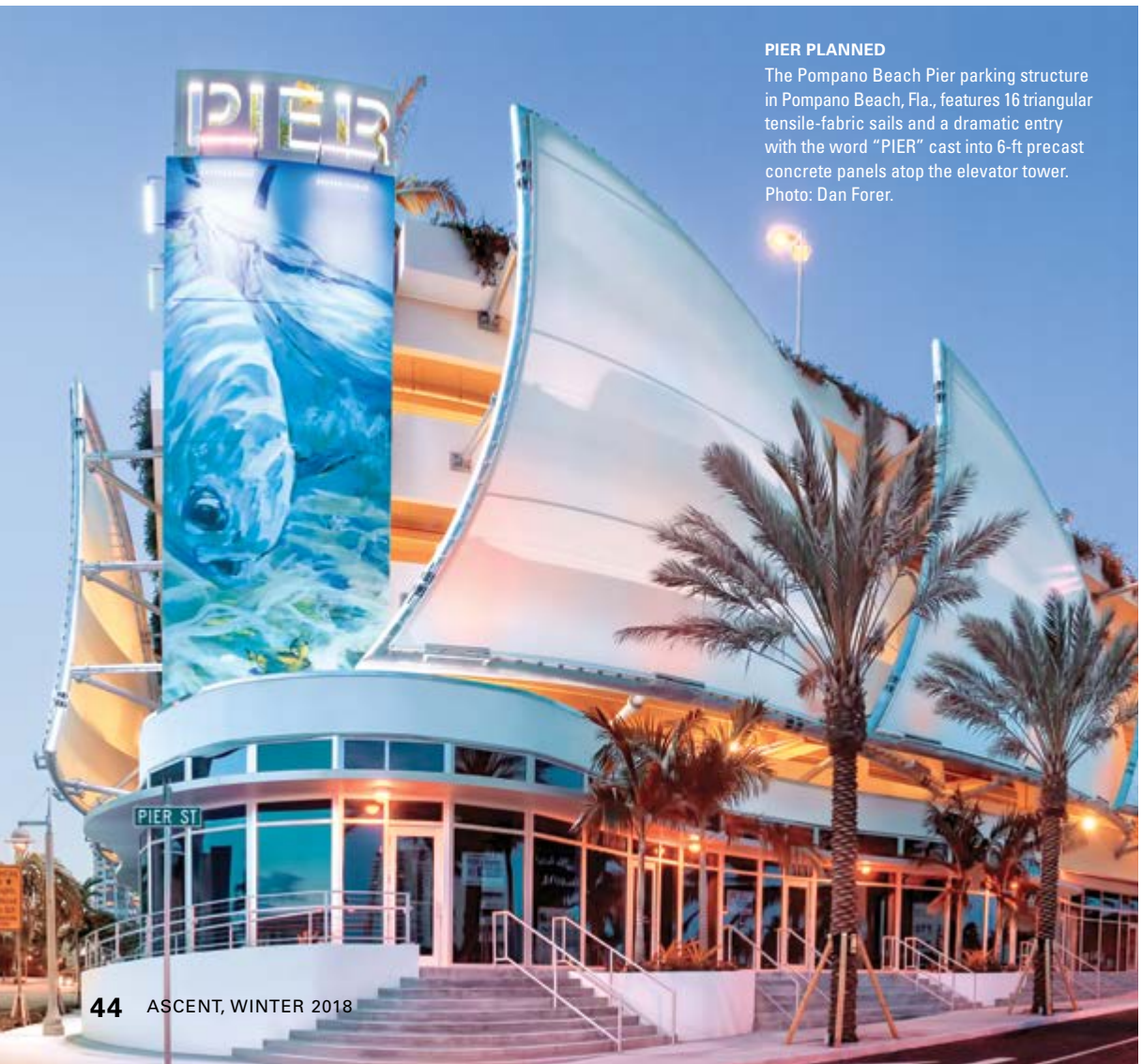
"The city stressed that it wanted an 'iconic' look for its parking structure, which got us thinking," says Jess Sowards, a partner at CSA. "We played with our crayons a little bit and came up with some creative ideas. Our goal was to use decorative concepts to disguise the building's function without completely hiding its purpose, as drivers needed to know where to go."

The sails project a maritime feel, although some people interpret them as shark's fins, he notes, which also accomplishes the goal. "They provide a free-flowing, billowing effect but they still offered low maintenance and allowed us to meet our open-air requirements so we didn't have to ventilate the building."

City officials immediately accepted the concept. "They fell in love with it," reports Garret Southern, vice president of operations for Kaufman Lynn. "Then it was up to us to reverse-engineer the concept to determine how to make it work from a constructability standpoint."

The 239,646-ft^2, four-story structure provides 662 parking spaces plus 10,000 ft^2 of first-floor retail and other functions, including some city offices. The retail space was designed and constructed to allow for future plans, which include a tourism office, a welcome center, and storage space for lifeguard operations.

'The city stressed that it wanted an "iconic" look for its parking structure, which got us thinking.'



PIER PLANNED
The Pompano Beach Pier parking structure in Pompano Beach, Fla., features 16 triangular tensile-fabric sails and a dramatic entry with the word "PIER" cast into 6-ft precast concrete panels atop the elevator tower. Photo: Dan Forer.

POMPANO BEACH PIER PARKING STRUCTURE

LOCATION
Pompano Beach, Fla.

PROJECT TYPE
Parking structure with retail

SIZE
239,646 ft^2

COST
$20.6 million

DESIGN-BUILD CONTRACTOR
Kaufman Lynn Construction, Boca Raton, Fla.

ARCHITECT
Currie Sowards Aguila Architects, Delray Beach, Fla.

OWNER
City of Pompano Beach, Pompano Beach, Fla.

STRUCTURAL ENGINEER
LEAP Associates International Inc., Tampa, Fla.

PCI-CERTIFIED PRECAST PRODUCER
Metromont Corp., Bartow, Fla.

PRECAST SPECIALTY ENGINEER
LEAP Associates International Inc., Tampa, Fla.

PRECAST COMPONENTS
600+ pieces comprising 60 ft 6 in. × 12 ft double tees, ramp double tees, lite walls, shear walls, columns, spandrel panels, decorative panels and columns, three-sided planter boxes, stairs, and other components

TAILORED MIXES
The building features a total–precast concrete structural framing system and façade that offered tailored concrete mixtures for increased durability and the most cost-effective system. Photo: Dan Forer.

TOTAL–PRECAST FRAMING SYSTEM

The project's precast concrete structural system and façade (often referred to as total–precast) comprise double tees, columns, lite walls, shear walls, spandrel beams, stairs, planter boxes, and other components. Metromont Corp. fabricated the precast concrete components.

Precast concrete provided two important advantages, says Sowards. "It provided the ability to tailor the concrete mix design for increased durability, including a corrosion-inhibiting admixture, which was critical in this corrosive environment. It also allowed us to detail all product reinforcement carefully to ensure we received sufficient concrete cover for increased durability. Placing the reinforcement in a plant-controlled environment with strict quality-control measures ensured proper location for each piece."

It offered the most cost-effective approach as well. "We looked at other options with the general contractor and structural engineer, but they had both done so many precast concrete projects that it became clear early on it was the best choice," he says. "The project's size and ability to repeat many pieces made it efficient, and the components created effective layouts within bays."

"Plant casting added quality and lessened site congestion, which was critical," says Craig Barrett, vice president of engineering at LEAP Associates, which provided precast concrete specialty design and structural engineer-of-record services. But it also required close coordination early on. "Precast provides the benefit of being cast off-site in pieces that we can bring to the site to assemble, like Legos®," Southern says. "But that requires early planning for all blockouts for piping, connections, cable railing, water and fireproofing needs, etc."

Precast concrete fabrication also ensured a high-quality finish, Southern adds. "One of the key benefits of precast was the quality of the finish we could achieve under plant-controlled conditions," he says. "The bright white appearance will remain consistent with only an occasional pressure washing. Precasting gave us a better form finish with faster turnaround."

Two concrete mixtures, a bright white tone for exterior decorative pieces and a gray tone for interior components, both feature a corrosion-inhibiting admixture to resist the nearby salt spray environment. "There are a thousand tones of white for both materials, so we matched the precast as closely as we could to the color of white we selected for the sails," explains Sowards.

"The sails aren't tight against the façade, so there's a little bit of forgiveness. And the shadows that the sails cast during the day as the sun moves create interesting variations."

The plant-cast quality also aided structural components overall, including stairs. "Cast-in-place concrete stairs don't provide an even finish," Sowards says. "With precast, the quality is better, and they can be quickly set in place to provide fast access to other levels."

> 'We could guide the project while it was being designed based on pricing and programming.'

COORDINATING SAIL FRAMING

A key element was coordinating the design of the sail framing with embeds needed to attach it to the precast concrete structure. "There were a lot of components, each with its own allowable tolerances, and we had to make sure those didn't combine to create interfacing challenges," Southern explains. "We worked closely with the fabric manufacture, structural engineer, and precast producer to ensure each had enough wiggle room without being out of alignment."

The fabric manufacturer, Birdair, devised the sails, framing, and lighting based on the engineering requirements, and then Kaufman Lynn worked with the precast concrete producer to create the structural elements to support those components. "Using the design-build method allowed us to make fast, informed decisions regarding not only constructability and engineering but also practicality and functionality," says Southern. "We could guide the project while it was being designed based on pricing and programming."

An aid to this work was the consolidation of the precast concrete specialty design and structural engineer-of-record services into one firm, LEAP Associates. "The preconstruction phase was intense," Southern says. "We involved LEAP very early in the process with the intent of reducing the amount of

SAILING ALONG
The fabric manufacturer devised the sails, framing, and lighting based on the engineering requirements, and then the contractor worked with the precast producer to create the structural elements to support those components. Photo: Kaufman Lynn.

engineering communication that was needed." Metromont also was involved early on. "They were a key part of the design-build team right away."

The parking levels were made flat, and floor-to-floor heights were raised beyond minimum requirements to provide easy sight lines and add safety for visitors. It also ensured that ocean views are clearly visible from virtually any point inside the structure. A speed ramp provides quick access to upper floors, with the first floor designated as valet parking for tenants of the various rental facilities and offices.

"There were many different building materials interfacing with the precast concrete due to the various functions and decorative elements," notes Barrett. "We had light-gauge steel, glass storefronts, precast concrete, structural steel, masonry, and others. Of course, the 800-pound gorilla was the sail system."

SAIL ENGINEERING

LEAP helped determine the optimum number of sails per façade and the number of attachment points for each. "We wanted to give them flexibility while ensuring structural stability. Coordinating all of this with the architect was critical, so it was helpful that we were handling all of the engineering issues," says Barrett.

Community input was gathered on various permutations of sail configurations, he notes, with engineers producing a number of elevation designs to find the optimum combination of shape and height. Four sails were placed on each façade, with the same shapes used on parallel sides owing to the slightly off-square footprint and space devoted to stair towers.

"The porous, 37-ft-tall sail screens encompass the structure's entire perimeter, creating a play of movement and subtle lighting,"

says Sowards. A cast-in-place concrete façade along the base curves in and out to add motion for passersby. "Delight and wonder were the design intent. The undulation of the panels at the building's base reinforces the thematic movement of wind and water. The design expresses the intention to create a true sense of place."

The tensile fabric provides wind-load capacity up to 170 mph, equivalent to a category 4 hurricane. The material withstood a major test in September, when Hurricane Irma rampaged through Florida. Although Pompano Beach did not take a direct hit, the sails were battered by tropical storms that the fabric withstood easily. "The ability of the precast to stand up to these forces was a primary factor in the success of this project," says Sowards.

The architects looked at other options, including perforated aluminum panels, he adds, before deciding on the fiberglass material. "Its ability to stand up to high wind loads and its ease of maintenance and durability so close to the ocean were the key points."

Birdair's crew worked with the engineers to create the shop drawings for the steel framework, using 10-in. steel tubing that supports the fabric. "The dynamic-loading factors were complex, but the team did a fantastic job with them," says Sowards. "The steel tubing is substantial and the connections had to be very robust, but it all worked very well."

Three-dimensional modeling helped plot the hundreds of embed plates needed in the precast concrete supporting members so the sails could be welded easily into place when both precast concrete and sails arrived on site. Each sail required six or seven attachment points on its frame to connect it to the four levels of support behind it.

Programmable LED lighting fixtures were attached by Birdair to the lowest horizontal supports of the steel framework, illuminating each sail with colors that can be controlled individually. The computerized fixtures allow as many as 256,000 color combinations on the 16 sails.

ROOFTOP AESTHETICS

The top level includes planters and rooftop vegetation to create a partially green roof. Other decorative elements were added as well. "The structure is surrounded by high-rise condos that look down on its roof, and the city wanted to ensure they had a pleasant view," Sowards explains. "We didn't have the budget to fill the roof with vegetation, so we dressed it up with a variety of elements."

ROOF AESTHETICS
The roof features blue canopies, sand-colored floor coating, and landscaping that creates an oceanside appearance from taller buildings nearby. Photo: Kaufman Lynn.

These include blue-tinted tensile-fabric canopies that protect parked cars from the sun, as well as green and tan coatings for the double tees to create a beach-like appearance. Planters with full-grown trees were added to each side except the east, which faces the ocean. Precast concrete planters along the perimeter allow plants to overflow down the building's side. "It adds some vegetation to the street view and makes it apparent there is something going on at the roof," Sowards says.

These dead loads, coupled with the live load from the parked cars, required beefing up the double tees that support the roof. "The long-span beams and double tees helped layout flexibility on each floor, and complicated the roof loading," says Barrett. Metromont cast tees with fatter stems that allowed for placement of additional prestressing in these members, which easily carried the additional loads. "Prestressed double tees are very efficient for these applications, and we could customize the precast layout to meet specific needs and various locations."

Additional planters for vegetation, all native to Florida and able to withstand salt and high winds, were placed along the streetscape, complementing the roofline vegetation. "Our goals were to tie into the 'new urbanism' and activate the streetscape with retail activity to begin the redevelopment of the area," says Sowards.

Precast concrete inherently provided the needed fire rating to separate the retail from parking functions, and a waterproof membrane was added above the retail spaces after all joints were sealed.

TWO MIXTURES
Two concrete mixtures, a bright-white tone for exterior decorative pieces, and a gray tone for interior components, both feature a corrosion-inhibiting admixture to resist the nearby salt-spray environment. Photo: Dan Forer.

The prominent elevation features a curving one-story structure topped with a blue-glass elevator tower. At the top of one corner, 6½-ft-tall precast concrete panels were erected with the word "pier" in cut-out capital letters, creating dramatic but intrinsic signage. The letters are lit from inside to create dramatic shadows at night. At the base, an aquatic mural was created as a film that was adhered to panels to add color. The format allows it to be updated as needed or changed to new images.

An additional challenge presented itself in containing illumination from the structure and through the elevator towers' glazing. The city has strict restrictions on spillover lighting during sea turtle mating season, which lasts from March to October, as lights can distract and disorient the animals. Spandrels and tees had to hide all interior illumination as well as lighting from cars, and glazing had to be designed to prevent spillover.

CONSTRUCTION CHALLENGES

Precast concrete's flexibility in casting provided a significant benefit once construction began. Shortly after demolition began, Kaufman Lynn discovered an 80-year-old pump station 26 ft below ground. "We knew there was a station, but we had no idea of its size," Southern says. Expecting it to be a fairly standard small unit, it turned out to be 30 × 30 ft square and 25 ft tall with 14-in.-thick concrete walls. "It was truly a vault."

It also was located where the elevator tower was to be placed and where erection was to begin. The contractor quickly notified the precast concrete producer, who shifted the casting sequence to begin at another corner, providing time to remove the station. "The ability to adjust and create components away from the site was a lifesaver," Southern says.

The erection moved smoothly, with trucks delivering the day's components early in the morning and arriving steadily through the day as pieces were picked and set. Even the erection of the sails created no disruptions. "It was an unusual aspect, but when you strip it down to its engineering and construction, it's all just numbers," says Southern. "Everything went together very well, which I credit to having all the engineering done by one company and an outstanding collaborative design-build team."

The schedule was compressed, as the parking structure was the first part of a larger redevelopment of the area. "It's always a chicken-or-egg concept, and in this case, they decided to build the parking support first and then develop other elements," says Sowards. Nearby developments are now under way.

> 'The city features it on their website, and that doesn't happen very often with a parking structure.'

The key goal was to open the parking structure prior to the city's big 4th of July celebration, so the 8000+ visitors flooding into the area would have easy access to parking and learn about the new facility. Despite early setbacks and the resequencing, the team completed the project 23 days ahead of schedule to provide an iconic landmark in plenty of time to celebrate.

"It turned out to be a really good project that the city was very happy with," says Sowards. "The city features it on their website, and that doesn't happen very often with a parking structure." Southern agrees. "It's a very dramatic and high-quality building, and it will be easy to maintain. I expect 30 years from now it will still look the same as it does now."

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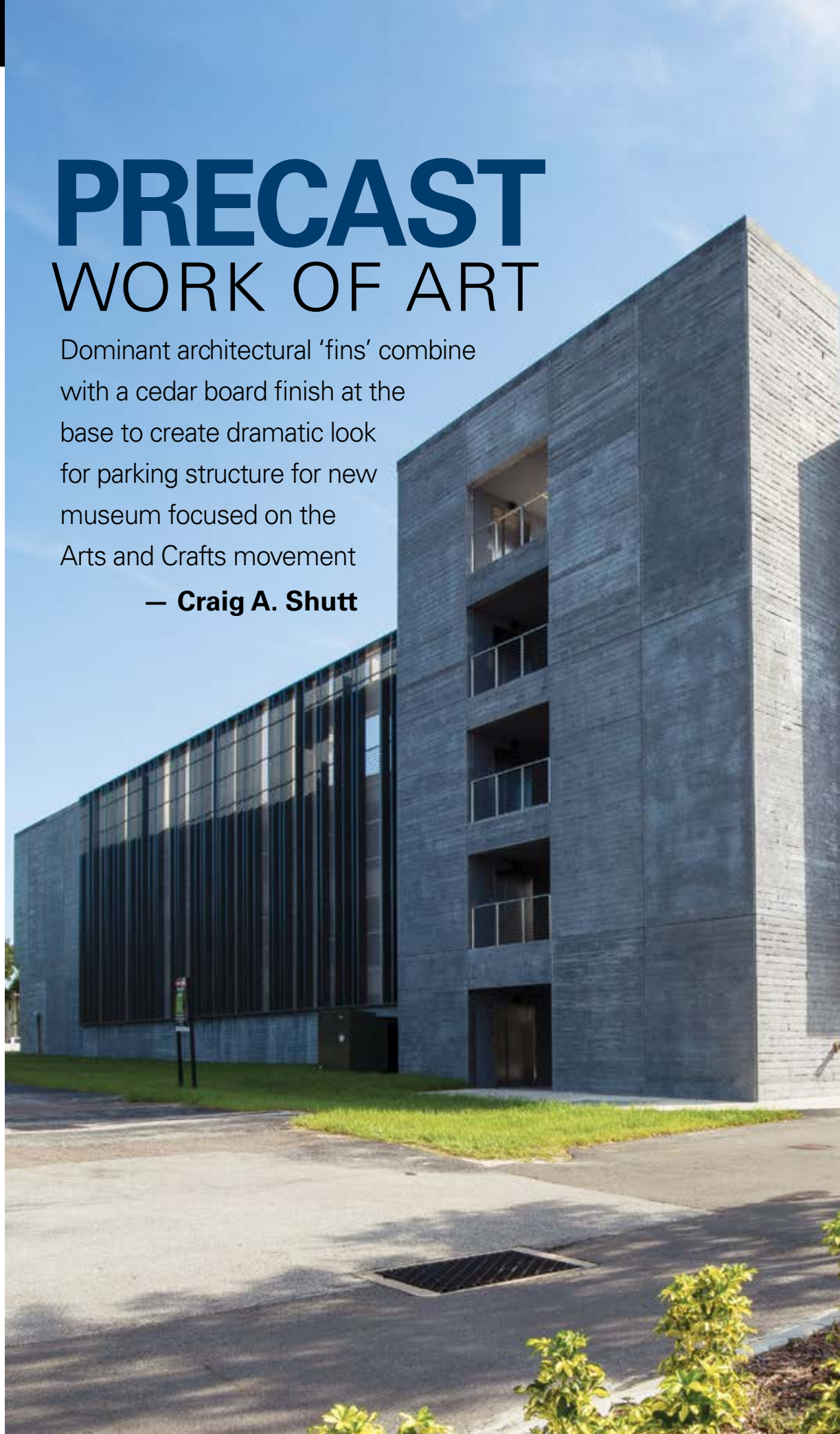
PRECAST WORK OF ART

Dominant architectural 'fins' combine with a cedar board finish at the base to create dramatic look for parking structure for new museum focused on the Arts and Crafts movement

— Craig A. Shutt



MUSEUM OF THE AMERICAN ARTS & CRAFTS MOVEMENT PARKING STRUCTURE

LOCATION
St. Petersburg, Fla.

PROJECT TYPE
Parking structure

SIZE
103,000 ft²

COST
$4 million

DESIGNER
Alfonso Architects Inc., Tampa, Fla.

OWNER
Museum of the American Arts & Crafts Movement, St. Petersburg, Fla.

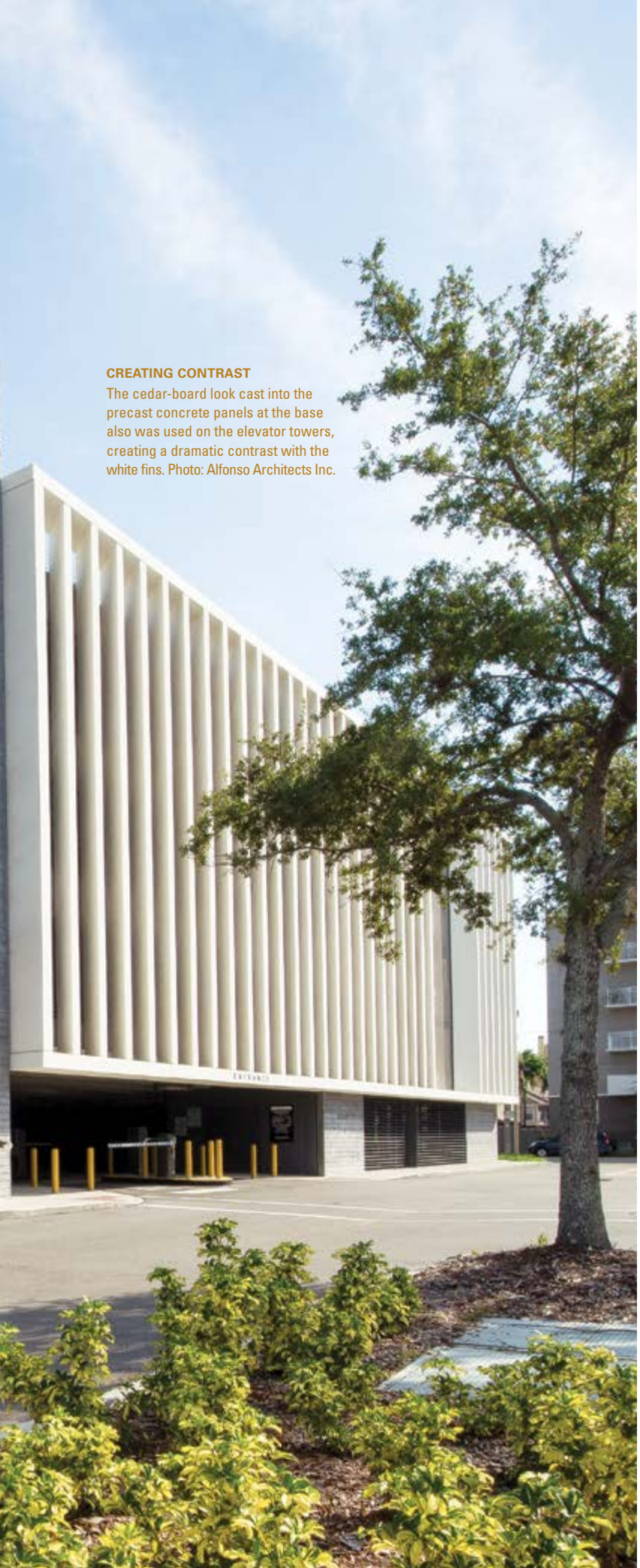
STRUCTURAL ENGINEER
Walter P. Moore & Associates Inc., Tampa, Fla.

CONTRACTOR
Manhattan Construction Co., Tampa, Fla.

PCI-CERTIFIED PRECAST PRODUCER
Coreslab Structures (TAMPA) Inc., Tampa, Fla.

PRECAST SPECIALTY ENGINEER
Stehler Structural Engineering Inc., Minneapolis, Minn.

PRECAST COMPONENTS
361 pieces including double tees, columns, inverted-T beams, L beams, lite walls, retaining walls, spandrels, stairs with landings, flat slabs, architectural wall panels, and other components



CREATING CONTRAST
The cedar-board look cast into the precast concrete panels at the base also was used on the elevator towers, creating a dramatic contrast with the white fins. Photo: Alfonso Architects Inc.

Officials at the new Museum of the American Arts & Crafts Movement in St. Petersburg, Fla., had big plans for their new facility, which comprises a 110,000-ft^2 museum to house collections of decorative arts from the Arts and Crafts movement and a restaurant alongside an existing office building. To ensure those buildings are easily accessible, they first commissioned a five-story total–precast concrete parking structure.

"Precast concrete offered, first and foremost, an economical design," says Richard Temple, principal in charge and the managing director of the Tampa office of Walter P. Moore, the engineer of record for the project. "It also aided with the tight site and compressed schedule."

Its aesthetic versatility also played a role. "We were directed toward a precast design by the architectural design. The building features a pretty elaborate façade, which we could effectively create only with precast concrete. At that point, it made sense to use it for the entire structure to take advantage of the efficiencies of combining the functions with one supplier."

The 103,000-ft^2 parking facility's structural frame consists of double tees, columns, inverted-T beams, L beams, lite walls, retaining walls, spandrels, stairs with landings, flat slabs, architectural wall panels, and other components. Its architectural features comprise 90 architectural vertical fins and base panels with a rough-sawn cedar appearance, which combine to create the dramatic exterior appearance. The project was completed on a "construction manager at risk" delivery method, with Manhattan Construction serving as construction manager.

VALUE-ENGINEERED TO PRECAST

The designer's original plan was to use cast-in-place concrete to create the board-formed finish, but the design evolved to include the screen of diagonal fins attached to the structural frame, according to Alberto E. Alfonso, president of Alfonso Architects Inc., the architectural firm on the project. "Switching to precast allowed us to cantilever the screen from the precast frame and fabricate the fins in a controlled environment, achieving crisp, long, slender planks."

The architectural design was planned to avoid the horizontal lines that parking structures inherently provide due to their long lines of spandrels and openings, explains Don Stehler, president of Stehler Structural Engineering, the precast concrete specialty engineer. "The goal was to draw attention to the verticality of the fins and offset the horizontal nature of the building. It was an interesting approach that worked very well to change the visual image."

TRUE CEDAR
The precast concrete producer used actual cedar boards screwed into the base of the forms to create the woodgrain appearance on the base panels. The boards also were spaced ¼-in. apart to create "form" lines between rows of boards. Photo: Alfonso Architects Inc.

The fins also served as a creative solution to the city's requirement that parking structures conceal vehicles and architecturally blend with their neighborhoods. The project, bounded by major traffic arteries in a commercial area adjacent to a historic residential neighborhood, serves as a transition between the two different locations.

"We've done many parking structures with decorative elements attached, but this one was unique due to the fins' size and weight," says Todd Fultz, vice president and project director at Manhattan Construction. The precast concrete producer, Coreslab Structures (TAMPA) Inc., presented various conceptual approaches for the design that the other team members weighed in on. "Coreslab was very helpful in bringing the concept to fruition from the beginning," says Temple. "There were a variety of challenges where their early input helped create efficiencies."

'We've done many parking structures with decorative elements attached, but this one was unique due to the fins' size and weight.'

FINS CONNECT TO STRUCTURE

The 35-ft-tall fins are 8 in. thick and were erected on the diagonal, creating wide panels that change their appearance when viewed from different angles. Although they appear to be resting on the 12-in.-thick L beam below them, the beams actually provide no structural support, but simply frame the fins. They in fact connect to the structure behind them, which handles their load.

FINS CANTILEVER
The fins cantilever 3 ft 8 in. over the horizontal frame, which was set first. Then temporary shoring secured them in position until they were welded back to the structure. Photo: Manhattan Construction.

MODULAR PANELS
The modular, panelized system for the base panels made erection move quickly and minimized joints despite the board-form finish. Photo: Coreslab.

CEDAR FORMS
The cedar boards, 1 × 6 inc. in size, were cut down from 12-ft-long boards to lengths of 6, 8, or 10 ft as needed. A sealer prevented water and pigment from being drawn from the concrete. Photo: Coreslab.

"Supporting the concrete screen was an engineering challenge," says Alfonso. The fins cantilever 3 ft 8 in. over the horizontal frame, which was set first. Then temporary shoring secured them in position until they were welded back to the structure. The upper beam, capping the fins, was set once all the pieces were erected. They are secured to the structural columns on alternating levels, to limit the amount of load being supported by any one beam, and were tied back to the columns at every level.

"The fins never produced bearing weight on the bottom piece," says Smith. It was an unusual project, he adds, because the architectural fins were entirely separate from the structural components, rather than the typical approach of combining functions. "The goal was to hide the interior of the building from the street without actually enclosing it," he explains. "The designers chose to achieve that with the screen of fins, rather than take a more traditional approach. It created a challenging design but one that's ultimately very striking."

An added challenge was the need to hide the connections from exterior views. They consist of 1-in. rods welded to ¾-in. plates on the fins and columns. "They were straightforward connections, but a bit more robust," explains Temple. "We had to position them to ensure the other fins blocked them from

ALIGNING PANELS
Close attention to detail was needed to ensure alignment of the form lines created in the base panels' cedar-board appearance. Photo: Coreslab.

view from outside. Varying the location from one level to another helped break up the pattern and hide them better." Cable barriers are used to align cars as drivers pull into spaces.

Adding to these complexities was the bright white finish, designed to create an arresting image of smoothness. "It was highly finished, which meant we had to be extremely careful to minimize pick points and keep all corners from being damaged," says Fultz.

The smooth, white appearance makes a dramatic contrast when lighting units, attached to the frame base between each set of fins, illuminates them at night. The lighting offers a variety of color combinations and patterns, which help celebrate holidays and special events. "It's a very striking building when it's lit up," says Temple.

CEDAR BOARDS CREATE FINISH

While striking, the fins weren't the greatest challenge for the precast concrete producer, notes Vern Smith, project consultant for Coreslab. The unusual base finish wins that prize. A cedar board appearance was created for the structure's base and for the stair and elevator towers. The finish was achieved by using actual 1 × 6-in., 12-ft-long cedar boards that were screwed into the base of the form prior to casting in needed lengths of 6, 8, or 10 ft.

"The formliner we created produced a shiny, unnatural look," explains Smith. "We tried the actual boards and got just what we needed with a little experimenting." A sealer was put onto the boards to prevent water and pigment from being drawn from the concrete and to allow the forms to release. Finding the ideal approach required a balance: too much sealer resulted in the cast concrete losing the desired graining, while too little sealer meant the boards pulled apart when released from the form. Just enough sealer created the desired look while allowing each set of boards to be used for as many as nine pours before losing detail.

Designers also wanted the boards spaced 1/4 in. apart to create horizontal "form" lines between rows of boards. "We created a system of cleaning the joints and pulling the panels that allowed us to cast panels quickly," Smith says.

Aligning the panels on the base structure also created challenges, adds Fultz. "The architects were very specific about the look they

ILLUMINATED FINS
The smooth, white appearance makes a dramatic contrast when lighting units, attached to the frame base between each set of fins, illuminates them at night. The lighting offers a variety of color combinations and patterns. Photo: Alfonso Architects Inc.

DRAMATIC FINS
The 35-foot-tall fins, 8 inches thick, create a dramatic appearance while meeting the city's requirement that parking structures conceal vehicles and blend with the neighborhood. Photo: Alfonso Architects Inc.

wanted for the rough-sawn board appearance. It took time to ensure the alignment was perfect."

NO STAGING AREA

The busy location prevented trucks from lingering at the site, with no staging area available. Construction on the adjacent restaurant also was under way during the erection, adding to the complications. Panels were picked and erected as delivered. Manhattan worked closely with the erection crews to devise a rigging plan to connect to each large fin's lifting points, rotate it into a vertical alignment, lift it into position, and set it into place for welding.

"We needed a strong game plan and took extra time to plot it out," says Fultz. "It worked well, with all of the pieces fitting in accurately with just a little play." Adds Smith, "We laid out a detailed plan that worked smoothly. The bearing haunches on the panels' backs were positioned perfectly so the cranes could connect to the panels and set them into place smoothly."

Foundations also were being set for buildings planned for future construction, complicating maneuvering on the site, says Temple. "We had to design the precast concrete foundations to coordinate with future plans. Everything had to be clearly defined to ensure that future construction would not be disrupted."

The contractor set a goal for piece erection, but the care with which the fins had to be set sometimes stretched that goal. "The fins were each counted as one piece, but they took much longer than any of the others. That pushed us to some long days, but we met the schedule demands."

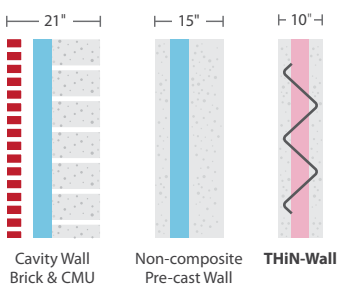
Temple agrees. "Coreslab made sure the tolerances were very tight, so the fins and framing came together smoothly. We needed to pay special attention to the alignment as the base panels were set, but it worked well."

The result was a dramatic look that makes a strong statement for the museum even before visitors arrive. It also has generated more business for the precast concrete producer. "Since we finished the cedar board finish and erected it on this project, we've had multiple requests for information on the technique, which have catapulted us to gain three similar jobs since," Smith reports.

The architect certainly was satisfied with the material choice. "Precast concrete provided an accelerated schedule and reduced construction costs over a cast-in-place structure," according to Alfonso. "It also provided a higher level of consistency and finish quality, being fabricated under controlled conditions. The vertical fins would have been far more challenging in cast-in-place concrete."

The $40-million, 110,000-ft^2 museum is now under construction, with completion scheduled for 2018. When visitors arrive to view its collections or eat at its restaurant, they can be assured that easily accessible, well-designed parking facilities will speed them to their destinations.

THERE'S A THiN WALL BETWEEN SUSTAINABILITY AND STRENGTH.



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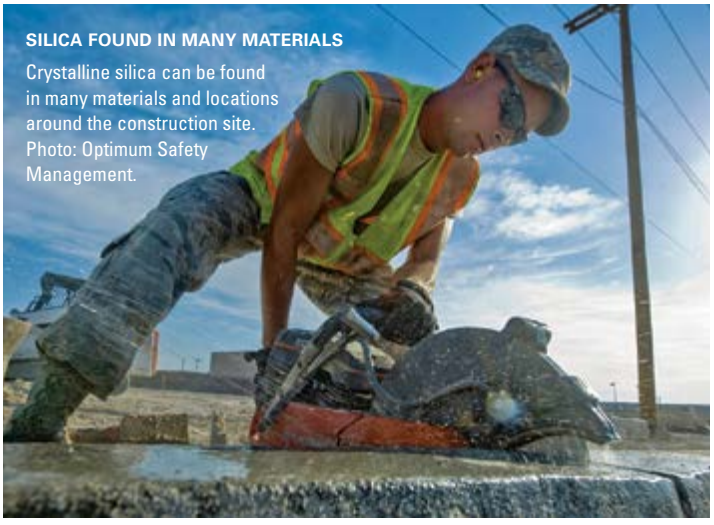
HOW OSHA'S New Silica Rule IMPACTS ARCHITECTS, CONSTRUCTION MANAGERS, AND GENERAL CONTRACTORS

— Steve Yates

Running a successful construction project involves many moving parts, none more paramount than ensuring the safety and health of tradespeople and the public. That effort has become even more complex with the recently introduced respirable crystalline silica standard. The tighter standard could leave you liable for any misapplications or irregularities.

Architects, construction managers, and general contractors may believe they are protected by contract language and liability protections. Unfortunately, that's not completely true. When things go wrong on a project, not only are lives impacted or lost, reputations are permanently stained, regardless of where liability points. And the new standard makes it more likely that members of the construction team could be impacted.

CONTROLLING EMPLOYER
Architects, general contractors, or construction managers may be deemed the "controlling employer" and be liable for controlling respirable crystalline silica at the site. Photo: Optimum Safety Management.



SILICA FOUND IN MANY MATERIALS
Crystalline silica can be found in many materials and locations around the construction site. Photo: Optimum Safety Management.

Never has providing the necessary assurances been a more complex task. On September 23, 2017, the Occupational Safety & Health Administration (OSHA) began enforcement of its new Respirable Crystalline Silica standard for construction. This regulation is one of the most significantly tightened standards ever in the construction industry. OSHA has reduced the acceptable level of silica to only 20% of the previous standard.

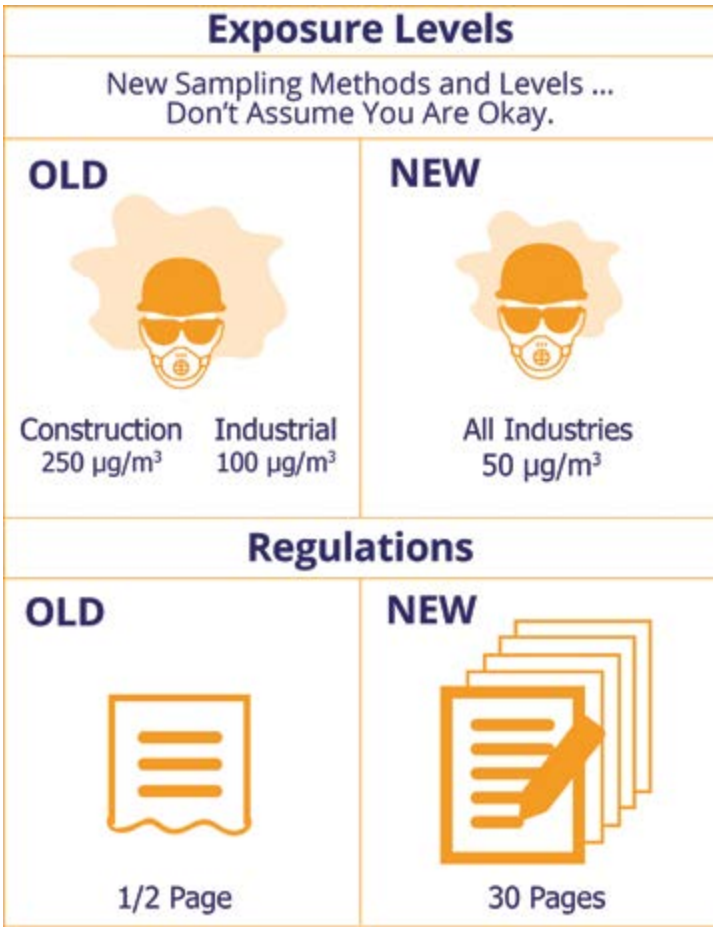
Never has providing the necessary assurances been a more complex task.

Much of the construction industry has been asleep at the wheel, waiting to see what the current administration will do with this regulation. To their dismay, after a short delay, the administration has allowed the regulation to proceed.

Now scrambling to catch up, many contractors are finding that new engineering controls, such as vacuum systems and attachments for drills and saws, are out of stock and back-ordered. Some contractors are still unfamiliar with the standard or are even choosing to ignore the regulation and proceed as usual.

WHY IT MATTERS TO YOU

So, you may be saying, "Why does this matter to me? I don't specify or use crystalline silica." The problem is that crystalline silica is everywhere on your project site. Many of today's construction products contain silica. When it is crushed, chipped, ground, cut, or otherwise fractured, it creates tiny particles. These particles are so small that they are respirable and create



OSHA RULES — OLD VS. NEW
Silica exposure levels have been significantly tightened, with regulations expanded. Photo: Optimum Safety Management.

significant health concerns if they are inhaled. If they are not controlled at the source when generated, they become airborne, exposing workers all over the site. They build up in areas such as gravel-haul roads, where traffic kicks up the dust, providing a fresh exposure every time. This exposes everyone on the jobsite long after the creating contractor has left, and the new OSHA exposure limits are extremely low. Are you beginning to see the complexity?

Complications arise due to the multi-employer nature of construction projects. Within its "Multi-Employer Citation Policy" (CPL 02-00-124), OSHA provides guidance to enforcement officers on how to view jobsite responsibilities for correction of hazards. They divide employer responsibilities into the following four categories. If you are deemed to be in any one of them, you are subject to citation.

- "Creating" employer, defined as one who "caused a hazardous condition that violates an OSHA standard."
  Example: Concrete contractor who has to grind a foundation poured incorrectly.
- "Exposing" employer, "whose own employees are exposed to the hazard."
  Example: Any employer afterward whose employees have exposure to airborne silica particles.
- "Correcting" employer, who "is responsible for correcting a hazard."
  Example: Dust-control vendor hired by you to treat the haul roads.
- "Controlling" employer, who "has general supervisory authority over the worksite, including the power to correct safety and health violations itself or require others to correct them. Control can be established by contract or … by the exercise of control in practice."

This final one is critical. The general contractor, architect, or construction manager can all be considered the controlling employer, requiring that this responsibility be taken seriously and plans formulated in the earliest stages of the project to handle these particles.

PROACTIVE ACTIONS

The controlling employer must be seen as being proactively involved in providing dust control because the dust is generated in many ways, some of them beyond the control of any of the other specific employers on the site. For instance, you would be found to have been proactive by OSHA if you require the concrete contractor to use vacuum controls to collect the dust as it is created. And, if you, as the controlling employer, provide dust control on haul roads by establishing a relationship with the correcting employer (likely paid by you). The activities, while easily invoked, must be included from the beginning to eliminate the potential for citation.

Unlike other industries, precast concrete producers and erectors have been proactive in preparing and educating clients through extensive efforts by PCI. While PCI members are well prepared to control their hazards, ultimately, control of your jobsite is your responsibility.

Creating effective partnerships with contractors is the best way to control jobsite safety. The safety and health of tradespeople and the public are of paramount concern. Take the necessary steps to ensure you and those around you are protected.

Steve Yates is president of Optimum Safety Management, a PCI Member and safety consulting firm in Naperville, Ill.

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PLANNING FOR THE FUTURE

As the service life of parking structures lengthen, technology and demographic changes could impact the buildings' usefulness. Can they be adapted for other uses? Will they need to be?

— Craig A. Shutt

HIGH CLEARANCE
The Ash Skyline Plaza in Fort Wayne, Ind., which combines seven stories of parking with first-floor retail and some office space, created 15-ft clearance on the first level to accommodate a bank's drive-through window. Higher clearances make it easier to adapt levels to commercial needs. Photo: Coreslab.

As precast concrete producers find creative methods to extend the service life of parking structures, this added resiliency and prolonged life cycle could prove to be a double-edged sword. While durability decreases maintenance and operating costs, it could make the structure obsolete if parking supply exceeds demand, or supply is not located where needed. With many technological advances and generational mindsets offering the potential to alter people's relationships with their automobiles, the industry is considering whether it needs to adapt, and in what form.

"Conversations about the future need and format of parking are not yet prevalent, but interest in these ideas is growing," says Anne Ellis, founder and CEO of Ellis Global in Washington, D.C., an AEC (architecture, engineering, and construction) technology and innovation consultant. "The conversation about adapting parking facilities to future needs currently is taking place among thought leaders rather than early adopters. In large part, that's because it's still unclear what trends will predominate and shape the future of parking."

The variety of trends coming to the fore makes it clear that assumptions about transportation, especially for short distances, are evolving, notes Sanjay Pandya, a parking practice builder and senior project manager with Kimley-Horn, a planning consultancy in Pleasanton, Calif. These trends include the steady movement of people into city centers, millennials' lessened interest in owning a car, the growth of car-sharing services, and cities putting more emphasis on pedestrian activities and providing and encouraging more public transportation, including light rail.

ADAPTING SPACES
The RWJ Fitness& Wellness Center in New Brunswick, N.J., includes levels of parking above and beside the commercial and retail space. Such designs offer potential for later adaptation to other uses if they are designed for that flexibility and future trends reduce parking demand. Photo: TimHaahs.

MOVEMENT TO URBAN CENTERS

"There has been a mass migration from suburbia to urban centers," says *The Parking Professional* magazine. In 2013, 2.3 million more people lived in metro areas than the previous year, according to U.S. Census Bureau data.

"The shift in population to America's metro areas has been increasing since 2010 with the economic recovery," says Jim Lewis, director of sales for architectural façade systems of Clark Pacific. Even so, suburban areas remain dominant, aided by people in rural areas moving to suburban centers. "America remains a largely suburban nation," according to a 2016 report by the Urban Land Institute.

The key lies in demographics, as those moving to urban centers are young professionals and baby boomers, who want easy access to entertainment. The growth of ride-sharing services, public transportation, and an emphasis on pedestrian access has lessened the need for them to own cars. Millennials have been less likely to obtain driver's licenses than previous generations, and they take fewer and shorter car trips, using alternative means of transportation. "Driving is not a social activity, which lessens their interest when there are other options for transportation." says Lewis.

The rise of transportation network companies (TNCs) has dramatically expanded the number of people who leave their cars at home and use ride-hailing apps to move short distances. At Dallas-Fort Worth International Airport in Texas, for instance, parking revenue was up in the first six months of the current fiscal year compared to last year, but it was nearly $4 million lower than projected, in part because of TNCs, according to Jenni Bergal at Pew Center.

FUNCTION DISGUISED
The new parking structure at Baylor University in Waco, Texas, features a façade design that disguises the building's function and smoothly blends in retail space. Adapting parking structures for future uses will require adapting exteriors to reflect those purposes. Photo: Carl Walker, a division of WGI.

AUTONOMOUS CARS' IMPACT

A significant game-changer could be the autonomous car, which dominates auto headlines today. Self-driving cars might not only drive passengers to a destination, they might then drive themselves away to be parked at a far location, explains Ellis. That could drastically change parking needs at large-volume sites such as airports and congested theater or entertainment districts.

"If drivers don't need parking in close proximity to their destination, which is often in congested areas with low supply and sky-high pricing, they might choose to use their own vehicle, which self-parks to transport them to events rather than take TNCs or public transportation," Ellis says. In essence, their own car, in which they're comfortable, could be used as a taxi service, parking miles away at a low rate and returning as soon as needed.

That could also change the type of parking needed. "If you are parking cars that self-park and can be retrieved automatically, you can use a more efficient parking layout than one requiring people to have access to the cars," Ellis points out. Self-parking vehicles can be parked closer together, and stair towers and elevators facilitating pedestrian access may not be necessary. "Designing parking structures for machines will be different than designing for people who control machines."

'Designing parking structures for machines will be different than designing for people who control machines.'

Some technology analysts predict subscription-based, on-demand vehicles will bring about the end of individual car ownership. But that scenario was challenged in a recent survey of building owners, developers, analysts, planners, designers, builders, and code officials conducted by Ellis Global for PCI. "Automated vehicles will be the death of mass transit," said one respondent. "We will need more parking, not less, as vehicles diversify in type and size."

The true unknown is what one respondent called the "personal connection" that people have to their cars and their personal spaces. "People use cars for storing and transporting things," notes

Photo: Carl Walker, a division of WGI.

Ellis. "They want to use their own car seats that they know were installed competently and by someone they trust. Individual modes of transport will be with us for a long time."

Some point to other examples of technological advances that were predicted to generate rapid changes in society, such as electronic books that would eliminate printed books. The tactile sensations and pricing, among other factors, have kept e-books from dominating the market. Likewise, despite much talk of the "paperless office," paper producers are still producing products.

Certainly, the recent Apple Park project in Cupertino, Calif., indicates the current state of requirements, regardless of new technologies. Apple's new precast concrete facility provides 11,000 parking spaces for 14,000 workers, because the city requires that many in its employee/parking ratio. Apple built more square footage to park employee cars than for office space. "Does that make sense for future needs?" *Curbed* magazine . "If companies don't require that much parking space, what will they do with it in the future?"

In some instances, companies are building their offices atop parking structures, using it as a base when footprints are tight. The Celgene headquarters in Summit, N.J., is one such project to take that approach, adding columns into the lower parking levels to support the steel-structured office levels above. (For more on this project, see the Overview article in this issue.) For such projects, being able to adapt those lower levels for office or commercial space in the future may provide significant benefits.

ADAPTING TO NEW USES

Mixed-use projects that incorporate parking levels especially need to consider future needs. Building flexibility for other purposes into these spaces could keep them useful and generate revenue that continues to keep the project successful even if parking needs decline. But can parking structures, with their unique design profile, durable construction, and specialized functions, adapt to other uses? Some say they can be adapted, but it will be easier if that need for adaptability is acknowledged upfront.

Other benefits to adapting unused parking space include the increases in property value if changes create higher value land usage, tax credits, and other advantages gained from sustainable adaptability rather than tearing down structures, and the added revenue that can be generated within the structure if new services are added—even minor adaptations such as turning one level into a refueling station and car wash, as many of the consolidated rental car facilities at airports now include.

"The tactics needed to adapt the function of parking structures are not a new design and construction consideration. These tactics have been employed previously," Ellis says. "But what is new is the concept of adapting for a future impacted by autonomous vehicles. There are many things that can be done to accommodate future scenarios."

'The tactics needed to adapt the function of parking structures are not a new design and construction consideration.'

Consider the electric vehicle. Many parking structures have added electrical infrastructure, she notes, to charge electric vehicles and to access solar panels that generate electricity to run the facility and more. Some are adding conduits, floor height, and space for future electrical needs.

Warehouses have long been adapted for residential units, notes Lewis, because their basic structure is durable and appealing, which is similar to what parking structures can offer. But the adaptations will be more extensive. "Substantial changes are needed to convert a space built for cars into one for humans, whether for housing, office space, or retail," he says. "But it can be done if they are designed for that adaptation from the start."

LMN Architects, for example, has announced plans for the 1.2-million-ft^2 skyscraper at 4th and Columbia Street in Seattle, Wash., that will include 840 residential units, 160,000 ft^2 of office space, 30,000 ft^2 of retail, and 400 parking spaces. That includes four floors of aboveground parking that can be converted to residential units.

"I feel we do have the responsibility, if the parking uses do change, to design to be able to adapt to that change," John Chau, a partner at the firm, told Wired.com in November 2016. The project is still being reviewed and won't open until 2019 or later.

Aiding this adaptability function for the project is that Seattle has already changed its parking minimums to reduce space requirements for projects near public transportation. More such changes by cities will be needed to encourage design changes if car usage drops and many of those in use remain on the street or park much further from the actual destination, eliminating the need for nearby parking for those vehicles.

Designers at Arrowstreet in Boston, Mass., also have considered the impact of new technologies on parking designs. By the time parking structures being permitted today are built, self-parking cars and autonomous vehicles likely will be a reality, notes Amy Korte, design partner. The firm's planners are forecasting a two-pronged approach to adapting to design needs.

PHASED EVOLUTION
Designers at Arrowstreet in Boston anticipate two phases of changes to parking structures in the coming years as autonomous vehicles become more popular. Renderings: Arrowstreet.

Phase 1, until 2025 or so, will include adjusting upper floors to create "hyper-efficient" parking layouts for autonomous cars while leaving lower levels more accessible. Phase 2, beginning in about 2025 and continuing for 10 years, will allow adaptation of upper floors to other uses, while lower floors will be re-laid out for autonomous cars that recharge as they wait for use. (For more on these concepts, see the renderings.)

Standalone projects offer different challenges than mixed-use projects that offer parking, Korte notes. "Standalone projects must evolve to address new technologies impacting user and fleet requirements. Most likely, they will be built more often on the outskirts of town, where cars will go to recharge until needed."

Arrowstreet is working on a design for a mixed-use structure in Boston's Seaport district using these concepts. The design for the residential/hotel/retail/parking building, which was permitted in 2014, was reengineered to adapt to anticipated changing parking needs. The initial plan, calling for three levels of below-grade parking for 643 cars, was revamped to offer one story of parking with a 15.5-foot ceiling. That height will allow stackers to be used, creating space for between 200 to 460 cars in a more efficient design.

"The goal is to design with short-term flexibility with higher ceiling heights to accommodate stackers if needed, or allow adaptation to other uses," Korte explains. The project is planned for completion in 2020. The changes saved costs, she adds, as it will save construction time and material by requiring fewer levels to be built. "We don't anticipate this change in design will add costs."

Their design already has been adapted. The plan provides space on the first floor to serve as pickup and queuing area for cars, but it's been redesigned to add space. "We realized there would need to be more space based on the multiple needs for parking in the mixed-use building." Currently, the plan is to use valets to transport cars to parking spaces.

WAYS TO ADAPT

Parking structures feature unique design elements that challenge their ability to adjust to other uses. But those restrictions aren't overwhelming. Some of the key areas to examine when considering future uses for excess parking spaces, according to Pandya, include:

- **Higher floor-to-floor heights.** By increasing ceiling heights to 15 ft on the first floor and 12 ft on upper floors, buildings can meet needs for commercial/retail space and ceiling heights of 9 ft and higher for office space with heating, ventilation, and air conditioning (HVAC) equipment added.
- **Removable interior ramps.** Floor framing can be designed to allow ramps to be easily eliminated to separate floors more effectively.

- **More accessibility.** Pandya suggests adding a 30-ft-wide light well between parking bays to provide space for future stair and elevator towers within each level. Placing perimeter stair and elevator cores outside of the building's footprint can facilitate removal of these structures, if needed, so better entries can be created.
- **Support for vertical expansion**. Columns, walls, and foundations can be designed to allow new levels to be added for residential or commercial space.
- **Higher floor loading.** Residential and commercial space requires higher design live loads than parking structures. A typical parking structure has a minimum-allowed live load of 40 lb/ft^2, but other uses might require 50 to 100 lb/ft^2, Lewis notes. Taking these considerations into account during the design phase can add flexibility for later adaptations.
- **Level flooring.** Parking structures typically offer sloped floors to aid vehicle circulation and drainage. This slope can be mitigated by providing additional floor drains.
- **Capabilities for new services**. Plan for future electrical services, HVAC, plumbing, and fire-protection services, including sprinklers. Allowing for electrical and mechanical chases that will accommodate duct work and cabling will make adjustments easier to any function, Pandya explains.

Many precast concrete producers report already being involved with projects that incorporate some of these tactics for adaptations. More than half, for instance, reported to Ellis Global that they have worked on projects in which higher live loads and increased floor-to-floor heights were provided. Other features in projects they have been involved with included flat floors, ability to reconfigure spaces, removable external ramps, and transformable façade systems. For more details, see Chart 1.

Many precast concrete producers report already being involved with projects that incorporate some of these tactics for adaptations.

At the same time, precast concrete producers indicated they have worked on projects that incorporated new technologies that are growing in popularity. More than half, for instance, said they have worked on designs that provided upgraded electrical capabilities to recharge electric vehicles. More than half also said they have assisted with designs to incorporate additional parking technologies of various kinds. Other high-scoring technologies included automated car-parking systems and autonomous parking systems designed for driverless cars. For more details, see Chart 2.

Although these changes may sound daunting (that is, expensive), they all can be accomplished without drastic alterations to plans. Precast concrete producers estimate that the alterations to structural designs would add about 10% to 15% to current pricing. "A low price point is important, because owners and developers don't want to boost their budget without some idea that the premium will pay off down the road," Ellis notes.

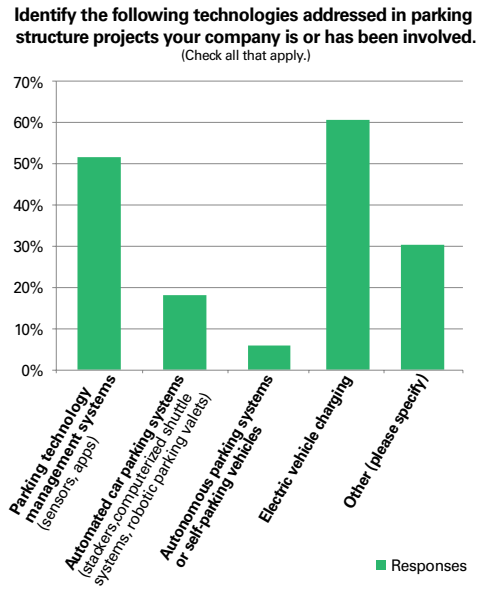


CHART 1. PRODUCERS INVOLVED
Precast concrete producers reported they had been involved with parking structure projects that incorporated a variety of new technologies, according to a recent survey by Ellis Global for PCI.

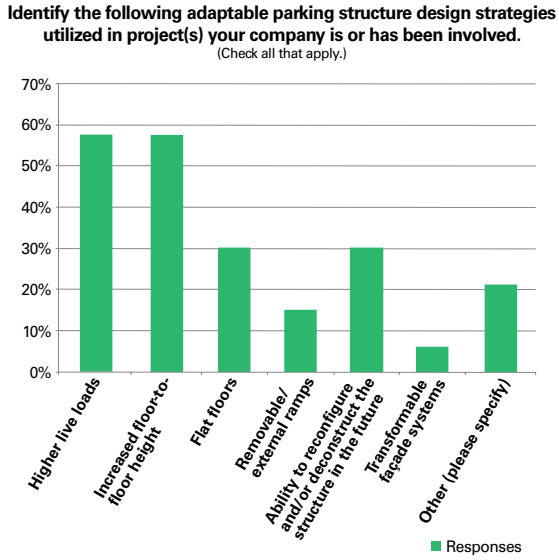


CHART 2. FEATURES INCLUDED
Parking structure designs often include features that make them more easily adapted to other uses in the future, according to respondents in a recent survey by Ellis Global for PCI.

FORECASTING CHANGE

The problem facing developers is that they must commit today to plans for a future that is rapidly evolving in ways no one fully comprehends yet. "There is neither clarity nor consistency concerning the potential impact of the autonomous vehicle on the built world," Ellis says.

BLENDING SPACES
The Zaragon West student resident in Ann Arbor, Mich., includes parking for 40 cars on levels two and three, behind a façade that blends with the rest of the building's residential nature. Such placement can add benefits when adapting space to other uses, if the parking levels were designed with that potential. Photo: maconochie photography.

That creates risks for developers. "Our buildings may be designed for a design life of 50 years or more, the investment period in the rate-of-return analyses may be shorter—7 to 10 years is common," she explains. "Cities and industry need to begin looking at ways they can smooth the connection between technology and those looking to build to suit future needs."

Regulatory and enabling infrastructures must be adapted and adopted to ease the path forward for those in the construction industry, she says. "AVs [autonomous vehicles] will require changes to regulatory standards, including building codes, legal, and insurance frameworks. These changes will take years to develop and adopt across many building jurisdictions in the United States."

That means reviewing current standards and generating an industry consensus and voice, with guidance and standards on matters outside current industry norms, she says. Cost information on each design alteration and more information on how they can fit into the existing International Building Code are required.

"The best people to understand how to adapt our cities, infrastructure network, and buildings to accommodate any changes are the planners, designers, builders, and regulators. They need to be part of the dialogue. Technology people seem to be discussing it, but few in the design industry are looking at it closely yet. I believe the first impact that autonomous cars and demographic trends will have will be seen on parking structures, but we don't know where and how much that will be."

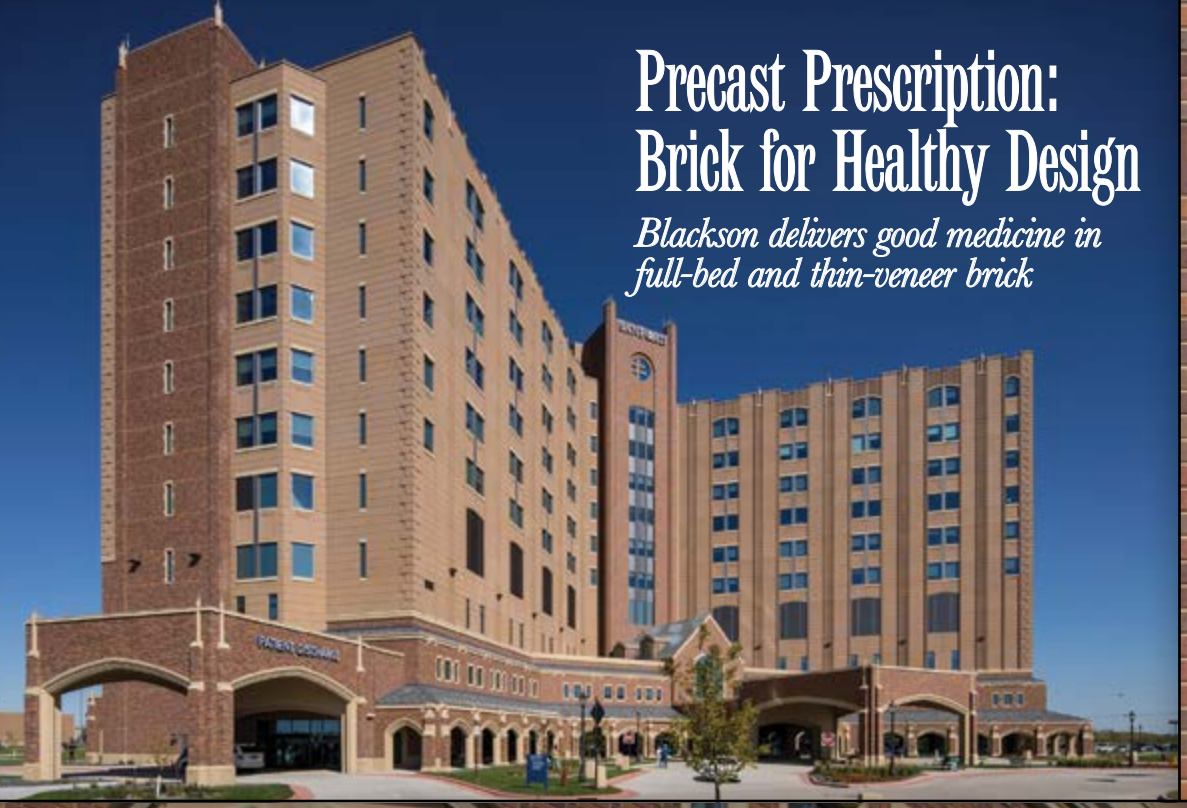
These trends will evolve in stages, initially with the early adopters followed by a rise in popularity that makes these changes grow. Whether that will follow the trend line of growth in hybrid and electric cars, or be slower (or faster), can't be determined. "It will happen step by step, but how fast those steps come could be surprising," Ellis says. She anticipates the initial deployment of autonomous cars that will begin to impact parking structure uses will come in the next 10 years.

Key indicators may provide clues to the force of the impacts, she notes. "Look to what the tech giants—Apple, Google, IBM, Tesla, etc.—are building and what technologies they are investing in." The caveat there, as seen at the new Apple headquarters, is that even large technology companies are restricted by what local zoning and building ordinances require, especially if they lag behind even the most recent codes.

She also suggests keeping abreast of TNC investments, as well as news of improvements to electric vehicles and battery advancements, which could enhance electric car appeal. City, state, and federal officials, including state departments of transportation, also need to be part of the discussion, to encourage changing policies and increasing incentives to prepare for the future as developments arise.

One good sign, as shown in the design concepts by LMN, Arrowstreet, and others, is that awareness of the potential for adaptive reuse has begun to appear and make its way into conceptual plans. "Awareness of these concepts is growing among planners and owners," says Ellis. "Now, it has to make its way to architects, engineers, contractors, and suppliers. The diversity of A/E/C perspectives will help ensure the approaches are constructible and cost-efficient."

Those conversations should include precast concrete producers, she stresses. "Precast producers know how to be efficient and effective, and they are involved in a large majority of the decisions on parking structures. They know how to meet owners' needs and create efficient designs. We need more discussions about what those needs are and what the future holds for parking structures during the service life of those being planned today. We need to help our clients plan and prepare for the future."



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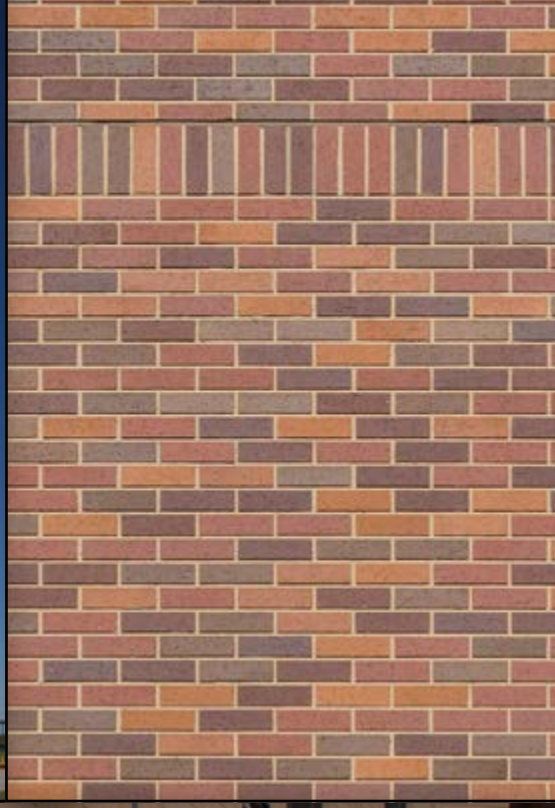

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CREATIONS in Concrete:

AN INTEGRATED ARCHITECTURE AND CIVIL ENGINEERING INSTRUCTIONAL PROJECT IN PRECAST CONCRETE

— Meghan Palmer

Students taking park in the NC State University studio, work in teams to design a precast concrete project. Photo: NC State.

How something is made can impact how it's designed—this is a principle, associate professor of architecture and director of graduate programs, Dana Gulling impresses upon students in her architectural design studios at North Carolina State University, where young architects learn to bridge technology and design with innovative ideas for new structures.

For Greg Lucier, research assistant professor in civil construction and engineering and manager of NC State's Constructed Facility Laboratory (CFL), understanding the broader impact of production details in building materials is key to the research he and his students perform as they test structures at full scale in the CFL.

These two disciplines—architecture and civil engineering—, while tangential, often did not overlap in the courses at NC State until recently, when Gulling and Lucier teamed up to create an interdisciplinary endeavor that blended the architectural studio learning environment with structural engineering.

Creations in Concrete, a new studio that started in the spring of 2017, brought together architecture and civil engineering students to study precast concrete. The integrated course offering is an elective, vertical studio for senior undergrad and graduate students. The civil engineering students were required to have a prestressed concrete course as a prerequisite. Additionally, the course included four sessions of a digital design workshop, instructed by David Hill, department head and associate professor of architecture, to examine material attributes and use parametric-based software and computer numerical control (CNC) machinery to propose new material applications.

'Integrating precast concrete design into a combined architectural/ engineering format is a unique experience.'

The studio is sponsored over four years by the PCI Foundation, which provides grants to educational institutions like NC State to better familiarize students with precast concrete as a structural and architectural material, and to be an incubator in initiating precast concrete to the instructional curriculum. Peter Finsen, executive director of Georgia/Carolinas PCI, the local participating PCI Chapter, and a member of the PCI Foundation's Board of Trustees, kicked off the studio with an introductory lecture. "Civil engineering schools typically teach a prestressed concrete course, and [those students] are more familiar with it than architecture students," says Finsen. "Integrating precast concrete design in a combined architectural/engineering format is a unique experience that provides a strong educational foundation for the industry."

"I think precast, probably more than any other building system, requires a close link between design, fabrication, and construction," Lucier explains. "Those disciplines have to be viewed holistically. With other types of construction, you can do the design and

not worry about who's going to build it, or vice-versa. But with precast, some of the things that make it very unique can also make it unforgiving."

That link between design and practice made precast concrete an optimal subject material for a studio that sought to fuse the worlds of civil engineering and architecture, worlds traditionally, but perhaps not deliberately, kept separate from one another despite their natural synergy. "Before integrated practices came up, you would get to a certain point in design development and then send it off to the structural engineer," Gulling says. But recent innovations in materials like precast concrete have taken a process that was previously linear and created an opportunity for collaboration.

During the studio, nine architecture students and four civil engineering students collaborated on a series of three projects that investigated precedent, component design and fabrication, and full building design concepts. Activities within the studio ran the gamut from reviewing case studies, to touring precast concrete manufacturing facilities, to attending the 2017 PCI Convention & National Bridge Conference in Cleveland, Ohio. Students visited and toured Gate Precast Company and had a hands-on workshop in the Materials Lab with US Formliner, a company that graciously provided instruction and rubber for molds that the students could cast on their own. The students created CNC-formed positive wood forms, then used the elastomeric rubber components to create their own formliners. Perhaps the most impactful part of the studio, however, came from the time the students spent in the CFL, constructing and testing full-size precast concrete panels. The components were attached to a seismic shake frame and tested, successfully.

The final project was a conceptual design for a cidery in Upstate New York. Such a building appealed to Gulling and Lucier because the program included a combination of small spaces nestled within large spaces and offered an ideal challenge. And it helped that the real site was accessible to the students, some of whom made the journey over spring break to assess it after attending the PCI Convention.

For Lucier and engineering graduate students like Meghan Strahler, the Creations in Concrete class was their first exposure to a studio-based environment outside of a classroom, where the emphasis was on creating a solution to an open-ended problem instead of listening to lectures and completing textbook-based problems.

NC State University architecture and civil engineering students from the PCI Foundation visit Gate Precast Company's Oxford, NC precast concrete plant. Photo: Peter Finsen.

"Working with the architecture students was a very eye-opening experience. Learning to cooperate and communicate effectively was critical," says Strahler. "Visiting precast concrete plants and participating in the casting of wall panels afforded me a feel for what was practical to achieve in construction beyond what design calculations may indicate."

"Eye-opening" is a phrase students and faculty alike used often during the course of the studio, working with a subject that Lucier believes one must witness firsthand to truly understand. "It's one thing to say, 'Weld a steel beam up there,'" he explains. "But if I say, 'I'm going to pour this concrete into this mold and it's going to look nice and it's going to have all the embeds and attachments we need to get it on the building,' that's a harder sell until you see it."

For Austin Corriher, who was a senior in architecture at the time he took the class, these real-world interactions with an interdisciplinary focus were both challenging and rewarding. "I've never actually gotten the chance to meaningfully interact with another nondesign major in a studio before," he says. "The immediate feedback of someone grounded in the real world came back to help after every design decision, even if a lot of them told us, 'No, this cantilever can't be 60 feet long.'"

And giving the students the opportunity to work together on their designs in the CFL was a large part of the studio's impetus. "We really wanted to use this university facility as an opportunity," says Gulling. "Especially in the school of architecture—we have such a great legacy and interest in the craft and art of having students make things." Plus access to precast concrete industry professionals who provided real-world advice and resources.

Students and faculty alike came away from the studio with a greater respect for both design and engineering, and they were challenged in their own practices to optimize and innovate their approach to problem-solving. Finsen, who represented Georgia/Carolinas PCI and the PCI Foundation when he visited NC State for intermediate and final critiques, praised the projects and the participants. "Dana and Greg did a great job working together and coaching the students," he reflects. "That kind of collaboration is what makes the studio a success."

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"***Manufacturer Qualification:*** The precast concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. Manufacturer shall be certified at time of bidding. Certification shall be in the following product group(s) and category(ies): [Select appropriate groups and categories (AT or A1), (B1,2,3, or 4), (C1,2,3, or 4), (G)]."

Product Groups and Categories

The PCI Plant Certification Program is focused around four groups of products, designated A, B, C, and G. Products in Group A are audited to the standards in MNL–117. Products in Groups B and C are audited to the standards in MNL–116. Products in Group G are audited according to the standards in MNL–130. The standards referenced above are found in the following manuals:

- MNL–116 *Manual for Quality Control for Plants and Production of Structural Precast and Prestressed Concrete Products*
- MNL–117 *Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products*
- MNL–130 *Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products*

Within Groups A, B, and C are categories that identify product types and the product capability of the individual plant. The categories reflect similarities in the ways in which the products are produced. In addition, categories in Groups A, B, and C are listed in ascending order. In other words, a plant certified to produce products in Category C4 is automatically certified for products in the preceding Categories C1, C2, and C3. A plant certified to produce products in Category B2 is automatically qualified for Category B1 but not Categories B3 or B4.

GROUPS

> GROUP A – ARCHITECTURAL PRODUCTS

CATEGORY AT – ARCHITECTURAL TRIM UNITS

Wet-cast, nonprestressed products with a high standard of finish quality and of relatively small size that can be installed with equipment of limited capacity such as sills, lintels, coping, cornices, quoins, medallions, bollards, benches, planters, and pavers.

CATEGORY A1 – ARCHITECTURAL CLADDING AND LOAD-BEARING UNITS

Precast or precast, prestressed concrete building elements such as exterior cladding, load-bearing and nonload-bearing wall panels, spandrels, beams, mullions, columns, column covers, and miscellaneous shapes. This category includes Category AT.

> GROUP B – BRIDGES

Please note for Group B, Category B1: Some precast concrete products such as highway median barriers, box culverts, and three-sided arches are not automatically included in routine plant audits. They may be included at the request of the precaster or if required by the project specifications.

CATEGORY B1 – PRECAST CONCRETE BRIDGE PRODUCTS

Mild-steel-reinforced precast concrete elements that include some types of bridge beams or slabs, sheet piling, pile caps, retaining-wall elements, parapet walls, sound barriers, and box culverts.

CATEGORY B2 – PRESTRESSED MISCELLANEOUS BRIDGE PRODUCTS

Any precast, prestressed element excluding super-structure beams. Includes piling, sheet piling, retaining-wall elements, stay-in-place bridge deck panels, and products in Category B1.

CATEGORY B3 – PRESTRESSED STRAIGHT-STRAND BRIDGE MEMBERS

Includes all superstructure elements such as box beams, I-beams, bulb tees, stemmed members, solid slabs, full-depth bridge deck slabs, and products in Categories B1 and B2.

CATEGORY B4 – PRESTRESSED DEFLECTED-STRAND BRIDGE MEMBERS

Includes all products covered in Categories B1, B2, and B3.

GROUP BA – BRIDGE PRODUCTS WITH AN ARCHITECTURAL FINISH

These products are the same as those in the categories within Group B, but they are produced with an architectural finish. They will have a form, machine, or special finish. Certification for Group BA production supersedes Group B in the same category. For instance, a plant certified to produce products in Category B2A is also certified to produce products in Categories B1, B1A, and B2 (but not certified to produce any products in B3A or B4A).

> GROUP C – COMMERCIAL (STRUCTURAL)

CATEGORY C1 – PRECAST CONCRETE PRODUCTS

Mild-steel-reinforced precast concrete elements including sheet piling, pile caps, piling, retaining-wall elements, floor and roof slabs, joists, stairs, seating members, columns, beams, walls, spandrels, etc.

CATEGORY C2 – PRESTRESSED HOLLOW-CORE AND REPETITIVE PRODUCTS

Standard shapes made in a repetitive process prestressed with straight strands. Included are hollow-core slabs, railroad ties, flat slabs, poles, wall panels, and products in Category C1.

CATEGORY C3 – PRESTRESSED STRAIGHT-STRAND STRUCTURAL MEMBERS

Includes stemmed members, beams, columns, joists, seating members, and products in Categories C1 and C2.

CATEGORY C4 – PRESTRESSED DEFLECTED-STRAND STRUCTURAL MEMBERS

Includes stemmed members, beams, joists, and products in Categories C1, C2, and C3.

GROUP CA – COMMERCIAL PRODUCTS WITH AN ARCHITECTURAL FINISH

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> GROUP G – GLASS-FIBER-REINFORCED CONCRETE (GFRC)

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Rocla Concrete Tie, Inc. C2
Tucson, (520) 447-8257

Stinger Bridge & Iron B4
Coolidge, (520) 723-5383

Tpac, An EnCon Company A1, B4, C4, C4A
Phoenix, (602) 262-1360

> ARKANSAS

Coreslab Structures (ARK) Inc. C4, C4A
Conway, (501) 329-3763

> CALIFORNIA

Bethlehem Construction Inc. C3, C3A
Wasco, (661) 391-9704

Clark Pacific A1, C3, C3A, G
Fontana, (909) 823-1433

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Adelanto, (626) 962-8751

Clark Pacific A1, B3, C4, C4A, G
Woodland, (530) 207-4100

Con-Fab California, LLC B4, C4
Lathrop, (209) 249-4700

Con-Fab California, LLC B4, C4
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Coreslab Structures (LA) Inc. A1, B4, C4, C4A
Perris, (951) 943-9119

KIE-CON Inc. B4, C3
Antioch, (925) 754-9494

Midstate Precast, L.P. A1, C3, C3A
Corcoran, (559) 992-8180

Oldcastle Precast Inc. B4, B4A, C2, C2A
Perris, (951) 657-6093

Oldcastle Precast Inc. C2
Stockton, (209) 466-4215

Precast Concrete Technology Unlimited dba CTU Precast A1, C3, C3A
Olivehurst, (530) 749-6501

StructureCast A1, B3, C3, C3A
Bakersfield, (661) 833-4490

Universal Precast Concrete Inc. A1, B1, C1
Redding, (530) 243-6477

Walters & Wolf Precast A1, G
Fremont, (510) 226-9800

Willis Construction Co. Inc. A1, C1
Hollister, (831) 623-2900

Willis Construction Co. Inc. A1, C1, G
San Juan Bautista, (831) 623-2900

> COLORADO

EnCon Colorado B4, C3
Denver, (303) 287-4312

Plum Creek Structures B4, C3, C3A
Littleton, (303) 471-1569

Rocky Mountain Prestress LLC Architectural Plant A1, C3, C3A
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Rocky Mountain Prestress LLC Structural Plant B4, C4
Denver, (303) 480-1111

Rocla Concrete Tie Inc. C2
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Oldcastle Precast B2, C2, C2A
Avon, (860) 673-3291

United Concrete Products Inc. B3, C3
Yalesville, (203) 269-3119

> DELAWARE

Concrete Building Systems of Delaware Inc. B3, C4
Delmar, (302) 846-3645

Rocla Concrete Tie Inc. C2
Bear, (302) 836-5304

> FLORIDA

Cement Industries Inc. B3, C3
Fort Myers, (800) 332-1440

Colonial Precast Concrete LLC C2
Placida, (941) 698-4180

Coreslab Structures (MIAMI) Inc. A1, C4, C4A
Medley, (305) 823-8950

Coreslab Structures (ORLANDO) Inc. C2
Orlando, (407) 855-3190

Coreslab Structures (TAMPA) Inc. A1, B3, C3, C3A
Tampa, (813) 626-1141

Dura-Stress Inc. A1, B4, B4A, C4, C4A
Leesburg, (352) 787-1422

Finfrock Industries Inc. A1, C3
Apopka, (407) 293-4000

Gate Precast Company A1, B4, C3, C3A
Jacksonville, (904) 757-0860

Gate Precast Company A1, C3
Kissimmee, (407) 847-5285

International Casting Corporation C4
Hialeah, (305) 558-3515

Metromont Corporation A1, C3, C3A
Bartow, (863) 440-5400

Precast Specialties LLC C4
Pompano Beach, (954) 781-4040

Skanska USA Civil SE B2
Pensacola, (757) 578-4147

Spancrete C2
Sebring, (863) 655-1515

Stabil Concrete Products LLC A1
St. Petersburg, (727) 321-6000

Standard Concrete Products Inc. B4, C3
Tampa, (813) 831-9520

Structural Prestressed Industries Inc. C4
Medley, (305) 556-6699

> GEORGIA

Atlanta Structural Concrete Co. C4, C4A
Buchanan, (770) 646-1888

Coreslab Structures (ATLANTA) Inc. C2
Jonesboro, (770) 471-1150

Metromont Corporation A1, C4, C4A
Hiram, (770) 943-8688

Spancrete C2
Newnan, (770) 252-8944

Standard Concrete Products Inc. B4
Atlanta, (404) 792-1600

Standard Concrete Products Inc. B4, C4
Savannah, (912) 233-8263

Tindall Corporation, Georgia Division C4, C4A
Conley, (404) 366-6270

> HAWAII

GPRM Prestress LLC A1, B4, C4, C4A
Kapolei, (808) 682-6000

> IDAHO

Forterra Structural Precast A1, B4, C4
Caldwell, (208) 454-8116

Teton Prestress Concrete LLC B4, C3
Idaho Falls, (208) 552-6606

> ILLINOIS

ATMI Precast A1, C3, C3A
Aurora, (630) 896-4679

AVAN Precast Concrete Products Inc. A1, C3
Lynwood, (708) 757-6200

County Materials Corporation B3, B3-IL
Champaign, (217) 352-4181

County Materials Corporation A1, B4, B4-IL, C4
Salem, (618) 548-1190

Dukane Precast Inc. A1, B3, B3-IL, C3, C3A
Aurora, (630) 355-8118

Dukane Precast Inc. A1, C3A
Naperville, (630) 355-8118

Dukane Precast Inc. A1, C3A
Plainfield, (815) 230-4760

ICCI Illini Concrete LLC B3, B3-IL
Tremont, (309) 925-2376

Illini Precast LLC B4, B4-IL, C3
Marseilles, (815) 795-6161

Lombard Architectural Precast Products Co. A1, C2, C2A
Alsip, (708) 389-1060

Mid-States Concrete Industries, LLC A1, B3, B3-IL, C3, C3A
South Beloit, (815) 389-2277

St. Louis Prestress Inc. B3, B3-IL, C3
Glen Carbon, (618) 656-8934

Utility Concrete Products LLC B1, B1A, C1, C1A
Morris, (815) 416-1000

> INDIANA

ATMI Indy, LLC A1, C2, C2A
Greenfield, (317) 891-6280

Coreslab Structures (INDIANAPOLIS) Inc. A1, C4, C4A
Indianapolis, (317) 353-2118

Hoosier Precast LLC B3, C1, C1A
Salem, (815) 459-4545

Precast Specialties A1, B1
Monroeville, (260) 623-6131

Prestress Services Industries LLC B4, B4-IL, C4, C4A
Decatur, (260) 724-7117

StresCore Inc. C2
South Bend, (574) 233-1117

> IOWA

Advanced Precast Co. A1, C1, C1A
Farley, (563) 744-3909

Forterra Pipe & Precast B4, C4, C4A
Iowa Falls, (641) 648-2579

MPC Enterprises Inc. A1, C3, C3A
Mount Pleasant, (319) 986-2226

PDM Precast Inc. A1, C3, C3A
Des Moines, (515) 243-5118

Rail One USA C2
Clinton, (563) 522-2795

> KANSAS

Coreslab Structures (KANSAS) Inc. B4, C4
Kansas City, (913) 287-5725

Crossland Prefab LLC C1
Columbus, (620) 249-1414

Fabcon Precast, LLC C3, C3A
Pleasanton, (913) 937-3021

Prestressed Concrete Construction LLC A1, B4, C4, C4A
Newton, (316) 283-2277

Stress-Cast Inc. C3, C3A
Assaria, (785) 667-3905

> KENTUCKY

Bristol Group Precast A1, B3, B3A, C3, C3A
Lexington, (859) 233-9050

Visit www.pci.org for the most up-to-date listing of PCI-Certified Plants.

de AM-RON Building Systems LLC B3, C3, C3A
Owensboro, (270) 684-6226

Forterra Pipe & Precast B3, C3
Louisville, (800) 737-0707

Gate Precast Company A1, C3, C3A
Winchester, (859) 744-9481

Prestress Services Industries LLC A1, B4, C4, C4A
Lexington, (601) 856-4135

Prestress Services Industries LLC B4, C3
Melbourne, (859) 441-0068

> LOUISIANA

Alfred Miller Contracting C3
Lake Charles, (337) 477-4681

Atlantic Metrocast Inc. C2
New Orleans, (504) 941-3152

Boykin Brothers LLC A1, B4, C3, C3A
Baton Rouge, (225) 753-8722

dp Concrete Products LLC B2, C2
Vinton, (337) 433-3900

F-S Prestress LLC B4, C4
Princeton, (318) 949-2444

Fibrebond Corporation A1, C1, C1A
Minden, (318) 377-1030

> MAINE

Superior Concrete LLC B2, C1
Auburn, (207) 784-1388

> MARYLAND

Atlantic Metrocast Inc. B2, C2
La Plata, (301) 870-3289

Larry E. Knight Inc. C2
Reisterstown, (410) 833-7800

> MASSACHUSETTS

Oldcastle Precast Inc. B4, C3
Rehoboth, (508) 336-7600

Precast Specialties Corp. A1
Abington, (781) 878-7220

Unistress Corporation A1, B4, C4, C4A
Pittsfield, (413) 629-2039

Vynorius Prestress Inc. B3, C2
Salisbury, (978) 462-7765

> MICHIGAN

International Precast Solutions LLC A1, B3, C3, C3A
River Rouge, (313) 843-0073

Kerkstra Precast Inc. A1, B3, C3, C3A
Grandville, (616) 224-6176

M.E.G.A. Precast Inc. A1, C3, C3A
Shelby Township (586) 294-6430

Mack Industries Inc. A1, B4, C3, C3A
Kalamazoo, (330) 635-5945

Mack Industries Inc. B3A, C3
Saginaw, (989) 755-4348

Peninsula Prestress Company B4, C1
Grand Rapids, (517) 206-4775

> MINNESOTA

Crest Precast Inc. B3, B3A, C3, C3A
La Crescent, (800) 658-9045

Fabcon Precast LLC A1, B1, C3, C3A
Savage, (952) 890-4444

Forterra Pipe & Precast B4, C2
Elk River, (763) 441-2124

Molin Concrete Products Co. C3, C3A
Lino Lakes, (651) 786-7722

Molin Concrete Products Co. A1, C1, C1A
Ramsey, (651) 786-7722

Taracon Precast C3, C3A
Hawley, (218) 216-8260

Wells Concrete A1, C3, C3A
Albany, (320) 845-2229

Wells Concrete C3
Rosemount, (507) 380-6772

Wells Concrete A1, C4, C4A
Wells, (800) 658-7049

> MISSISSIPPI

F-S Prestress LLC B4, C4
Hattiesburg, (601) 268-2006

Gulf Coast Pre-Stress Inc. B4, C4
Pass Christian, (228) 452-9486

J.J. Ferguson Prestress-Precast Inc. B4
Greenwood, (662) 453-5451

Jackson Precast Inc. A1, C2, C2A
Jackson, (601) 321-8787

Tindall Corporation, Mississippi Div. A1, C4, C4A
Moss Point, (228) 246-0800

> MISSOURI

Coreslab Structures (MISSOURI) Inc. A1, B4, C4, C4A
Marshall, (660) 886-3306

County Materials Corporation B4
Bonne Terre, (573) 358-2773

Mid America Precast Inc. A1, B1, C1
Fulton, (573) 642-6400

Prestressed Casting Co. C4
Ozark, (417) 581-7009

Prestressed Casting Co. A1, C3, C3A
Springfield, (417) 869-7350

> MONTANA

Forterra Building Products B4
Montana City, (406) 442-6503

Forterra Pipe & Precast B4, C3
Billings, (406) 656-1601

Missoula Concrete Construction A1, B3, C3, C3A
Missoula, (406) 549-9682

> NEBRASKA

American Concrete Products Co. B1, B1A, C1, C1A
Valley, (402) 331-5775

Concrete Industries Inc. B4, C4, C4A
Lincoln, (402) 434-1800

Coreslab Structures (OMAHA) Inc. A1, B4, C4, C4A
LaPlatte, (402) 291-0733

Enterprise Precast Concrete Inc. A1, C2, C2A
Omaha, (402) 895-3848

> NEVADA

Western Pacific Precast B4, C2
Sloan, (702) 623-4484

> NEW HAMPSHIRE

Newstress Inc. B3, C3
Epsom, (603) 736-9000

> NEW JERSEY

Boccella Precast LLC C2
Berlin, (856) 767-3861

Jersey Precast B4, C4, C4A
Hamilton Township, (609) 689-3700

Northeast Precast A1, B3, C3, C3A
Millville, (856) 765-9088

Precast Systems Inc. B4, C4
Allentown, (609) 208-1987

> NEW MEXICO

Castillo Prestress, a division of CRMC, Inc. B4, C4
Belen, (505) 864-0238

Coreslab Structures (ALBUQUERQUE) Inc. A1, B4, C4, C4A
Albuquerque, (505) 247-3725

Ferreri Concrete Structures Inc. A1, C4, C4A
Albuquerque, (505) 344-8823

> NEW YORK

David Kucera Inc. A1, G
Gardiner, (845) 255-1044

Lakelands Concrete Products Inc. A1, B3, B3A, C3, C3A
Lima, (585) 624-1990

Oldcastle Precast B3, C3, C3A
Selkirk, (518) 767-2116

The Fort Miller Company Inc. B1, B1A, C1, C1A
Greenwich, (518) 695-5000

The L.C. Whitford Materials Co. Inc. B4, C3
Wellsville, (585) 593-2741

> NORTH CAROLINA

Coastal Precast Systems LLC B4, C2
Wilmington, (910) 604-2249

Gate Precast Company A1, C3
Oxford, (919) 603-1633

Metromont Corporation A1, C3, C3A
Charlotte, (704) 372-1080

Prestress of the Carolinas B4, C4
Charlotte, (704) 587-4273

Utility Precast Inc. B3, B3A
Concord, (704) 721-0106

> NORTH DAKOTA

Wells Concrete C4, C4A
Grand Forks, (701) 772-6687

> OHIO

DBS Prestress of Ohio C3
Huber Heights, (937) 878-8232

Fabcon Precast LLC A1, C3, C3A
Grove City, (952) 890-4444

High Concrete Group LLC A1, C3, C3A
Springboro, (937) 748-2412

Mack Industries Inc. C3
Valley City, (330) 460-7005

Mack Industries Inc. B3A,C3
Vienna, (330)638-7680

Prestress Services Industries of Ohio LLC (I-Beam) A1, B4, C3
Mt. Vernon, (740) 393-1121

Prestress Services Industries of Ohio LLC (Box Beam) B3, C3
Mt. Vernon, (740) 393-1121

Rocla Concrete Tie Inc. C2
Sciotoville, (740) 776-3238

Sidley Precast Group, A Division of R.W. Sidley Inc. A1, C4, C4A
Thompson, (440) 298-3232

> OKLAHOMA

Arrowhead Precast LLC A1, C3, C3A
Broken Arrow, (918) 995-2227

Coreslab Structures (OKLA) Inc. (Plant No.1) A1, C4, C4A
Oklahoma City, (405) 632-4944

Coreslab Structures (OKLA) Inc. (Plant No.2) B4, C3
Oklahoma City, (405) 672-2325

Coreslab Structures (TULSA) Inc. B4, C4
Tulsa, (918) 438-0230

> OREGON

Knife River Prestress A1, B4, C4, C4A
Harrisburg, (541) 995-4100

R.B. Johnson Co. B4, C3
McMinnville, (503) 472-2430

> PENNSYLVANIA

Architectural Precast Innovations Inc. A1, C3, C3A
Middleburg, (570) 837-1774

Brayman Precast LLC B3, C1
Saxonburg, (724) 352-5600

Concrete Safety Systems LLC A1, B3, B3A, C3, C3A
Bethel, (717) 933-4107

Conewago Precast Building Systems A1, C3,C3A
Hanover, (717) 632-7722

Visit www.pci.org for the most up-to-date listing of PCI-Certified Plants.

Dutchland Inc. C3
Gap, (717) 442-8282
Fabcon Precast LLC A1, B1, B1A, C3, C3A
Mahanoy City, (952) 890-4444
High Concrete Group LLC A1, B3, C3, C3A
Denver, (717) 336-9300
J & R Slaw Inc. A1, B4, C3, C3A
Lehighton, (610) 852-2020
Nitterhouse Concrete Products Inc. A1, C4, C4A
Chambersburg, (717) 267-4505
Northeast Prestressed Products LLC B4, C3
Cressona, (570) 385-2352
PENNSTRESS, a division of MacInnis Group, LLC A1, B4, C4
Roaring Spring, (814) 695-2016
Say-Core Inc. C2
Portage, (814) 736-8018
Sidley Precast Group, A Division of R.W. Sidley Inc. C3
Youngwood, (724) 755-0205
Universal Concrete Products Corporation A1, C3, C3A
Stowe, (610) 323-0700

> RHODE ISLAND

Hayward Baker Inc. C2
Cumberland, (401) 334-2565

> SOUTH CAROLINA

Florence Concrete Products Inc. B4, C3, C3A
Sumter, (803) 775-4372
Metromont Corporation A1, C4, C4A
Greenville, (864) 605-5000
Metromont Corporation C3
Spartanburg, (864) 605-5063
Tekna Corporation B4, C3
Charleston, (843) 853-9118
Tindall Corporation, South Carolina Division A1, C4, C4A
Spartanburg, (864) 576-3230

> SOUTH DAKOTA

Forterra Pipe & Precast (Rapid City) B4
Rapid City, (605) 343-1450
Gage Brothers A1, B4, C4, C4A
Sioux Falls, (605) 336-1180

> TENNESSEE

Construction Products Inc. of TN B4, C4
Jackson, (731) 668-7305
Gate Precast Company A1, C3, C3A
Ashland City, (615) 792-4871
Mid South Prestress LLC C3
Pleasant View, (615) 746-6606
Ross Prestressed Concrete Inc. B4, C3
Bristol, (423) 323-1777
Ross Prestressed Concrete Inc. B4, C4
Knoxville, (865) 524-1485

> TEXAS

Coreslab Structures (TEXAS) Inc. A1, C4, C4A
Cedar Park, (512) 250-0755
CXT Inc. B1, B1A, C1, C1A
Hillsboro, (254) 580-9100
East Texas Precast A1, C4, C4A
Hempstead, (281) 463-0654
Enterprise Concrete Products LLC B3, C3
Dallas, (214) 631-7006
Enterprise Precast Concrete of Texas LLC A1, C3
Corsicana, (903) 875-1077
Gate Precast Company A1, C1, C1A
Hillsboro, (254) 582-7200
Gate Precast Company C2
Pearland, (281) 485-3273
GFRC Cladding Systems LLC G
Garland, (972) 494-9000
Heldenfels Enterprises Inc. B4, C4
Corpus Christi, (361) 883-9334
Heldenfels Enterprises Inc. B4, C4
San Marcos, (512) 396-2376
Legacy Precast LLC C4, C4A
Brookshire, (281) 375-2050
Lowe Precast Inc. A1, C3, C3A
Waco, (254) 776-9690
Manco Structures Ltd. C4, C4A
Schertz, (210) 690-1705
NAPCO PRECAST LLC A1, C4, C4A
San Antonio, (210) 509-9100
Rocla Concrete Tie Inc. C2
Amarillo, (806) 383-7071
Texas Concrete Partners LP B4, C4
Elm Mott, (254) 822-1351
Texas Concrete Partners LP B4, C4
Victoria, (361) 573-9145
Tindall Corporation A1, C3, C3A
San Antonio, (210) 248-2345
Valley Prestressed Products Inc. B2
Houston, (713) 455-6098
Valley Prestress Products Inc. B4
Eagle Lake, (979) 234-7899

> UTAH

Forterra Structural Precast A1, B4, C4, C4A, G
Salt Lake City, (801) 966-1060
Harper Precast B2, C1
Salt Lake City, (801) 326-1016
Olympus Precast A1, B3, B3A, C3, C3A
Bluffdale, (801) 571-5041

> VERMONT

Joseph P. Carrara & Sons Inc. A1, B4, B4A, C4, C4A
Middlebury, (802) 775-2301
S.D. Ireland Concrete Construction Corp. B1, C1
Williston, (802) 863-6222
William E. Dailey Precast LLC A1, B4, B4A, C3, C3A
Shaftsbury, (802) 442-4418

> VIRGINIA

Atlantic Metrocast Inc. B4, C4
Portsmouth, (757) 397-2317
Bayshore Concrete Products Corporation B4, C4
Cape Charles, (757) 331-2300
Coastal Precast Systems LLC A1, B4, C3
Chesapeake, (757) 545-5215
Hessian Company LTD t/a Faddis Concrete Products B2, C2
King George, (540) 775-4546
Metromont Corporation A1, C3, C3A
Richmond, (804) 665-1300
Rockingham Precast B4
Harrisonburg, (540) 433-8282
Smith-Midland A1, B2, C2, C2A
Midland, (540) 439-3266
The Shockey Precast Group A1, C4, C4A
Winchester, (540) 667-7700
Tindall Corporation, Virginia Division A1, C4, C4A
Petersburg, (804) 861-8447

> WASHINGTON

Bellingham Marine Industries Inc. B3, C2
Ferndale, (360) 380-2142
Bethlehem Construction Inc. B1, C3, C3A
Cashmere, (509) 782-1001
Concrete Technology Corporation B4, C4
Tacoma, (253) 383-3545
CXT Inc., Precast Division B1, C1, C1A
Spokane, (509) 921-8766
CXT Inc., Rail Division B2, C2
Spokane, (509) 921-7878
EnCon Northwest LLC B1, B1A
Camas, (360) 834-3459
Oldcastle Precast Inc. A1, B4, C4
Spokane Valley, (509) 536-3300
Wilbert Precast Inc. B3, C3, C3A
Yakima, (509) 325-4573

> WEST VIRGINIA

Carr Concrete a division of CXT Inc. B4, C3
Williamstown, (304) 464-4441
Eastern Vault Company Inc. B3, C3
Princeton, (304) 425-8955

> WISCONSIN

County Materials Corporation B4, B4-IL
Janesville, (608) 373-0950
County Materials Corporation B4, C3
Roberts, (800) 426-1126
International Concrete Products Inc. A1, C1
Germantown, (262) 242-7840
KW Precast LLC B4, B4-IL, C4
Burlington, (708) 562-7770
MidCon Products Inc. A1, C1
Hortonville, (920) 779-4032
Spancrete A1, B4, C3, C3A
Valders, (920) 775-4121
Stonecast Products Inc. A1, C1
Germantown, (262) 253-6600
Wausau Tile Inc. AT
Rothschild, (715) 359-3121

> WYOMING

voestalpine Nortrak Inc. C2
Cheyenne, (509) 220-6837

> MEXICO

Dura Art Stone, Inc. A1, C1A
Tecate, (800) 821-1120
PRETECSA, S.A. DE C.V. A1, G
Estado de Mexico 52, (555) 077-0071
Willis De Mexico S.A. de C.V. A1, C1, G
Tecate BC, MX 52, (665) 655-2222

> CANADA

BRITISH COLUMBIA

APS Precast, a Division of C&S Group Operations Ltd. A1, B4, C3, C3A
Langley, (604) 888-1968
Armtec Limited Partnership A1, B4, C3
Richmond, (604) 214-3243

NEW BRUNSWICK

Strescon Limited A1, B4, C4, C4A
Saint John, (506) 632-7521

NOVA SCOTIA

Strescon Limited A1, B4, C4, C4A
Beford, (902) 494-7400

ONTARIO

Artex Systems Inc. A1
Concord, (905) 669-1425
Global Precast Inc. A1
Maple, (905) 832-4307
Prestressed Systems Inc. B4, C4
Windsor, (519) 737-1216

QUEBEC

Betons Prefabriques Trans. Canada Inc. A1, B4, C3, C3A
St-Eugene De Grantham, (819) 396-2624
Betons Prefabriques (Bombadier Plant), A1, C2
Alma, (418) 668-6161
Betons Prefabriques (Papeterie Plant), A1, C3, C3A, G
Alma, (418) 668-6161
Prefab de Beauce Inc. A1, C3
Sainte-Marie-de-Beauce, (418) 387-7152

> UAE

Arabian Profile Company Glass Reinforced Product LLC G
Sharjah, 971(6) 5432624

Visit www.pci.org for the most up-to-date listing of PCI-Certified Erectors.

When it comes to quality, why take chances?

When you need precast or precast, prestressed concrete products, choose a PCI-Certified Erector. You'll get confirmed capability with a quality assurance program you can count on.

Whatever your needs, working with an erector who is PCI-certified in the structure categories listed will benefit you and your project.

- You'll find easier identification of erectors prepared to fulfill special needs.
- You'll deal with established erectors.
- Using a PCI-Certified Erector is the first step toward getting the job done right the first time, thus keeping labor costs down.
- PCI-Certified Erectors help construction proceed smoothly, expediting project completion.

Guide Specification

To be sure that you are getting an erector from the PCI Field Certification Program, use the following guide specification for your next project:

"***Erector Qualification:*** The precast concrete erector shall be fully certified by the Precast/Prestressed Concrete Institute (PCI) prior to the beginning of any work at the jobsite. The precast concrete erector shall be certified in Structure Category(ies): [Select appropriate groups and categories S1 or S2 and/or A1]."

Erector Classifications

The PCI Field Certification Program is focused around three erector classifications. The standards referenced are found in the following manuals:

- MNL–127 *Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products*
- MNL–132 *Erection Safety Manual for Precast and Prestressed Concrete*

GROUPS

> CATEGORY S1– SIMPLE STRUCTURAL SYSTEMS

This category includes horizontal decking members (e.g. hollow-core slabs on masonry walls), bridge beams placed on cast-in-place abutments or piers, and single-lift wall panels.

> CATEGORY S2– COMPLEX STRUCTURAL SYSTEMS

This category includes everything outlined in Category S1 as well as total precast, multi-product structures (vertical and horizontal members combined) and single– or multistory load-bearing members (including those with architectural finishes).

> CATEGORY A– ARCHITECTURAL SYSTEMS

This category includes non-load-bearing cladding and GFRC products, which may be attached to a supporting structure.

> ARIZONA

Coreslab Structures (ARIZ) Inc. A, S2
Phoenix, (602) 237-3875

RJC Contracting Inc. S2
Mesa, (480) 357-0868

Steel Girder LLC dba Stinger Bridge & Iron S1
Coolidge, (502) 723-5383

Tpac, An EnCon Company A, S2
Phoenix, (602) 262-1333

> CALIFORNIA

MidState Precast L.P. A, S2
Corcoran, (559) 992-8180

Walters & Wolf Precast A
Fremont, (510) 226-5166

> COLORADO

EnCon Field Services LLC A, S2
Denver, (303) 287-4312

Gibbons Erectors Inc. A, S2
Englewood,, (303) 841-0457

Industrial Manufacturing & Installation Inc. S2
Littleton, (303) 791-4455

Rocky Mountain Prestress LLC A, S2
Denver, (303) 480-1111

> CONNECTICUT

Blakeslee Prestress Inc. S2
Branford, (203) 481-5306

> FLORIDA

Concrete Erectors Inc. A, S2
Altamonte Springs, (407) 862-7100

Coreslab Structures (MIAMI) Inc. A, S2
Medley, (305) 823-8950

Florida Builders Group Inc. S2
Miami Gardens, (305) 278-0098

Jacob Erecting & Construction LLC A, S2
Jupiter, (561) 741-1818

Pre-Con Construction Inc. A, S2
Lakeland, (863) 688-4504

Prestressed Contractors Inc. S2
West Palm Beach, (561) 741-4369

Specialty Concrete Services Inc. A, S2
Umatilla, (352) 669-8888

Toronto, LLC S2
Apopka, (407) 293-4000

W.W. Gay Mechanical Contractor Inc. A, S2
Jacksonville, (904) 388-2696

> GEORGIA

Bass Precast Erecting Inc. S2
Cleveland, (706) 809-2718

Jack Stevens Welding LLP S2
Murrayville, (770) 534-3809

Precision Stone Setting Co. Inc. A, S2
Hiram, (770) 439-1068

Rutledge & Sons Inc. S2
Canton, (770) 592-0380

Southeastern Precast Erectors Inc. (SPE Inc.) A
Roswell, (770) 722-9212

> IDAHO

Precision Precast Erectors LLC A, S2
Post Falls, (208) 981-0060

> ILLINOIS

Area Erectors Inc. A, S2
Rochelle, (815) 562-4000

Mid-States Concrete Industries S2
South Beloit, (815) 389-2277

> INDIANA

Chicago Steel Construction, LLC S2
Merrillville, (219) 947-3939

> IOWA

Cedar Valley Steel Inc. A, S2
Cedar Rapids, (319) 373-0291

Industrial Steel Erectors S1
Davenport, (563) 355-7202

Northwest Steel Erection Inc. S2
Grimes, (515) 986-0380

US Erectors Inc. A, S2
Des Moines, (515) 243-8450

> KANSAS

Carl Harris Co. Inc. A, S2
Wichita, (316) 267-8700

Crossland Construction Company Inc. S2
Columbus, (620) 442-1414

Griffith Steel Erection Inc. A, S2
Wichita, (316)941-4455

> LOUISIANA

Alfred Miller Contracting S2
Lake Charles, (337) 477-4681

> MAINE

Reed & Reed Inc. S2
Woolwich, (207) 443-9747

> MARYLAND

DLM Contractors LLC A, S2
Upper Marlboro, (301) 877-0000

E & B Erectors Inc. A, S2
Elkridge, (410) 360-7800

E.E. Marr Erectors Inc. A, S2
Baltimore, (410) 837-1641

EDI Precast LLC A, S2
Upper Marlboro (301)877-2024

L.R. Willson & Sons Inc. A, S2
Gambrills, (410) 987-5414

> MASSACHUSETTS

Prime Steel Erecting Inc. A, S2
North Billerica, (978) 671-0111

> MICHIGAN

Assemblers Precast & Steel Services Inc. A, S2
Saline, (734) 368-6147

Construction Specialties of Zeeland Inc. S1
Zeeland, (616) 772-9410

G2 Inc. S2
Cedar Springs, (616) 696-9581

Visit www.pci.org for the most up-to-date listing of PCI-Certified Erectors.

Midwest Steel Inc. A, S2
Detroit, (313) 873-2220

Pioneer Construction Inc. A, S2
Grand Rapids, (616) 247-6966

> MINNESOTA

Amerect Inc. A, S2
Newport, (651) 459-9909

Fabcon Precast LLC S2
Savage, (952) 890-4444

Molin Concrete Products Company S2
Lino Lakes, (651) 786-7722

Wells Concrete A, S2
Maple Grove, (800) 658-7049

> MISSISSIPPI

Bracken Construction Company A, S2
Ridgeland, (601) 922-8413

> MISSOURI

JE Dunn Construction A, S2
Kansas City, (816) 292-8762

Prestressed Casting Co. S2
Springfield, (417) 869-7350

> NEBRASKA

Central Nebraska Steel LLC S2
Kearney, (308) 627-6683

M&M Steel Erection Inc. S2
La Vista, (402)614-0988

Moen Steel Erection Inc. A, S2
Omaha, (402) 884-0925

Patriot Steel Erection A, S1
Omaha, (402) 431-2744

Topping Out Inc. dba Davis Erection–Omaha A, S2
Omaha, (402) 731-7484

> NEW HAMPSHIRE

American Steel & Precast Erectors A, S2
Greenfield, (603) 547-6311

Newstress Inc. S1
Epsom, (603) 736-9000

Pinnacle Precast & Steel Erectors Inc. S2
Manchester, (603) 493-1669

> NEW JERSEY

CRV Precast Construction LLC S1
Eastampton, (609) 261-7325

J. L. Erectors Inc. S2
Blackwood, (856) 232-9400

JEMCO-Erectors Inc. A, S2
Shamong, (609) 268-0332

Jonasz Precast Inc. A, S2
Westville, (856) 456-7788

Kenvil United Corp. S1
Kenvil, (973) 927-0010

> NEW YORK

Koehler Masonry Corp. S2
Farmingdale, (631) 694-4720

Oldcastle Building Systems Div./Project Services A, S2
Selkirk, (518) 767-2116

Tutor Perini Corporation Civil S1
New Rochelle, (914) 739-1905

> NORTH DAKOTA

Comstock Construction Inc. S2
Fargo, (701) 892-7236

Magnum Contracting Inc. A, S2
Fargo, (701) 235-5285

Midwest Precast Services A, S2
Fargo, (701) 893-0188

PKG Contracting Inc. S2
Fargo, (701) 232-3878

> OHIO

Precast Services Inc. A, S2
Twinsburg, (330) 425-2880

Sidley Precast Group, A Division of R.W. Sidley Inc. S2
Thompson, (440) 298-3232

> OKLAHOMA

Allied Steel Construction Co. LLC S2
Oklahoma City, (405) 232-7531

> PENNSYLVANIA

Century Steel Erectors S2
Kittanning, (724) 545-3444

Conewago Precast Building Systems A, S2
Hanover, (717) 632-7722

High Structural Erectors LLC A, S2
Lancaster, (717) 390-4203

Kinsley Construction Inc. t/a Kinsley Manufacturing S2
York, (717) 757-8761

Maccabee Industrial Inc. A, S2
Belle Vernon, (724) 930-7557

Nitterhouse Concrete Products Inc. A, S2
Chambersburg, (717) 267-4505

> SOUTH CAROLINA

Davis Erecting & Finishing Inc. A, S2
Greenville, (864) 220-0490

Florence Concrete Products Inc. S2
Florence, (843) 662-2549

Steel Clad Inc. A, S2
Greenville, (864) 246-8132

Tindall Corporation A, S2
Spartanburg, (864) 576-3230

> SOUTH DAKOTA

Fiegen Construction Co. A, S2
Sioux Falls, (605) 335-6000

Henry Carlson Company A, S2
Sioux Falls, (605) 336-2410

> TENNESSEE

Mid South Prestress LLC S1
Pleasant View, (615) 746-6606

> TEXAS

Coreslab Structures (TEXAS) Inc. A, S2
Cedar Park, (512) 250-0755

Derr and Isbell Construction LLC A, S2
Euless, (817) 571-4044

Gulf Coast Precast Erectors LLC S2
Hempstead, (832) 451-4395

Precast Erectors Inc. A, S2
Hurst, (817) 684-9080

S 'N' S Erectors Inc. S2
Arlington, (817) 823-8016

> UTAH

Forterra Structural Precast A, S1
Salt Lake City, (801) 966-1060

IMS Masonry A
Lindon, (801) 796-8420

OutWest C & E Inc. S2
Bluffdale, (801) 446-5673

> VERMONT

CCS Constructors Inc. S2
Morrisville, (802) 888-7701

> VIRGINIA

The Shockey Precast Group S2
Winchester, (540) 667-7700

> WISCONSIN

International Erectors, Inc. S2
Kenosha, (262) 656-7009

J. P. Cullen & Sons Inc. S2
Janesville, (608) 754-6601

Miron Construction Co. Inc. A, S2
Neenah, (920) 969-7000

Spancrete A, S2
Valders, (920) 775-4121

The Boldt Company S2
Appleton, (920) 225-6212

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Kai-Uwe Bergmann, *AIA, RIBA, partner, BIG—Bjarke Ingels Group*

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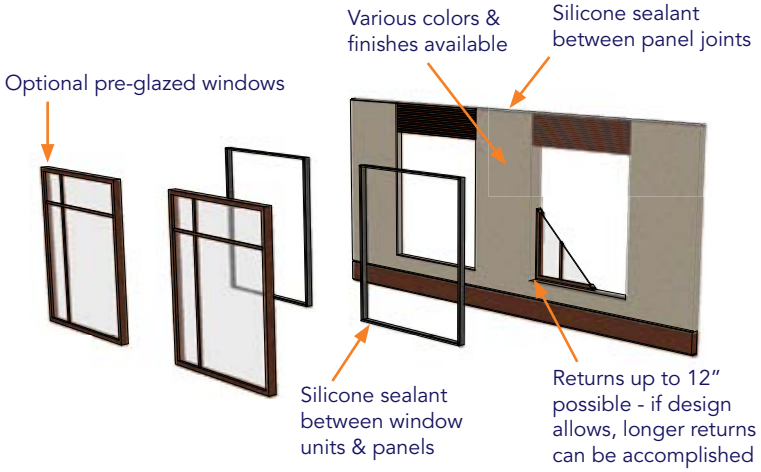
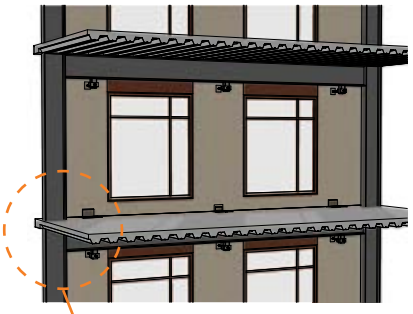
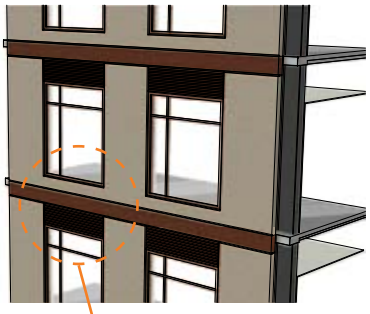
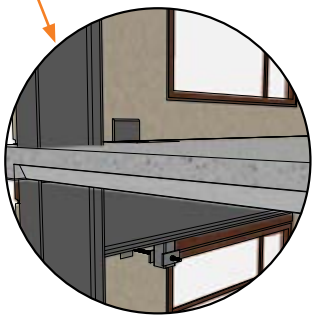


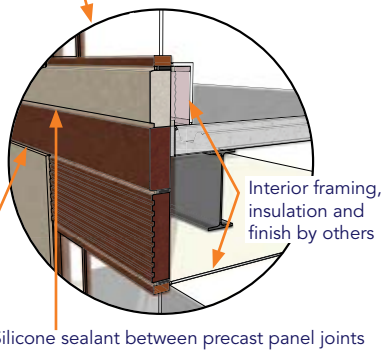


Interior View



Exterior View





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