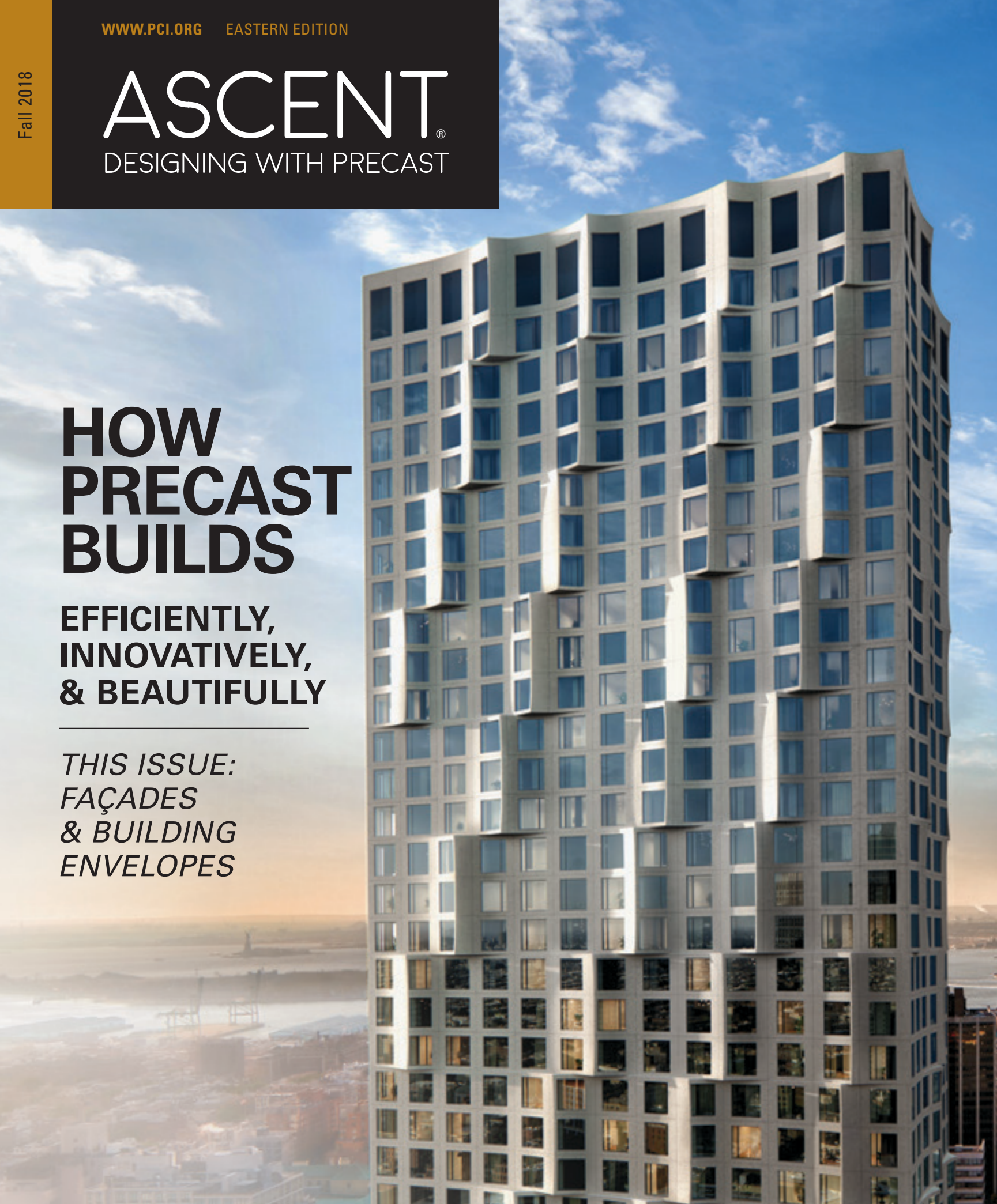
WWW.PCI.ORG EASTERN EDITION

Fall 2018

ASCENT®

DESIGNING WITH PRECAST



HOW PRECAST BUILDS

EFFICIENTLY, INNOVATIVELY, & BEAUTIFULLY

THIS ISSUE: FAÇADES & BUILDING ENVELOPES

METROBRICK®
FAST SHIP PROGRAM
Thin Brick Fast

Quick turnaround for small orders.

SEVEN colors and **SIX blends** available.

Usually ships within **FIVE days**!*

Now Offering BLENDS

*Levels of inventory vary. Our ability to fast ship is based on a first-come first-served basis. Inventory is designed to assist in quick turn around for smaller quantity orders- normally under 10,000 sq. ft. Lead time for blends is approximately two to four weeks.

MADE IN THE USA
CANTON, OHIO

U.S. GREEN BUILDING COUNCIL MEMBER

METROBRICK®
ARCHITECTURAL THIN BRICK

metrothinbrick.com | 1.888.325.3945 | email:info@ironrock.com | P.O. Box 9240 Canton, OH 44711

Simply the Best!

- Over 12 Million in Use Worldwide.
- Patented Face Sweep Promotes Flexibility in Tension and Eliminates Reinforcing Interferences.
- Successfully Tested to Full Capacity with ¼" x 2½" Fillet Weld.
- 100% Made in the USA.
- ***Stainless Steel*** and ***J-Finish Carbon Steel Vector Connectors*** are in Stock, Ready to Pack and Ship.

Vector Connector

The Industry Standard Shear Connector

1½" Faceplate Offers Abundant Welding Area Tolerances!

*Visit our **website** for more information and a complete line of our products.*

Your Connection Connection

7131 North Ridgeway Avenue • Lincolnwood, IL 60712 USA
847-675-1560 • 1-800-742-8127 • **www.jvi-inc.com**

A NEW DIMENSION OF THIN BRICK.

More sizes. More textures. Make your spaces move with Endicott thin brick. Experience uninterrupted design throughout your entire project.

ENDICOTT™

PCI Premier Partners

Endicott's keyback thin brick is manufactured to meet the requirements of ASTM C1088, Exterior Grade, Type TBX, and the more stringent size tolerances of +0" -1/16 required for precast applications.

Endicott Thin Brick & Tile, LLC
402-729-3323 | endicott.com

***ASCENT*® IS A PUBLICATION OF PCI**

Executive Editor: Tom Bagsarian
Managing Editor: Craig Shutt
Ascent Layout Concept:
MB Piland Advertising + Marketing
Graphic Designers:
Russell Duncan and Justin Goode
Ad Sales:
Trice Turner
Sales Specialist
312-583-6784
sales@pci.org
Reprint Sales and Subscriptions:
Tom Bagsarian
tbagsarian@pci.org
Precast/Prestressed Concrete Institute:
Robert Risser, PE, President and CEO
Industry Technical Review Team: Peter Finsen, Corey Greika, Thomas Ketron, Ed Knowles, Jane Martin, Mark McKeny, Brian Miller, Kim Wacker, and Roger Becker

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. 4, ISSN 10796983) is published quarterly by the Precast/Prestressed Concrete Institute, 200 W. Adams St., Suite 2100, Chicago, IL 60606.

If you have a project to be considered, send information to Tom Bagsarian.
tbagsarian@pci.org

On the cover: The façade at 11 Hoyt Street.
Rendering: Binyan Studios.

FEATURES

Precast elements add style and efficiency to the CoBank building in Greenwood Village, Colorado. Photo: Rocky Mountain Prestress.

DEPARTMENTS

ROBERT IVY, FAIA
CEO
AMERICAN INSTITUTE OF ARCHITECTS
PHOTO: WILLIAM STEWART

Envelopes, Energy, Health, and Supply

Ascent discussed the precast concrete industry's role in building envelopes and building healthy structures with Robert Ivy, who has led the American Institute of Architects in one role or another for more than a decade and a half. Excerpts from that conversation:

Ascent: **What issues or trends are architects seeing in the area of building envelopes and façades?**
Ivy: Compatibility of sealants, degradation of insulation over time, and long-term performance of the envelope are all important to architects and designers.

Ascent: **How important is energy performance for your members, and how can the precast concrete industry help architects in this area?**
Ivy: Energy performance is critical to our members' businesses, their clients' building performance, and the Institute's goals for the built environment's contribution to climate change mitigation, such as the 2030 Commitment. Operational building performance is relevant at all levels, from highly efficient, affordable housing units that free more household income for residents, to city districts that share distributed energy. Our energy and carbon solutions start with passive strategies, including a tight, well-insulated building envelope.

Ascent: **How can precast concrete producers help in designing and building healthy structures?**
Ivy: The most impactful step precast concrete producers can do is measure and disclose the impact of the supply chain and manufacturing process through life-cycle analysis (LCA). LCA will calculate carbon emissions from their manufacturing and distribution processes. Climate change has an enormous impact on public health by increasing rates of asthma and cardio vascular disease, increasing insect-borne illnesses such as Lyme disease and Zika, among other human impacts.

Cement accounts for 5% of global CO_2 emissions, with production growing by 2.5% annually. Once impact is measured, manufacturers can work to optimize manufacturing for cleaner production and often reap financial savings by gaining efficiency in the process.

Where precast concrete suppliers are adding insulation in insulating concrete forms and structural insulated panels, they can review the ingredients in the materials to identify hazards and begin to remove toxic materials. This affects people across the entire supply chain, from extraction to recycling to disposal, by removing hazards and improving health outcomes of everyone who comes in contact with the materials.

Robert Ivy, FAIA, has been the CEO and executive vice president of the American Institute of Architects (AIA), with more than 250 chapters and over 90,000 member architects and design professionals, since 2011.

3D Printing Transforms Precast Prefabrication

Forms produced utilizing 3D printing for prefabricated concrete exterior systems can be the solution for a complex geometrically challenging façade.

As part of a research project to verify the transformative possibilities of 3D printing for concrete applications, Gate Precast Company is using 3D printed forms in the production of a 42-story tower in Brooklyn, NY, clad exclusively with polished and acid-etched architectural precast concrete.

Through a design-assist relationship, Gate Precast, Two Trees, and architecture firm COOK FOX refined some of the window profiles on the tower to make it cost effective and practical to make use of the 3D printed forms. The multi-faceted window panels include aluminum framing and glass pre-assembled and caulked at the plant prior to shipping to the jobsite, streamlining the installation of the façade.

Casting on the 3D printed forms also provided the added benefit of incredibly sharp details and improved finishes.

GATE PRECAST COMPANY
precast concrete systems

Monroeville, AL
Jacksonville, FL
Kissimmee, FL
Winchester, KY
Oxford, NC
Ashland City, TN
Pearland, TX
Hillsboro, TX

WWW.GATEPRECAST.COM
(888) 470-3450

FOLLOW US!
gateprecastco

North Shore Medical Center Expands

SALEM, MASSACHUSETTS

Administrators at North Shore Medical Center wanted to expand their hospital facility to better serve the community and keep current with new technologies. But they also wanted to ensure the building remained cost-efficient. To that end, they asked designers at Shepley Bulfinch in Boston, Mass., to limit the exterior construction costs to $65 per ft^2.

To help achieve this goal, while also creating an attractive appearance that complemented the adjacent medical buildings, designers specified architectural precast concrete panels and spandrels in two finishes with the same concrete mixture. The panels were attached to a steel frame, with smaller pieces around windows connecting to larger panels, which were erected column to column on the five-story building.

The $138-million project was designed to offer a new emergency department, which will be twice the size of the existing space. The five-story, 225,000-ft^2 facility will include 62 diagnostic rooms, 10 observation rooms, and space for pediatric care. An additional 24 private inpatient rooms are included in the expansion. The addition supplements a revamping of the adjacent hospital facility into a behavioral health center.

The 387 panels feature a tan, sandstone-like sandblasted finish that contrasts with panels cast with tight reveals that create a darker appearance with more texturing. The "corrugated" appearance of the ribbed panels helps add visual interest by providing contrasts in texture and color. A rubber formliner was used by Strescon Ltd. in Burlington, Mass., which fabricated the precast concrete components.

A number of unusual pieces were cast, including projections that extend 18 in. from the panel faces. Some were placed horizontally above windows as "eyebrows," while others were set vertically beside windows. MacNamara Salvia in Boston is serving as the structural engineer on the project, while the general contractor is Walsh Brothers Inc. in Boston.

The erection took only two months and was completed in December 2017. The building is scheduled to open in the summer of 2019.

PCI Foundation Renews Clemson Support

CHICAGO, ILLINOIS

The PCI Foundation has renewed its support for Clemson University's precast studio in Clemson, S.C., for three more years. Over the past five years, the Clemson/PCI Foundation architecture program (above) has offered two approaches: five architecture studios, with a total enrollment of 51 graduate students and undergraduate seniors in a vertical studio (a sequential studio that students take to finish their degrees), and opportunities for more than 360 students to take architectural structures courses.

"Its main studio program has developed a unique approach based on hands-on experiential learning and the direct involvement of industry partners and professionals," says Marty McIntyre, PCI Foundation executive director.

A typical studio consists of three distinct projects, each representing a key step in the learning process about material possibilities and the industry at large. The three projects are identified with unique characteristics and learning objectives.

In addition to the main studio, special lectures and modules are part of the regular architectural structures course curriculum, which includes site and plant visits and lectures by Peter Finsen, executive director of Georgia/Carolinas PCI.

O'Hare Multimodal Center Consolidates Functions

CHICAGO, ILLINOIS

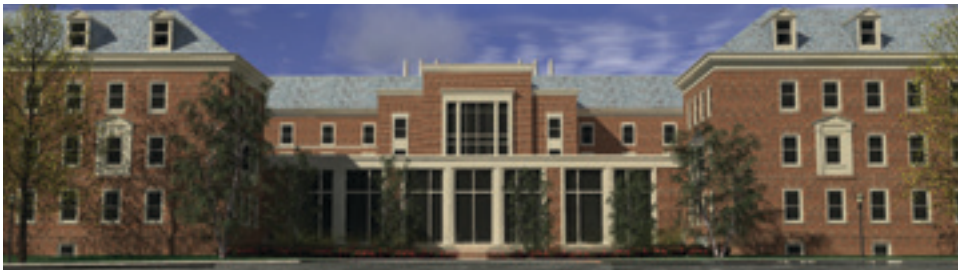
The new O'Hare Multimodal Transportation Center is being constructed with a total–precast concrete framing system. The facility features a massive 2.5 million-ft^2 joint-use parking structure, helixes, a multilevel 240,000-ft^2 rental car quick turnaround (QTA) building, a transit center, and outbuildings. The joint-use facility includes a 73,174-ft^2 customer service lobby (100,000 ft^2 counting cores) located 42 ft above grade.

The designers' goal was to meet the challenging need of relocating and consolidating rental car operations and public parking onto limited space. To achieve this, the facility was constructed on an existing parking lot. It provides a direct connection to the airport transit system and to all terminals, as well as to existing bus lines and the Metra rail system with access to downtown Chicago.

The joint-use parking structure contains five stories, with the first three holding a consolidated rental car facility (CRCF) covering 1.5 million ft^2 and including 4365 parking stalls for 13 rental brands. The top two floors provide 2624 covered parking stalls for public parking. The top floor of the CRCF can be expanded to add up to four levels. Columns on the interior, cast with 15,000-psi concrete, allow for more span and space.

The customer service center, located on level four, includes self-serve kiosks, counters for rental-car transactions and 50,000 ft^2 of retail space. It is adjacent to a new 430 × 60-ft airport transit system (ATS) station. The QTA facility is a three-story, 240,000-ft^2 building that contains rental car administration offices and services such as fueling and car washing.

Submit your headline news for consideration in a future issue of *Ascent* to Tom Bagsarian at tbagsarian@pci.org.



The project was designed by the architectural/engineering firm Transystems Corporation & Consultants in Chicago, with Austin Power Partners JV serving as construction manager. The firm is a joint venture consisting of Austin Commercial in Dallas, Tex., along with Power Construction Co. LLC and minority partner Ujamaa Construction Inc., both in Chicago. The project is being built under the construction manager at risk delivery method.

The complex required 6,600 precast concrete pieces, including columns, beams, slabs, double tees, stairs, walls, and spandrel panels. Illini Precast LLC in Westchester, Ill., fabricated and erected the structural components, while MPC Enterprises in Pleasant, Iowa, cast the architectural pieces, and AVAN Precast Concrete Products in Lynwood, Ill., produced the precast concrete stairs. Precast Engineering Corp. in Brookfield, Wis., served as the precast concrete specialty engineer.

The scale of the project and the logistics of designing, producing, transporting, erecting, and detailing so many precast concrete pieces from various Midwest plant locations, all on a schedule constantly impacted by weather and varying site conditions, created a major challenge. Precast concrete was chosen due to its design efficiency, ability for fast delivery of finished product, and reduced cost, according to Illini Precast.

In addition to the durability and reduced waste benefits of precast concrete, the project offers numerous sustainable-design features, such as a solar farm, integrated photovoltaics, low-energy light fixtures, native landscaping, and a 68,125-ft^2 green roof on the QTA building. To provide natural light and ventilation, the CRCF design includes two 60-ft-wide courtyards planted with evergreen and deciduous trees. At the ATS area, extensive exterior overhangs provide depth and shadow as well as sun screening and weather protection.

Construction started on the 33-acre project in May 2015. It is scheduled for completion in 2018.

University of Minnesota Expands Residences

MINNEAPOLIS, MINNESOTA

After debating for years whether to renovate or demolish an aging residence hall to build a new one, administrators at the University of Minnesota decided on a $104.5-million renovation and addition for Pioneer Hall, the oldest dorm on the Twin Cities campus. To ensure the new and renovated façades complemented the look of the sections being retained, designers specified architectural precast concrete panels with thin-brick inserts.

Originally built in stages between 1928 and 1932, Pioneer Hall was outdated, didn't meet codes, and was not accessible for people with disabilities. The new design, spearheaded by KWK Architects in Saint Louis, Mo., who partnered with architecture/engineering firm TKDA in St. Paul, Minn., will transform the dormitory into a more spacious living area with places to gather and study, like other recently built popular residences on campus.

The new dining space will be moved from its current underground location and brought to grade level to serve all students living in the Superblock, a quartet of freshman dorms (including Pioneer) on the edge of campus. Seating capacity, meal, serving, and seating options will all be expanded, and the new facility will accommodate 850 students at a time. New meditation rooms and lounges will also be provided.

The project will preserve the character-defining features of the original building, which features a historic red brick exterior, while gutting much of the interior. The new housing component increases the number of beds to 756 and incorporates study and community spaces to enhance the experience of first-year students.

Wells Concrete in Maple Grove, Minn., fabricated 45,015 ft^2 of precast concrete wall panels for the project, including 280 pieces of 12-in. insulated wall panels. The majority of the work was to expand the south and north courtyards, with great attention paid to matching the original building's historic appearance.

Each of the panels has two windows with architectural precast concrete frames and an intricate cornice, all surrounded by cast-in brick. The brick itself is laid in a Flemish bond, and blends three colors chosen to match the original brick. The frames around the windows were cast using 3-D printed molds in the precast concrete panels. (For more on this process, see the article in this issue).

Wells also provided panels for the entryway renovations on the west and east sides of the building and a small number of hollow-core slabs, solid slabs, double tees, and beams for the floor and roof of a loading dock area. McGough Construction in Saint Paul, Minn., is the general contractor on the project.

Once completed, Pioneer Hall will comprise 257,000 ft^2, which includes 85,600 ft^2 of renovated space and 171,400 ft^2 of new construction. The renovated Pioneer Hall is slated to open in time for the fall semester 2019.

Gate Names Chief Structures Engineer

JACKSONVILLE, ARKANSAS

Gate Precast has named Joe Tuttle chief engineer for structures at its Jacksonville, Ark., office. In his new role, Tuttle provides structural precast concrete engineering services for Gate's nine plants. His first assignment is for the North American Properties Assemblage parking structure in Tallahassee, Fla., designed by M-A Architects. Materials for the project will be produced in Gate's Jacksonville, Fla., prefabricated concrete systems facility.

Domino Development Features Precast Panels

WILLIAMSBURG, BROOKLYN, NEW YORK

Two Trees Management is converting the site of a historic Domino Sugar refinery (above) and the adjacent land into a five-building mixed-use community. The 3-million-ft² mega-development includes renovation of the refinery along with construction of several large multi-use buildings, including a 42-story mixed-use residential building that will feature a façade of 993 architectural precast concrete panels.

The buildings will surround Domino Park, a park and waterfront esplanade that includes an urban beach. The park opened this summer, ahead of construction on the other buildings. A five-block-long elevated Artifact Walk documents the history of the 160-year-old refinery building and the area, featuring original factory machinery and architectural features salvaged from the warehouse. Landscaped sections and a picnic area, food stations, and other amenities line the path to the Walk.

The south-end park offers more active spaces, including a dog run, bocce court, sports field, and volleyball court. At the center, Water Square features such amenities as a four-level seating section, a space for viewing the river, a garden decorated with the refinery's original syrup tanks, and a central water feature.

When completed, the 10-year project will reportedly contain 2,300 apartments, 500,000 ft² of commercial space, and a new school. For more on the architectural precast concrete panels, see the article on 3-D printing techniques on page 14 in this issue.

Submit your headline news for consideration in a future issue of *Ascent* to Tom Bagsarian at tbagsarian@pci.org.

Smith-Midland Names New CEO

MIDLAND, VIRGINIA

Smith-Midland Corp. has appointed Ashley Smith its new chief executive officer, replacing Rodney Smith, who remains chairman of the board. Smith, son of Rodney Smith, began his full-time career with the company 33 years ago in the Sales & Marketing department.

He was named president and chief operating officer in 2008 and has been involved with management and oversight of all company divisions throughout his tenure. He was named to the board in 1994.

Smith-Midland Signs Largest Contract

MIDLAND, VIRGINIA

FAM Construction LLC (a joint venture of Ferrovial Agroman US and Allan Myers) has named Smith-Midland to supply 900,000 ft² of its SoftSound brand noise-absorptive precast concrete soundwall panels for the Interstate 66 Outside the Beltway express lanes project in northern Virginia.

The 22.5-mile-long project will provide two express lanes alongside three regular lanes on I-66 from Interstate 495 to Route 29 in Gainesville, Va., along with other amenities and space reserved for future transit options. The Midland, Va., plant began production this summer, with final project completion scheduled for 2022.

PCI HEADQUARTERS
phone: (312) 786-0300
email: info@pci.org
www.pci.org

Florida Prestressed Concrete Association—Diep Tu, PE
phone: (407) 758-9966
email: diep@myfpca.org
www.myfpca.org

Georgia/Carolinas PCI (GCPCI)—Peter Finsen
phone: (678) 402-7727
email: peter.finsen@gcpci.org
www.gcpci.org

PCI Mid-Atlantic—Tom Holmes
phone: (717) 723-6010
email: info@pci-ma.org
www.mapaprecast.org

PCI Central Region—Phil Wiedemann
phone: (937) 833-3900
email: phil@pci-central.org
www.pci-central.org

PCI Gulf South—Dan Eckenrode
phone: (228) 239-3409
email: pcigulfsouth1@att.net
www.pcigulfsouth.org

PCI of Illinois & Wisconsin (PCI-IW)
email: info@pci-iw.org
www.pci-iw.org

PCI Midwest—Mike Johnsrud, PE
phone: (952) 806-9997
email: mike@pcimidwest.org
www.pcimidwest.org

PCI Mountain States—John Dobbs, PE
phone: (303) 562-8685
email: jdobbs@pcims.org
www.pcims.org

PCI Northeast—Rita L. Seraderian, PE, LEED AP
phone: (888) 700-5670
email: contact@pcine.org
www.pcine.org

PCI West—Ruth A. Lehmann, PE, PMP
phone: (949) 420-3638
email: ruth@pciwest.org
www.pciwest.org

Precast Concrete Manufacturers' Association of Texas (PCMA of Texas)—Chris Lechner
phone: (210) 633-6743
email: lechner@pcmatexas.org
www.pcmatexas.org

thermomass®

The Beauty of Sustainable Design

Ponderosa Commons - University of British Columbia

Vancouver, British Columbia

As part of a comprehensive program of environmentally responsible design elements, Surespan and Thermomass partnered to manufacture a insulated precast panel solution, creating a durable, thermally efficient building envelope that reduces interior energy consumption year-round.

All-in-One
BUILDING ENVELOPE

Thermomass-insulated precast panels provided a durable, modern, energy-efficient building envelope that largely eliminates thermal and moisture concerns.

Gold
USGBC LEED

This 600,000 SF student community facility - made up of three distinct mixed-use buildings - is one of a number of Thermomass projects to achieve LEED Gold status.

Sustainable
BEST PRACTICES

Advanced lighting and plumbing fixtures, along with a Thermomass-insulated precast exterior will help UBC meet its goal of becoming one of the greenest universities in the world.

About Us

Thermomass manufactures a full line of concrete insulation systems for use in precast concrete projects. With over 30 years of experience, we are the industry leader in high-performance concrete sandwich wall technology. Working hand-in-hand with our clients on thousands of projects, we have developed a complete line of insulation systems designed to provide maximum energy-efficiency, durability and performance.

Learn more about this and other projects:
thermomass.com/projects

thermomass.com (800) 232-1748 Boone, Iowa, USA

Unique Advantages

Products
From the smallest office to the largest stadiums and everything in between, Thermomass offers a full selection of concrete insulation and composite ties.

Experience
Not only are we the global leaders in insulated concrete products, we helped found the industry. No other company can match our track-record of success.

Service
We're there for every step: from preliminary design, to panel detailing, to installation, and final walk-through. That is dedication that no other company can deliver.

The Domino Sugar Refinery residential development in Brooklyn, N.Y., features a number of new buildings as well as renovation of the original building. Gate has cast 993 wall panels using 3-D printed window blockouts to speed its fabrication of pieces for a 42-story residential building in this rendering. Photo: Gate Precast.

3-D PRINTING

3-D Printed Forms Expand Design Options

Printing precast forms with carbon-fiber-reinforced ABS polymer offers durability, high quality, and added intricacy—if designs and costs can be optimized

By Craig A. Shutt

Three-dimensional (3-D) printing has revolutionized many manufacturing processes, producing components quickly and precisely for industries such as healthcare, automotive, aviation, and the military. Now, precast concrete producers are testing the concept to create forms for casting components, and the first applications offer considerable benefits in the right circumstances.

"This could represent a real turning point in the industry," says Mo Wright, marketing director at Gate Precast Co., based in Jacksonville, Fla. The precast concrete producer has taken the lead on evaluating 3-D printed forms, running tests on a complex ornamental piece, and then using them to produce window blockouts in 993 precast concrete panels for a major project.

The 3-D process involves printing the mold from 3-D building information models programmed into a Big Area Additive Manufacturing (BAAM) machine from Cincinnati Inc. The one used by Additive Engineering Solutions (AES) in Akron, Ohio, which produced many of Gate's forms, outputs up to 80 lb per hour in sizes up to 12 × 5.5 × 6 ft. The pieces are built using acrylonitrile butadiene styrene (ABS) thermoplastic with a 20% mixture of chopped carbon-fiber threads, a typical mixture for these pieces, to add durability. They were machined to final dimensions on AES's Quintax five-axis router. ▶

ORNL STUDY WAS CATALYST

The concept of 3-D printed molds for concrete applications began with the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tenn., which is in the third year of a five-year research program with PCI to determine how new technologies can improve the thermal efficiency of buildings. These have mostly focused on technologies for improved insulated panels.

ORNL has worked for some time with 3-D printing concepts, and codeveloped the BAAM machine. As part of the program in which Precast/Prestressted Concrete Institute (PCI) participates, researchers evaluated 3-D printing concepts for its potential. "We didn't know if it could be made to work in the industry, but we thought it was worthwhile to examine the potential," says Diana E. Hun, a research and development staffer at ORNL.

ORNL consulted with its program's advisory group from PCI, requesting details of a component to test the concept. At the time, Gate was pursuing a Nordstrom project near Columbus Circle in New York, N.Y., that featured an elaborate façade. Gate sent details of one of the cornices to ORNL, which consulted with Tru-Design of Knoxville, Tenn. That firm in turn worked with Thermwood of Dale, Ind., to use its large-scale additive manufacturing 3-D printing and computer numerical control routers to produce a 1-ft-wide segment of a much longer cornice shape for the building.

"We were looking for a project to test the concept on," explains Steve Brock, senior vice president of engineering at Gate and a member of the PCI advisory team for the ORNL project. "We had evaluated it in theory, and we wanted to take it to the next level and create essentially a mock-up to see if there were any issues we overlooked."

Concrete was poured in the mold to create the intricate, rounded facets and sharp edges of the cornice's face. Gate cast 40 concrete pieces

Advanced Engineering Solutions printed some of the forms for the Brooklyn project for which ORNL initially worked on designs. Photo: AES

MANY BENEFITS TO 3-D

Gate's team found significant benefits to the 3-D printed molds. "3-D printing is just another tool we can use, but it creates molds that perform really well," says Wright. "They're extremely durable, easy to manage and handle, easy to repair, fast to create, and able to produce a very high-quality product."

Durability is the chief benefit, all agree. The combination of ABS polymer and carbon-fiber reinforcement creates high resiliency that allows the forms to be reused many more times than with other materials. "We can easily get more than 100 casts from one mold, compared to only a dozen or more from wood or fiberglass molds," says Wright.

On its first project to use the molds in real time, a new mixed-use building on the grounds of the former Domino Sugar Refinery complex in Brooklyn, N.Y., one 3-D mold is expected to be used for 210 pours to create window blockouts for panels.

"The project required many different shapes and sizes of window block-outs," says Brock. "They're not cookie-cutter openings; they're different widths with undulating slopes and deep recessed windows." The mold inserts had to be durable for up to 200 pours and for multiple moves in the plant. They also had to be rigid to fully consolidate the concrete in the deep vertical pours to reduce bug holes.

"There were so many shapes and sizes that the plant's mold shop would not be able to build all the molds and keep up with the production required," Brock says. "The panels are looking great, with nice looking acid-etched, vertically poured surfaces, and the molds are still holding up well."

Such durability not only can reduce per-piece costs on large, repetitious jobs by spreading the cost of the form over more pieces, but it saves table time needed to change to new forms and keep casting.

"Having a casting table locked up but not pouring while new forms are assembled is costly. Those tables are valuable real estate," explains Wright. "We need to be effective on a 24-hour basis, so the quicker we can change out molds, the faster we can produce pieces. If we can produce a mold in six to eight hours and keep casting with it for hundreds of pieces rather than take weeks to create new molds and then replace them every 15 to 20 pours, we're considerably more efficient."

Dan Juntunen, president/CEO of Wells Concrete in Albany, Minn., agrees. "Architectural bed space is valuable," he says. "It's generally the highest cost per square foot on any project." If they can achieve even 100 pours with a 3-D printed mold—and most seem to provide significantly more—the savings mounts up quickly over one that's replaced every 20 pours. "The 3-D molds allow us to eliminate downtime, compared to losing three or four days overall to replacing and aligning new forms."

Wells is using 3-D printed forms to cast components for Pioneer Hall, a student residence at the University of Minnesota. The panels complement the existing brick walls that remain on the renovated structure. "There have been zero issues with the forms so far," he says. "It's really been bulletproof. There's been a huge savings in reliability in our use to date."

The casting of the wall panels for the Pioneer Hall project featured inset brick surrounding the 3-D printed blockouts that created the window shapes. Photo: Wells Concrete.

DETAILED DESIGNS POSSIBLE

As Gate's work on the Nordstrom cornice showed, the molds also can create highly detailed pieces that otherwise might not be reproducible. "The 3-D printed molds can create more complex, intricate pieces, which may not be possible to be produced any other way," says Wright.

The 3-D printed molds also have an advantage in hiding joints, notes ORNL's Hun. Typical forms are created with seams where material pieces are joined. "Hiding joints can be difficult by hand and adds several steps," she says. "The 3-D printed form creates a monolithic piece. It needs attention, but it can work better than man-made forms."

Gate's Wright agrees. "Wood pieces have to be nailed, caulked, and resined to create round corners or ensure the joint remains watertight," he explains. "The 3-D printed molds are incredibly watertight, so we can achieve sharp facets with no imperfections. The resulting pieces have an incredibly smooth finish with no transitions apparent."

Wells' Juntunen adds, "The quality of the final pieces definitely goes up with 3-D printing. They are crisp and clean, with no joints or seam lines. We couldn't have obtained the look we got for the Pioneer Hall inset-brick panels any other way," he says. "And they couldn't have gotten a better appearance by doing it with any other material."

This insert (4) was cast by Thermawood for Gate Precast during a test of 3-D printed forms. The piece was set into a larger form to create the intricate face of a 1-ft-wide cornice, to see if it could replicate the actual 30-ft-long cornice installed on a Nordstrom store in New York, N.Y. Photo: Gate Precast.

ONE DRAWBACK: COST

The one drawback, which will take some time to overcome, is the expense. The polymer material is more costly than other options, so the molds need to be used for components being replicated many times—ideally hundreds of times. That eliminates their use on many projects.

The overkill is easy to see. If 40 pieces are needed and a $1500 wood form can produce 20 pieces, two sets of wood forms can achieve the goal for $3000. Using an ABS form might cost $9000 but produce 200 or more pieces. But if only 40 pieces—or even twice that—are needed, the ABS form can't be justified.

"Most architectural precast façades we produce are custom-designed," points out Gate's Wright. "It's highly unlikely we'd be able to reuse a form, so producing highly durable forms at a higher cost wouldn't pay off." Wells' Juntunen agrees. "Nothing we do is plug-and-play. Every scenario is different. It's hard to say, here's how we'll use it and how much it will cost until we know more."

But savings are possible. Wells, for instance, was able to save considerable amounts because the profile required for its casting wasn't very deep. "When we realized we could create the pieces with a 4-inch-high profile rather than the 18-inch-high one we'd considered, it made a huge difference," says Gary Pooley, regional sales manager at Wells, who worked on the project.

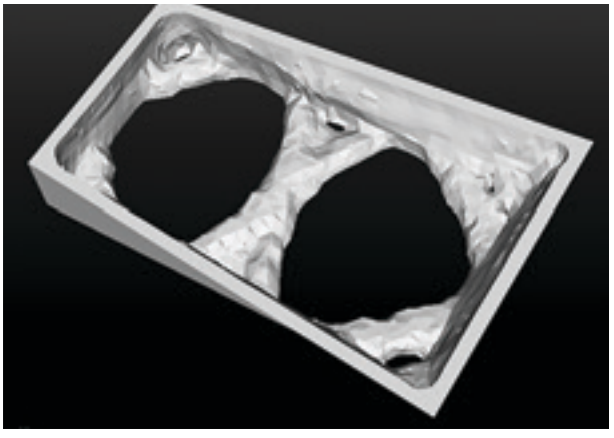
'We need to do more research and experimentation. With more time we can optimize the molds.'

Gate also could have saved if its crew had had more time to refine the design, says ORNL's Hun. "The deadline was so tight to turn around the mold design that we weren't able to optimize it and find ways to decrease the amount of polymer." That not only decreases material cost but takes less printing time. ORNL has since reviewed the design and found significant savings, she noted.

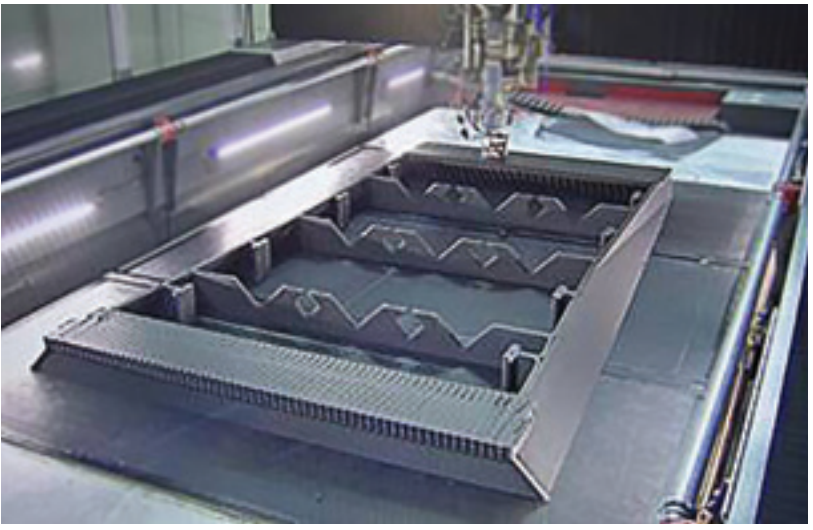
Gate's Brock agrees. "We had one month to complete the design, and it took three tries for us to get what we wanted," he says. "At that point, we took it and ran. We didn't have time to optimize the design, and that would have saved money. There also are less expensive materials to use than 20% carbon-fiber ABS. We need to do more research and experimentation. With more time, we can optimize the molds to reduce what could be a 600% cost difference between ABS and wood."

Brock predicts 3-D printed forms will excel in three applications: high volumes of repetitive and simple commodity pieces, where the ABS molds can be used hundreds or maybe even thousands of times; high volumes of repetitive and complex pieces, where alternatives to ABS would make forms costly to keep creating; and one-time custom pieces that are so complicated or detailed that precast concrete producers cannot afford to tie up their mold-building staff to create for a minimal amount of concrete to pour.

Panels cast with 3D-printed forms were cast in a variety of shapes and sizes to fit the designers' aesthetic goals. Note the blackouts were turned upside down to create a different shape while reusing the same form. Photo: Gate Precast



After the castings began, ORNL went back to try to better optimize the final design its staff created for the window blockouts, with more time to work on it. The design was the final optimized one that could be even more effective, they say. Photo: ORNL



DOMINO SUGAR PROJECT

Gate Precast and Wells can see the potential in the two projects under way. The Domino Sugar Refinery project consists of renovating the massive, 160-year-old refinery building and constructing several new buildings to create a multiuse complex, including a 42-story, mixed-use commercial and residential tower clad with precast concrete wall panels. The tower, 260 Kent, was bid and won by Gate while evaluating the Nordstrom cornice.

The ABS forms provided the interior sides of window blockouts in various shapes and sizes within the larger panel forms. ORNL produced forms for 20 window sizes and turned 17 over to AES. "We focus on research, not production, so we weren't capable of producing all of the forms Gate required," explains Hun. "We worked closely with AES, exchanging ideas as they arose. There were really no issues or challenges that blocked us."

"Gate and ORNL came to us to see if we could produce more of the 3-D printed molds," explains AES's Andrew Bader, vice president and cofounder. "We saw they wouldn't pose any challenge for our printers." From their end, they were able to optimize some of the molds, he notes. "We cut about 50 pounds from some of the molds, which saved material cost and printing time."

AES's molds were very similar, he adds, but there were a variety of sizes, requiring new molds. This resulted in part due to the varying floor-to-floor heights and the module sizes needed to accommodate the residential interior layouts. Even so, the designers reduced the number of window sizes to boost the number of pieces each mold could cast.

"We went through several iterations of the variation in panels with Gate's input," says Pam Campbell, partner at Cook Fox Architects, the architect on the project. "We looked at how the façade would be panelized and how many modules would be ganged together at each run of façade, based on the crane capacity and transportation limitations. We arrived at a balance that retained the amount of patterning and visual variation in the façade while accommodating the optimized panelization of the modules."

The goal was to maintain the variation in sizes while facilitating repetition, she adds. "Gate really pushed the idea of using the 3-D printed molds, and they ensured we could retain the variation in the façade that was needed while coming up with a cost-effective solution for the molds."

Forms printed with ABS polymer reinforced with a 20% mixture of carbon fibers provide new potential for long-run casts of precast concrete pieces. This mold, printed by the Oak Ridge National Laboratory for Gate Precast, was used as a window blockout inside a panel form for a massive wall-panel project now under way. Photo: ORNL.

The use of 3-D printed molds played to the owner and Cook Fox's concept for the building, she adds. "We have been working with precast panels on several projects over the past eight years, and on this project, we wanted to push our knowledge of the system further and test its limitations. We wanted to create more slender profiles than we have done previously and study a variety of finishes to emphasize the angles of the panel design through light, shadow, and reflection."

The firm's experience with precast concrete panelized systems led them to select it for this project. "We approached Gate specifically due to the variety and level of finishes we wanted in the design."

Even slight changes, by 1 in.—which did occur—required new molds to be produced, notes Brock. "Some of the molds were highly repetitive and gave us a couple of hundred pours, while others we made out of wood because we had to cast only one piece." Some of the 3-D printed mold blockouts were upside-down versions of others, allowing the pieces to be reused while still creating a different window shape.

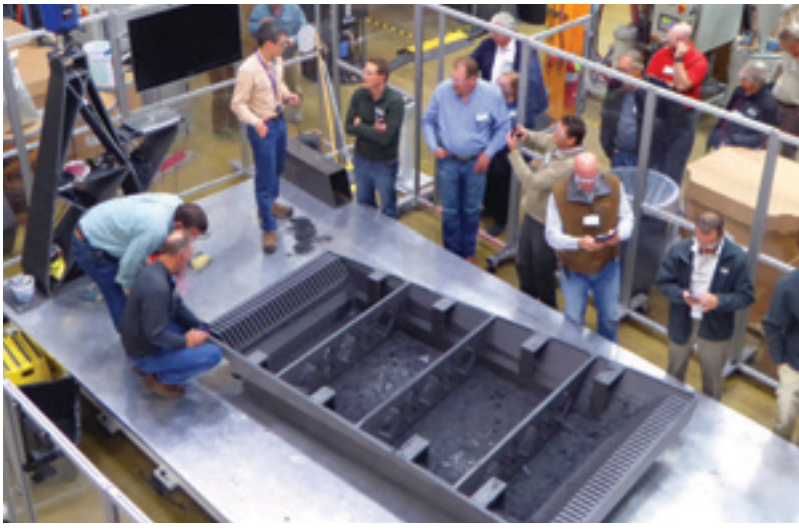
Gate won the job before it realized that producing the precast concrete panels with 3-D printed molds for a portion of the molds could make it more efficient—if they could make it work. "It was extremely risky, but we realized it was an ideal project to test the concept on, so we decided it was worth the risk," says Wright.

MOCK-UPS TWEAK DESIGNS

A variety of samples were created to show the owner and designers how the 3-D printed molds would work. The team collaborated with Two Trees Management, the development company on the project that also served as general contractor. "Two Trees was very supportive of the importance of mock-ups in this process," says Campbell. "They brought Gate into the project early to allow for iterations of full-scale mock-ups that brought to light changes that we made."

These included even small details, such as the exact location of the drip edge, the depth of the caulk-joint recesses, and the interface of the polished finish and the acid-wash finish. "These were all reviewed and worked out in early mock-ups, so there were no surprises."

The tolerances the designers and Gate required for the project were easily managed, notes AES's Bader. "We're used to doing projects for the aerospace industry, where tolerances are extremely tight. Precast products can require tolerances to 1/16 of an inch or so, whereas aerospace often needs tolerances to 0.02 inch. That made it much easier. Beyond that, the design and engineering for the parts are quite similar to what we do for others."



ORNL helped create the initial form designs and cast several iterations to find the best approach. Photo: ORNL.

PIONEER HALL HOUSING

AES also produced 30 forms for the Pioneer Hall project for Wells. That project renovates and adds onto an existing student residence at the University of Minnesota to create an H-shaped building, with new portions aligning with those built in stages between 1928 and 1932. The goal for the design is to "preserve the character-defining features of the original

The central entry infill area was replaced on both sides of the connecting wall in the H-shaped housing unit. Photo: McGough Construction Co.

building, including its historic red-brick exterior, while gutting much of the interior," explains Brian D. Morse, senior architect at TKDA, the architectural firm on the project.

Wells' panels are being erected in the expansion of the north and south courtyards, with careful attention paid to the inset brick to complement, but not exactly duplicate, the original look. Smoothly finished buff-colored end pieces separate the existing building and the new panels that butt against it, helping to make the transition less jarring.

"Matching the appearance was a sensitive issue," says Morse. The original building featured a Flemish bond brick that was hand-laid, with tolerances that varied in coursing and layout. The new panels maintain a contemporary coursing in colors similar to the original. "Our goal was to create a complementary but distinctly different look to acknowledge the differences."

That was especially apparent in the window surrounds, which in the original building featured wood trim and sill. The new precast concrete windows, which consist of punched windows in the concrete panels, feature surrounds with a different appearance from the originals. They were cast with the ABS forms.

"The use of 3-D printed forms didn't factor into the design," Morse says. "Wells told us about their plan to use them, but that was as far as it went." As it turned out, the forms created smooth joints that wouldn't have been possible with hand-formed joints. "The pieces turned out really nice and crisp."

The forming method likewise had no impact on the construction activities, says Jesse Turner, project manager for McGough Construction, the general contractor. Regardless of how the forms were made, precast concrete provided the most economical answer. "We performed cost scenarios for other options, including precast concrete backup with hand-laid brick, and precast proved to be the most affordable."

McGough worked closely with the design team and Wells to create the most efficient sizes and designs, he notes. "We reviewed design plans and edited them to what would be most efficient. Wells mentioned they'd be using ABS material for the forms, but it didn't impact our plans."

It was Turner's first project using precast concrete panels, and they provided a variety of benefits. "In the end, it was certainly a good decision to use the material. We maintained a high level of quality control, especially on the corner edges. They achieved a nice, soft edge that turned out great. And there were no installation issues."

LESSONS LEARNED

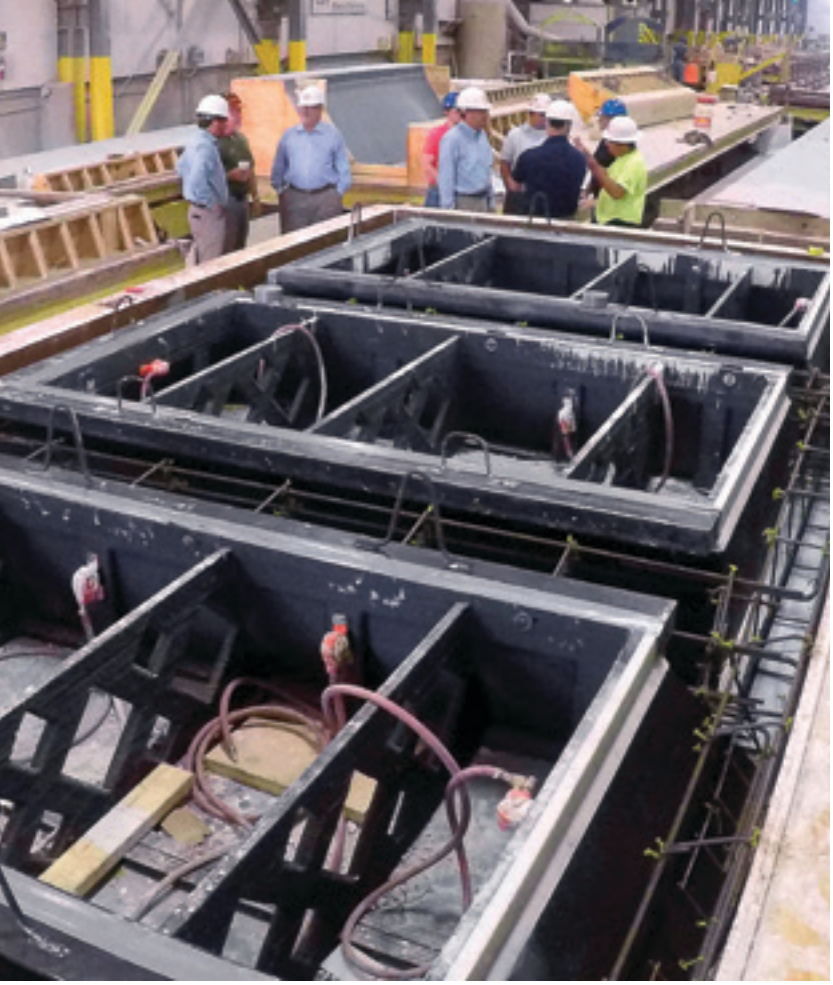
That type of review will help spread the word about 3-D printed forms to both precast concrete producers and designers. "Our hope is that the rest of the precast industry can learn from this work done on the Domino project," says Wright. "Along with PCI, we've hosted a number of tours at our Winchester facility in the hopes that this type of technology will be further embraced."

'We started from nothing to try this new technique, and we learned a number of lessons.'

Brock agrees there was a learning curve. "We started from nothing to try this new technique, and we learned a number of lessons." One of those was that added vibrators aren't needed to eliminate imperfections in deep casts. "We had 20-inch-deep pieces, and our vibrating tables worked well. They produced components with no bug holes in a nice, vertical pour with no added vibrators needed."

Another aspect also let them scale back their preventative measures. "We feared we'd need to attach the forms to the pad to prevent them from floating up as the concrete was poured," he says. "But we learned we don't need brackets to hold them down."

Joining the design team early also allowed more input into minor changes that can make a big difference, as with the Domino



Gate's 3-D printed forms were cast by both ORNL and AES owing to the large number and ORNL's limited production facilities. The forms fit inside the larger panel forms to create the window blockouts and were printed on Cincinnati-type machines.
Photo: Gate Precast

Sugar Refinery windows. "When we can work with designers to create more repetitive pieces without diluting their architectural vision, everyone will benefit," says Brock.

AES's Bader agrees. Shallow angles in the forms were initially a challenge, but that was quickly resolved. "Precast producers learned a lot from these initial projects. And while each project is different, there are many lessons that carry over to the next project. The printer doesn't care what shape it's printing or who it's for. Ultimately, we expect we will print most molds that are difficult to construct out of traditional materials like wood or fiberglass, especially if the shapes are complex or have intricate curves or organic shapes."

Gate wants others to learn about the advantages and to benefit from their experience, Wright stresses. "We need more people in the design and precast industries to embrace the material so more pieces are produced, more machines are purchased, more volume is created, and more competition arises. All of those will help reduce costs and make precast more top-of-mind for large, complicated projects."

That doesn't mean 3-D printed forms will become an industry standard soon, they warn. "The shift to using this technique won't be overnight," says Wright. "The setup system will have to change to accommodate these forms, and people will have to be trained to use the equipment and materials. They will have to be integrated into everyone's workflow."

CONTINUOUS IMPROVEMENT

Precast concrete producers also won't rest on their laurels now that they've found initial success. "There may be other materials, such as glass fiber, bamboo, or other plastics, that would create more effective forms," suggests Brock. ORNL's Hun agrees. "It's possible that someday the material could become so durable that these forms could replace steel forms used for standard components if they're damaged. They're less expensive than a new steel form would be."

Certainly, precast concrete producers are looking to use the forms again. "These forms work especially well for large projects with repetitive architectural pieces, and that's our wheelhouse," says Wright. "We often do projects of that size." Adds Brock, "We've estimated more projects with the intent of using 3-D printed forms, and it will not be long before we're utilizing this technology again."

Wells, too, has bid other projects, including a mid-rise building in downtown Minneapolis, Minn., where the intricacies of the design made 3-D molds the best solution. "We can now offer to create any shape that designers want for window accents, along with other features," says Matt Everding, director of operations at Wells. "Keeping the unique designs repetitive helps control the cost. This technique opens a lot of doors for designers. It ensures we can offer them the creativity they are looking for and help take precast to the next level."

'It will take time, but we want to stress that, from a design standpoint, the sky is the limit with these forms.'

It will require an evangelical approach by those who have used the forms. "We need to spread the word through social media, Lunch & Learn programs, meetings, and personal presentations," says Juntunen. "It will take time, but we want to stress that, from a design standpoint, the sky is the limit with these forms. If they have an idea, we can make it happen."

TKDA's Morse has become a believer. "Now that I've seen what they can do with these forms, my next project may be a little funkier."

BUILD TO LAST.

When you build with Spancrete precast, your structures will stand the test of time. That's because we've been perfecting precast for more than 70 years. Since the beginning, we've focused on quality, service and innovation. As a result, our precast systems are faster to install, longer lasting, safer and more sustainable. From virtual design to installation, we'll work with you to make legendary structures.

Today, Spancrete is building the modern classics.

spancrete.com | 855-900-SPAN

PRECAST CONCRETE

Architectural Façades

Precast concrete elements are commonly adopted by designers because of their aesthetics, function, and speed of construction benefits

By Monica Schultes

The architecture, engineering, and construction market is experiencing pressure to reduce delivery times and meet ambitious architectural goals at the same time. The façade plays a key role, as it has a significant impact on the functional, economic, and aesthetic aspects of the overall building.

Modern architecture emphasizes clean, simple, and linear forms of building expression. It has encouraged more extensive use of prefabricated systems like precast concrete.

Precast concrete covers the gamut of form and function, utilitarian and decorative. Architectural façades are where the imagination can run free. The precaster is the facilitator that enables the building to meet both budget and aesthetic goals.

In addition to achieving the aesthetic goals of the project, the design of the envelope has to balance comfortable thermal and acoustic levels together with safety and accessibility. Instead of requiring several different materials, precast concrete wall systems perform multiple functions. They manage heat gain, heat loss, and moisture penetration.

Whether residential, commercial, or office structures, precast concrete can build efficiently and beautifully. These examples from across the country present an opportunity to explore a variety of architectural aesthetics. They demonstrate a freedom of expression that includes exposed structural forms, application of materials like thin brick, and façades that employ concepts of light and shadow. ▶

CoBank's 275,000-ft², 11-story office building is the third phase of the Village Center Station development and the bookend to the Village Center Station plaza. Photo: Ross Cooperthwaite, Cooperthwaite Productions.

COBANK CENTER

LOCATION
Greenwood Village, Colo.

PROJECT TYPE
Office

SIZE
274,287 ft²

DESIGNER
Davis Partnership Architects, Denver, Colo

OWNER
Shea Properties, Greenwood Village, Colo.

STRUCTURAL ENGINEER
S.A. Miro Inc., Denver, Colo.

CONTRACTOR
Adolfson and Peterson Construction, Aurora, Colo.

PCI-CERTIFIED PRECASTER
Rocky Mountain Prestress, Denver, Colo.

PRECAST COMPONENTS
716 double tees (office building), 533 double tees (parking structure), 256 beams (office), 93 beams (parking structure), 352 spandrel panels

The knifepoints at the end of building were some of the challenges in fabricating the panels for this football-shaped structure. Photo: Rocky Mountain Prestress.

COBANK CENTER, GREENWOOD VILLAGE, COLO.

CoBank Center is an 11-story, 274,287-ft^2, Class A office building with a six-story precast concrete parking structure partially wrapped under the office tower and extending outside. The unique structure is located in Village Center Station, a mixed-use transit-oriented development. The new office tower will include ground-floor retail; CoBank, who is leasing the building, will occupy 10 of the 11 floors.

With the exception of a cast-in-place core, the office building is all–precast concrete beams, spandrels, double tees, and inverted tees. Roof framing is also precast concrete. The 332,000-ft^2 parking structure provides space for 970 cars across three bays and shares the office tower's building framing system. Engineers used an insulated precast concrete wall system that minimized the number of shear walls to create a more open feel in the parking structure.

COLOR SAMPLES

"The Rocky Mountain Prestress plant is close to our office, and we went back and forth through the sample and mock-up process," recalls Fred Pax, senior associate with Davis Partnership Architects. The building owner, Shea Properties, and tenant CoBank were also involved in the selection process and had their own ideas regarding the desired aesthetic.

"We were looking for a color to set it apart from the surrounding precast structures. The result was a white panel with a medium acid-etch finish that provided a contemporary feel," says Pax. "The panel profile was selected to create shadow play as the sun moves across the sky."

While a white palette was selected, the building is not plain vanilla. There are a variety of unique shapes and more than 50 radius panels. The teardrop or football shape of the office building was driven by the site geometrics. "We started out with a trapezoidal shape that fit the site well and maximized square footage. Just playing with that form, we added broad curves on the more obtuse angles and ended up with very dynamic look," says Pax.

'We were looking for a color to set it apart from the surrounding precast structures. The result was a white panel with a medium acid-etch finish that provided a contemporary feel.'

Rocky Mountain Prestress developed custom forms to cast more than 50 curved spandrel panels. Photo: Rocky Mountain Prestress.

The main entry boasts a two-level lobby with access to two levels of conference, meeting, and prefunction spaces bathed in natural light. Photo: Ross Cooperthwaite, Cooperthwaite Productions.

Precast concrete helped meet the owner's budget. This project took advantage of precast concrete as both the building skin and to provide the structure. "You don't have to double up and be redundant on the skin. You can clad the building and provide building structure with one system," explains Pax.

CoBank Center was changed in the drawing stage from an all curtainwall building to a total–precast concrete system. The exterior spandrels serve as both an architectural skin and a structural element, making precast concrete a cost-competitive option.

'The panel profile was selected to create shadow play as the sun moves across the sky.'

TRUE CURVE

Thanks to the flexibility of precast concrete, designers were able to create the exterior wall as a true curve, and not a faceted wall that would have been the result of a curtain wall design. However, the flowing, geometric shape of the building presented some significant construction challenges. Thanks to early and effective collaboration—and the extreme versatility of precast concrete construction—the building team was able to develop innovative solutions to each of these challenges.

"I was impressed by the ability to create radius panels for the corners [20 ft]. The ability of the precaster [Rocky Mountain Prestress] to be able fabricate a curved form like that was unexpected," says Pax.

Dan Parker, director of client services with Rocky Mountain Prestress, recalls, "It was a challenge with the knifepoints at the end of building." The sweeping design of the building presented several framing challenges. One issue was the need for a cantilevered load-bearing spandrel at the building corners. By design, a column wasn't allowed to be placed at the corner, so a cantilever system was created. This involved a 15-ft cantilever of the spandrels at the corners. These spandrels not only support the double tees; they also pick up the load from the spandrels on the non-load-bearing side.

There is also a transfer beam on the fourth floor that conveys the load from above. A large bridge girder was used for this. In the two-story lobby, the precast concrete was hung from the level above to avoid introducing a column.

In total, 352 noninsulated spandrels were used for the project, 53 with a radius. Spandrels on the office building have a white acid-etch finish while spandrels on the parking structure have a grey acid-etch finish, both with custom formwork and radius.

The office is comprised of 716 double tees and 256 beams, while the parking structure used 533 double tees and 93 beams. The double tees span 46 ft on the outside bays and 26 ft on the center bay of the three-bay-wide structures.

View of the entry promenade in the evening. Photo: Ross Cooperthwaite, Cooperthwaite Productions.

The team selected precast concrete for both performance and function. The whole project came together efficiently and beautifully, and received LEED Silver certification.

The design is a graceful trapezoid that, despite its iconic geometry, offers highly efficient interior space for offices and open workstations. Photo: Ross Cooperthwaite, Cooperthwaite Productions.

SEPARATE SPACE

A portion of the shear walls that separate the parking structure from the office building are unique. They were preinsulated at the precast concrete plant to provide separation between the parking on one side and conditioned space on the other.

The building also offers amenities that include a two-story lobby, a wellness center, a cafeteria, a data center, and a landscaped plaza with dramatic lighting and multiple water fountains. The project received LEED silver certification.

To meet the schedule, Rocky Mountain Prestress used two cranes on site: one to erect precast concrete components on the parking structure and the other to erect components on the office tower. The whole project came together efficiently and beautifully.

The team selected precast concrete for both performance and function. As the primary envelope system, it experiences structural loads as well as air, heat, and moisture loads and serves this purpose concurrently. At the same time, the precast walls possessed the desired aesthetic attributes for the CoBank Center project.

The architect endeavored to continue the aesthetic cohesiveness of the campus and connect it to the primary public corridor.

COOK CHILDREN'S MEDICAL CENTER SOUTH TOWER, FORT WORTH, TEX.

It's no medical mystery that hospital buildings use enormous amounts of energy, primarily for heating and cooling. That is why high-performance building envelopes are critical. Cook Children's wanted to get the envelope right in their efforts to optimize energy use. The team looked to materials such as precast concrete wall panels to help maintain good building health.

Cook Children's Medical Center (CCMC) South Tower is a nine-story, 318,000-ft^2 hospital expansion featuring new state-of-the-art operating rooms, an expanded emergency department, clinical laboratory space, and Heart Center for the Dallas-Fort Worth metro area's largest pediatric healthcare provider.

Cook Children's leadership developed a set of guiding design principles that helped ensure that the Medical Center campus remained unified and coherent over time.

The South Tower is intentionally designed to continue the aesthetic cohesiveness of the campus, while incorporating new materials and advances in construction technology. Custom insulated precast concrete panels were meticulously detailed to achieve the look of natural limestone, cast stone, and glazed brick that have historically been used on previous buildings and additions.

"The use of precast panels fit well with the long-established architectural 'kit of parts.' It helped keep construction costs down and saved time in the construction schedule, all while still meeting the Medical Center's exacting standards and high quality," says Sean Patrick Nohelty, principal at David M. Schwarz Architects.

COOK CHILDREN'S MEDICAL CENTER SOUTH TOWER

LOCATION
Fort Worth, Tex.

PROJECT TYPE
Hospital addition

SIZE
318,000 ft^2

COST
$260.5 million

DESIGN ARCHITECT
David M. Schwarz Architects, Washington, D.C.

ARCHITECT OF RECORD
CallisonRTKL, Dallas, Tex.

OWNER
Cook Children's Hospital, Fort Worth, Tex.

STRUCTURAL ENGINEER
CJG Engineers, Houston, Tex.

CONTRACTOR
Linbeck, Fort Worth, Tex.

PCI-CERTIFIED PRECASTER
Gate Precast, Hillsboro, Tex.

PRECAST COMPONENTS
Insulated panels

The new South Tower's patient bed tower, assembled from Cook's unique precast concrete architectural "kit-of-parts," rises seven stories above grade with a two-story extension that breaks down its massing to the scale of pedestrians.

"There is an emphasis on architecture and aesthetics, particularly at this institution. CCMC was originally built in 1989 with a very particular aesthetic. David M. Schwarz Architects has been involved with them ever since," adds Nohelty. It was a tall order: the precast concrete technology and material had to emulate and blend with everything that preceded it.

CHOOSING BY ADVANTAGES

There was an extensive vetting process to make sure that the desired outcome could be achieved with precast concrete. It was predominately considered to save time from a cost and schedule perspective. Nohelty says that "ultimately the 'choosing by advantages' analysis proved that precast was the better solution and the mock-ups proved that they could achieve the desired aesthetic."

"One of our big concerns going in was our previous experience with precast that it looked too uniform, too systemized, too repetitive. We wanted it to look more natural and add variations, not just piece to piece, but within each piece to emulate individual blocks of stone. The latter was accomplished with false joints and color variation in the precast panels," recalls Nohelty.

COLOR BY NUMBER

According to Conrad Filo, quality control manager with Gate Precast, it was a rigorous process. A rolled-on application of dry pigment with an iron-oxide base turned that particular precast concrete section slightly darker.

'The QA/QC process was rigorous; every single panel was inspected and approved at the plant before it was shipped to the site.'

Gate was introduced to a new product from Dynamic Color Solutions (DCS) that helped them achieve the consistent color they were aiming for throughout the production process. The DCS pigment powder also helped to ensure repeatability with the daily production process.

Chemicals like sodium bicarbonate were used to lighten the precast concrete color, and they went about the task of meticulously emulating the subtle changes and mottled appearance found in natural limestone.

'The architect was exacting in their quest for a mottled appearance, but the design intent was carried out meticulously.'

"The chemical powders were measured out to the gram and the team experimented with various treatments until we found the product that was color-fast, so the pigment would be permanent in the matrix," explains Filo. "It slowed production, but the end result was worth it."

"This process is not new, but it was adjusted for this project. No one recipe works for everyone," he adds.

The Gate Precast lab technician followed the pattern of individual squares of simulated limestone that were designated in a puzzle-like fashion. Each color variation was offset by a false joint within the panel. No two panels looked exactly the same, to respect the randomness of the façade designated by the architect.

Finally, an acid wash removed any excess pigment or color to maintain the same exposure and contributed to the fine, smooth finish that was the ultimate product. The carefully curated panels followed a color pattern in production. The color-by-number pattern was carried through shop drawings and out to installation in the field.

Gate went through some trial and error in the initial stages, but later it worked very well. "The QA/QC [quality assurance/quality control] process was rigorous; every single panel was inspected and approved at the plant before it was shipped to the site," recalls Filo. "The architect was exacting in their quest for a mottled appearance, but the design intent was carried out meticulously."

"I gained an appreciation for precast in general and Gate in particular for really being artisans with their work," Nohelty says. "They care deeply about their product and are very inventive." In his opinion, they shared his passion for the architecture and were equally proud of the result.

FIRST IPD

In addition to being the first use of precast concrete at CCMC, it was also the first use of integrated project delivery (IPD) for the hospital and team members. They agreed upon terms for the team and the schedule was set for the job. Twelve companies signed the initial contract as partners in the IPD project. The budget was established during that validation period. The IPD team would be on the hook for any schedule or cost overruns.

Seen here at dusk, the new South Tower bookends the garden forecourt and main entry drive to the Medical Center.

After all the intricacies in production, the team faced additional complexities on-site. Working on an operating hospital campus is never easy. CCMC has a dense urban campus, and the job fully occupied the site from curb to curb, which left no lay-down area.

The South Tower was delivered in a carefully sequenced construction and transition schedule consisting of over 30 phases to facilitate the relocation and expansion of multiple departments and minimize the impact on ongoing operations at the hospital.

Roads could not be closed because access to the emergency room and parking structure was required. Gate Precast delivered panels sequentially just in time for the crane to pick and erect.

"We will definitely be using precast for more projects on campus—it has validated itself," says Nohelty. "Now we have learned how to use precast to achieve our client's goals and they are a trusted partner." The team gained an education on this project, and many of the lessons learned stemmed from the IPD process.

BIM

"This was our first foray into using BIM [building information modeling] in a fully integrated way where all consultants were participating," says Nohelty. The goal was to be efficient in time and to reduce waste. "We went from concept to DD [design development] level and right to Gate Precast producing shop drawings, basically skipping one whole step in the design process. Gate was an excellent partner in the design-assist process," he adds.

The team used BIM not just to build and create, but also to make sure penetrations in panels were coordinated. The panels are insulated and extremely thick, so there was extensive coordination for all penetrations. "We did not want to core drill at all after manufacturing," says Nohelty.

He summarizes, "Gate Precast's collaborative design-assist program was instrumental in helping our team achieve the milestone schedule, budget, and aesthetic goals for the exterior skin. Advanced technologies were employed to emulate the sophisticated appearance and detailing of the original brick and limestone hospital building."

Ultimately, the project required 667 insulated architectural precast concrete panels encompassing 76,000 ft^2, with various finishes including embedded glazed bricks and limestone- and cast-stone-like appearances.

Nohelty concludes, "The new South Tower realized the architect's vision using precast concrete to emulate the randomness in coloring of natural stone and imperfections of hand-laid masonry used on the existing campus over 25 years ago. The thermal efficient precast enclosure system, which acts as air, water and vapor barrier, features XPS [extruded polystyrene] foam insulation, embedded glazed brick, and a simulated limestone finish that successfully captures the timeless character of the historic campus."

The Carmel Park East parking structure is the first piece of a multiphased project to support the mixed-use development of Carmel City Center. Photo: Tony Frederick Photography.

CARMEL PARK EAST PARKING STRUCTURE, CARMEL, IND.

A parking structure by its very nature is a functional structure, but that doesn't mean it can't be beautiful. Parking is often the first thing people experience when arriving at a destination, and the last thing they experience when leaving.

Not too long ago, parking structures were typically designed simply to store cars. It was acceptable to consider parking strictly utilitarian in nature. Most recently, the focus of parking structure design has turned to the façade; that is why the Carmel Park East parking structure is included in this overview of architectural examples from across the country.

The structure is the first piece of a multiphased project to support the mixed-use development of Carmel City Center. When complete, the $300 million, 1 million-ft^2 campus located in the heart of Carmel, Ind., will include a hotel, retail space, and an office building.

The addition of 730 spaces is intended to serve the retail, office, and residential projects currently under construction. Public financing incentives allowed Pedcor Development to provide parking, public spaces, and upscale design. "It was an interesting project because the city paid for the garage, yet Pedcor Development will maintain it," recalls Jared Plank, project manager with American Structurepoint. The subsidized development is intended to reshape the downtown area and support the walkable urban mixed-use project.

Plank describes the intricate precast concrete façade for the Carmel Park East parking structure. Cornice pieces and arched panels were part of the elaborate design that echo classic architecture common in the Midwest. "We modified the design because an additional floor was added and several new options were provided," explains Plank.

FREE PARKING

The city of Carmel felt strongly about providing free parking for residents and visitors, and they had input as to the design. They wanted the parking for the mixed-use facility to complement and enhance the design of the surrounding buildings and neighborhood. This architectural continuity is reflected in the

CARMEL PARK EAST

LOCATION
Carmel, Ind.

PROJECT TYPE
Parking structure

SIZE
46,000 ft²

COST
$9 million

DESIGNER
American Structurepoint, Indianapolis, Ind.

OWNER
Pedcorp Development, Carmel, Ind.

STRUCTURAL ENGINEER
American Structurepoint, Indianapolis, Ind.

CONTRACTOR
FA Wilhelm, Indianapolis, Ind.

PCI-CERTIFIED PRECASTER
Coreslab Structures, Indianapolis, Ind.

PRECAST COMPONENTS
Spandrel panels

resulting precast concrete panels with embedded thin brick that emulates the traditional brick representative of the area.

The Midwest features many colonial-style buildings with classic brick architecture, but many of the finishes and fixtures on the newly named Veterans Way Garage have been updated for architectural enhancements.

TIGHT SCHEDULE

CoreSlab Structures was involved from the beginning to collaborate on the façade and assist in meeting the tight schedule. Precast concrete panels on the cast-in-place frame helped meet the aggressive schedule. The precast concrete installation lasted seven weeks during winter 2017. The team had less than a year to erect the entire parking structure. "The timing of the façade was the biggest contribution precast made to meet project goals," says Plank.

"The precast panels spanned horizontally 48 feet to skip intermediate columns," Plank adds. "On one elevation, the slab had to have special detailing to account for additional shear loads. The intent was to simulate columns within the precast panels, which are supported on the slab edge. The surrounding elevations featured long panels with thin brick that span column to column."

'The timing of the façade was the biggest contribution precast made to meet project goals.'

The criteria from the City of Carmel prescribed that the parking structure design complement the commercial and mixed-use structures in the area, as well as use local materials as much as possible.

Local precast concrete manufacturer Coreslab Structures (Indianapolis) worked closely with the architect to create the desired aesthetic for the parking structure. One of the production efficiencies developed by Coreslab was to set up master molds at the plant consisting of wood and fiberglass, which were able to be reused multiple times.

"To create the solid arches, we actually used flat steel plate, rolled it, and welded it into place to ensure a consistent smooth, curved surface for every pour," says Corey Greika, vice

'The panels also had to hang from the structure, because the base had to be open for future retail.'

president and sales manager with Coreslab Structures (Indianapolis). "This ensured that the arches were in exactly the correct location on each panel. There was consistent communication with Structurepoint, who served as both the architect and engineer of record, to detail the façade without compromising the features required."

The resulting aesthetic effect is a balanced blend of function, design flair, and local flavor.

UNIQUE ASPECTS

"One unique aspect of the project was that the design allowed for a road to travel through the garage," says Plank. "We had to account for ambulance loading to maintain access to the upper level of City Center area. Another unique twist was the use of brick pavers at the entrance level on the garage floor, in keeping with the City aesthetic."

"The solid architectural precast panels provide vehicular impact resistance in most locations. They serve as vehicular barriers, saving on redundant cable restraints on that side of the garage," says Greika. "The panels also had to hang from the structure, because the base had to be open for future retail. Because the structure was a moment frame, we had to ensure that the precast panels have enough flexibility in them to not act as shear walls for the structure."

At-grade retail is intended to activate the streetscape, and complement the mixed-use development.

While some parking structures make no attempt at style and are purely functional, the Carmel Park residents and visitors will be pleased with the aesthetics of the structure. By concentrating parking into an elevated structure, it allowed for more room to be creative with the visual appearance, and became a safe and inviting destination.

The multiple developments in this area establish a high-quality architectural aesthetic. Specifically, Pedcor's Carmel City Center distinguishes itself through the unique use of materials and design features that include masonry face brick, metal features, glass storefronts, architectural concrete panels, and a unique blend of colors, textures, and signage to enhance the community and define the city.

Precast concrete panels on the cast-in-place frame helped meet the aggressive schedule. Erected in just seven weeks, the precast concrete installation took place during the winter of 2017, with the entire parking structure constructed in one year. Photo: Tony Frederick Photography.

Thin bricks are assembled in the bottom of the form, ready for the precast concrete to be placed. Photo: Coreslab Structures (Indianapolis).

For the construction o Kaiser Permanente's state-of-the-art medical office building, everything that will be in a framed panel (both C-CAPP® and metal panels) was installed and caulked at the Clark Pacific facility to erect a weathertight barrier in one step. All photos: Clark Pacific.

KAISER PERMANENTE RIVERSIDE MEDICAL OFFICE BUILDING

LOCATION
Roseville, Calif.

PROJECT TYPE
Medical office building

SIZE
251,800 ft²

DESIGNER
HOK, San Francisco, Calif.

OWNER
Kaiser Foundation Health Plan, Oakland, Calif.

STRUCTURAL ENGINEER
John A. Martin & Associates, Los Angeles, Calif.

CONTRACTOR
Rudolph & Sletten Inc., Roseville, Calif.

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

PRECAST COMPONENTS
Wall panels, C-CAPP® (thin-shell) panels

KAISER PERMANENTE RIVERSIDE MEDICAL OFFICE BUILDING, ROSEVILLE, CALIF.

To provide the best care possible to their members, Kaiser Permanente is building a new state-of-the-art medical office building to replace their current Roseville Riverside facility. When complete, the new five-story, 210,000-ft² building will include nearly double the number of provider offices, a larger pharmacy, a larger laboratory, and expanded services including an on-site MRI suite.

Outpatient services will remain operational throughout construction. The existing one- and two-story buildings will be demolished to create staff parking. Valet parking is offered at no cost to members and visitors during construction. The new facility is scheduled to be open for patients in fall 2019.

The exterior of the five-story medical office building consists of a mixture of metal panels, lightweight precast concrete panels, glass curtainwall, glazed storefronts, and concrete masonry units. For design cohesiveness, the one-story pavilion building uses the same exterior materials as the medical office building. The pavilion building design includes a parapet to shield the rooftop mechanical equipment.

The two buildings are situated in a way that allows a single entry canopy feature to tie the two together. The placement of the buildings also creates an opportunity for outdoor courtyards that feature water-efficient gardens and space for multiple outdoor programs.

Kaiser's new medical office building (MOB) seems to be following the trend away from generic condo suites that lacked space for affiliated interdisciplinary physician groups, and did not offer imaging, lab work, therapy, or pharmacy services.

The new and improved MOB is more sustainable, more convenient, more digital, and more architecturally pleasing. All of these trends affect the design, layout, floor plans, and communications infrastructure. "There is more flexibility now with architectural features, since it is not part of hospital; they have more flexibility in the design," says Eric Rhondeau, project manager for precast concrete producer Clark Pacific.

MOBS GO MODULAR

From a structural perspective, medical office buildings are using prefabricated systems to streamline design and construction. "While everyone has their own distinct style for the exterior, the interiors are changing, too," says Justin Chung, project manager with John A. Martin & Associates. "Kaiser is taking a modular approach, not copy and paste, but have a system in place so they don't have to reinvent the wheel each time they need a new facility."

"Most of these MOB projects are design-assist, so the GC [general contractor] is plugged in early. This was not a true IPD, but we are were all communicating and coordinating early in the design process before permitting," says Chung. The precaster (Clark Pacific) was plugged in early with the architect to review panel and window layouts as well as any other exterior systems that integrated with the cladding panels.

To limit trades on site and improve safety and efficiency, Clark Pacific was responsible for the entire envelope under their scope of work. Panels were stored in the yard, waiting to be transported and installed as needed.

"With the structure, too, we like to coordinate with the precaster to see if any supplemental steel is needed, or if there are any special loads imposed on our structure. It helps to have that information early so we know what to expect," says Chung.

One modular feature that Kaiser has used for their MOBs is ConX® system. It is a moment frame system, so there is no diagonal bracing to interfere with architecture. Because it eliminates the need for on-site welding, four weeks were saved on the schedule by using this system in lieu of traditional steel construction.

PREGLAZING

Typically, there are multiple contractors involved in construction of this type. An innovative approach from Clark Pacific reduced those numbers considerably. They went from precaster to prefabricator and were responsible for the entire envelope under their scope of work. (For more information about preglazing, see the Perspective article in this issue.)

"That is a lot of responsibility for a precaster to take on, but the customer has to deal with only one (sub)contractor; we are the exterior façade, period," emphasizes Rhondeau.

The Kaiser Roseville MOB, with its punched windows, was a good opportunity to include the entire envelope system. A local company (ALCAL) installed the windows at the plant. "Everything that will be in a framed panel. Whether it is Clark Composite Architectural Precast Panels (C-CAPP®) or metal panels, the windows will be installed and caulked at the plant, which ensures the erection of a weather-tight barrier minus the panel-to-panel joints," says Rhondeau.

In just a few months, Kaiser had a complete building envelope dried in, which is much faster than typical construction. There are many advantages to moving this step off-site. "We think we will see a lot more of these types of projects, where more prefabrication is done in the plant," predicts Rhondeau.

ON-SITE

While the Kaiser project did not have excessive schedule constraints, working on an operational medical campus is always a challenge. Precast concrete and other prefabricated systems help to limit site disruption. "It was a very tight location already and the limited access was another reason to take operations off-site," says Rhondeau. Construction workers had to be shuttled to the site during the day due to limited parking and access. "A lot of our work had to be performed at night, since trucking was limited around the campus during the day."

The architect and owner worked with Clark Pacific to achieve

the preferred colors, finishes, and contrasting aesthetics. "Once that was decided, it was straightforward casting the architectural panels," says Rhondeau. Clark Pacific produced a palette of façade solutions for Kaiser. They manufactured a combination of C-CAPP® panels plus metal panels to achieve the desired goals.

There is a unique architectural feature on the north side of the building. "The large sail with concave panels is not only an aesthetically pleasing feature, but Clark Pacific provided a panelized approach, whether it was metal panels or their precast panels. They showed flexibility with their system to create this nice radius or odd shapes," says Chung.

'The customer has to deal with only one (sub)contractor; we are the exterior façade, period.'

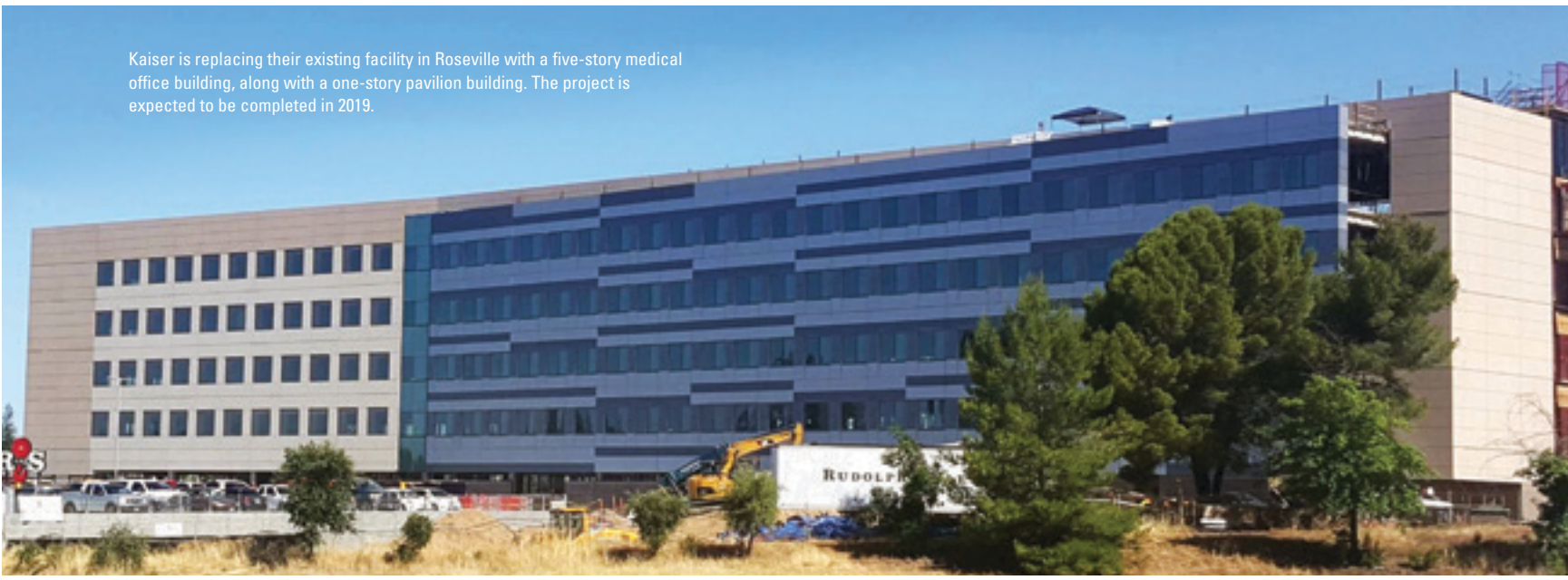
Exterior colors for the MOB and pavilion building include a sandy beige color for the concrete panels with varying degrees of exposed gray aggregate. The insulated metal panel colors are silver and weathered zinc arranged in a pattern that provides a contrast to the beige precast concrete panels. The majority of the north, east, and west elevations consist of pewter-colored mullions, clear vision glass, and light-gray-colored spandrel glass. The base of the building is designed to have chocolate brown concrete masonry units with a shiplap profile for added visual interest.

Chung recalls, "This was our first time working with Clark and we learned where the secondary steel might go, and we learned how to work with them better. In the future we will streamline the process a little better, but it was a good learning experience for us. We were plugged into the weekly meetings and when there were conflicts, we were able to assist."

"This is an opportunity to offer a different approach to our customers. The flip side of the additional risk to preglazing the panels is also additional control and flexibility for us," says Rhondeau.

"We learned the importance of off-site manufacturing and how that impacts schedules," Chung says. "Prefabrication always has a lot of coordination, learning curves, and hurdles to understand with precast capabilities for those contractors who are not familiar with this system."

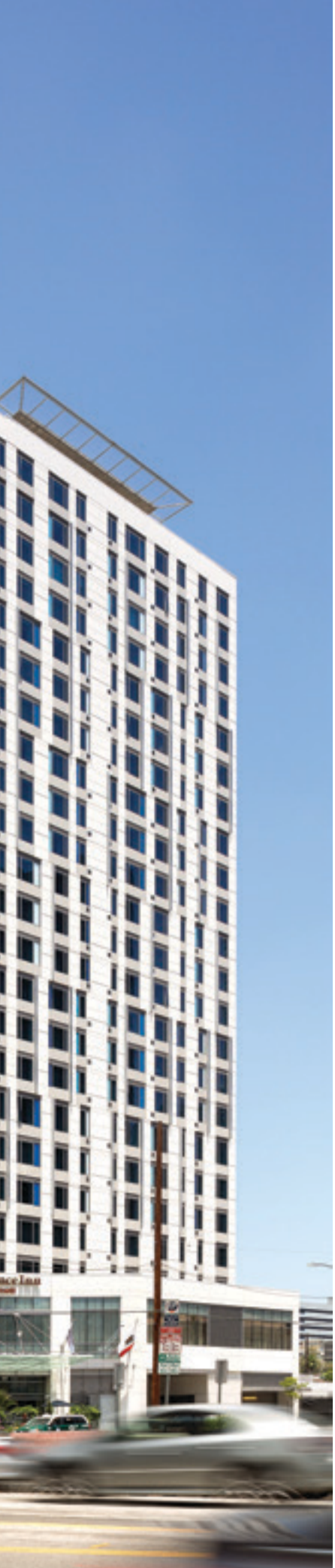
These four projects depict how diverse owners value the architectural design aesthetic brought forth by precast concrete. No matter the interior or structure category, in all these examples the exterior skin showcases precast concrete's versatility and how it builds beautifully and efficiently. In all cases, aesthetics were essential to the sense of architectural continuity and critical to the success of a project. The combined use of precast concrete elements is commonly adopted by designers because of the considerable benefits in terms of aesthetics, function, as well as speed of construction. Precast concrete cladding was used around the country for quality surface finishes that require minimal treatment as well as their buildable solutions.



Kaiser is replacing their existing facility in Roseville with a five-story medical office building, along with a one-story pavilion building. The project is expected to be completed in 2019.

'Achieving a nearly entirely enclosed envelope early in the building process reduces the amount of conflicting activity on the jobsite.'

The south corner of the L.A. Live Marriott features preglazed panels from Clark Pacific. Photo: Josh Partee Photography.



PREGLAZING

Demand for Preglazing

Precasters use preglazing to push the envelope, maximizing the benefits of prefabrication

By Monica Schultes

The idea of prefabrication with precast concrete has ceased to be a novelty. Even though the current practice is excellent, to meet future challenges it makes sense to integrate more systems into the building façade that boost efficiency and economy. New insights are continuously being gained in the area of preglazing, which is of great and ongoing interest within the design community.

The modular construction market is growing exponentially. A focus on work-zone safety, the need for reduced construction time, ease of installation, and, above all, the desire to reduce costs, all fuel the demand for building off-site.

First, there was thin-brick cast into precast concrete panels to gain aesthetic versatility, cost savings, and higher performance. Then insulation encapsulated in the panel at the plant provided increased energy efficiency and time savings. To avoid having to make any penetrations on-site, electrical conduit and boxes were also installed at the plant. Now growing in popularity is the concept of creating complete building façade units prefabricated under factory-controlled conditions.

Some precast concrete producers are extending their capabilities and demonstrating how complete window units can be integrated seamlessly into precast concrete panels, preassembled at the precast concrete facility.

Clark Pacific installs preglazed panels for the L.A. Live Marriot project. Photo: Clark Pacific.

JOB SAFETY

One example is Wells Concrete's partnership with Marvin Windows to offer the Integrity® line of window products to be installed at all their production facilities prior to shipment to jobsites.

"Achieving a nearly entirely enclosed envelope early in the building process reduces the amount of conflicting activity on the jobsite. The windows are installed in a safe, controlled environment to ensure quality control as well as reduce jobsite injuries," explains Gary Pooley, regional sales manager with Wells Concrete in Albany, Minn.

Wells' Integrity® window system offer the thermal capabilities of fiberglass windows as well as rapid enclosure for other trades following on to fit out the interior.

To demonstrate to clients the attributes and benefits of the integrated system, Wells preinstalled Integrity® windows in their own operations buildings. Next to samples and mock-ups, designers can view options for headers, sills, jambs, and other window features.

"While they are not a good fit for every project, it seems obvious in an industry that values speed, quality, and lean construction methods that reduced trades on-site and an improved schedule are a well-needed solution," says Pooley.

'Our customers want to have one prefabricator take on all the responsibility for the entire façade.'

ONE SOURCE

While preglazing has been around for a decade, recent demand has spiked.

"Our customers demand it to help them solve problems they face enclosing the building with a cost-effective solution," said Jim Lewis, director of sales, architectural façade systems, for Clark Pacific in West Sacramento, Calif. "Our customers want to have one prefabricator take on all the responsibility for the entire façade."

"It really isn't revolutionary," says Lewis. "It just fills a need.

It used to be elevators were one of the most complicated aspects of constructing a building—now it is the façade and the envelope."

In California, Clark Pacific worked with long-time strategic glass partner, AGA (Architectural Glass and Aluminum) to come up with multiple options. Prefabricated components in the panel include insulation, preglazed punched windows, block-outs for louvers, LED lighting conduits, light strips, and plenum boxes.

Their thin-shell Clark Composite Architectural Precast Panels (C-CAPP®) were used to clad the 23-story L.A. Live Marriott hotel, a 295,750-ft^2 hotel in Los Angeles, Calif., with 393 units of various sizes. The ability to combine so many systems into one panel in the yard under controlled conditions had a lot of appeal," says Mike Ryan, director of architectural systems for Clark Pacific. "The jobsite savings on the Marriott project was huge due to preinstalling so much equipment."

TIMING IS EVERYTHING

"Ideally when we are brought onto a project at the design development stage, we can design and manufacture a system that meets budget needs with the most aesthetic options," Ryan says. "The total enclosure and energy system needs to be considered early and as one system, as each part affects others. Too often, concepts are mixed and matched and it creates a busy, inefficient wall system."

"Once the project goals and desired outcomes are set, the panel becomes the design team's canvas. Following our Target Value Design process, we guide the team through design options to meet target values and design determined at the beginning of the project." Ryan notes, "Adding glass and glazing to our panel systems allows for the complete integration of the two systems."

In the early stages there were some growing pains, as offering these options requires additional areas in the plants where the glazing and caulking would be performed, as well as the need for more staging and storage areas. In addition, a lot of time was spent in R&D, testing various window systems and connections.

Wells Concrete prepares the first mock-up panel after initiating their partnership with Marvin Integrity® windows. Photo: Wells Concrete.

SCHEDULE

"This came about from a desire to compress schedule," recalls Mo Wright, marketing director with Gate Precast. "That was the initial impetus in 2010 when we worked on the Florida International University (FIU) Science Classroom Complex in Miami, Fla." The FIU project used preglazed precast concrete wall panels system on the six-story, 136,000-ft^2 building. Before delivery to the site, each precast concrete panel was preglazed, caulked, and inspected.

Gate suggested installing windows at the plant to save time and money on this project. "The idea evolved from the ever-shrinking schedule. Owners (public or private) know the faster they can build and complete their

At the former Domino Sugar factory site, deep white precast concrete panels frame the windows and emulate the structure of sugar crystals. Units are ready to be shipped to the project in Brooklyn, N.Y. Photo: Gate Precast.

project, the less they are paying for construction financing and other associated costs," says Wright. The faster they can start generating revenue from their investment, the better.

"Inspections are done on the ground, so no lift is required. There are also life safety benefits when installing an all-inclusive section of wall, including solid area, window caulk, air, thermal and vapor barrier. Those are all trades that work adjacent to the edge of the building or from lifts or scaffolding," adds Wright. In some cases, there is no room for scaffolding to install the windows at the jobsite.

This process shines when it is a large job with many repetitive windows. When the project includes a large curtain wall or storefront system, then the window sub would already be mobilized to the jobsite and preglazing would not benefit that project. Wright states, "Each project is different, so our decision to preglaze panels at our plant is made on a case-by-case basis." Gate is selectively promoting preglazing to the design community. "It is not one size fits all," says Wright.

'The bottom line is more efficiency and the building is dried in right away.'

Gate's most recent example features two main panel systems with two and three punched openings per unit. The project is a 42-story, mixed-use waterfront tower on the former Domino Sugar factory site in Brooklyn, N.Y. (For more on this project, see the article on 3-D printed forms on page 10 in this issue.)

TRANSPORTATION

"More than 10 years ago, we preglazed our first job and were unsure of the impact transportation would have on the windows. It seems that both materials have similar stiffness and we have no concerns," says Dan Parker, director of client services at Rocky Mountain Prestress in Denver, Colo.

The glazing laborers are content to perform their work on the ground. The result is a higher quality of caulking and installation versus scaffolding and swinging materials on a crane. "The bottom line is more efficiency and the building is dried in right away," says Parker.

Parker agrees that punched windows are the best fit. "It doesn't work with ribbon windows." While additional handling of the panels is required, overall, the project saves money.

"The windows need to be protected during the welding process typical for total–precast systems," he advises. Recently, Rocky Mountain Prestress preglazed the windows at the Colorado Center Tower III. (For more information, see the case study article in this issue.).

SUMMARY

The design community understands the added value prefabrication brings to a project, and chooses to maximize the use of these components. Precast concrete producers can deliver a complete building enclosure system that enables fast-track installation, reduces trades on-site, improves safety, and minimizes moisture to the interior.

The design/construction community is turning toward adopting modular construction methods that are cost-effective due to efficient in-factory processes and reduced waste. In moving toward more prefabrication, precast concrete producers are taking on the entire building façade (and some, the entire structure). This idea is not new in the world of prefabricated bathroom pods and kitchen modules. It is a simple concept: what was once typically performed at the jobsite is now being done in the plant.

Building A Concrete Future™

dependability design/build innovation people performance
products relationships

USC Village
Los Angeles, California

Photo courtesy of USC/ Gus Ruelas

CORESLAB® STRUCTURES

ARIZONA
Phoenix 602.237.3875

ARKANSAS
Conway 501.329.3763

CALIFORNIA
Los Angeles 951.943.9119

CONNECTICUT
Thomaston 860.283.8281

FLORIDA
Miami 305.823.8950
Orlando 407.855.3190
Tampa 813.626.1141

GEORGIA
Atlanta 770.471.1150

INDIANA
Indianapolis 317.353.2118

KANSAS
Kansas City 913.287.5725

MISSOURI
Marshall 660.886.3306

NEBRASKA
Omaha 402.291.0733

NEW MEXICO
Albuquerque 505.247.3725

OKLAHOMA
Oklahoma City 405.632.4944
Oklahoma City 405.672.2325
Tulsa 918.438.0230

TEXAS
Austin 512.250.0755

ONTARIO, CANADA
Dundas 905.689.3993
Stoney Creek 905.643.0220

Visit us online at:
www.coreslab.com

40 Building A Concrete Future. Since 1979 CORESLAB

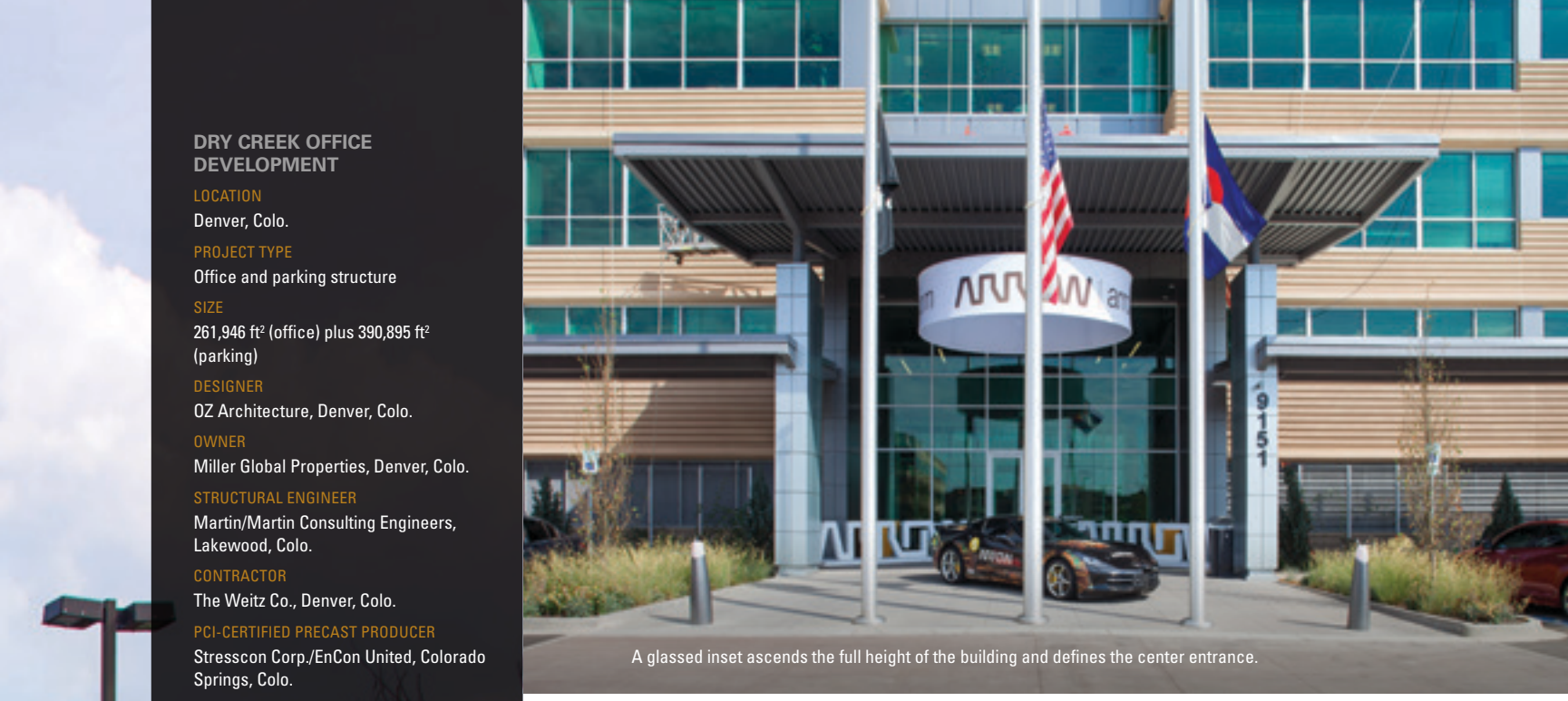
PRECAST REDESIGN

Precast Conversion Offers Adaptability

Redesign to total–precast concrete structure saves $1 million and schedule time while easily handling eleventh hour design changes

By Roy Diez

The Dry Creek Office Development was designed in steel and converted to a total-precast office building and parking structure, cutting four months from the schedule, which allowed the tenant who signed during the design phase to move in quicker. Photos: James Ray Spahn, courtesy of The Weitz Company.



A glassed inset ascends the full height of the building and defines the center entrance.

DRY CREEK OFFICE DEVELOPMENT

LOCATION
Denver, Colo.

PROJECT TYPE
Office and parking structure

SIZE
261,946 ft² (office) plus 390,895 ft² (parking)

DESIGNER
OZ Architecture, Denver, Colo.

OWNER
Miller Global Properties, Denver, Colo.

STRUCTURAL ENGINEER
Martin/Martin Consulting Engineers, Lakewood, Colo.

CONTRACTOR
The Weitz Co., Denver, Colo.

PCI-CERTIFIED PRECAST PRODUCER
Stresscon Corp./EnCon United, Colorado Springs, Colo.

OFFICE SPECIALTY ENGINEER
Encon Design/EnCon United, Denver, Colo.

PARKING SPECIALTY ENGINEER
CEG New Mexico, Albuquerque, N.M.

PRECAST COMPONENTS
Total–precast concrete structure including load-bearing spandrels, double tees, inverted tees, two stair cores, elevator core, shear cores. Perimeter spandrels have beam and column lines on the inside. Sloping double tees with a topping also were used for the roof. In all, the office building features 1320 pieces, while the parking structure used 1020 pieces.

The new Dry Creek Office Development, located along Interstate 25 in Denver, Colo., was designed in steel and converted to a total–precast office building and parking structure. This cut four months off the construction time, allowed tenants to move in faster, and netted the owner a substantial savings.

Conversion from a steel design happened during preconstruction and before drawings had started, says Chris Montoya, vice president of engineering for Stresscon Corp. in Colorado Springs, Colo., which fabricated the precast concrete components. Made aware of the upcoming project, the firm's vice president of sales, Don Palmer, contacted The Weitz Company in Denver to offer competitive pricing and an accelerated construction solution that could make the complex project work efficiently. Accordingly, Stresscon was brought into the design team and the project was converted from steel, thanks to the economy and speed of precast concrete.

"The project started with comparing two structural systems: precast and cast-in-place concrete," explains Kevin Schaffer, principal at OZ Architecture in Denver. Part of the decision, he notes, involved trying to create a campus look with other nearby precast concrete buildings. Another factor was the schedule. "Precast is faster to construct," says the architect. "It provides a faster schedule."

It also offered better economics, he adds. "The pricing for precast was better at the time and that is why the project went with precast."

'BOUNCE' ELIMINATED

There were other benefits as well, notes Tom Haning, senior preconstruction manager at Weitz. "I think the most important factor in the change from steel to precast was the tenants' desire to have a floor structure that was not 'bouncy' or vibrating."

At schematic design, he explains, the structural engineer felt that to meet the criteria, the steel weight per square foot for a composite system needed to be 12 to 13 lb. "Precast was an economical option because the bounce factor was not an

Once a tenant was signed, designers added a seventh story of office space and approximately 600 spaces in the parking structure. Photo: Jim Davis, courtesy of Stresscon Ltd.

issue," he says. "The cost savings was, of course, a major factor as well as savings of time, which allowed earlier occupancy."

The conversion started with Haning contacting Stresscon's Palmer. "I've known Tom for decades," relates Palmer. "He sent over a schematic drawing and wanted a quote for architectural cladding on a steel frame and for a parking garage in precast. I told him I would give him a price for the building as though it was a total–precast structure. We made a model and developed a price, and we presented it to him." The result was approximately $1 million less than the steel solution.

'The structure was designed in steel, but they showed that it was more economical to go with precast.'

"The structure was designed in steel, but they showed that it was more economical to go with precast," notes Haning. "It was quite a bit less in cost. We also selected precast because it was faster. We felt we were going to be able to save about a month off the schedule time."

Reducing schedule time added to the savings, as it can be more challenging to connect precast concrete panels to a steel frame than to a concrete frame, Palmer says. "Certainly we've had very successful and economical jobs cladding precast on steel frames when the suppliers in the pipeline listen and coordinate with you," he explains. "But, generally, it costs more to erect precast on a steel frame than on a concrete frame because I control my own destiny with a concrete frame. So it's usually faster to get a total–precast building up than it is to erect steel and then clad it."

Based on the huge projected savings, Stresscon was able to present their system to the developer. "They did not have a predisposition toward steel or precast," says Palmer. Another meeting followed with the design team, consisting of the architect, engineer, contractor, and superintendents. "We were significantly lower with the precast frame. The contractor was on board because he has used a lot of precast in the past and liked the speed of precast."

As a result, precast concrete won out. "I volunteered to give them an alternative look at an all–precast building, and the numbers shook out," Palmer summarizes. "There was a significant savings and the owner took advantage of it."

Dry Creek consists of a seven-story office tower and an adjacent five-level parking structure on 4.94 acres. Except for an entry vestibule, the office tower's first floor serves as executive parking. Extending outside, the structure then offers four elevated levels, providing a parking ratio of six spaces per 1000 ft^2 of offices. Surface parking is also available.

'GOLDEN RECTANGLE' DESIGN

Seemingly in the form of a "golden rectangle," the building features horizontal ribbons of precast concrete spandrels

and glazing that run across the front of the building. A glassed inset ascends the full height of the building and defines the center entrance.

"The structure depth is impressive," says Stresscon's Montoya. "It doesn't look like a concrete building. It looks very light. There is a lot of glazing, lots of glass."

The tower's total–precast concrete shell consists of two precast concrete stair cores, an elevator core, load-bearing spandrels, double tees, and inverted tees. Design was completed with the precast concrete shear cores and perimeter spandrels with beam and column lines on the inside. A mechanical yard includes precast concrete partition-style walls, with some that retain soil. The foundation consists of drilled piers, with a grade beam. Roof construction includes sloped double tees with topping. "The project focused on using precast," says architect Schaffer.

The spandrels feature deep reveals that created added shadowlines on the building. "We did several studies to find unique ways to use the formliners. The ribbed look on the precast panels was the result of many different concept iterations with our client."

The building's spandrels vary in size but are typically 7 ft tall. The double tees span 60 ft in the outside bays and 24 ft in interior bays. Lightweight double tees were used to improve economy, allowing the precaster to get two pieces on a load and reduce shipping costs. A number of architectural mixtures were used for the concrete.

The office and parking structure are built into a hillside. Construction was required to retain one level of soil by the office structure and three levels, or 35 ft, of soil by the parking structure. Soil retention is done by a rock anchor and Gunite wall with precast concrete walls then erected in front of that system.

There is a different lateral system in the parking structure, which has two stair cores. The parking structure uses precast concrete litewalls and shear walls, and the precast concrete facing the Gunite soil-retention system consists of grey precast concrete wall panels. Double tees in the parking structure are field-topped.

The parking structure required an approximately 30-ft excavation and shoring that was put on a wall abutting the Dry Creek state highway. Originally, it was planned to be cast-in-place concrete. "Before we got started, we determined that we couldn't do cast-in-place concrete for that high of a wall," according to Haning. "We ended up doing precast."

CHALLENGES ADDRESSED

Construction of the combined structure contained numerous challenges for the design and erection team, says Montoya. Several issues for the precast concrete system included maintaining

Double tees used in the office building helped eliminate the sense of bouncing or vibrating that steel flooring would have provided.

Early design changes altered the erection plan when construction of the parking structure was performed by a different crane rather than using one to erect both structures. Photo: Jim Davis, courtesy Stresscon Ltd.

architectural quality by holding tolerances for the glazing, maintaining the camber of the double-tee floors, and handling unusually large duct runs.

"The labor shortage in Denver has affected several trades," explains the engineer. "Because of the lack of experienced trades in this area, we had to do a lot of repairs to the foundation to get the precast to set right." On the plus side, a shortage of on-site labor made precast construction, fabricated off-site, even more advantageous.

Attention had to be paid to ensure the proper camber throughout the facilities. "In the parking garage, as long as we had drainage, camber didn't come into play," Montoya says. "But in the office building, the floors had to be level. When the tees sit in the sun they expand on the top surface and this induces a camber."

When they saw too much camber, they looked for creative ways to reduce it. "We might load a tee with a 'deadman' to keep the camber low. In some cases we dapped our tees," in which a notch is put into the bearing edge so that the tees are a little lower.

The long ducts also took special care. "We had engineering accomplishments that we've never done before," Montoya says. "There are very large ducts—50 inches wide by 17 inches high—that run through the interior inverted tee beam lines. These beams were already shallowed-up, and the tees were dapped to reduce structure depth and keep the whole system shallow. We had to work with mechanical to figure out the best place for these openings."

Attention had to be paid to ensure the proper camber throughout the facilities.

ALTERATIONS DURING DESIGN

About halfway through design, the owner signed Arrow Technologies as a tenant. One of Denver's largest tech employers, Arrow also owns a nearby building. The tech firm requested numerous changes to the new structure.

"This was a big challenge." says Schaffer. "We started the design as a spec office building and toward the completion of construction documents, we learned there was a tenant for the entire building. We had to take a step back in the process after we were complete with construction documents and retrofit the building to a tenant."

To that end, a floor was added to the office tower and approximately 600 spaces were added in the parking structure. "We also made modifications to the exterior to help the building better relate to the tenant's building across the street." As these changes occurred at the design phase, they had minimal impact on the construction plan.

In addition, the parking structure, originally designed with one elevated deck, was expanded to four elevated decks. This dramatically changed the precast concrete erection plan, says Montoya. "It was a very tight site and it had a really aggressive schedule," he says. "We originally planned to do the project with two cranes. With the garage expansion, we couldn't track our crane where we wanted because we would have had to ramp down. It took the idea of two cranes off the table."

CRANE PLAN ADJUSTED

The plan had been to have two cranes track from west to east, and when they got to the end of the building, the crane inside

Early design changes altered the erection plan when construction of the parking structure was performed by a different crane rather than using one to erect both structures. Photo: Jim Davis, courtesy Stresscon Ltd.

the footprint would have tracked into the footprint for the parking structure, Montoya explains. "But now there was an excavation where the crane wanted to go and we would have had to build both a huge ramp and a level area in the footprint of the parking structure to complete erection from inside that footprint." Without access to the west the need for the second crane was eliminated, as that crane would have had to turn a corner and come out to the south.

The originally plan for 90 crane days (50 days with one and 40 days with the other) had to be changed to do all the work with one, while doing it in the same allotted time. "The contractor and tenant did not want to move the schedule." To resolve the issue, a different erection crew and crane were used to erect the parking structure.

One key change came after concrete was produced. Most of the office spandrels were red with a buff-colored bullnose feature and an acid-etched finish. This approach didn't match Arrow's current building, so the contractor stained the red concrete to a darker tan.

"The exterior of the spandrels were originally designed to have a different color of paint than the verticals," explains Haning. "The owner made the decision that they wanted to change that so they all blended in together. This was after we had already put up about three floors. All the precast spandrels were already fabricated, so we had to get a third party to come out and paint them. Our clients are very happy with the results."

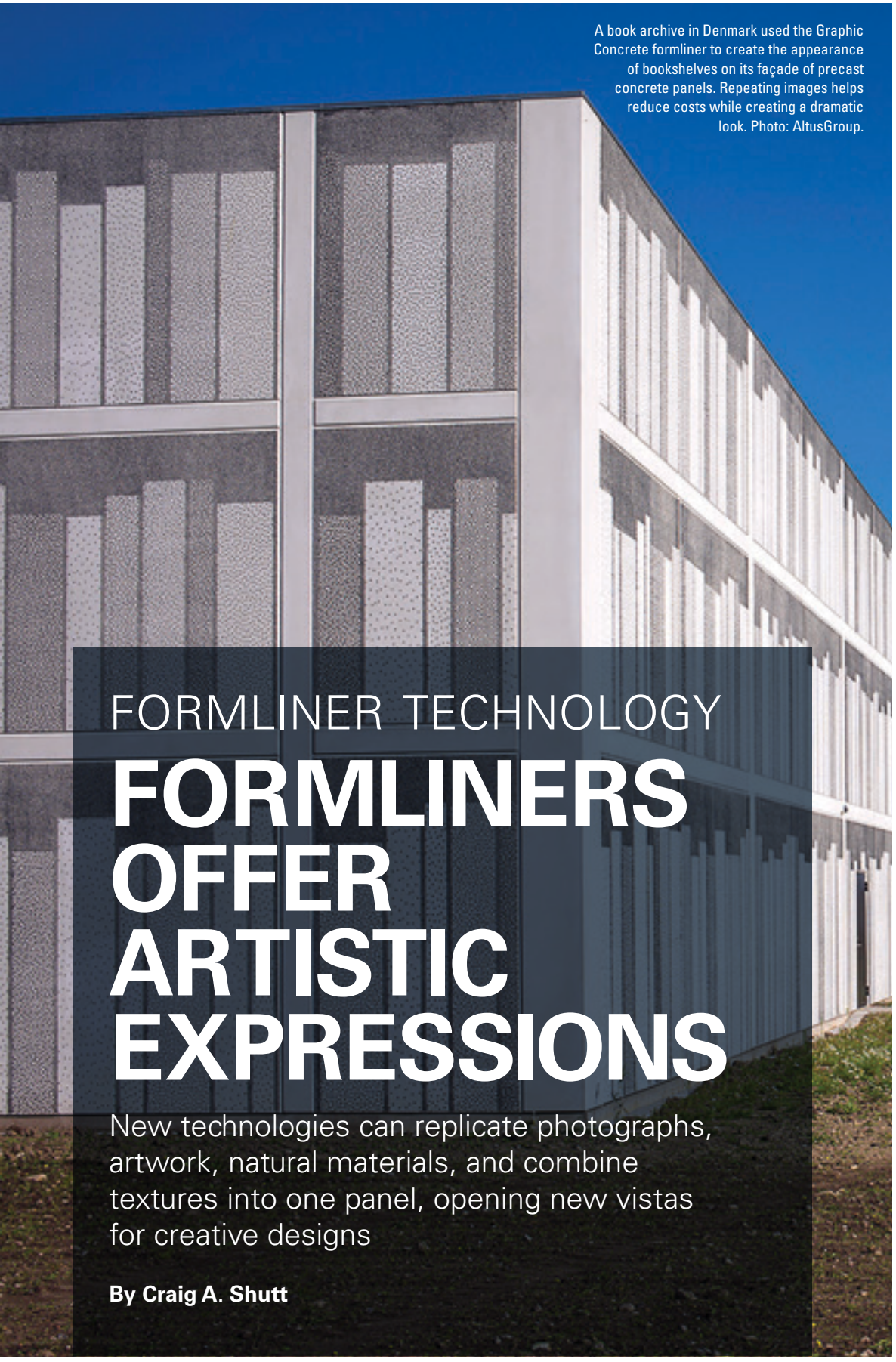
'Our clients are very happy with the results.'

Another late change from the tenant required the structure to step up and down to accommodate a false floor with data cables beneath. "We had to figure out how to provide four inches of void space under big areas of the floor," adds Montoya. "Arrow also added a data center, so there were a lot of changes to allow for additional generators and cooling equipment. These were fairly heavy loads."

Montoya applauds the effort. "We had our office erection crew out there six days a week working long hours for 16 weeks, and they actually pulled it off. We came really, really close to our completion date. Even with weather delays and the time needed to repair the cast-in-place foundation, we were less than two weeks late."

"Precast is certainly a suitable option for suburban offices," concludes Schaffer. "We had some challenges in terms of floor levelness and camber in the office building, but we made it work. We also left the ceilings out of the top level of the office building and exposed the precast structure to create an open workplace space. That made it similar to what you find in some of the old warehouse districts of Denver. The parking structure went together very quickly.

"We are pleased with the result. When you see it from the Dry Creek side, you would never know there are around 1200 cars in it."



A book archive in Denmark used the Graphic Concrete formliner to create the appearance of bookshelves on its façade of precast concrete panels. Repeating images helps reduce costs while creating a dramatic look. Photo: AltusGroup.

FORMLINER TECHNOLOGY

FORMLINERS OFFER ARTISTIC EXPRESSIONS

New technologies can replicate photographs, artwork, natural materials, and combine textures into one panel, opening new vistas for creative designs

By Craig A. Shutt

The possibilities for using formliners to create dramatic images can be seen in this use of the Graphic Concrete technique, which produced the images of 28 famous French creators on the concrete façade of an upper secondary school in Crevin, France. The technique is licensed to AltusGroup members in North America.

Designers RE-Suunnittelu used the Graphic Concrete formliner to retard large portions of the whiter concrete face mixture on precast concrete panels to reveal the darker aggregate beneath in decorative patterns and images on the Valio Lapinlahti Factory in Lapinlahti, Finland.

Designers long have used formliners to achieve specific appearances with precast concrete wall panels. Altering the depth and texture of a panel's face can create attractive artistic statements. Today, formliners can go much further to create unique aesthetics that open new doors to creative expression, including replicating photographs, artwork, or natural materials in more realistic ways.

"We are using formliners more often with our projects today," says Todd Ault, a senior project architect at Gould Evans, an architectural firm in Kansas City, Mo. "The options are more varied, and the costs are coming down. If you design it right, a custom formliner can be virtually as inexpensive as a standard one; that encourages us to find new, creative ways to use them. Today, if you want to replicate natural materials like stone or board, it's the way to go."

'We are using formliners more often with our projects today.'

Precast concrete producers also have seen interest grow. "Sophisticated designers know about precast concrete and want to use the inherent benefits of its plasticity to create interesting looks, from simple bumpouts or reveals to something more complex," says Dirk McClure, director of business development at Enterprise Precast Concrete in their Kansas City office, who has worked with designers at Gould Evans and other architectural firms on recent projects.

The Helsinki Culinary School used the Graphic Concrete technique inside the building to depict fruits and vegetables used in the school. Photo: AltusGroup.

The new Marriott Hotel and apartment tower in downtown Calgary, AB, Canada, includes a five-story parking structure and 10,000-ft^2 conference center at its base clad with precast concrete panels featuring a custom-finished formliner that creates a stepped-ribbed finish with smooth-, fine-, and coarse-grain finishes on individual ribs. Photo: U.S. Formliner.

Precast concrete producers can help refine and optimize techniques if brought into the design phase at an early stage, McClure notes. "Architects often have an idea or a 3-D rendering they send to us to see if we can achieve what they're looking for," he explains. "They ask if it makes sense to do it in precast, and if so, how can they make that happen efficiently and effectively."

GRAPHIC CONCRETE TECHNIQUES

Enterprise's most recent formliner addition has created a stir, with several projects incorporating the technique. Graphic Concrete, a patented technology used in Europe for about 15 years, uses a surface retarder applied to a membrane printed with a pattern or artwork to transfer the image onto the concrete face. It retards away the face mixture to reveal the high-contrast aggregate beneath, creating a dramatic and precise appearance.

The process begins with the membrane being printed with a reverse version of the desired image and the retardant, which is then placed in the bottom of the form and concrete is poured over it, as with any formliner. When the concrete is cured and extracted from the form, the retarder membrane is power-washed away, revealing the image embedded in the concrete. Variations in the pigments and aggregates exposed can create variations in color and contrast.

The technique is owned by Graphic Concrete Ltd. in Finland and licensed exclusively in Canada and the United States to AltusGroup, a joint venture of 19 North American precast concrete producers who sell several precast concrete systems.

"Our goal is to enable architects and designers to turn their visions into reality," says Lena Weckström, consulting architect and business development manager at Graphic Concrete Ltd. "Our products can be tailored and the outcome of each project is unique. We believe in building a better built environment through the use of Graphic Concrete."

Enterprise has taken the lead on the concept, doing a variety of test panels and now putting it into use on several projects. "It's a pretty exciting concept," says McClure. "We can impose any image onto precast panels. It's a specialized technique, but it can be used in many ways, and we're only beginning to scratch the surface. It can be a game-changer for a building's appearance."

John Carson, executive director at AltusGroup, agrees. "It won't fit every project, but it's a unique, novel, 'signature' type of application that creates a distinctive aesthetic and makes a specific design statement."

Precast concrete using the Graphic Concrete formliner can be used in high-traffic areas, including floors, although precast concrete producers in North America mostly are using it in vertical applications during its introductory phases. Photo: AltusGroup.

In Europe, the concept has been used to create decorative designs, murals, and even combinations of people's faces taken from photos. In North America, the most dramatic use will be seen on the Murphysboro (Ill.) High School, now under construction. Exterior precast concrete panels feature a tall image of a grove of cedar trees cast with a yellow background and tan ground and trees. The illustrated panels, designed by architectural firm Hurst-Rosche, are framed by smooth panels in a complementary finish.

"There were discussions with the designers about several potential approaches and this was chosen as a more economical option," McClure says. "By repeating the pattern on each panel, we could lower the cost." In fact, he notes, the cost was close to that of a thin-brick application, which consists of a formliner into which thin bricks are set by hand before the concrete is poured. A premium, finite aggregate was used to contrast with the pigmented concrete.

"The application is very durable," he says. "We have seen it used for lobby floors and other heavy-wear locations. We intend to use it only in vertical wall applications for now until we are certain of how it will wear in high-traffic areas."

'These are often one-time, specialized uses, but they're so prominent that the owners use them to make a statement.'

EMBOSSED IMAGES

A related concept creates images in the concrete with an embossing technique that's typically used for larger images, such as emblems, company names, and other signage. One recent example was completed by Enterprise above the entrance to the University of Kansas' athletic facility. It features an outline of a football player, with deeper blockouts used to contrast his arm and leg bands. The player's jersey has the number "48" on it, an homage to Kansas legend Gale Sayers, who went on to play for the Chicago Bears.

"These are often one-time, specialized uses, but they're so prominent that the owners use them to make a statement or project their identity," McClure says.

A similar technique was used to create a leaf pattern consisting of short reveals in various widths to create different shades for the Carsa Parkade in Victoria, BC, Canada. The pieces were cast with formliners produced by Nawkaw Corporation/U.S. Formliner for Canon Design in Vancouver, BC, the design consultants. The design called for precast concrete with oak leaves and cast-concrete wall art, according to Sonny Arora, regional sales manager for U.S. Formliner.

The Murphysboro (Ill.) High School, now under construction, features one of the first applications of the Graphic Concrete in North America. Repeating the two-panel design created a dramatic visual while reducing costs. The building was designed by Hurst-Rosche. Photo: Enterprise Precast Concrete.

BOARD-FORM FINISHES GROW

Image-based techniques are only one type of application gaining popularity. "We're also seeing interest in board-form appearances and finishes, both vertically and horizontally," says McClure. "The detail and customization we can provide has grown and architects like the look in a durable material."

The most recent example from Enterprise is on two new buildings being built on the Cerner Innovation Campus in Kansas City, Mo. The company supplies health-information technology and services. The buildings feature two lower floors with precast concrete panels finished with a highly textured board-form finish replicating cedar planks. Above that is a layer of glass curtain wall topped by tower floors fitted with a stainless-steel skin.

"Our design concept was to create the look of an organic material on the first floors," explains Ault, who worked on the project at Gould Evans. "We realized that by using precast concrete, we could create a formliner that offered a strong appearance." Molds were created using distressed 1½-in. cedar boards with significant depth to them.

'We realized that by using precast concrete, we could create a formliner that offered a strong appearance.'

"We needed a very authentic look because in some areas, visitors can walk right up and touch the panels," he explains. "But they also had to read from a distance as boards." The panels were 5 to 10 ft wide and varied in height from 19 to 29 ft.

A similar technique was used at the Museum of the American Arts & Crafts Movement in St. Petersburg, Fla., a 110,000-ft^2 museum housing collections of decorative arts from the Arts and Crafts movement and a restaurant. The building features a total–precast concrete structural framing system, with distinctive precast concrete "fins" set into a precast concrete "frame."

The base of the building features panels with a rough-sawn cedar appearance, created by placing 1 × 6-in., 12-ft-long cedar boards into a form and screwing them into place.

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

"The architects were very specific about the look they wanted for the rough-sawn board appearance. It took time to ensure the alignment was perfect." says Todd Fultz, vice president and project director at Manhattan Construction, which served as construction manager. The precast concrete producer, Coreslab Structures (Tampa) Inc., presented various conceptual approaches for the design that were discussed.

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. 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," says Vern Smith, project consultant for Coreslab. (For more on this project, see the article on page 50 in the Winter 2018 issue of *Ascent*.)

Textures also were a key ingredient in the precast concrete panels produced for the Marriott Hotel and apartment tower in downtown Calgary, AB, Canada. The mixed-use project features a five-story parking structure and 10,000-ft^2 conference center at its base clad with panels featuring a custom-finished formliner supplied by U.S. Formliner. The design required a stepped-ribbed finish with smooth-, fine-, and coarse-grain finishes on individual ribs. The panels were sealed to avoid discoloration and reduce efflorescence, according to Arora.

MIXING AND MATCHING

In addition to these various texture and graphic treatments, precasters have become skilled at mixing techniques on one panel, cutting casting and erecting time, and saving on-site labor to install accent pieces. An example is the parking structure for the Martha Jefferson Hospital on the outskirts of Charlottesville, Va.

"The parking structure provided a unique challenge to match the hospital's traditional materials in precast concrete," says David Plank, associate principal and project architect at Kahler Slater. "When we design parking structures, precast concrete is always our first choice, because it offers the best value in terms of cost, durability, and speed of construction. We designed the hospital with the look we wanted, and we had enough faith in the local precasters that they could replicate the materials we used."

The facility features a total–precast concrete structural system consisting of double tees, beams, columns, walls, stairs, and architectural spandrels. The structure was relatively easy to design, measuring three bays wide and six stories tall to provide the needed 765 spaces in the approximately 250,000-ft^2 rectangular building. But achieving the needed appearance required careful attention.

Surrounded in the complex by buildings with façades featuring brick and dark gray cast stone, the parking structure was designed to feature a dark brown wood siding look (achieved with formliners) as well as embedded cast stone and brick features. Brick was used primarily on the lower floors, acting as a solid base, while cast-stone panels frame the glass-enclosed stair towers on the end. The wood siding appearance was used on upper levels and as accents for the windows and to frame the perimeter. (For more on this project, see the article on page 28 in the Winter 2015 issue of *Ascent*).

To achieve all of these variations, the panels feature three finishes and four concrete mixtures: one each for the lap siding, cast-in lintels and sills, mortar around the inset brick, and the gray panel backup. The inset brick added another texture and color to the aesthetic palette.

This array of techniques, along with many others offered by precast concrete producers, can kick-start design concepts that create unique aesthetic statements. "There are so many choices today, and the options keep expanding as we find new techniques and architects challenge us with new ideas," says McClure. "There's really no specific trend in pattern preferences. Each project is its own custom design, and architects are finding there is a unique concept that will work for each project."

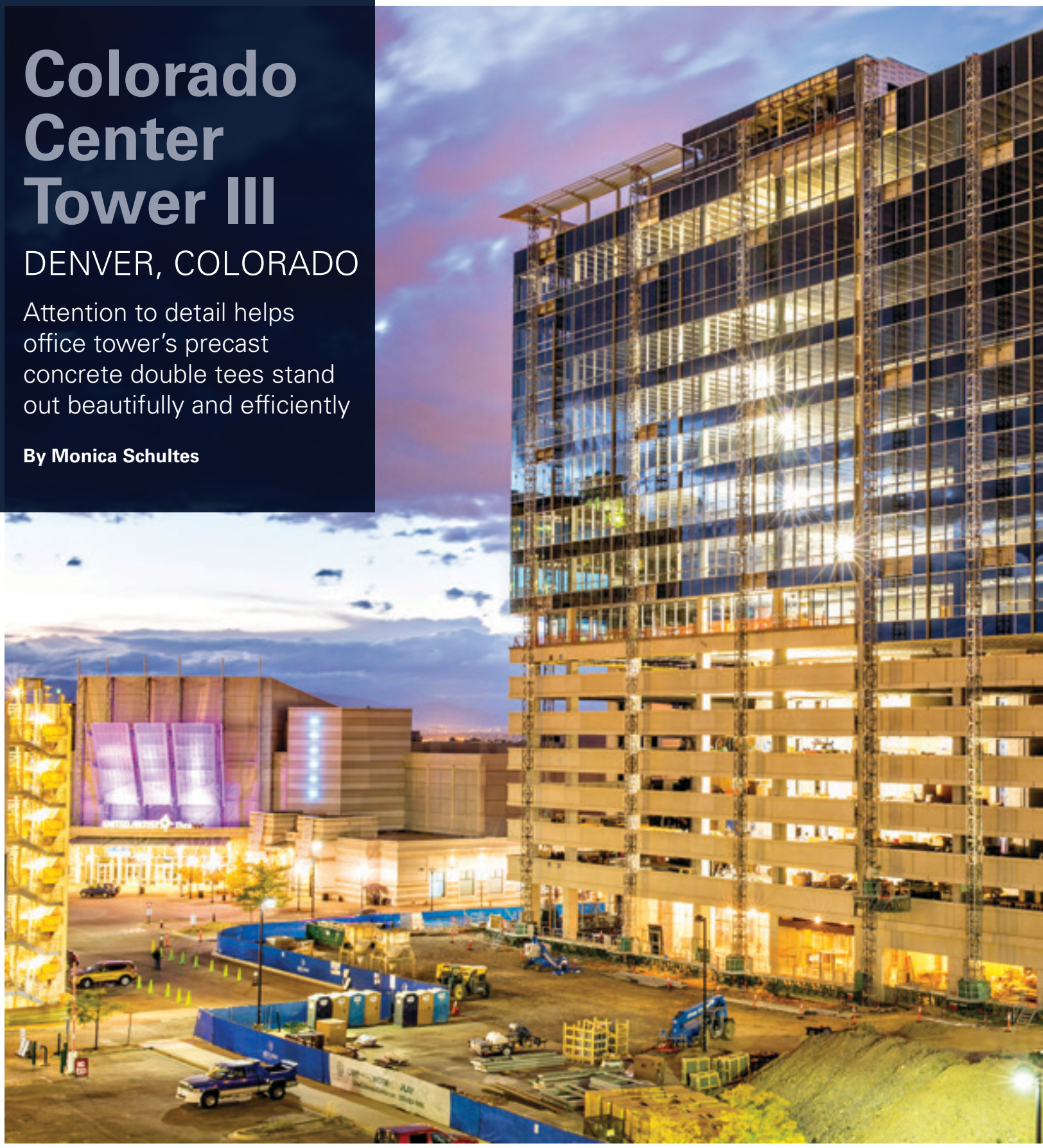
Deep formliners were used to create an embossed image in the shape of a football player (Kansas' Gale Sayers) to give the athletic facility at the University of Kansas a dramatic and customized appearance. Photo: Enterprise Precast Concrete.

Colorado Center Tower III

DENVER, COLORADO

Attention to detail helps office tower's precast concrete double tees stand out beautifully and efficiently

By Monica Schultes



Careful attention was given to the structural design as well, with exposed precast concrete double tees providing an extra layer of depth and texture to the façade. Photo: Sam Adams/Tryba Architects.

Colorado Center is a premier, 13-acre office/retail/entertainment/residential complex. It is located between downtown Denver, Colo., and the Denver Tech Center, and adjacent to Interstate 25. The transit-oriented development is adjacent to FasTracks light-rail and bus lines, providing convenient access to downtown as well as the Tech Center. In addition to providing access to CarShare locations, a new pedestrian/bike overpass connects the site to the neighborhood across the interstate, and is complemented by shower facilities and a bike storage and repair facility.

Master-planned by Tryba Architects in 2007 prior to the recession, the development now features three office towers (including the new Tower III) totaling 500,000 ft^2, residential apartments, and 767 structured parking spaces.

The design vision for the mixed-use development also included the creation of an open-air shopping strip with pedestrian walkways connecting the various structures. This 24-hour "Main Street" is comprised of high-quality restaurant and retail uses. It now includes a 120,000-ft^2 entertainment center with a United Artists movie/IMAX theater and a Dave & Buster's. There has been a huge investment in the site development concept and design.

CLASS AA OFFICE

Colorado Center offers unparalleled views of the Rocky Mountains and the Denver skyline. Tower III completes the office component of the transit-oriented development with live/work/play/shop options. Beyond ground-level retail and restaurant space, the first seven floors are parking, the next eight are Class A office space, and the 16th level offers a rooftop terrace and enclosed event venue.

The total–precast concrete structure includes precast concrete columns, double tees, inverted tees, beams, spandrels, and window walls. Nearly 300,000 ft^2 in all, the building, while predominantly precast concrete, includes a significant amount of glass curtain wall. The floor-to-ceiling glass heights provide abundant natural light.

The 15-story structure includes 8000 ft^2 of ground level retail with high floor-to-floor clearance, restaurant and café, seven levels of structured parking, and 203,000 ft^2 of offices on eight floors. Raising the office space allows tenants the opportunity to enjoy the panoramic views as well as direct access to the building from the parking levels. Future development at the site calls for a companion residential tower.

CUSTOM BLEND

Scott Maclay, account manager with Rocky Mountain Prestress in Denver, recalls they collaborated with Tryba Architects to achieve the desired color, texture, and finish. "In this case, the color was selected to match the existing office campus." The result was a buff color with acid wash that were also used for the parking structure below.

"We wanted to be able to respect the context of the established building, while elevating the campus with a modern design," says Emmett Harrison, senior associate with Tryba Architects. "When you can reinforce the relationship of the new development to what is already there, the connection allows the new design to enhance the presence of the existing buildings as well. In this case, precast was the primary element to establish that relationship."

SHADOW PLAY

In addition to efforts to match the color, a corrugated formliner was introduced to provide visual depth and texture to the façade "One of the unique things about Colorado is that we have excellent sunlight. We are always looking for opportunities to use those crisp shadows that play across a façade throughout the day. You can use something simple like a formliner to achieve various tones within the same mix of concrete," says Harrison.

The owners also wanted a slightly more industrial look than is typical for an office building, with exposed structure and systems in lieu of the standard dropped ceiling. The double tee became a unifying design element as a result. "The double tees bring a strong linear rhythm to the structure, which we were able to use to provide a layer of visual unity that helped to tie the garage below to the office above," Harrison explains. "The texture and spacing of the double tees informed the design of the other elements on the building—from the curtainwall mullions to the light fixtures—to achieve a unified composition that extends the full height of the building when viewed from outside."

'The double tees bring a strong linear rhythm to the structure, which we were able to use to provide a layer of visual unity that helped to tie the garage below to the office above.'

PRECAST PILASTERS

In the office levels, L beams support the double tees. Adjacent to these are built-up precast concrete wall column sections where

A custom formliner was developed to capture the crisp shadows that play across a façade throughout the day in the Denver area. Photo: Rocky Mountain Prestress.

The roof terrace offers unparalleled views of the Rocky Mountains and was designed to accommodate everything from corporate training to wedding receptions to afternoon yoga. Photo: Sam Adams/Tryba Architects.

exterior window wall panels are cast with large pilasters on the back to reduce the number of pieces. The pilasters helped carry the gravity load to the foundations.

"To minimize piece count and production cost, [on the north elevation] we used integral pilasters, which caused the panels to be very heavy," says Maclay. In addition, mullions for the glazing system were all designed to align with the double tees.

With space for 400 cars, the parking structure features field-topped precast concrete double tees and offers direct access to the offices above. Vehicles circulate via a circular ramp system.

UNDER EXPOSED

Precast concrete was even incorporated into the building architecture by leaving the underside of the double tees exposed in the offices. The ultimate goal is to achieve an open workspace that cultivates collaboration. However, the challenge is how to organize the systems usually hidden from view in Class A space.

"More and more often, tenants are asking to tear out the ceilings so they have more space," says Maclay. "So the double tees wereexposed in this building, too." There was a lot of coordination with the design team to manage all the mechanical, electrical, and plumbing (MEP) blockouts so that the structure could be exposed. Rocky Mountain Prestress used self-consolidating concrete to achieve a smooth finish on the underside of the double tees with very few bug holes. Maclay adds, "You still see the MEP systems, but they are well organized."

Another design challenge was the roof terrace. "We integrated the roof top terrace after the project was 50 percent constructed," says Charlie McLean, associate with Martin/Martin Consulting Engineers in Lakewood, Colo. "However, we knew there was the possibility of a future roof terrace and designed for the additional load. But, we were able to get the design in before the precast was made and the columns and foundation had the capacity for the extra loads." Roof loading did drive an increased depth of precast concrete double-tee stems when needed. The steel frame on the terrace is a separate structure with exposed steel trellises, which required coordination with the architect and contractor. The roof also features tree planters, a trellis, and a fire pit, with an enclosed structure that's home to an event space with a fireplace and catering kitchen.

> 'We integrated the roof top terrace after the project was 50 percent constructed,'

SPEEDY INSTALLATION

Six months were cut off the schedule by using precast concrete. That was accomplished by using two cranes erecting

simultaneously to speed the installation. While it might seem like a perfect location for construction right off the interstate, three 100%-occupied buildings surround the site. The contractor controlled traffic around the site, and since there was no storage or laydown area, the just-in-time delivery method was effective in getting the panels offloaded each morning.

Another factor that sped up installation was that the punched window wall panels were preglazed in the precaster's plant prior to shipping. "The preglazed panels saved an incredible amount of time, so scaffolding was not required to glaze the building," says Maclay. Because it is a total–precast concrete building, the perimeter wall panels with punched windows were welded to the structure and the glazing had to be protected from weld slag during the installation. So, a protection system was developed using aluminum frames and lightweight fire blankets that were installed over the windows at the jobsite prior to setting. (For more information about preglazing, see the Perspective article in this issue.)

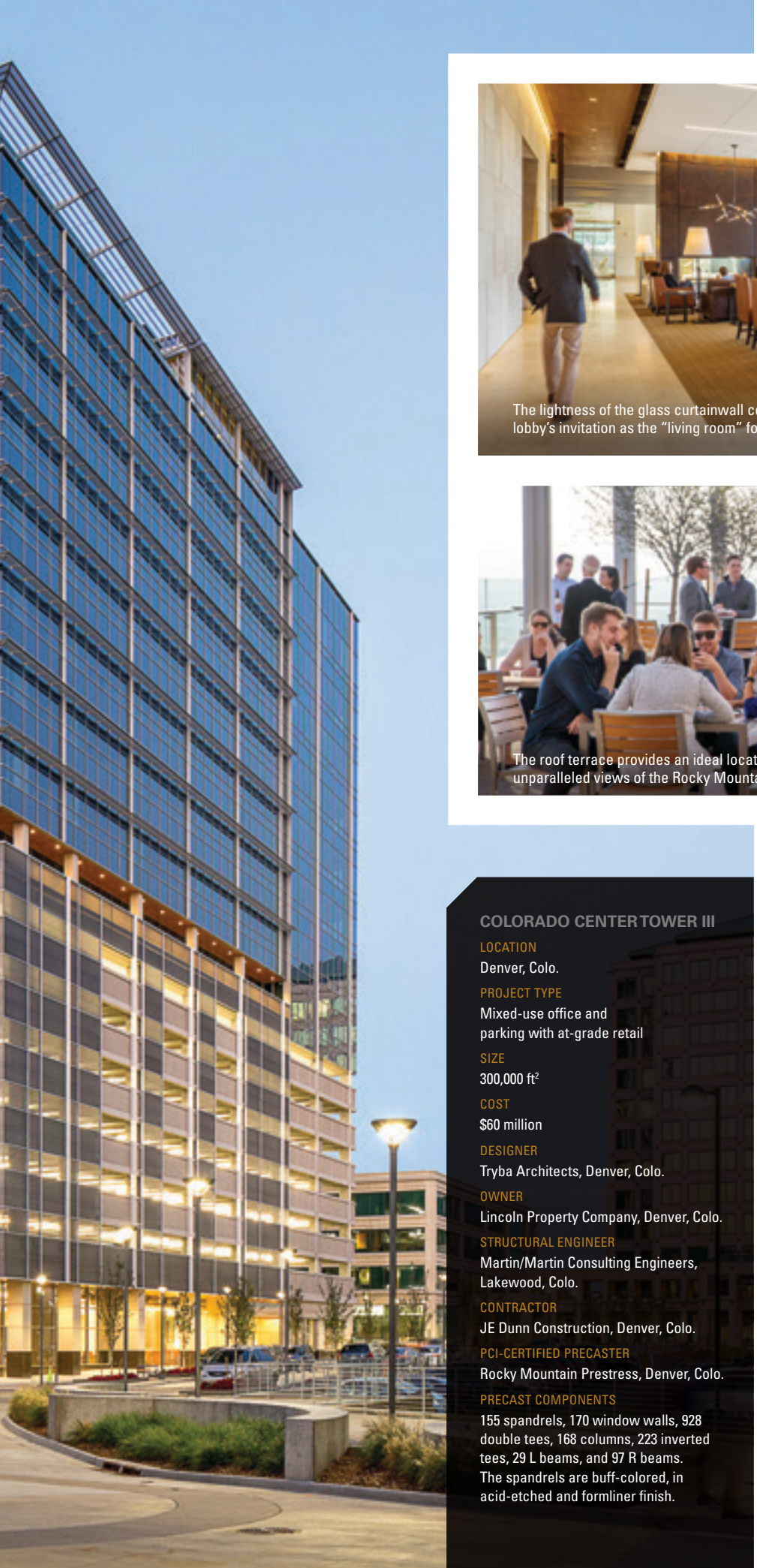
BEAUTIFUL AND SUSTAINABLE

Seeking LEED gold certification, the building has numerous sustainability features. It includes a thermoplastic polyolefin three-ply, built-up roofing membrane with a vapor barrier applied directly to the topping slab. Insulated glazing units feature foil-faced wool taped to the interior face of mullions to act as a vapor barrier. Curtainwall glazing consists of high-tech SolarBan glass.

Precast concrete components were all locally produced and off-site precast concrete production helped divert waste from the landfill. In addition, structural concrete mixtures contained up to 12.2% fly ash. Spray foam insulation was applied to the interior of the noninsulated precast concrete spandrels and wall panels. Finally, the use of a precast concrete structure and skin makes for a durable building that isanticipated to last longer than the traditional building, lowering the building's overall life-cycle costs.

Additional sustainability features include the use of low-flow plumbing fixtures, LED

The precast concrete for Tower III was carefully developed with Rocky Mountain Prestress to match the existing campus (background), while modern materials such as curtainwall and a metal screen lend fresh consideration to a familiar material. Photo: Sam Adams/Tryba Architects.



The lightness of the glass curtainwall contrasts with the monolithic precast concrete, underscoring the lobby's invitation as the "living room" for the campus. Photo: Sam Adams/Tryba Architects.

The roof terrace provides an ideal location for special events, meetings, or just a quick lunch, all with unparalleled views of the Rocky Mountains. Photo: Sam Adams/Tryba Architects.

COLORADO CENTER TOWER III

LOCATION
Denver, Colo.

PROJECT TYPE
Mixed-use office and parking with at-grade retail

SIZE
300,000 ft^2

COST
$60 million

DESIGNER
Tryba Architects, Denver, Colo.

OWNER
Lincoln Property Company, Denver, Colo.

STRUCTURAL ENGINEER
Martin/Martin Consulting Engineers, Lakewood, Colo.

CONTRACTOR
JE Dunn Construction, Denver, Colo.

PCI-CERTIFIED PRECASTER
Rocky Mountain Prestress, Denver, Colo.

PRECAST COMPONENTS
155 spandrels, 170 window walls, 928 double tees, 168 columns, 223 inverted tees, 29 L beams, and 97 R beams. The spandrels are buff-colored, in acid-etched and formliner finish.

lighting, materials with low volatile organic compound emissions on the interior, and direct evaporative cooling. The projectis engaged in the commissioning process. The design team partnered with the local utility company(Xcel Energy) to evaluate the energy efficiency of early design decisions, which helped to inform everything from lighting densities to the depth of the exterior sunshades.

Colorado Center Tower III is very visible and will stand alone because of the design quality. Maclay adds, "The three key issues the owner, architect, and contractor considered were achieved with precast:

1. the precast panels were able to match the surrounding buildings;

2. the precast was installed six months faster than the steel;

3. it was less expensive."

The first helped build beautifully; the second and last demonstrate the efficiency of selecting precast concrete for the total structure.

Gilsanz Murray Steficek

Integrity is key to their people and their projects

By Monica Schultes

Gilsanz Murray Steficek (GMS) is a multidisciplinary structural engineering and building envelope consulting firm headquartered in New York, N.Y., with offices in Los Angeles, Calif., and Bloomfield, N.J. They take great pride in their collective expertise in structural design, façade consulting, special inspections, construction administration, forensic analysis, component and systems engineering, and engineering for construction logistics. In over 25 years in business, they have won over 250 awards.

GILSANZ MURRAY STEFICEK LLP, ENGINEERS AND ARCHITECTS

The façade at 11 Hoyt Street evokes the cusps of a wave in sections. The scallops allow for more than 190 unique floor plans to accommodate a diverse mix of residents. Precast concrete panels frame 8-ft-tall windows that maximize views of the waterfront. Rendering: Binyan Studios.

HOW DID YOUR FIRM GET INVOLVED IN THE BUILDING ENVELOPE INDUSTRY?

Gilsanz Murray Steficek was founded in 1991 by three structural engineers who had worked together at SOM/Skidmore, Owings & Merrill's New York City office: Ramon Gilsanz, Philip Murray, and Gary Steficek. While the initial focus of the new firm was structural engineering, in 1999 a former colleague from SOM joined them to create the building envelope group. Joseph Blanchfield has extensive experience as a technical architect and cultivated the group that is now responsible for the construction administration of the firm's most successful high-rise curtain wall projects, recladding projects, and façade restoration projects.

The three original principals of Gilsanz Murray Steficek continue to give back to the community and encourage their team to do the same. GMS views active involvement in professional societies as a key way to develop and retain bright young talent. Employees participate in various committees in all the key construction associations.

Achim Hermes, partner at Gilsanz Murray Steficek's Building Envelope Consulting Group, specializes in curtain wall and window consulting, including involvement in all phases of design and construction. Hermes has worked on a wide range of projects, both new construction and renovation. Hermes shared the firm's philosophy and the challenges facing the building envelope of the future.

One of the biggest challenges facing the design and construction industry today is the building envelope. That focus on the envelope includes sustainability as well as energy and code compliance.

WHAT IS THE FIRM'S PHILOSOPHY WHEN APPROACHING ENVELOPE CONSULTING?

Our philosophy is to approach every project as unique while keeping constructability and budget in mind. Above all else, GMS strives to provide outstanding service and technical excellence.

Unlike our structural group, which often works directly for the architect, most of our work on the envelope side is contractually with the owner. With that in mind, we approach the projects with keeping the owner's interests at the forefront. It is a team effort and we make sure every project is executed and designed professionally and soundly.

We approach client expectations with open minds and explore creative options to find the right solutions for every project,

520 Park Avenue is a skyscraper under construction on East 60th Street and Park Avenue on the Upper East Side of Manhattan, designed by Robert A.M. Stern Architects. All photos: GMS.

This midtown development located at 301 East 50th Street is a thoughtful balance between well-proportioned windows, precast concrete with limestone walls, and sun shading create a comfortable, yet expansive and panoramic, view of the city.

regardless of size, complexity, and material. We try to stay within budget and serve as mediator between the architect and the owner. Unfortunately, the budget is not always shared with us in the beginning of the project. Sometimes it is a difficult position to be in, where the design needs to be changed or adjusted to make it suitable, not just from a budget point of view but from a constructability or building performance point of view. When the architect wants to preserve the original design, we find common ground and work together toward project goals.

The U.S. has been in its infancy regarding our energy codes and compliance. We are trying to catch up with the rest of the developed world with methods to curtail our energy usage. For a long time, energy codes were not actively enforced in New York City, but that has changed in the last three to four years.

We now see a more holistic approach to the building design with particular attention to how the structure interacts with the enclosure system. GMS is currently involved in three residential high-rise projects in New York City that utilize architectural precast panels that range from 51 to 66 stories in height.

A particular challenge is how the large-scale precast façade panels accommodate the building movements of the structure related to wind and seismic-induced interstory drift, as well as concrete creep and long-term deflections of slabs and columns. Placement of gravity anchor locations is important, which should be near columns to minimize midspan slab deflections, and the correct sizing of panel joints is critical to allow free movement of the panels to each other and maintain a watertight enclosure. We have learned that early coordination of the superstructure and the façade elements is key to find a good balance and to avoid changes late in the project, which can be costly and result in potential delays.

WHAT ARE THE STRENGTHS AND CHALLENGES OF A PRECAST CONCRETE ENVELOPE?

Precast concrete as a façade element has many advantages. Precast panels are inherently air and watertight, as long as you have the right precast fabricator with a history of sound manufacturing and engineering, which starts with the right concrete design mix, optimized steel reinforcement, and proper casting and consolidating of the concrete into the panel forms to avoid honey-combing and crack development. Proper detailing of the panel-to-panel joints is critical for a watertight system. We incorporate a pressure equalized dual seal on the exterior with properly placed weeps. Correct installation of the sealant joints should be checked during construction for quality control.

Precast panels, unlike metal curtain walls, are considered "mass walls," and with continuous insulation installed on the interior side of the wall or placed within the precast panel itself, U-values can be achieved relatively cost-effectively to meet today's, and even more stringent future energy code requirements.

Precast as a façade cladding material has become very popular among architects for its variety of available finishes. The concrete surface can either be finished smooth, textured, and/or colored.

Other finish materials, such as natural stone or brick, can be cast into the panels to achieve a more traditional look, and done in an economical panelized system.

One example of a brick-faced precast panel façade is 150 Charles Street in the West Village neighborhood of Manhattan. [See the sidebar project profiled on page 62.]

520 Park Avenue, a 64-story-tall tower nearing completion on the east side of Manhattan, incorporates Indiana limestone in its precast façade. Here the windows were installed into the precast panels at the precast manufacturer's plant. (See the Perspective article on preglazing in this issue.) We currently have two other high-rise projects under construction that also incorporate preinstalled windows. Minimizing field labor and speed of installation is very important in New York City, so this approach makes a lot of sense.

One common concern we hear from architects about precast panel systems relates to panel joints. Architects like to minimize the number of joints in the façade and place joints in a pattern that avoids the appearance of a "grid," which can pose a challenge. We often bring in precast manufacturers early in the design phase of the project to weigh in on all available options and develop solutions collaboratively to try to address these concerns, in many instances successfully.

HOW ARE BUILDING ENVELOPES CHANGING?

Looking forward, the trend is moving away from all-glass buildings. Design architects are exploring other materials that can be used to achieve desired aesthetics.

We would like to see greater focus on practicality in design, but without sacrificing innovative new design approaches. There could be some inroads in glazing technology to improve solar heat control, especially in the residential market. Unfortunately, available products such as electro-chromatic smart glass, for example, are still too costly, so they haven't gone mainstream yet.

The motor court at 11 Hoyt Street in New York. Photo credit: Rendering by Binyan Studios.

GMS CULTURE & STRATEGY

GMS's leaders involve themselves in professional activities and publish technical papers relevant to structural design. They are dedicated to building their future reputation on the firm's exceptional service to clients and their projects—big and small.

The company believes that it is important for employees to learn the structural engineering profession from both inside and outside of the office. While the mentorship of young staff by GMS senior engineers forms the foundation of employee development, participation in standards committees helps staff to grow in ways that they would not otherwise. By actively engaging in the advancement of the practice through participation in standards committees, engineers not only enhance their understanding of how codes are written, they are also exposed to the latest advances in the engineering profession and develop relationships with leaders in the field. In doing so, they gain the confidence needed to become leaders in their own right.

Rendering: Hayes Davidson.

150 CHARLES STREET, NEW YORK, N.Y.

PROJECT
150 Charles Street

LOCATION
New York, N.Y.

OWNER
The Witkoff Group

TYPE
Residential

SIZE
15 stories, 176 ft, 91 units

ARCHITECT OF RECORD
COOKFOX

DESIGN ARCHITECT
COOKFOX

STRUCTURAL ENGINEER
Gilsanz Murray Steficek

FAÇADE CONSULTANT
Gilsanz Murray Steficek

150 CHARLES STREET, NEW YORK, N.Y.

This West Village address houses luxury residences in one of the most desirable locations in New York. Overlooking the Hudson River and Hudson River Park, the façade features precast concrete panels with dark red brick. The building is a careful composition of stacked volumes that are gradually set back, preserving the neighborhood's scale and romantic character.

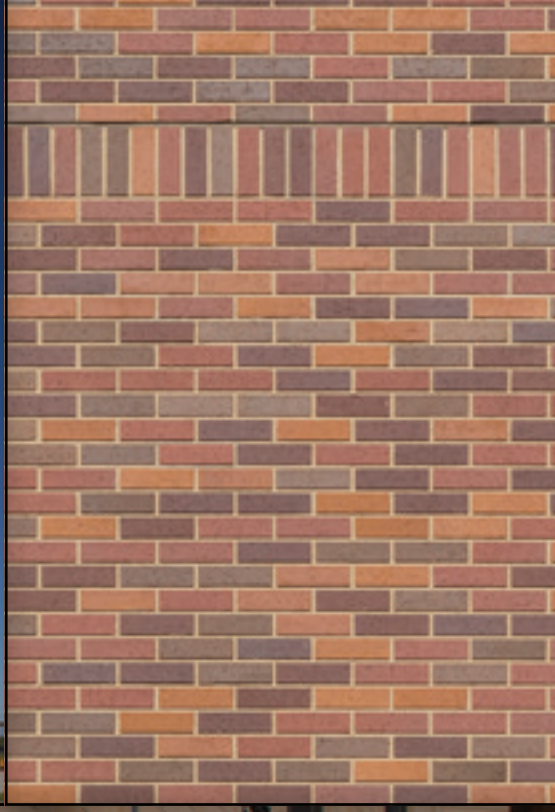
This 300,000-ft^2, 16-story luxury residential development consists of 98 condominium units. The project incorporates the façade structure of an existing four-story warehouse for the lower podium floors. Above, two corner towers flank a midblock volume and each floor steps back, forming a cascade of terraces toward the Hudson River. The superstructure accommodates 40,000 ft^2 of landscaped courtyards, green roofs, and planted terraces with up to 5 ft of soil cover. The building's total landscaped area is equivalent to the combined areas of four small neighboring parks.

Another source of high gravity loads was the façade system. In addition to prefabricated panel components (precast concrete with cast-in thin brick exterior), the building features a variety of façade systems, including masonry cavity walls, curtain walls, window walls, stone cladding, and storefront assemblies. Having both structural and building envelope teams in-house at GMS eliminated the need for time-consuming requests for information, enabling speedy communication and coordination of interacting structural and envelope systems.

150 Charles Street has over 300 columns, though few of these extend the full height of the building. Columns are transferred from level to level because each floor has a distinct architectural layout. The 41 various column sizes employ 250 transfers, whereby columns substantially change location, size/shape, or orientation between floors. In-slab transfers range in thicknesses from 18 to 22 in. Designating a single uniform thickness was not possible due to architectural layouts and required clearance for mechanical systems.

Precast Prescription: Brick for Healthy Design

Blackson delivers good medicine in full-bed and thin-veneer brick



Blackson Brick Co. delivers:

- leading commercial manufacturers
- unlimited color selections
- knowledgable, responsive support
- nationwide distribution network

Sanford Medical Center Fargo
HKS Dallas
Gage Brothers Sioux Falls
M.A. Mortenson Fargo

Endicott
30% Bordeaux, 30% Burgundy,
20% Executive Ironspot,
20% Copper Canyon Velour Modular

Build Green,
Build Better:
Blackson Brick.

PCI Premier Partners

214.855.5051
pci@blacksonbrick.com

BLACKSON BRICK CO.

University of Southern California Professor Doug Noble, director of the graduate building science program, works with students to embrace the thermal qualities of precast concrete by placing the studio project in the middle of the Joshua Tree National Park. Photos by Doug Noble.

FOUNDATION PROGRAMS

USC Precast Concrete Façade Experiments

By Marty McIntyre, PCI Foundation

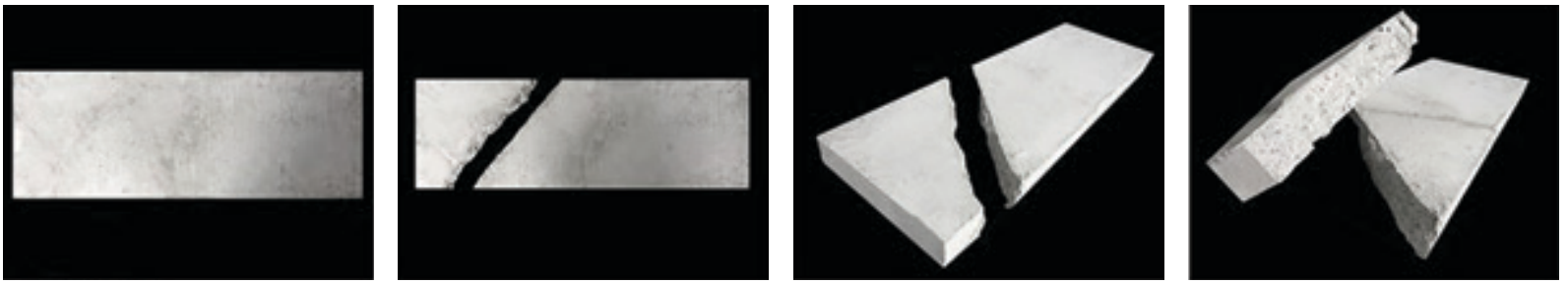
Each of the PCI Foundation programs develops its curriculum and interests independently, meaning that no two programs are ever alike. Many of the programs have some focus on the precast concrete façade, some focusing strictly on the aesthetic qualities and others looking more at the performance of the material and at ways to help students understand the properties of thermal mass.

At University of Southern California, professor Doug Noble, director of the graduate building science program, works with students to embrace the thermal qualities of precast concrete by placing the studio project in the middle of the Joshua Tree National Park. Each of the students is assigned to one of the precast concrete plants that are part of PCI West, the PCI regional affiliate that covers California and Nevada. As part of the class, they can have questions answered by that plant's personnel, as well as have tours of two Clark Pacific plants. Students take what they learn through the classes and tours and work on a project specially selected to take advantage of certain qualities of precast/prestressed concrete.

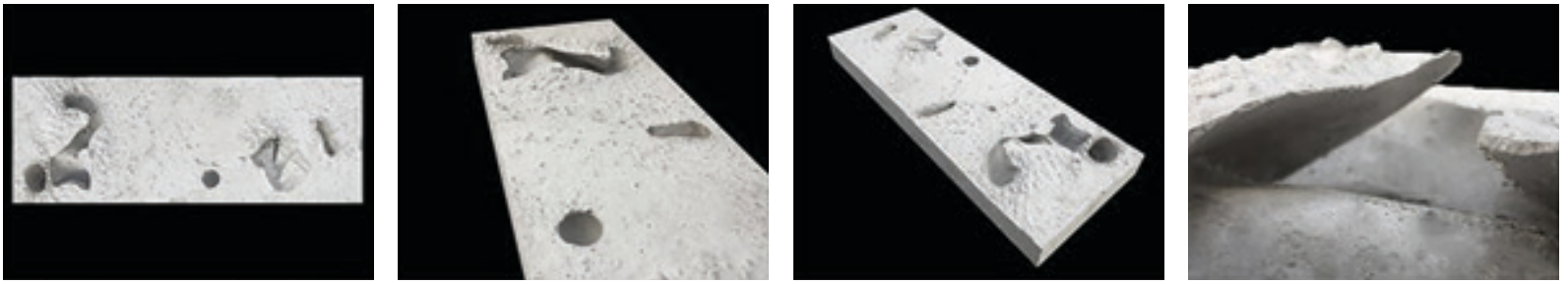
The climate of Joshua Tree is extreme: the summers are sweltering, the winters are cold, and it is dry and mostly clear year-round. Over the course of the year, the temperature typically varies from 35 to 99°F, and often exceeds 110°F. Even in the course of a day, there can be great temperature swings.

Students in the Precast Studio spend the bulk of their time working on a project for the Joshua Tree Park, such as a hypothetical visitors center, research center, or overnight shelter for high schoolers—the projects are not intended to be built, as the park has no intentions for any built structures. Among the reasons to use precast concrete include the advantages of off-site fabrication, product durability, and concrete's thermal mass.

EXPOSED AGGRAGATE



EMBEDDING PLASTICS (COMPLEX FORMS)



Another component of the program is a two- to three-week experiment and inquiry into precast concrete façades. Each year, students come up with new ways to play with concrete, with varying degrees of success. The panels are small, typically just 1 × 2 ft, but each one is the type of creative inquiry that you only see from college students.

Playing with the precast concrete façade gives the students some license to be creative and work with the precaster to better understand the practicalities of building with precast concrete. So even a "failed" experiment can have amazing value as a teaching tool.

What has struck Noble over the years is that it isn't always the projects he thinks will work that actually succeed. "One of the very successful projects was what I called 'self-tanning concrete,'" he says. "We mixed some materials into the face mix that changed the color of the concrete at different temperatures. At about 77 degrees, the color changed to a lighter color. As it got colder, the concrete got darker and more absorptive."

"We didn't expect it to work very well, but we were astonished that it actually worked very well. Even the warmth of your hand would change the color," says Noble. "The problem, of course, is that the powder is expensive. One of the problems we thought we would have is making it adhere, but it actually did that very well."

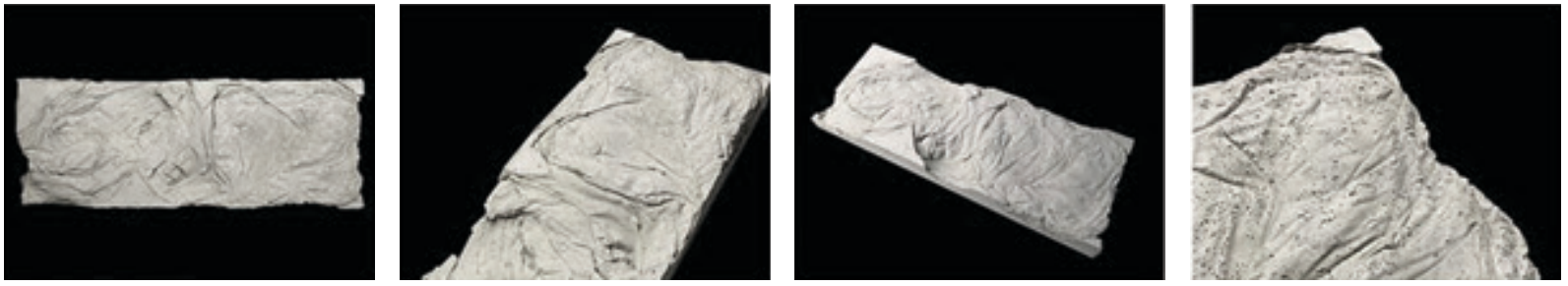
In a short two- to three-week experiment, the avenues of cost and real-world parameters can hardly be addressed. But the beginnings of the experiment lead the students to have an open and inquisitive mind throughout the semester.

"The way Doug sets the semester up, giving the students feedback from both precasters and architectural professionals, allows the students to come up with organic ideas," says Ruth Lehmann, executive director of PCI West. "The students have several chances to interact with Brad Williams of precast producer Clark Pacific, which gives them a much better practical understanding of how precast elements are fabricated and installed."

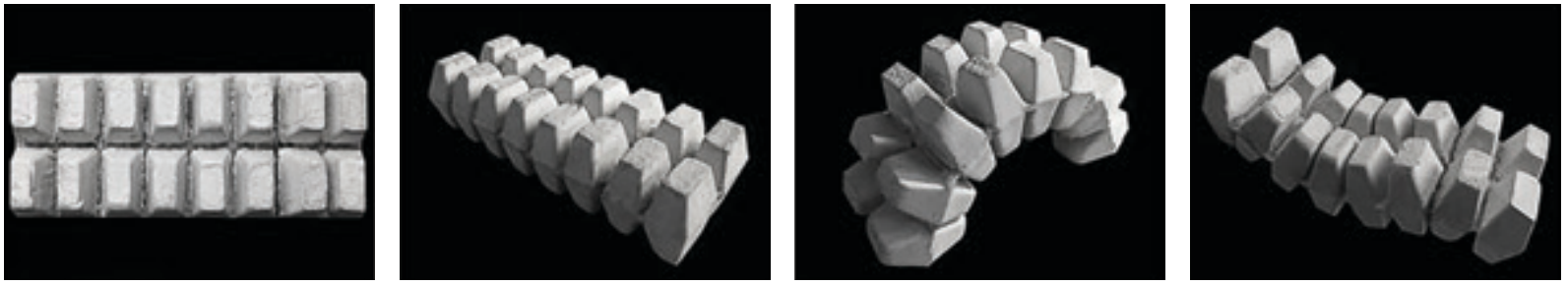
'Giving the students feedback from both precasters and architectural professionals, allows the students to come up with organic ideas.'

In many cases, the students are able to build upon this façade experiment to shape their final project. Lehmann remembers one student who was especially successful at turning a façade project into something that could delight all the senses. "The students were using a polymer material to create a precast element to explore the ability of the material to be formed in many ways, but also use repetition of the element to identify multiple façade formations. One student used his model form and connected the elements into a mesh so that the whole façade system would move. As a project at Joshua Tree National Park was going to be a museum, the student wanted visitors to experience the sound and feeling of the wind by having the precast elements move. The idea was that one would walk past the precast wall and would experience the building with all the senses. Precast wouldn't be static. It would be dynamic—sound and movement using these precast elements. That idea started with him using a miniature element and went from there."

FABRIC FORMED (LOOSE)



EMBEDDING PLASTICS (FLEXIBLE RESPONSIVE)



Photos:USC

Given the short time frame and creativity of the student body, a few projects have stuck out for Noble, who has done the studio for six years.

- One student used what they called "bruise paint." With that experiment, there was a white paint included in the face mixture containing red microbeads that only showed if the piece got hit. The experiment worked, but the students had trouble finding a more practical use for it. On the other hand, the students had a chance to play with something new.
- Another student looked at how precast concrete might be used as a growth medium for plants, sort of a "chia pet" but on a larger scale. There was some plant growth that sprouted; however, with the time constraints and limited light for growing, the experiment had limited success. (Student: Miki Fujiwara)
- Another student tied embedding rare earth magnets into the precast concrete to see if other magnets might stick to the walls. The first go-around failed because the magnets were too close to the surface and broke the concrete. And, given the short time frame, there was no time to fix the issue.
- Experimenting with the flexibility of precast concrete has long been on the list of students working with concrete. One student came up with a flexible concrete that was cast on a porous rubberized mat. He was then able to cast the sample and let it wiggle—no breaking. The big question: you have wiggly concrete; what will you do with it? (Student: Jonah Schatz)
- The acoustic properties of precast concrete that used ground recycled rubber tire materials were a surprise. The team went in with high hopes but found that there was not a significant difference in noise reduction. (Student: Matthew Maneval)
- One of the more successful experiments was a translucent precast concrete that was finished with tiny LED wires and fiber-optic glass wire. The wires ran from one side to the other, and were woven so the light might go in one spot on the outside of the panel, but could come out in at a completely different spot on the other side. Noble felt that this could have great potential for working with a sunlight for stairs or moving light into a basement. (Student: Yuan Yao)

'By the end of the studio, the students really cared about the fabrication and installation of their precast elements and I could see that was addressed in their final design.'

For Lehmann, who has both architectural and engineering training, there are great advantage for the students who experience the hands-on work of this precast studio.

"By the end of the studio, the students really cared about the fabrication and installation of their precast elements and I could see that was addressed in their final design," Lehmann says. The precast studio helps them make practical adjustment in their final project, without making design compromises, because they have a much better understanding of how the precast really comes together."

BRINGING EDUCATION RIGHT TO YOU
PCI conducts lunch-and-learn presentations and seminars on an ongoing basis.

PCI Continuing Education

PCI is a registered continuing education provider with the American Institute of Architects (AIA), and the National Council of Examiners of Engineers and Surveyors (NCEES). PCI also has registered programs with the International Code Council (ICC). PCI's educational offerings include a variety of programs to fit your schedule and preferred learning environment, such as webinars, seminars, lunch-and-learns, and online education. To learn more, visit **pci.org**.

Distance Learning Opportunities

> WEBINARS

PCI webinars are presented live each month by industry experts on a variety of topics from design and construction to sustainability and more. All webinars are FREE, one-hour long, and presented twice during the webinar week, at noon Pacific (3:00 p.m. Eastern) and noon Eastern. Webinars provide an inexpensive way to stay up to date on new materials, products, concepts, and more while earning continuing education credits. Visit **pci.org** for the full webinar schedule and registration information.

> PCI ELEARNING CENTER

The PCI eLearning Center is the first education management system dedicated to the precast concrete structures industry. This free 24-hour online resource provides an opportunity for architects and engineers to earn continuing education credits on demand. Each course includes a webinar presentation recording, reference materials, and a quiz.

In-Person Learning Opportunities

> SEMINARS AND WORKSHOPS

PCI and its regional affiliates offer seminars and workshops all over the United States on a variety of topics. Visit **pci.org** for up-to-date seminar listings, additional information, and registration.

UPCOMING SEMINARS AND WORKSHOPS:

Quality Control Schools

Level I-II
NASHVILLE, TN
Monday, December 3 – Wednesday, December 5, 2018

Level III
NASHVILLE, TN
Wednesday, December 5 – Saturday, December 8, 2018

CFA
NASHVILLE, TN
Monday, December 3 – Wednesday, December 5, 2018

CCA
NASHVILLE, TN
Thursday, December 6, 2018

Visit www.pci.org/schools or www.pci.org/events for more information and to register.

> LUNCH-AND-LEARNS

PCI's lunch-and-learn/box-lunch programs are a convenient way for architects, engineers, and design professionals to receive continuing education credit without leaving the office. Industry experts visit your location; provide lunch; and present on topics such as sustainability, institutional construction, parking structures, aesthetics, blast resistance, the basics of precast, and many more. Visit **pci.org** for a list of lunch-and-learn offerings and to submit a program request.

Photo: LS3P.

PRECAST/PRESTRESSED CONCRETE

Design Resources

PCI develops, maintains, and disseminates the Body of Knowledge for designing, fabricating, and constructing precast concrete structures and systems. It is from this Body of Knowledge that building codes, design guides, education, and certification programs are derived. Please visit www.pci.org for all of these design resources and more.

Architectural Precast Concrete Color and Texture Selection Guide, 2nd Edition (CTG-10)

The "Architectural Precast Concrete—Color and Texture Selection Guide" has been reprinted with 12 new color and texture pages, plus identification pages with mixture designs. This includes nine new color pages with two new colors per page, two pages of new formliners, and one page of new clay brick-faced precast. The numbers in the guide have not been changed, so that there is no confusion between the old and the new versions. This is a visual guide to assist architects in the initial selection of color and texture for architectural precast concrete. Illustrating more than 500 colors and textures for enhancing the aesthetic quality of precast concrete panels, the guide is an extension of the information included in the architect-oriented Architectural Precast Concrete manual (MNL-122). Cements, pigments, coarse and fine aggregates, and texture or surface finish with various depths of exposure were considered in creating the 287 6.75- by 11-in. color plates, the majority of which display two finishes on the same sample. The materials used to produce the samples are identified in the back of the guide for handy reference. The three-ring binder has removable inserts.

Architectural Precast Concrete, 3rd Edition (MNL-122)

This fully revised edition includes new sections on sustainability, condensation control, and blast resistance. You'll get extensive updates in the areas of color, texture, finishes, weather, tolerances, connections, and windows, along with detailed specifications to meet today's construction needs. Includes full-color photographs and a bonus DVD.

Precast Prestressed Concrete Parking Structures: Recommended Practice for Design and Construction, 3rd Edition (MNL-129-15; e-pub)

Decades of research have proven that precast, prestressed concrete is a cost effective, durable solution for parking structures. Over 140 pages present the latest concepts in design and construction, including 16 pages of full-color photography and many details and design examples. This is the most comprehensive publication of its kind.

Designer's Notebooks – Free

The PCI Designer's Notebooks provide detailed, in-depth information on precast concrete relevant to specific design topics such as acoustics, mold, and sustainability.

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

When it comes to quality, why take chances?

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

Whatever your needs, working with a plant that is PCI-certified in the product groups it produces will benefit you and your project.

- You'll find easier identification of plants prepared to fulfill special needs.
- You'll deal with established producers—many certified for more than 30 years.
- Using quality products, construction crews can get the job done right the first time, keeping labor costs down.
- Quality products help construction proceed smoothly, expediting project completion.

Guide Specification

To be sure that you are getting the full benefit of the PCI Plant Certification Program, use the following guide specification for your next project:

"***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 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 precast concrete producer 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

These products are the same as those in the categories within Group C, but they are produced with an architectural finish. They will have a form, machine, or special finish. Certification for Group CA production supersedes Group C in the same category. For instance, a plant certified to produce products in Category C2A is also certified to produce products in C1, C1A, and C2 (but not certified to produce any products in C3 or C4A).

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

These products are reinforced with glass fibers that are randomly dispersed throughout the product and are made by spraying a cement/sand slurry onto molds. This produces thin-walled, lightweight cladding panels.

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

> ALABAMA

Forterra Building Products B4, C4
Pelham, (205) 663-4681

Gate Precast Company A1, C4, C4A
Monroeville, (251) 575-2803

> ARIZONA

Coreslab Structures (ARIZ) Inc. A1, B4, C4, C4A
Phoenix, (602) 237-3875

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

Clark Pacific C4, C4A
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
Shafter, (661) 630-7162

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

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

Midstate Precast, LP 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
Denver, (303) 480-1111

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

Rocla Concrete Tie Inc. C2
Pueblo, (719) 569-4003

Stresscon Corporation A1, B4, B4A, C4, C4A
Colorado Springs, (719) 390-5041

> CONNECTICUT

Blakeslee Prestress Inc. A1, B4, C4, C4A
Branford, (203) 481-5306

Coreslab Structures (CONN) Inc. A1, B1, C1
Thomaston, (860) 283-8281

Oldcastle Precast B2, C2, C2A
Avon, (860) 673-3291

United Concrete Products Inc. B3, C2
Yalesville, (203) 269-3119

> DELAWARE

Concrete Building Systems of Delaware Inc. B3, C3
Delmar, (302) 846-3645

Rocla Concrete Tie Inc. C3
Bear, (302) 836-5304

> FLORIDA

Building Blocks GFRC, LLC G
Kissimmee, (214) 289-9737

Cement Industries Inc. 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
Okahumpka, (512) 250-0755

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, B2, C3
Kissimmee, (407) 847-5285

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

Leesburg Concrete Co. Inc. C1A
Leesburg, (352) 787-4177

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

Precast Specialties LLC C4
Fort Pierce, (772) 266-5701

Skanska USA Civil SE B4
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, C3, C3A
Hiram, (770) 943-8688

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 Building Products 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 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

Spancrete C2
Crystal Lake, (815) 215-8230

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 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

Illini Precast-Speed, LLC C3
Charlestown (708) 562-7700

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, C3, C3A
Dyersville, (563) 744-3909

Forterra Building Products B4
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 A1, 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

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

> KENTUCKY

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

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

Forterra Building Products B1, C1
Louisville, (800) 737-0707

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

Prestress Services Industries LLC A1, B4, C4, C4A
Lexington, (859) 299-0461

> 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) 515-7368

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

Kerkstra. Precast Inc. C3
Trenton, (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

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 Building Products 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 A1, 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, C3A
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, 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, C3
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. B3, C3
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

> NEW YORK

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

Lakelands Concrete Products Inc. A1, B3, B3A, C1, C1A
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

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 Corporation Northwest 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

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

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

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 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

Smith-Columbia B2, C1
Hopkins, (803) 708-2222

Tekna Corporation B4, C3
North Charleston, (843) 853-9118

Tindall Corporation, South Carolina Division A1, C4, C4A
Spartanburg, (864) 576-3230

> SOUTH DAKOTA

Forterra Building Products B4
Rapid City, (605) 343-1450

Gage Brothers Concrete Products Inc. 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

American Concrete Products B3, C3
Dallas, (214) 631-7006

Coreslab Structures (TEXAS) Inc. A1, C4, C4A
Cedar Park, (512) 250-0755

CXT, Incorporated - Buildings B1, B1A, C1, C1A
Hillsboro, (254) 580-9100

East Texas Precast A1, C4, C4A
Hempstead, (281) 463-0654

Enterprise Precast Concrete of Texas LLC A1, C3A
Corsicana, (903) 875-1077

Gate Precast Company A1, C3A
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
El Paso, (915) 799-0977

Heldenfels Enterprises Inc. B4, C4
San Marcos, (512) 396-2376

Legacy Precast LLC A1, 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

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 Prestress Products Inc. B2
Houston, (713) 455-6098

Valley Prestress Products Inc. B4
Eagle Lake, (979) 234-7899

> UTAH

Forterra Building Products A1, B4, C4, C4A, G
Salt Lake City, (801) 966-1060

Harper Precast B1, C1A
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, C3, C3A
Middlebury, (802) 775-2301

William E. Dailey Precast LLC A1, B4, B4A, C3, C3A
Shaftsbury, (802) 442-4418

> VIRGINIA

Atlantic Metrocast Inc. B4, C4
Portsmouth, (757) 397-2317

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

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, C4A
dba Illini Precast - 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, C3A
Germantown, (262) 253-6600

> 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

NEW BRUNSWICK

Strescon Limited A1, B4, C4, C4A
Saint John, (506) 633-8877

NOVA SCOTIA

Strescon Limited A1, B4, C4, C4A
Bedford, (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

Saramac 9229-0188 Quebec, Inc. A1
Terrebonne, PQ, (450) 966-1001

> 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

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

Tpac, An EnCon Company A, S2
Phoenix, (602) 262-1360

> CALIFORNIA

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

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

> COLORADO

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

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

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
Longwood, (407) 862-7100

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

Florida Builders Group Inc. S2
Miami Gardens, (305) 627-8900

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) 809-7583

Derr and Isbell Construction LLC A, S2
Roswell, (770) 910-9996

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

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

RGR Erectors, Inc. S2
Cleveland, (706) 809-2718

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

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

> IDAHO

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

> ILLINOIS

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

Continental Erectors, LLC S2
La Salle, (815) 666-4003

Creative Erectors, LLC A, S2
Rockford, (815) 229-8303

Mid-States Concrete Industries S2
South Beloit, (800) 236-1072

> 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, (800) 236-1072

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

Tricon Construction Group A, S2
Dubuque, (563) 588-9516

US Erectors Inc. A, S2
Pleasant Hill, (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
Pikesville, (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

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

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

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

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

Ben Hur Construction Company S2
Earth City (314) 298-8007

JE Dunn Construction A, S2
Kansas City, (816) 474-8600

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
Gretna, (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

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

TCN & Co., LLC A, S1
Marlton (856) 685-0904

> NEW YORK

Gotham Structures NY, LLC S1
New York, (212) 260-0208

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

Oldcastle Precast A, S2
Selkirk, (518) 767-2116

Tutor Perini Corporation Civil S1
New Rochelle, (914) 739-1908

> NORTH DAKOTA

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

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

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

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

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 Inc. 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

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

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

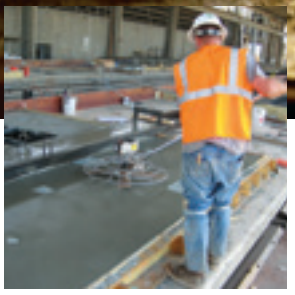
Spancrete A, S2
Valders, (414) 290-9000

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

SPECIFY PCI CERTIFICATION

THERE IS NO EQUIVALENT

Photo courtesy of USC/Gus Ruelas.



PCI
Precast/Prestressed Concrete Institute

The Precast/Prestressed Concrete Institute's (PCI) certification is the industry's most proven, comprehensive, trusted, and specified certification program. The PCI Plant Certification program is now accredited by the International Accreditation Service (IAS) which provides objective evidence that an organization operates at the highest level of ethical, legal, and technical standards. This accreditation demonstrates compliance to ISO/IEC 17021-1.

PCI certification offers a complete regimen covering personnel, plant, and field operations. This assures owners, specifiers, and designers that precast concrete products are manufactured and installed by companies who subscribe to nationally accepted standards and are audited to ensure compliance.

IAS ACCREDITED
Management Systems Certification Body

To learn more about PCI Certification, please visit

www.pci.org/certification

A gift in your will takes a simple designation and costs you nothing during your lifetime.

Please contact the PCI Foundation at (708) 386-3715 or email info@pci-foundation.org to inform the PCI Foundation of your gift and become a member of the Legacy Society.

PCI Foundation

"High Concrete saw our design as a wonderful opportunity to really show off their skills, talents and products. It has been a sincere joy to work with a group of precasters who are as engaged as they have been, willing to roll up their sleeves to work on solutions rather than seeing obstacles, and I am sure that they are proud of their efforts as much as we are."

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

Photograpy © Rasmus Hjortshøj—COAST

THE NEW SHAPE OF PRECAST

1200 Intrepid at the Philadelphia Navy Yard is the newly completed precast concrete work of art designed by world-renowned starchitect Bjarke Ingels Group (BIG). The front entrance façade gently curves inward while stretching outward creating a startling and gravity-defying visual that mimics the curved bows of the nearby battleships. The unique engineering requirements of the project meant that the gravity loads flowed directly to the ground and were not tied to the steel frame. Almost every piece of the front entrance façade is unique. This very complicated project presented a challenge that required an innovative solution using technical, engineering and creative expertise, and would not have been possible without the use of BIM and 3D modeling. For more information on this project and others visit us at www.highconcrete.com/news.

HIGH CONCRETE GROUP LLC

An Affiliate of High Industries Inc.

HIGH CONCRETE GROUP LLC ■ CONCRETE INNOVATIONS AND ANSWERS© ■ CALL US AT 800-PRECAST ■ WWW.HIGHCONCRETE.COM