MASS TRANSIT ISSUE

WINTER 2016

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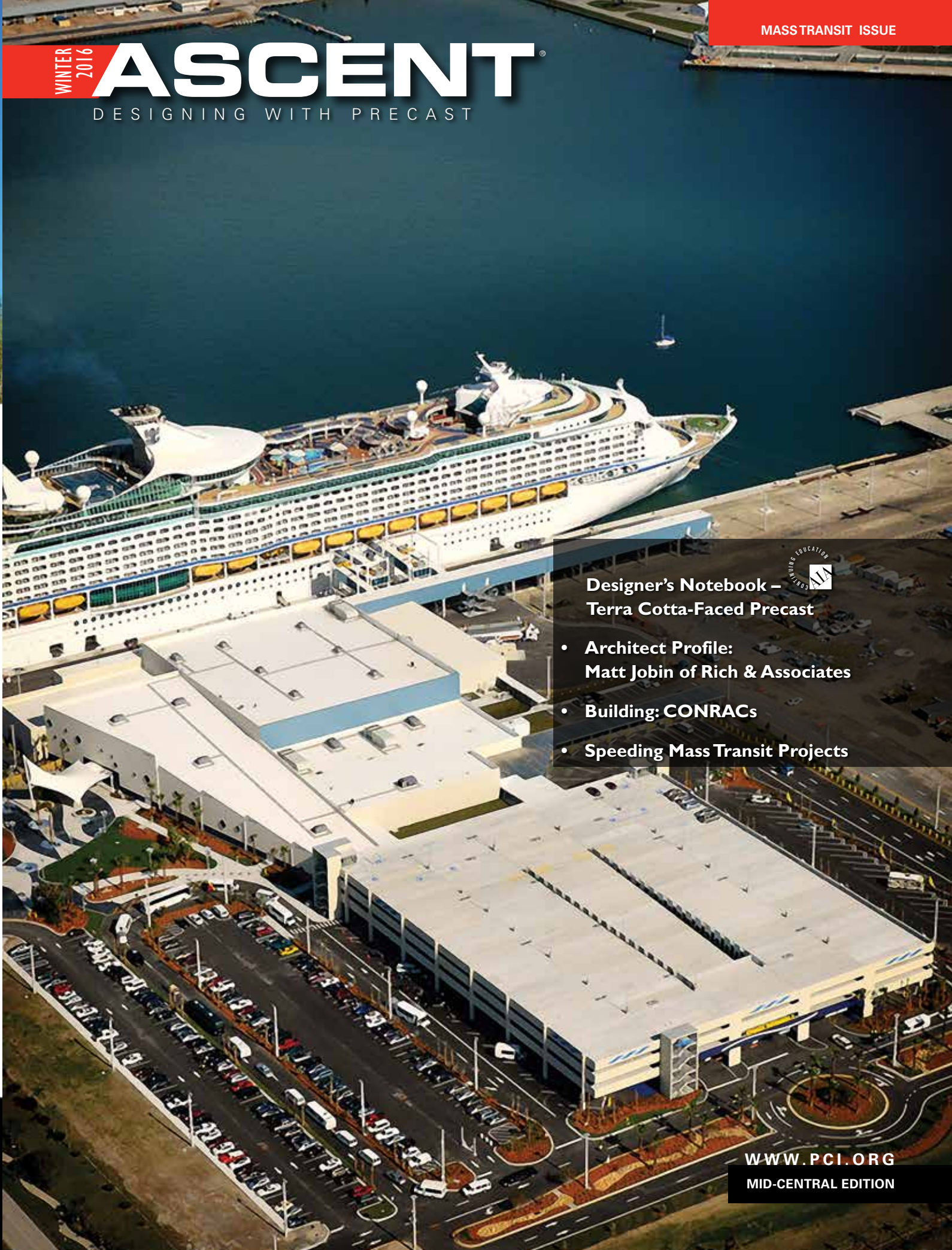

Designer's Notebook – Terra Cotta-Faced Precast

- Architect Profile: Matt Jobin of Rich & Associates
- Building: CONRACs
- Speeding Mass Transit Projects

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Solomon Cordwell Buenz
Graduate of Illinois Institute of Technology

Photo: Sylvia Schnackenburg

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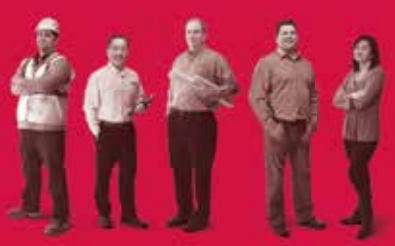

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Precast concrete aids mass transit projects and their specific logistical challenges by offering benefits in construction speed, durability, design and aesthetic versatility.

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More airports are consolidating rental-car facilities to add efficiencies, and high-performance precast concrete helps meet the additional functional challenges they create.


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New Year, New Opportunities

Brian Miller, P.E., LEED AP
Executive Editor
bmiller@pci.org

Happy New Year! It seems like these "new years" keep coming faster the older I get. What's exciting about each new year is it presents a chance to start over or try something new. Many people make New Year's resolutions, such as to exercise more, save money, or visit relatives. Whatever your New Year's resolution is, it's a way of saying, "I'm going to improve my life this year and do something different."

We like to do things different to improve. This applies to our work as well. Maybe we will re-organize our office or prioritize our projects. Or maybe we will try to design and build better structures. To be sure, it's expected that we will design and build what is asked of us, but sometimes we need to push others we work with, such as an owner, contractor, or engineer, to elevate goals.

Often architects and some engineers (since I am one) can be visionaries that drive a project to a new level. This is part of the challenge of high-performance design—to build essentially the best structure we can for the given location and circumstances. It should be our goal to consider how the materials and systems we are using relate to each other and find ways to truly optimize the value they provide. We should push a little beyond our "comfort zone."

You have heard me say it before, but precast concrete offers a high-performance material that helps accomplish this. In this issue of *Ascent*, we highlight mass-transit projects that use high-performance precast concrete to not only accomplish their goals but often exceed them. From CONRACs to airports to cruise terminals, high-performance precast concrete provides incredible opportunities to save time and money while building resilient high-performance structures.

So in 2016, are you going to do the same things you have always done? Or are you going to lead others to a better built structure using the most high-performance materials and techniques available?

As for me, I am trying something new as well. As of November 1st, 2015, I took a new position with W.R. Grace as their global marketing director for precast concrete. It's a new and exciting challenge that pushes me out of my comfort zone.

I have truly enjoyed my time at PCI, and as executive editor of *Ascent* magazine. This has been the most rewarding job of my career, and it has been my privilege and honor to serve our industry in this capacity. I thank all of you for being loyal readers and hope that you have found, and will continue to find, value in this publication. I look forward to still seeing you in the industry as we continue to advance and improve the built environment.

ASCENT

On the cover: Port Canaveral, Fla., used precast for several of its structures. Photo: Aero Photo.

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Seawall Uses Precast Concrete Z Superstructure

SEATTLE, WASHINGTON

Oldcastle Precast in Auburn, Wash., was selected by the joint-venture team of Mortenson-Manson, GC/CM, to supply precast concrete Z-shaped superstructure segments and 20-foot-tall seawall face panels for the city's new $371-million Elliott Bay Seawall Reconstruction Project at the waterfront in downtown Seattle.

The project, operated by the city's Department of Transportation, will replace the 100-year-old seawall built between 1916 and 1936. A retaining wall between the Bay and the waterfront, it suffers from significant timber decay and deterioration from continued exposure to storm wave and tides. The new structure consists of a cast-in-place concrete support slab with custom precast concrete face panels, Z-superstructure segments, and precast concrete sidewalk panels.

The precaster worked closely with the GC/CM and structural engineer Magnusson Klemencic Associates to customize the design and engineering of the fascia panels and superstructure segments. The Z-superstructure components act as the concrete backbone for the seawall's cantilevered sidewalk.

The 400 superstructure segments measure 8 feet wide and 9 feet tall and extend 13 feet, while the 400 fascial panels are 8 feet wide by 20 feet tall with a thickness of 15 inches. A variety of architectural finishes were applied to the components.

The use of the precast concrete components improved constructability, accelerated the construction schedule, and overcame the unique demands of the project. Funded mostly by a 30-year, $290-million bond measure, the project is scheduled for completion in mid-2016.

Precast Concrete Featured in Public Square Remake

CLEVELAND, OHIO

The renovation of Cleveland's Public Square, a National Historic Site, will feature precast concrete as a key element of its new landscaping design. The 10-acre Square in the downtown area serves as an integral part of the city's center.

Prominent landscape architectural firm James Corner Field Operations designed the renovation to include an "event lawn" on the north side with a splash zone and café on the south side, along with a walkway built from precast concrete components. Wausau Tile in Wausau, Wis., is fabricating the precast concrete components.

Precast concrete was chosen for the project due to its quality, timing, and economic benefits, according to the architectural firm. In addition, precast concrete's versatile aesthetic properties allowed the architects to create the artistic appearance they desired.

In all, 1,195 precast concrete pieces will be cast, encompassing 2.3 million pounds. An estimated 70 truckloads of products will be transported, starting last June and ending in January 2016. Completing the project on time was critical, as city officials wanted it finished prior to hosting the Republican National Convention this summer.

Oldcastle Shows Precast Is Elementary

SPOKANE, WASHINGTON

The Oldcastle Precast team of Plant Manager Peter Gay, Designer Scott Hersey, Project Manager Tina Fischer, Estimator Ken Turnbull, and Sales Manager Chuck Prussack spoke to children at the Regal Elementary School Career Fair in Spokane, Wash. The goal was to inspire and educate kindergarten through sixth-grade students about careers in engineering, drafting, production, construction, and precast concrete product development.

The precaster adopted the school as a community project, delivering weekly food bags to help hungry schoolchildren on the weekend. In return, the principal invited the firm to attend its Career Fair. Employees created wooden models of items that they build and showed the students how the pieces fit together like puzzles.

Four models were built: a simple-span bridge, a multiple-span bridge, a posttensioned bridge, and a three-story building model. "The model concept helped the children visualize what Oldcastle Precast makes and how the precast concrete components are put together at a jobsite," says Prussack. The engineering department created drawings showing how the pieces fit together and produced a computer presentation explaining how a posttensioned, segmented bridge works.

"During our presentation, as the children were building the models, we explained what our jobs entailed and what part each of us played in the precast process," says Prussack. After asking about career aspirations, the team wove in some of their own career opportunities to meet those goals. Safety was stressed by having the children wear hard hats and safety vests as they built their models.

"The children loved working on the building and bridge models. There were broad smiles all around," Gay says. "I am looking forward to next year."

Oldcastle Precast made wooden models of the types of structures that it builds to use with students at the Regal Elementary School Career Fair in Spokane, Wash. Photo: Oldcastle Precast.

Gate Names Plant Managers in Kentucky, Texas

KENTUCKY AND TEXAS

Steve Schweitzer

Jim Stini

Gate Precast Co. has named Steve Schweitzer vice president and operations manager of its Winchester, Ky., plant and Jim Stini operations manager at its Pearland, Texas, hollow-core concrete plant. Schweitzer's experience in the precast concrete industry spans 36 years, including most recently in the commercial sales and estimating departments at Prestress Services Industries. Schweitzer will be responsible for all operational and administrative issues at the Kentucky facility.

Stini has worked for Gate since 1996, most recently as estimating and sales manager. Stini will handle operational duties in the Pearland office. Over the past 25 years, he has estimated and managed hundreds of projects, covering all market sectors.

Lorenz rejoins PCI staff

CHICAGO, ILLINOIS

Emily Lorenz

Emily Lorenz has rejoined PCI as a part-time employee. She will serve as editor-in-chief of *PCI Journal*; associate editor of *Aspire*, the concrete bridge magazine; and manager of PCI's sustainability activities. Lorenz previously served in these capacities at PCI from 2005 to 2010. In the interim, Lorenz was an engineer at CTL Group in Skokie, Ill., and managed a successful sustainability consulting firm.

Thermomass names Nesset president

BOONE, IOWA

Thermomass has appointed Brad Nesset president. Nesset has been with Thermomass since 2005. He takes over from Tom Stecker, president since 2004, who stepped down but will assist Thermomass on development opportunities. As president, Nesset will report to Eoin Lehane, president of Meadow Burke.

Submit your headline news for consideration in a future issue of *Ascent* to Stephanie Corrigan at scorrigan@pci.org.

Creating Connections

Through his 30+ years at Rich & Associates, Matt Jobin has emphasized collaboration to handle challenges as the parking-structure business evolves

— Craig A. Shutt

Matt Jobin, AIA

The Z, a 10-story, 1,282-car parking structure creates a "parking experience" for users of a nearby mixed-use building designed to revitalize the district. The precast concrete façade features trapezoid-shaped spandrels that create large, dimensional windows along its length and horizontal openings that band the structure. All photos: Rich & Associates.

Over the 33 years Matt Jobin has designed parking structures at Rich & Associates, he's seen an evolution in design that addresses the facilities' purpose, function, and aesthetics. Adapting to owners' needs and collaborating with teammates has kept him challenged and looking forward to the next project.

"I really like the smaller size of our firm and being able to directly work with clients and develop a relationship with other architects and contractors as we create the projects," he says. "It produces a close atmosphere and great collaborations."

Jobin began working at Southfield, Mich.-based Rich & Associates, which specializes in parking structures, in 1983 after graduating from nearby Lawrence Technological University. Even before he had acquired a job, he'd made a connection. He applied for an internship and discovered that the interviewer went to his high school. "We had an immediate rapport, and I decided to start out here. I've been here ever since."

He began with basic duties, such as doing study maps, feasibility studies, and redlining changes on construction plans. Little by little, he worked up to managing projects and now serves as an associate and senior project manager.

Parking Evolutions

Through the years, he's seen parking-structure concepts evolve. "Early on, owners wanted us to design vanilla boxes and pack in as many parking spaces as possible. But the trend over the last 15 years or so has put more focus on architectural design and aesthetic needs, especially for projects in downtown areas or connected to a campus or other buildings. It's been a great change."

Owners have seen how the appearance of the project can impact users' impressions of the facility, which typically is the first and last interaction they have on their trip. "We've been able to incorporate brick and try other creative exterior materials to integrate these otherwise utilitarian buildings into the urban fabric. Inside, we are also now including similar upgrades to architectural finishes and adding decorative touches. But owners still demand a well-functioning parking structure for both vehicular and pedestrian traffic flow."

A prime example of the aesthetic treatments being provided is The Z, a 10-story property in Detroit, Mich., tasked with revitalizing the city's historic Broadway district. The 1,282-car, parking structure creates a "parking experience" for users. The precast concrete façade became a key element of the design, featuring trapezoid-shaped spandrels that create large, dimensional windows and horizontal openings that band the structure. It won the 2014 award for Best Parking Structure in PCI's Design Awards competition.

The project also features several amenities that add to the user experience, Jobin notes. "A lot of custom amenities have been provided to really boost the experience." These include the installation of artwork on the interior and along the public-alley façades and vehicle window-washing stations.

Boosting Amenities

Owners are looking to boost amenities, especially first-floor retail spaces. "Municipalities in particular want more activity around their parking facilities, and they're creating retail and other amenities that allow pedestrians to interact with the space. They're adding bike racks, public washrooms, recycling containers, and other amenities. They consider the buildings to be public utilities and want to add services."

The Old Town Parking Structure in Traverse City, Mich., features a variety of sustainable-design concepts generated from public design charrettes. These include a green roof over a portion of the roof-level parking and atop the stair towers, charging stations for electric vehicles, solar panels to generate electricity, and a snow-melt system.

The notion of being a good public steward has extended to environmental concerns, he notes. Projects are more often following LEED criteria, even if they aren't registered, and adding charging stations for electrical cars and using recycled materials. Environmental concerns played a key role in the Old Town Parking Structure created for the City of Traverse City, Mich.

Rich & Associates led the design team of local consultants for the 510-car building, which provided much-needed general parking in the downtown area as well as monthly spaces for a local insurance company. Several public design charrettes generated suggestions for amenities to aid the environment. These included a green roof on a portion of the roof-level parking and atop the stair towers, solar panels to generate electrical power, built-in snow-melt systems, bike racks, and public washrooms. The project received a Silver LEED rating.

Adding Durability

Alongside more interest in environmental concerns is more awareness of the need to boost durability and resistance to corrosion, especially in northern climates where a lot of deicing salts are used. "Developers are retaining ownership of garages longer now," he explains. "Before, they kept them three to five years and weren't interested in investing to ensure the building retained its durability for the long haul. Now they're keenly aware of the need to maintain them for as long as possible."

Precast concrete inherently provides a high-quality, durable system due to its low water-to-cementitous ratio, high strength, low porosity, and being manufactured with a high degree of quality control. However, we see the addition of corrosion inhibitors, epoxy rebar, concrete sealers, and other durability enhancers to even further increase the service life, and reduce life-cycle costs. Rich & Associates also advocates a maintenance program to owners. "They often don't realize what they need to do," he says. "We want to give them the tools and educate them on the basics so they make the best decisions."

Too many owners ask about using de-icing agents and other upgraded features but don't bother washing down the floors at winter's end. "It baffles me, because that's the easiest, cheapest, and most effective step in maintaining a garage's longevity," he says. "Removing the corrosive de-icing salts needs to be the first line of defense in the battle to get a parking structure to last."

'Removing the corrosive de-icing salts needs to be the first line of defense in the battle to get a parking structure to last.'

To raise awareness, the company provides a custom maintenance manual for each project. They include steps to take each year for each area. It also provides a list of products used, warranty lengths, and suppliers' contact information. "It's a real tool to allow them to reach out and get the support they need."

The manual evolved from the firm's own experience in owning and operating parking structures. MEDPark Inc., the company's development and management arm, has provided financing, development, and parking management for more

The Campus Martius One parking structure in Detroit, Mich., was value-engineered from cast-in-place to precast concrete to provide a more efficient design. The nine-story, 2,100-car structure features a façade clad with Mankato limestone to match a nearby office building and 16,000 square feet of ground-floor retail space.

Rich & Associates provided parking consulting and architectural design services for the Erato Street Cruise Terminal Garage at the Port of New Orleans. The precast concrete structure combines 107,000 square feet of terminal space on the first two levels and 1,020 parking spaces on the four levels above. An exterior, single two-way spiral ramp provides easy access while an internal ramp connects the parking floors.

than 30 years. "We learned from our experience what works to prevent structure deterioration and the timing for inspections." he explains, "Materials such as caulking and expansion joints are critical components for maintaining structure longevity."

Precast concrete projects account for about 70% of the firm's designs. "Precast has been a very cost-effective, versatile, and durable structural system for parking structures," he says. "One of the advantages of a complete precast structural system is that the exterior structural members can serve as the architectural façade and can be fabricated with an infinite number of architectural finishes."

Design-Build Grows

Rich & Associates has become more involved in all aspects of projects as design-build delivery methods have grown. "We find the method works very effectively for many clients. Bringing on the precaster and subcontractors early to work through issues and get an early precast bid package put together makes a big difference in the overall project schedule."

They've also seen the tables reversed, with developers contacting precasters they've worked with previously to lead the project. Several recent projects have begun that way, he says. "Owners assume the precaster can do all the design work, and that's not generally the case. The proper functional design is still a critical component. We have worked directly for the precaster as the designer of record in a role that works well in these situations."

Rich & Associates keeps its designs simple, he notes, incorporating accessibility and other features that owners don't always consider. "We need to be sure there's adequate queuing space and ramping capacity to handle the types of users." In one recent case, Jobin talked the owner into adding a second ramp because capacity was so high and the structure often served event-driven groups that would leave simultaneously.

> 'We have to sell owners on the value of adding efficiency and providing functional aspects.'

"We have to sell owners on the value of adding efficiency and providing functional aspects that allow users to enter and exit quickly rather than put in more spaces," he says. "They don't always consider those aspects."

Their role as consultant gives them opportunities to value-engineer projects. That aided the construction of the Campus Martius One project in Detroit, a nine-story, 2,100-space structure. It was redesigned from cast-in-place concrete to precast concrete to make it more efficient and cost effective. That change also allowed for the creation of a Mankato limestone-like finish that matched the adjacent office building. It was constructed over an operating, elevated Detroit People Mover station and track. The structure has two below-grade levels that connect to parking beneath the office building.

Intermodal Projects Growing

Intermodal projects have been a continuing area of focus for the firm as well. Recent projects have included the Erato Street Cruise Terminal Garage at the Port of New Orleans, La., the West Virginia University Intermodal Garage in Morgantown, W.Va., the Massport Logan Express Parking Garage in Framingham, Mass., and the Cherry Street Transit Parking Structure in Terre Haute, Ind. (for more on this final project, see the article in this issue.)

"Intermodal parking structures have become very popular in the last 15 years in an effort to improve mobility and decrease emissions," Jobin says. "Combining auto parking with different modes of transportation is the basis of these facilities. Additional amenities are typical, including ticketing, waiting rooms, commercial spaces, and bicycle storage."

The variety of projects brings Jobin into contact with a range of clients, designers, and contractors. Those one-to-one skills have also been put to use in the local community, such as in a mentoring program with his alma mater, where he occasionally works with senior engineering students on their school projects, offering advice and reviewing progress.

It's one more way that Jobin uses his interactions to produce better projects and make new connections. "Parking structures are a niche market, but I enjoy the challenge of working with other architects and clients and going through the process, from design to construction. Meeting with clients and the design team is very enjoyable, and I want to share that with others."

There may even come a day when he's interviewing candidates for internships and runs across someone from his old high school who would be the perfect fit for the company.

"High Concrete Group's involvement during design was key to the success of the precast work on this project."—Eric Marin, Ross Barney Architects

HOUSE FOR ENERGY

The Ohio State University's new ten-story chiller plant uses precast concrete panels with a series of openings that allow a view inside, while keeping the interior temperature consistent and the energy use regulated. The plant building is more than just a concrete box with openings however. Conceived of as a "House for Energy," the envelope showcases the energy-efficient chiller equipment inside and records the sun's energy on the exterior. The building features high-polish finished precast concrete panels and "fins" of glass, which cast colored light rays across the concrete surface. The result is a dynamic facade that changes with the time of day, season and the location of the observer.

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Speeding Mass Transit Projects

Precast concrete aids mass transit projects and their specific logistical challenges by offering benefits in construction speed, durability, design and aesthetic versatility

— Craig A. Shutt

Projects that support transportation services—including rail lines, buses, and airline terminals—offer distinct logistical challenges that add to traditional design and construction requirements. Foremost, they usually must be constructed around active services that place restrictions on when and where construction can take place. The benefits provided by precast concrete often are called upon to bring these projects in on budget and on schedule.

In many cases, no matter what type of construction has been used on the service buildings themselves, precast concrete is specified for accompanying parking structures that will provide support services for the main transportation hubs. Some of the key benefits include providing complementary aesthetic appearances to existing or new buildings, plant-based fabrication that minimizes site congestion and impact, quick erection and reduced weather delays that accelerate construction and help ensure on-time completion, and sustainable-design attributes.

The following projects show ways in which designers have used precast concrete on mass transit projects to meet the owner's goals while overcoming the distinct logistical challenges that these designs present.

Denver Airport Expansion

A number of key challenges faced designers when officials at the Denver International Airport needed to expand their terminal space by adding five gates onto one of their concourses. The construction had to be done quickly to allow the airport to add needed flights and to reduce disruptions to the airfield. And logistics would have to be closely considered, as some of the work would take place within only a few feet of the working terminal and taxiing airplanes, service vehicles, and passengers.

Designers chose a precast concrete structure and enclosure system to meet these goals. Approximately 565 pieces, covering 72,232 square feet, were required to construct the terminal expansion. Included in those pieces were nine-piece monolithic moment frames that were cast at the plant and then fit together onsite like jigsaw pieces.

"There was an exhaustive study done to determine the fastest and most effective way to build the new gates," explains Kevin Sullivan, president of Wong Strauch, the architect of record. To meet the airport's commitments to airlines, the project had to be designed and built in a 24-month window. "We found that precast concrete would provide the best option to meet our goals."

'We found that precast concrete would provide the best option to meet our goals.'

Using precast concrete for the terminals was a new approach, Sullivan notes. "We've been involved with the airport on other projects, where precast concrete typically is used for the parking structures. But this application offered the best solution for the terminal."

This was a much different type of application of the material for us, agrees Morgan Lysohir, construction executive and project manager at Milender White, the general contractor. "In this case the structural framing that had to be integrated with interior storefronts and interior finishes with a large, open area at its center. It was a great decision to use precast concrete."

Casting components off-site at the plant eliminated a lot of congestion and logistics from the airfield, she explains. "It let us get away from all the traffic with much of the construction. The number of concrete trucks we would have had to drive across the working airfield would have been significant and had a major cost and time factor to it. Precast concrete worked quickly and efficiently by doing so much of the work off-site."

"The speed of construction was a hot item for the airport, because they wanted the terminal gates opened on a very fast schedule," says Gerald Shook, project coordinator at Stresscon Corp., the precaster. "The entire project was fast-tracked: the shop-drawing schedule was condensed, with limited time to set up everything and cast it, and then the erection in the field had a tight schedule to completion."

Site Challenges

Adding to the challenges was the winter weather through which the construction had to continue. "Some days, temperatures were in single digits or negative numbers, so it was definitely a challenge," says Lysohir. Adds Stuart Karp, field superintendent, "A significant amount of protection and tenting had to be provided, including heat wagons. We had to use a lot of hoses to heat and maintain the pieces for post-tension grouting and dry packing." In some cases, the hoses had to be coiled over two levels to reach the required areas of the splice sleeves to ensure the grout set.

Congestion at the site required close communication and detailed logistics to avoid any conflicts. The new precast framing was erected up to the edge of the existing structure, with only a 3-inch joint between them, which was filled with an expansion

Photo: Milender White Construction Co.

joint. The floor system had to cantilever to this point from supports 5 feet away. "The general public was on the other side of that 3-inch gap when we began construction, so we had to be very careful with the process," says Karp. "As we moved further away, we had a little more leeway."

The work was complicated by the foundations being laid as work progressed out from the terminal, causing trucks to have to drive over existing grade beams, and a 150-foot boom crane being maneuvered so as to protect the grade beams. "It became a very critical process that had to be designed to protect the active airfield and existing foundations," says Sullivan.

Contractors also were concerned about safety due to the possibility of high winds arising while working near active areas, notes Lysohir. Coordination also was required working with the cranes with planes taxiing by. "The planes sometimes were within 100 feet of where we were working. Everything had to be monitored very closely."

Photo: Milender White Construction Co.

Photo: Wong Strauch Architects.

A preliminary study showed designers that using precast concrete to add five gates onto the Southwest Airlines terminal at the Denver International Airport would provide the most economical approach with a tight sight and a short deadline.

PROJECT SPOTLIGHT

Denver International Airport Terminal
Location: Denver, Colo.
Project Type: Terminal expansion
Size: 80,000 square feet
Designer: Wong Strauch Architects, Denver, Colo.
Owner: Denver International Airport
Structural Engineer: Weingart Structural & Civil Engineering Consultants, Denver, Colo.
Contractor: Milender White Construction Co., Arvada, Colo.
PCI-Certified Precaster: Stresscon Corp., Denver, Colo.
Precast Components: 565 precast concrete components including straight columns, H-columns, U-columns, spandrels and 672 splice sleeves

Moment Frames Constructed

The work moved quicker thanks to the use of moment frames that connected major segments. These frames were needed to supply a large, open area in the center of the terminal where people gather before moving to their gate. "The precast concrete design could achieve that goal easily using the moment frames," says Shook. "It allowed us to posttension the pieces together onsite rather than have to use shear walls."

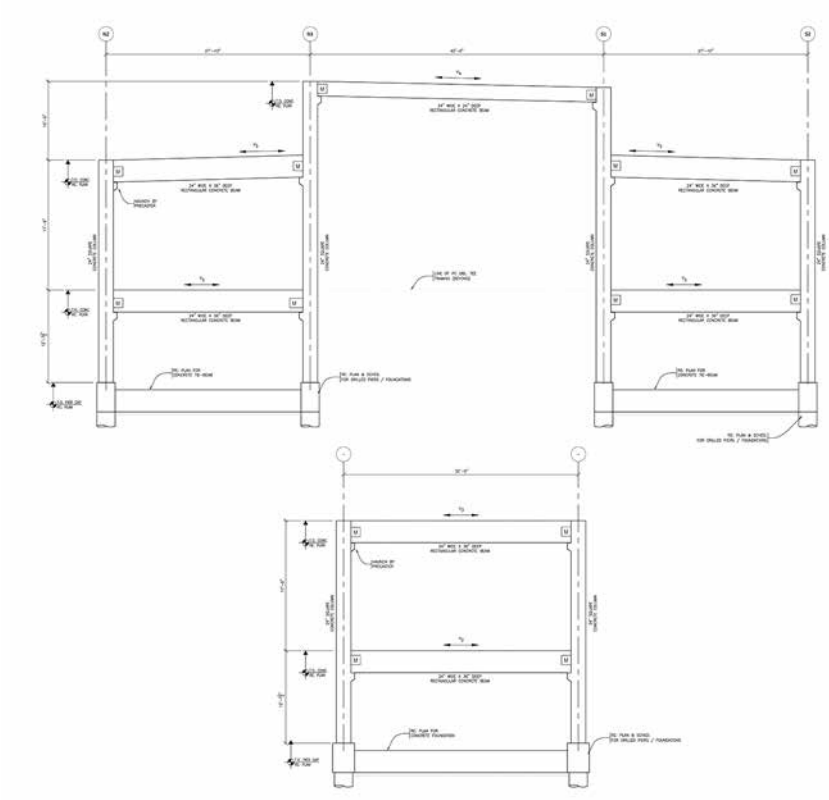
The moment frames were used to "keep the interiors as open as possible, not only in the center section but in the hold rooms and retail areas," says Sullivan. "The airport wanted everything as open as possible. They wanted to invoke an airy feeling to the entire addition."

Each frame comprised nine precast concrete pieces, consisting of straight column sections, H-shaped sections, and U-shaped sections. The frames were tied together using splice sleeve-type connections. Each receiving piece had four sleeves, with three strands per sleeve, cast into its edges that fit into dowels cast into the other pieces, with a 1/8-inch tolerance. In all, 672 splice sleeves were used, along with 288 pieces of 0.6 strand totally 9,800 linear feet.

"We had to fit them together from a 50-foot height, so we had to hold to very tight tolerances to make it work," says Karp. "There were some field adjustments needed, as would be expected, but it really went very smoothly." In one place, the design called for back-to-back moment frames that created "a means and methods challenge" for threading the posttensioned strand and dogging off the ends to tension it," he notes. "That was the biggest challenge, but we were prepared for what was needed."

"We did a painstaking review with the architect and airport to ensure the details were precise before any fabrication was done," Lysohir says. "When we got to the site with all the pieces and fit them all together, it was very smooth, just like building blocks coming together."

The moment-frame pieces were erected into place before the main structure was tied in due to the finish work that was needed. "It was really a two-function erection, with the first part finishing before we could work out from there," says Karp. "We erected the moment-frames by themselves and did dry-packing and posttensioning before beginning any finishing. Then we tied the main structure and flooring into those structures."



Lower Level Left Open

Additional connection embeds were cast into some spandrels to allow expandable walkways to planes to be secured. The lower level of the building remained open to provide for vehicle access and delivery locations for the retail spaces above. Masonry infill was used to fill in locations on this level.

Working at the airport also required close attention to security needs for all personnel. "It was an active airport, and we had to meet security requirements like anyone using the airport," Shook notes. "Everything and everyone had to be badged through security every day."

Finishes were specified to complement or match those on the existing building, which were primarily precast concrete panels produced by another precaster. Most of the panels had an acid-etched finish to meet this requirement. Standard strip windows in 400-foot lengths, were installed between the spandrels, with standard door openings for the terminals.

The project moved smoothly and efficiently, so much so that when it was

Moment frames were cast at the plant and then fit together onsite, with the goal of keeping interiors as open as possible. They were erected before the main structure was tied in due to the finish work that was needed. Diagram: Stresscon.

Photo: Clarke Caton Hintz.

completed, the airport and Milender White presented Stresscon with an award for safety excellence. "Throughout a very risky operation, they had no incidents or injuries and nothing that disrupted the schedule," Lysohir reports. "They ran a very safe and efficient operation." In fact, the project was completed 1 day ahead of schedule.

"We had done other airport projects, but nothing as extensive as this one," says Shook. "We'd created posttensioned moment frames, but this was the first where the entire structure required monolithic and posttensioned frames. Product tolerances were critical to be successful, but we achieved them." The erection took only 33 days to complete.

The design offers potential for the future, he notes. "The moment-frame design provides a viable solution for open structures at airports, as well as other structures that need a completely open design. It can emulate a cast-in-place design while eliminating all of the activity and congestion that it would produce at the site."

For this project, it was the right concept, says Lysohir. "Stresscon did a fantastic job and helped make this a very successful project." Sullivan agrees. "Precast concrete not only gave us the fastest construction time possible, it also was a very economical solution."

The 186,000-square-foot, five-story, 500-car parking structure built for the MTA Metro-North Railroad line in White Plains, N.Y., features a total-precast concrete structure and architectural panels. A key logistical challenge came in building a new utility facility inside the garage so those services could be shifted over, then building the rest of the parking around it.

Photos: Metropolitan Transportation Authority of the State of New York / Patrick Cashin.

PROJECT SPOTLIGHT

Metro-North Parking Structure

Location: White Plains, N.Y.
Project Type: Railroad station parking structure
Size: 186,000 square feet
Cost: $41.8 million
Preliminary Design: Gannett Fleming Engineers and Architects, Camp Hill, Pa., in association with Sowinski Sullivan Architects P.C., Sparta, N.J.
Architect: Clarke Caton Hintz, Trenton, N.J.
Design-Builder: Prismastic Development, Fairfield, N.J.
Owner: MTA Metro-North Railroad, White Plains, N.Y.
Structural Engineer: Stantec Consulting Services Inc. (formerly FST), New York, N.Y.
Site/Civil & Geotechnical Engineer: Langan Engineering, New York, N.Y.
MEPFP Engineer: Kelter & Gilligo Consulting Engineers, Princeton Junction, N.J.
PCI-Certified Precaster: Dailey Precast, Shaftsbury, Vt.
Precast Components: Total-precast concrete structural system consisting of double tees, columns, beams, spandrels, wall panels and stair/elevator core components

Metro North Parking Structure

As reliance on public transit grows in cities, the need for support structures also intensifies. Ensuring passengers have places to safely and easily park or drop off travelers are critical to encouraging more use. That was the dilemma facing officials at MTA Metro-North Railroad in White Plains, N.Y. A new parking structure was needed to replace the existing, smaller one as the rail line's passenger total reached 2,200 customers per day.

The new 186,000-square-foot, five-story structure contains 500 parking spaces, a net gain of 391. It includes three lower floors of permit parking and two higher floors of metered parking. Spaces on the first two floors were provided to meet ADA requirements.

The tight site, durability needs, fast schedule, and other factors led the designers to specify a total-precast concrete structural system and architectural spandrels. The components included double tees, columns, beams, spandrels, flat panels, and stair/elevator core pieces. Dailey Precast fabricated the components.

Design-Build Method Used

The project used the design-build delivery method of construction. The preliminary design was performed by Gannett Fleming Engineers and Architects in association with Sowinski Sullivan Architects. Prismatic Development served as the design-build lead, with URS Corp. providing construction management, inspection and supervision. The team of firms included architectural firm Clarke Caton Hintz (CCH), Langan Engineering, Kelter & Gilligo Consulting Engineers, and Stantec Consulting Services Inc. (formerly FST Engineers Inc.).

"The fairly tight schedule drove the decision to use a design-build format," says Jim Branch, senior principal at Stantec. "Design-build excels under a tight schedule." So too does precast concrete, as it can begin casting as site-preparation work gets underway. And this site had a lot of prep to be done. It included demolishing the existing 109-car parking structure, maintenance building, a surface lot, and several utility sheds.

"We evaluated several options, and the precast concrete system proved to be the most efficient," says Michael Nelson, senior associate and project manager with CCH. "It also offered the benefit of durability and speed of construction while maintaining the design aspirations of the project."

Precast concrete often is the choice when working on a design-build project, notes Branch. "We often choose precast concrete, if only because it's usually the most economical. The cost can vary with demand, but even when precasters are busy, it's usually very competitive and offers other advantages over a steel-frame design in our climate."

"We were involved from the early design process," says Erik Subik, project manager at Dailey Precast. "We worked very closely with the other members of the team to ensure all of the logistics were worked through for the challenges that had to be addressed."

Utility Service Moved

The biggest challenge came from the existing utility services that were housed in a small storage building adjacent to the new structure's site. The services, consisting of three generators, fuel-oil storage, and mechanical systems, needed to remain operational to service the adjacent Metro headquarters building until the new services were constructed in the lowest level of the new parking structure.

"The proximity of the new structure relative to the adjacent headquarters required us to be fairly surgical in how we brought openings to the building envelope to meet code required ventilation while providing necessary fire protection to the nearby structure," says Nelson. "There were many site constraints and logistics challenges to address. The structure is constrained on all sides with the headquarters to the east, a neighboring structure several feet from the southern property line, and overhead power lines immediately to the west."

The work was completed in two phases, with the structures to house the utility services erected and the systems put into place first. Once they were operational, the original utility structure could be removed and work could proceed on the rest of the building.

The station and track alignment were across the street and did not pose site restrictions, but power lines were located on several sides of the project and had to be coordinated to work around them while doing glazing on the stair towers, Branch says.

A taller ceiling height was needed on the first level to accommodate backup generators and associated fuel-oil storage for the adjacent building, Nelson notes. That allowed ample space for retail storefronts, which were placed along the main street elevation near the elevator core along the primary access path used by commuters.

The precast concrete structure also achieved the very stringent fire-rated assembly requirements associated with the building's backup systems. "We could follow the requirements for mixed-use structures without any additional needs," says Branch. A waterproofing membrane was added to the double tees on the second floor above retail spaces to prevent any moisture seeping through from cars arriving during inclement weather, says Subik.

Decorative Façades Created

A series of stainless-steel mesh screens were installed on the infill panels of the first floor level exterior. Designed to be decorative, they secure the parking structure if needed, with concealed rollover doors at the entries. The screens feature die-cut, stainless-steel artwork by Situ Studio titled Percolate. The pieces, commissioned by MTA Arts & Design, features various forms of vaporizing droplets, referencing the role water has played in the city's history. It consists of approximately 125 panels in ever-changing forms of water bubbles attached to the metal mesh in random patterns.

"The designers did a good job of setting up the embed locations and clearances needed, so we could cast the pieces and have the mesh installed quickly," says Subik. Some required special inserts to secure them in place. A larger stainless-steel screen was used to front the entrance to the roof. Onto it was placed a stainless-steel, die-cut logo and signage directing users to the entry and providing a signature design.

The aesthetic design was planned to relate the parking structure to the adjacent headquarters building, with the precast concrete color and embedded thin brick providing a traditional look. "Several colors of brick were selected and randomized to create a

blend that reflects and complements the older brick palette found at the headquarters," Nelson explains.

Horizontal spandrels feature a buff-finished limestone look that offers a contrast in color and texture. An imported sand and aggregate mix was used for the spandrels that posed unusual challenges, according to Timothy Breen, sales manager at Daily Precast. "The mix that was selected had a high lime content, which caused it to set up quickly, making it harder to work with."

It also showed any minor handling scuffs or mars, requiring careful handling. "We spent considerable time after the fact doing a final detailing of all the pieces. "This was a signature focal point for the company, so we paid a lot of attention to detail and washing the pieces clean after the erection." The precaster also spent time minimizing dust and soot from the mechanical equipment during the erection to ensure no additional marks on the panels.

Sustainable-Design Concepts

The team also added sustainable-design concepts wherever possible. The structure was designed to meet code requirements for an open parking structure, which minimized the need for mechanical ventilation. Building systems, equipment, and lighting were designed to achieve a 35% improvement over state energy-code requirements. The structure also offers bicycle-storage and scooter parking along with charging stations and dedicated parking for fuel-efficient vehicles.

One of the biggest additions was the use of bright-white double tees to construct the roof, generating a high albedo. This mix consisted of local aggregate and sand with white cement. All of the upper tier double tees were cast with this mix. "It was a challenging mix to create, but reducing heat island effect on the roof was a key goal for the owner," says Nelson.

In addition, the owners feared it would raise costs to have to remove snow from the roof after heavy snowfalls, so the design team created a designated area on the roof where snow can be stored after plowing. That required boosting the load requirements in that area and ensuring the potential added load could be directed into the columns and to the ground, Branch says.

Native and drought-tolerant landscaping was installed, as were new crosswalks and traffic signals. New decorative lighting includes architectural light poles at the structure's perimeter and an LED linear grazer that dramatically illuminates the stainless steel fabric over the drive entry.

The result of the close attention to detail by the design team and successful tackling of logistics by the construction team created an aesthetically pleasing structure that provides all of the functional benefits required of such a demanding building use while achieving sustainable-design features. "Precast's modular construction is a big benefit to construction in the Northeast," says Branch. "It gives us a lot of bang for the buck."

City officials agreed. "I am so proud to cut the ribbon on a facility that will serve the needs of our commuters," said Joseph Giulietti, Metro-North Railroad president at the ribbon-cutting ceremony. "The fact that it was completed in a timely, cost-effective way confirms our continued commitment to our customers."

Cherry Street Parking

In some situations, parking and transportation functions can be combined into the same facility. That was the design approach taken for the Cherry Street Transit Facility in Terre Haute, Ind., near the campus of Indiana State University. Lack of parking in the downtown area led the city and Indiana's Department of Redevelopment to create a 216,000-square-foot, five-story parking structure that also provides office space for the transit authority and amenities for the bus-transfer point.

The project features a total-precast concrete structural system consisting of double tees, inverted tees, L-beams, columns, beams, shear walls, litewalls, slabs, structural columns, architectural spandrels, and other components. Coreslab Structures (Indianapolis) Inc. provided the structural components, while Gate Precast Co.'s Ashland City, Tenn., plant fabricated the architectural panels and the structural columns that support the panels and double tees.

"The facility was designed to provide much-needed improvements to the bus-transfer system and public parking for area businesses," explains Matt Jobin, project manager for Rich & Associates, which served as architect and engineer on the project in association with Sanders & Associates. (For more on Rich & Associates' work, see the Architect's Profile in this issue.)

In addition to 626 parking spaces, the L-shaped facility includes an inner

The total-precast concrete structural system provided a quick and easy erection. Many panels feature several finishes, including two colors of thin-set brick and accents. Photos: Rich & Associates.

PROJECT SPOTLIGHT

Cherry Street Transit Facility

Location: Terre Haute, Ind.
Project Type: Parking structure with bus-transfer station and office space
Size: 216,000 square feet
Cost: $14 million
Designer/Engineer: Rich & Associates Inc., Southfield, Mich., in association with Sanders & Associates, Terre Haute, Ind.
Owner: City of Terre Haute/Indiana State University, Terre Haute, Ind.
Contractor: Hanning Construction Co., Terre Haute, Ind.
PCI-Certified Precaster (structural): Coreslab Structures (Indianapolis) Inc., Indianapolis, Ind.
PCI-Certified Precaster (architectural panels and structural columns): Gate Precast Co., Ashland City, Tenn.
Precast Components: Double tees, inverted tee beams, L-beams, columns, beams, shear walls, litewalls, wall slabs, structural columns, and architectural panels

Photo: Sanders and Associates.

Photo: Sanders and Associates.

Photo: Coreslab Structures (Indianapolis) Inc.

The precast concrete design for the Cherry Street Transit Facility in Terre Haute, Ind., allowed for a variety of finish treatments. The first floor features floor-to-floor heights 3 feet taller than upper floors, to provide clearance for buses and create a more open feel.

covered bus lane along the long side of the L, plus public and driver restrooms, a waiting area with spaced benches during waits for bus transfers, and office space.

The first floor features floor-to-floor heights 3 feet taller than upper floors, to provide clearance for buses and provide a more open feel, explains Mike Owings, engineering manager at Coreslab. To retain the openness needed for the bus lane and provide lateral stability, a "healthy-sized" shear wall about 20 inches wide and 36 feet long was placed along the long side of the L. On upper floors, litewalls were used to provide more visibility and allow daylight to reach further into the interiors.

Pretopped Double Tees

The double-tee floor members provided were pretopped, allowing the surface of the 6,000-psi components to serve as the driving surface, saving time and material. "It provides excellent durability and lower maintenance costs, as well as a shorter construction time-frame," says Jobin. The double tees also provide a two-hour fire rating, which was required due to the facility's multiple uses.

The long side of the L features 60-foot-long double tees, while the shorter side had a slight offset and needed 63.5-foot-long spans. The longest component provided was the closure spandrel over the ramp at the top level, where a 64'11 ¼" long, 6'9 ¼" tall member was needed. This piece was cast and delivered as one piece, reducing pick time and transportation costs, according to Bill Henderson, vice president of operations at Gate.

Ramps are located in the 90-degree corner of the L, allowing large, flat floors. An express ramp provides quick access to the upper floors to reduce congestion on the first level near the bus-transfer station.

Multiple Finishes Used

The architectural spandrels feature a complex finish consisting of two colors of thin brick embedded in most of the panels. The brick covers the first level and creates a frame around three-story arches above, with tan-colored horizontal spans through the center of the arches at each level. The horizontal portions are set behind the brick surrounding sections, creating a dimensional appearance emphasized by reveals and the difference in finish and color, explains Chris Winfield, project manager at Gate Precast.

The arched top-level panels consist of four pieces: A double-arched piece, a horizontal tan segment, a V-shaped portion of the arch at the center, and two half-V shapes on either side. To these were added rollup bricks with a ¾-inch chamfer that was cut in half at the kerf to create two pieces that could create the infilled-arch design of the cornice.

Columns supporting the entry points in the parking structure feature an Ashlar-stone texture, created with a custom formliner on the precast concrete pieces. The texture provides a dominant base while adding texture and contrast. One-inch brick was used to provide projections, creating a dimensional feel, on the stair towers as well, Winfield notes.

The spandrels, columns, and wall panels were designed as load-bearing pieces for the structural double tees. Pockets were cast into the spandrels to support the double tees, with through-sleeves provided in the columns so the spandrels could be fit in from behind and bolted into place, explains Winfield.

"This approach greatly reduced the material that would have been

A bus lane was incorporated into the 216,000-square-foot, five-story Cherry Street Transit Facility structure in Terre Haute, Ind., providing weather protection and gathering points for patrons to transfer buses. Two precasters, one for structural components and one for architectural panels, collaborated on the project. Photo: Sanders and Associates.

required to construct a façade after the structure was erected," says Jobin. "This resulted in overall savings in construction costs, due to the material savings and the shorter construction time frame."

Smooth Erection Process

Delivery and erection went smoothly, although the backside of the L in the corner was "pretty snug," says Winfield. "We were tight to the street and had to maneuver carefully in that area." An historic church adjacent to the parking structure also created an obstacle, as it had to be preserved and remain in operation during construction.

The project moved smoothly with close communication between the precasters. "It definitely added a level of complexity to the project with two precasters providing components," says Owings. "We coordinated it closely to ensure everything arrived on time and went together quickly."

Jobin agrees that everything moved smoothly. "The project was a success for the city. The facility blends in seamlessly with its neighboring, downtown surroundings and provides the public with a convenient place to park in the heart of Terre Haute."

Quality Products Are Just One Part of a Successful Precast Project

Rocky Mountain Prestress teamed with Thermomass to provide durable insulated panels to protect the NREL Research Support Facility from all manner of Colorado weather while also forming an integral piece of the building's passive heating and cooling operations.

Since its founding in 1980, Thermomass has pioneered the high-performance sandwich panel market and has helped clients around the world design and build durable, versatile, and energy-efficient concrete walls. We manufacture a complete line of precast insulation products and nonconductive ties, but we know that great projects depend on more than just quality materials.

Over the past 35 years, our corporate philosophy has been that our success, and that of our clients, is a balance of three things. Exceptional products are key, but expert service and proven performance are equally important. Newer firms in the industry may try to shortcut this holistic approach, but we believe that each of these sectors is critical to the success of not only our company, but of every project in which we participate.

Innovative Products

Thermomass' core business is the manufacture of energy-efficient composite construction materials, created using a specialized process known as pultrusion. Different than injection molding or extrusion operations, the pultrusion process allows us to create continuous lengths of reinforced polymer structural shapes that deliver constant cross sections and consistent results—a critical factor for sandwich wall connectors and their long-term structural integrity.

Thermomass offers a comprehensive product line of wall ties with the strength and flexibility of steel plus the nonconductive and noncorrosive properties vital to today's energy-saving, sustainable building practices.

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Dedicated Service

With a team of engineers, architects, and product technicians boasting more than 200 years of combined experience, our Technical Services Department has been a part of thousands of projects, each with distinct challenges and goals. As a result, we can offer a unique blend of practical thinking and real world experiences to our clients. Whether it is advice on the compatibility of our systems with stated project goals, recommendations on details, or a thermal analysis on a potential project, our technical department is there for clients every step of the way.

Our Sales Support Staff are experts in the precast market through continuing education programs for the design community, industry-specific committees, and code body participation. In addition to our team headquartered in Iowa, we have strategically placed individuals around the United States and the world to better serve local markets. This level of industry expertise and involvement results in a partnership with our clients that allows us to tackle even the most challenging project.

And when it comes to taking all of the drawings and details for a project and turning them into industry-leading concrete insulation systems, the Thermomass Production Team is second to none. Combining years of operations experience, advanced pultrusion and CNC production techniques, and dedication to both efficiency and safety; our manufacturing experts deliver the world's safest concrete sandwich wall system.

Thermomass-insulated precast panels from Stresscon help reduce energy costs while maximizing interior space for the recent Loveland Service Center project.

Gate Precast teamed with Thermomass to provide insulated architectural precast cladding panels for the Chandler Hospital Pavilion at the University of Kentucky.

Comprised of fiber composite connectors and prefabricated rigid insulation, Thermomass insulation systems are fully tested, install easily, and have been used in a wide variety of award-winning precast projects.

Concrete Results

Consistent parts yield consistent results. That theme echoes throughout all aspects of the Thermomass project cycle, especially during the manufacturing process. As part of our stringent quality control procedures, Thermomass connectors are subject to rigorous third party evaluation. We exhaustively test all of our connectors and actively publish those findings. Thermomass products are listed with some of the industry's highest evaluation services, including ASTM, UL, the International Code Council, and the National Fire Protection Association.

We also carefully examine panels in service to see how they perform long after the panels are erected. We continually assess how our systems help minimize safety concerns during critical events like fires, collisions, blast loads, extreme wind loads, and seismic activity.

Perhaps the most telling measure is this: Thermomass systems have been selected for thousands of projects all over the world over the past four decades, many of which have garnered industry acclaim. For example, Thermomass products and assistance have played vital roles in recent PCI award-winning projects such as:

- University of Kentucky Chandler Hospital Pavilion (Sustainable Design Award, 2014),
- First Baptist Church of Dallas (Best Religious Structure, 2015),
- The Woodlands Nordstrom store (Best Retail Facility, 2015),
- City of Loveland Service Center (Best Warehouse/Distribution Center, 2015).

Additionally, Thermomass has been involved in a number of recent high-profile, zero-energy projects for notable clients like the National Renewable Energy Laboratory and NASA.

A Comprehensive Approach

From its humble beginnings to its current position as an industry leader, Thermomass has always adhered to the principal that the success of each project is more important than any bottom line, sales goal, or marketing agenda. From the beginning, our aim was to help clients design and construct buildings that would stand the test of time. To accomplish that, we realized that our success would be measured by more than just the total number of parts shipped to the jobsite.

Thermomass will always deliver innovative, quality products. But dedicated service and concrete results are also part of the fabric that makes insulated precast concrete one of the most durable, versatile, sustainable, and cost-effective construction methods available today.

For more information: www.thermomass.com.

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Model Design
BEST PRACTICES

Because the RSF project was so successful, NREL designers are offering its design for the building to developers for free to encourage further net-zero construction.

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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.

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Precast Aids in Smooth Cruising

Constructing precast concrete parking structures at one of the nation's busiest cruise-terminal ports offers benefits that aid economics, schedule, and other goals

— Craig A. Shutt

Port Canaveral, Fla., already the third busiest port in the world for cruise-passenger traffic, continues to expand its services to serve more cruise ships. Precast concrete parking structures are helping to relieve congestion and facilitate the logistics of handling thousands of arriving and departing passengers on the same days. Photo: AeroPhoto.

Already the third busiest port in the world for cruise-passenger traffic, Port Canaveral, Fla., continues to expand its operation to serve more customers on bigger ships. As the number of terminals grows, there also is a growing need for support facilities, especially parking structures to facilitate smooth movement of passengers to and from the ships. Completing these projects on fast-track schedules without disrupting passenger traffic creates major challenges that precast concrete structural systems can meet.

The port features six operational cruise terminals, plus several others being phased out or under renovation and not in service. It also contains four parking structures to support the terminals, including one just completed and another underway.

The port, along Florida's eastern "Space Coast," has completed other projects recently, including a $7.8-million enlargement of its basin for larger ships and a $25-million expansion of its south side with a 22,000-square-foot, seven-story Exploration Tower. The port served 4 million cruise passengers in 2015, and that number is expected to double by 2020.

"We develop our plans based on the needs of the cruise lines, and with the anticipated growth, we are going to be building more terminals and parking structures in the coming years," says Dave Perley, senior director of port construction and infrastructure. The projects continue to expand in scope, he notes. The most recent precast concrete parking structure, still being constructed, was planned for 750 cars, but it was expanded after they found that the just-completed 1,000-car structure already was over capacity.

Newest Parking Structure

The recently completed four-level structure serves the new Cruise Terminal One and was designed and built by the design-build team of Ivey's Construction and Finfrock. It features passenger drop-off and baggage-handling services on the first level, with

parking spaces on the second floor up. "That was a concept suggested by the design-build team during the planning stage," says Perley.

The structure consists of a precast concrete structural system (total precast), including double tees, columns, beams, shear walls, litewalls, stairs, and other components. The 433,764-square-foot project was constructed, along with the new terminal, in less than 12 months to serve the Royal Caribbean line.

The parking structure has five 60-foot-wide bays on a 360-foot-long footprint. Two crews were used to erect the structure to shorten the schedule and keep it off the critical path of construction for the terminal being built next to it. Working on the site required the authority to review how best to maintain traffic and control security with the port's own security, local police, Department of Homeland Security, and the Coast Guard, Perley notes. "We need the off-site construction and just-in-time delivery system that precast concrete provides because we have no storage space on the site. We're too tight."

Cruise Terminal, which was recently completed, features passenger drop-off and baggage-handling services on the first level, with parking spaces on the second floor up. The 433,764-square-foot project was constructed, along with the new terminal, in less than 12 months to serve the Royal Caribbean line. Photo: Finfrock.

PROJECT SPOTLIGHT

Terminal One Parking Structure

Location: Port Canaveral, Fla.

Project Type: Parking structure

Size: 433,764 square feet

Design-Build Team: Ivey's Construction, Merritt Island, Fla., and Finfrock, Apopka, Fla.

Owner: Canaveral Port Authority, Port Canaveral, Fla.

PCI-Certified Precaster: Finfrock, Apopka, Fla.

Precast Components: Double tees, columns, beams, shear walls, spandrels, stairs

Earlier Parking Structure

Prior to building Cruise Terminal One, the port had selected the design-build team for the Cruise Terminal Six parking structure, designed for 750 cars with retail space on the first floor for passengers and crew to purchase last-minute items before heading on their cruise.

In this case, the design-build proposal offered parking consulting, design, and precast concrete manufacturing with a reconfigured footprint from the criteria documents. Finfrock served as architect of record, structural engineer of record, design-build contractor, and parking consultant for Ivey's Construction.

"We provided the only proposal with a path to meet the owner's budget while still maintaining the required amenities package, which included a drop-off area, employee lounge, and retail shops for employees and cruise patrons," says Dan Helmick, executive vice president of project development at Finfrock. They also allowed the option of expanding the structure on one side if needed.

Retail space on the first floor currently consists of a crew-oriented market. "Crews typically don't have much time to pick up supplies and sundries between cruises, so the store works out well for them," Perley says. Additional stores also are planned. The retail spaces are located on the first floor near the disembarking stations. All levels have higher ceilings than are typical for parking structures, he notes, to accommodate so many cars with luggage racks on top.

Design-Build Preferred

The authority typically uses design-build packages for the parking structures, he notes. "We give the teams the initial concept and design criteria but try not to get too precise with our requirements to allow them to innovate. They are always coming up with new ways to skin the cat, and we want to leave it to them to decide how to create the most efficient design."

A variety of factors are weighed to find the best option for the port's needs in each case, he explains. "We like to keep up with what the industry is doing while remaining flexible. As a government agency, it often comes down to price, but we look at the most efficient design for the price so we can get the best value, even if it's not the lowest cost."

> 'We look at the most efficient design for the price so we can get the best value, even if it's not the lowest cost.'

On occasion, construction teams propose steel parking structures, he notes. "But schedule and cost, along with maintenance, usually steer the projects to precast concrete. That really gives us the best bang for the buck."

Precast concrete spandrels had the terminal's blue logo cast into them, after which they were painted to create a dimensional appearance. Photo: Finfrock.

Congestion Proves Challenging

"The biggest challenge is working around an operational cruise terminal," says Helmick. "The port is very conscious of the passengers' experience and doesn't want construction to interfere in any way or have an effect on them." That goal creates challenges on "ship days," the days the cruise ships come into port to disembark passengers and take on a new group.

"It's always a challenge to work around active terminals," says Perley. On the most recent project, the work progressed next door to an existing terminal, where on ship days 4,000 passengers were disembarking while another 4,000 were arriving to go aboard in an eight-hour period. "It creates a lot of traffic and can become very difficult."

To facilitate deliveries and coordinate schedules especially on ship days, the precaster created a software program called Piece Tracker. The product-management program tracks each piece through the system. "It's a lot like FedEx, tracking each piece from design through production, storage, loading, and shipping," explains Helmick. "We can ship directly to the hook to minimize truck traffic and overshipping."

The system also lets the precaster schedule around ship days to minimize deliveries on those days and they are coordinated closely. "It gives us a very detailed, piece-by-piece system coordinated with dates for erection rather than general delivery times in hopes that we can avoid ship days.

Spandrels with the port's logo cast into them are shown. Two crews were used to shorten the schedule and keep it off the critical path of construction for the terminal being built. Photo: Canaveral Port Authority.

Design-build packages are typically used for the parking structures, allowing bidders to use their most innovative techniques and custom expertise to create the most efficient system. Photo: Finfrock.

It's a more surgical approach that creates more efficiency." Finfrock's vertically integrated process, acting as architect, engineer, and contractor, gave them more control over the process, he notes.

Corrosion-Prevention Plan

The port's site along the Atlantic Ocean in a hurricane zone also required special attention. The precaster used a customized corrosion-prevention plan, including stainless-steel and galvanized plates. Connections were reinforced to meet the area's stringent requirements for wind loads.

'The area's code requirements are very high and pretty prescriptive.'

"The area's code requirements are very high and pretty prescriptive," says Helmick. "But they're not much different from the rest of Florida, and we do a lot of projects here. So they weren't anything out of the ordinary for being on the coast." Adds Perley, "We factored that into the design approach and used the specific connections we needed, but they weren't unusual."

The structure has a complementary finish to the other parking garages and terminals, featuring a smooth gray concrete that was painted with a sandy, textured elastomeric paint. "We try to keep the finishes basic and maintenance free," Perley explains. The precaster was able to incorporate the port's distinctive, stylized-wave logo, into the parking structure which was cast into the spandrels on the upper level and painted blue.

More in the Future

Additional parking structures are planned for the future as the terminals expand. One terminal expansion is underway, scheduled for completion in May, when another renovation will begin for completion in November. Those are being expanded to accommodate the arrival in November of the Norwegian Epic, the third-largest cruise ship in the world with 4,100 passengers, and Royal Caribbean's Oasis of the Seas, the largest cruise ship in the world, carrying 6,000 passengers (and 2,400 crew members).

"We have been very successful with our projects and meeting our schedules," says Perley. "Our only regret is that we don't think big enough. It seems that every time we finish a parking structure, we decide it isn't big enough."

Those parking structures, as designed, no doubt will be constructed with precast concrete, he says. "The ability to bring the precast concrete components directly to the site and go truck to hook keeps everything moving and gets it all into place quickly. Those trucks move through here quickly and are gone again."

For more information on these or other projects, visit www.pci.org/ascent.

PROJECT SPOTLIGHT

Terminal Six Parking Structure

Location: Port Canaveral, Fla.

Project Type: Parking structure

Size: 274,543 square feet

Design-Build Team: Ivey's Construction, Merritt Island, Fla., and Finfrock, Apopka, Fla.

Owner: Canaveral Port Authority, Port Canaveral, Fla.

PCI-Certified Precaster: Finfrock, Apopka, Fla.

Precast Components: Double tees, columns, beams, shear walls, spandrels, stairs

Five 60-foot-wide bays on a 360-foot-long footprint were used for Cruise Terminal One.

Building Concrete Community

Students in South Dakota State University's Precast Studio cast projects and install them in communities, learning interpersonal skills that aid professionalism.

— Craig A. Shutt

Third-year architecture students in the precast concrete studio at South Dakota State University (SDSU) learn both theoretical and practical applications of the material's benefits, as they cast components they have designed. The finished products are installed in local communities, giving students an opportunity to learn how to look at projects from the client's point of view—and negotiate to achieve their design plans.

'Our goal was to get our students into the communities and teach them to cast precast concrete projects for the town's betterment.'

"Our goal was to get our students into the communities and teach them to cast precast concrete projects for the town's betterment," explains Brian T. Rex, associate professor and department head. The program is called "Building Concrete Community" and is the foundation for the school's precast concrete instruction encouraged by the school's partnership with the PCI Foundation. The program operates in conjunction with the construction-management and structural-engineering departments. It includes several smaller, one-credit classes on various topics as well as the larger two-credit class that develops community projects.

The program also receives extensive support from local PCI member company Gage Brothers as well as four Sioux Falls-based architectural firms: Koch Hazard Architects, Architecture Inc., TSP, and Perspective Inc. In addition to the PCI Foundation funding, the four companies pledged $34,000 to the program over a 10-year period. "They really put skin in the game for us," Rex says.

The architecture curriculum, founded in 2010, is the first and only degree-offering program in the state and the first new school of architecture in the region in the last 100 years. Students hail from 24 cities in South Dakota, six states, and several countries. The demand for architecture graduates is significant, Rex notes, as nearly three-quarters of architects practicing in the state are nearing retirement age.

"The PCI Foundation Trustees were impressed with the partnership between a school of architecture and a school of construction management," says Thomas J. D'Arcy, PCI Foundation chairman. "We also liked the 'hands-on' approach to learning. The trustees applaud the effort to provide students with a unique learning experience that may include getting their hands dirty."

Gage Offers Support

The precast curriculum began in 2012, although planning began much earlier. "We've had the support of Gage Brothers and its president, Tom Kelley, for a long time, and we often would visit their plant and get their input for any precast concrete programs we ran," Rex explains. "Tom Kelley has been a big supporter and is a real leader in the state, so the university encouraged us to work closely with Gage Brothers when we could. When they proposed the studio concept, it made sense to us."

"The program is working great on many fronts, from jobsite tours to question-and-answer sessions on se-

Students in the precast concrete studio courses at South Dakota State University take their academic discussions into the field at nearby Gage Brothers Concrete Products. They see how precast concrete components are fabricated and watch as their own designs come to life.

nior precast building design projects," says Kelley. "The big fun is all of the hands-on opportunities available, such as the students building forms and panels for the community-service projects." The students also visit the plant as well as fabricate and finish panels.

"These students have experienced the entire process: designing panels, drawing tickets, building forms, fabricating pieces, finishing panels, and erecting the finished product. Our engineers and manufacturing personnel have enjoyed the interaction as much as the students have. It has truly been a very fun adventure and results in these young professionals entering the market with a better understanding and comfort level with precast concrete. That's a good thing for everyone."

Precast concrete provides a natural course of study for the school, Rex notes. "Precast concrete makes so much sense here, in this climate and with our nonmetropolitan areas," he says. "Getting skilled workers here when towns of 20,000 people are 1 ½ hours apart can be a challenge. And the more architects can specify prefabrication in a plant, the better they like it. Furthermore, the short construction season makes an all weather system, like precast, the best option.

Precast concrete structures built in these towns have been extensive but utilitarian, he notes. Often, he can't convince students that an architectural precast concrete project, especially one with embedded thin brick or formliners, is actually precast concrete.

That is changing as more students take the courses and become acquainted with precast concrete's potential. Input from Gage Brothers includes plant tours, advice with projects, casting of designed components, and other activities. For example each year, Gage Brothers hires a bus to take 70+ architecture students to Minneapolis to provide a tour of the city's notable precast concrete structures.

'No one comes out of our architecture school without knowing ways to build with precast concrete pretty well.'

Students designed and constructed a six-panel precast concrete monument along the banks of the Missouri River in Mobridge, S.D., to serve as the focal point for a gathering spot.

"No one comes out of our architecture school without knowing ways to build with precast concrete pretty well," Rex says. "Local firms love it, because we use a lot of precast concrete in this area."

Other departments also benefit, as the school works in conjunction with the construction-management department, where students take the smaller, one-credit courses. "Those students are more focused on the management part of their discipline, so they're less inclined to get their hands dirty," Rex says. "But we offer them the opportunities if they're interested." Mechanical-engineering students jumped at the chance to work with the program, he notes, running tests on the student's precast concrete components and checking slump tests. "I never know what connections will develop."

Community Projects Develop

Classwork for the two-credit course includes creating a speculative 60,000-square-foot office building that helps students work out complexity of designs on paper and see the benefits precast concrete offers. The community projects begin in the students' first year, when they perform a study on possible precast concrete structures to create. In year two, they look at how to develop the project and select a community to work with. In year three, they design and cast the project.

"The students follow the project all the way through to completion," Rex says. Due to fallout or transfer of students along the way, about 30 students will have been with the project from its beginning. Classes are held in four-hour blocks twice a week. "That allows us to hold their attention for a long time, get into a project, and clean it up each time."

The program's first project consisted of a branding sign created from six precast concrete panels designed to serve as the focal point for a new gathering place along the banks of the Missouri River in Mobridge, S.Dak. It includes a galvanized frame and creates a landmark to help define the town's relationship to the river. Students also were each assigned to redesign a nearby building to show the community what could be developed further.

It offered a great experience for professors and students alike, Rex says. The school worked with the local Hutterite community, a religious group that volunteered to help with site construction. "They can make anything," he says. "This was the first project they did with us, and it went great. It was me, the students and two Hutterites—speaking low German—when the trucks rolled up with 32,000 pounds of precast concrete, clips for assembly, and shop drawings. We called Gage Brothers several times for consultation, but we got the panels constructed quickly."

Student Evaluation

Ethan Millar took part in the first SDSU studio as a third-year architecture student and worked with the town of Mobridge to develop the park enhancements along the Missouri River. He also attended the 2014 PCI Convention in Dallas and helped create a poster in the show hall that promoted the studio's work.

"The studio is a break from how the other classes are set up," he says. "Focusing on one material for a semester allows us to more fully understand precast concrete and its properties, which can then lead to experimentation with the material."

The hands-on approach was a significant difference from other classes, he adds. "Actually being able to carry out the project from design to construction and installing the precast onsite along with the rest of the project was my favorite memory."

The program will aid his professional career, he notes. "Understanding precast concrete will unquestionably help me. Precast concrete is used in a wide array of projects, and already having an understanding of precast will help me in the design process."

Presentations by students include input from industry professionals, including staff at Gage Brothers as well as employees at four local architectural firms who support the programs.

The project gained a lot of attention. "We initially went to Mobridge and presented our ideas," he says. "That primed the pump, and we now have a waiting list of seven or eight towns that want us to present concepts to them for what the students can do."

Learning Lessons

Encouraged, the students created a more ambitious plan for The Kansas Mall in Huron, S.D. Students presented 11 concepts to improve the unattended, city-owned park property. A budget of $82,500 was created from a combination of grant funds, city dollars, corporate donations, and fund-raising efforts. But before the project could be produced, political issues derailed it.

"It was a great lesson for students in having to deal with larger city councils and various agendas," he says. "But it was tough to handle having the plan fall apart." The class created a fast-track project and returned to Mobridge, which welcomed an addition to its earlier project.

This year, students are working with officials in Webster to create a new gateway to the town's football stadium on the outskirts of town in a small valley that provides low visibility, with no parking nearby. The project consists of a 4.5-foot-deep, 60-foot-long AASHTO girder with aesthetic touches to form a focal point for entering the stadium. The beam will be cast in February and erected in May—and already has received city council approval. The program is being directed by Assistant Professor Frederico Garcia Lammers.

Webster's project was a great learning process, he notes. "The students were very excited about a design for downtown Webster. The city leaders very politely explained what they needed instead of that. They did a really good job of opening the students' eyes to how to adapt their plans to fit the client's true needs."

Next year's project, in Volga, also is progressing, with the most likely candidate being an architectural wall to replicate the look of a historic railroad depot that was demolished. "We're working with them now," Rex says. "We have our favorite project, and they have their favorite. We're letting the students negotiate with the town to decide what will be built. It's fun to watch them figure it out."

Planning for the Future

The school has major plans for the future, as it moved into a new Architecture, Math & Engineering building this fall. It provides a 135-by-35-foot space for equipment that will include casting beds now being planned. Those will take their lead from Gage Brothers, which also is moving into a new facility and having new form tables constructed. "We've been invited to watch those being installed, and we plan to take notes and build our own tilting beds based on theirs."

Currently, Gage Brothers casts components for the school from the students' construction—if they meet Gage's requirements. "They won't cast in our forms unless we've followed their specs precisely, and they critique what we did and where we went wrong. It's a good lesson for students to see how precise the business can be."

The school already has a crane that can erect components, he notes, so creating casting beds will give students a more in-depth knowledge of the industry. "Once we have all of our pieces in place, we will be talking with the PCI Foundation about what additional support they can give us," he says. "We want to grow our program and ensure the students are receiving the most well-rounded education about precast concrete possible."

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CONRAC Projects Increase Nationwide

More airports are consolidating rental-car facilities to add efficiencies, and high-performance precast concrete helps meet the additional functional challenges they create

— Craig A. Shutt

When officials at Nashville International Airport decided to create a Consolidated Rental Car (CONRAC) facility, they knew they faced significant challenges. Each company had its own procedures and signage needs, and they all wanted the building located close to the terminal to facilitate customer use. Airport officials also wanted to make efficient use of the space while creating a sustainable design and an aesthetically pleasing appearance. All of these goals were met with the structure, which features a precast concrete structural framing system (also referred to as total-precast system) and architectural spandrels.

"We bid the project with alternative designs for precast concrete and cast-in-place concrete," explains Traci Holton, manager of design for the airport. "Precast concrete came out more cost effective, for several reasons. But a lot of factors went into choosing it beyond the economics, including scheduling and the site situation." The three-level facility houses space for 2,400 rental cars along with related services.

The chosen site was directly opposite the main terminal, in what had been some of the long-term parking space adjacent to the short-term parking, just 360 feet away. That required a fast schedule to bring it online quickly and close coordination to allow access for delivery of precast concrete components. "It was right in the middle of the action. The schedule was fast, and it was important to stay on schedule."

The CONRAC facility at Nashville International Airport features a total precast concrete structural system, which met designers' goals for efficiency, aesthetics, economics, and sustainable design, among others. The three-level facility houses space for 2,400 rental cars along with related services. Photo: Dematteі Wong Architecture.

Precast Concrete Benefits

Economics and speed of construction are two key reasons why precast concrete is often chosen for these projects. Its durability and ability to continue construction through the winter offer additional benefits and led designers at TransSystems to specify precast concrete for the facility they are designing for Chicago's O'Hare International Airport. "We chose it for the economics but also for how much easier it would be to get the project built if we could erect components through the cold winter," says Norman Lin, senior architect. "That will save us considerable time."

TransSystems designers earlier had specified precast concrete for the Mineta San Jose International Airport CONRAC, the first in the country to integrate a quick-turn-around (QTA) operation and California's largest precast concrete parking structure at 1.8 million square feet. The precast concrete design provided a number of benefits, including the ability to adapt to an oddly shaped site, provide durability for refueling and washing services, and meet the high seismic requirements.

'The operation and design are evolving and becoming much more complex today.'

Although CONRAC facilities may resemble parking structures from a distance, they are far more complex—and they are growing in popularity. "It's a fairly new building type, going back only to the 1980s," explains Wesley Wong, principal at Dematteі Wong Architecture, which designed the Nashville facility in conjunction with local architect Moody Nolan. "But the operation and design are evolving and becoming much more complex today. These structures represent a consolidation of a number of functions and have a variety of components which need to be integrated."

They comprise such operations as a customer service area, with rental

The precast concrete system at the Nashville CONRAC facility provided a variety of dramatic elements, including a curved helix-ramp enclosure to which sculptural pieces were attached (below). Photos: Demattei Wong Architecture

counters and offices for each company; rental car pick up return areas; a maintenance area, consisting of fueling, car washing, and detailing services requiring specialty equipment; and storage areas for vehicles. More CONRAC facilities are expanding service areas to upper floors, creating additional challenges for accommodating fuel and water at these locations.

'These are absolutely the wave of the future.'

"These are absolutely the wave of the future," says Wong. "Even the smaller-sized airports are building them. The processes of how they function and operate are evolving, but it makes the airport and rental-car operations more sustainable, efficient, and profitable." That's important, he notes, because rental-car revenues are typically one of the top money makers, along with airline and parking fees for airports, making them a key customer. "The rental-car industry is a major airport player because of the revenue generated."

The buildings' complexities make them far more complicated to design than a parking structure, designers agree. "People think of them as parking structures, but CONRACs are really a unique type of building with a high-level of customer service," says Lin. Wong agrees. "Parking cars is only one aspect of their operation. The building that houses their operations is important, because it gives the rental-car companies an opportunity to showcase their product while also allowing them to efficiently prepare cars for their customers. There is much more activity 24 hours a day than in most other building types."

Parking structures have more predictable activities and traffic flows, notes Nashville's Holton. "In a CONRAC, there are people working and customers coming in 24/7/365. They're working at booths and using equipment, and they need barriers to separate companies and security requirements to protect the cars," she says. "They have to be able to move cars around smoothly and direct customers with their own unique signage. Each company has their own way of operating." CONRAC facilities also often include a multimodal aspect, requiring bus traffic and drop-off for passengers transitioning from the terminal, or returning.

High Activity Levels

That activity level requires brighter spaces than most parking structures demand. "The floor-to-ceiling heights are taller than for parking structures, with elevated footcandles to make them more like offices," she explains. Adds Wong, "The electrical load is high due to the various functions and there is a need for high lighting levels, up to four times what you'd find in a typical parking structure."

Dramatic photography was used as an aesthetic treatment for the San Jose International Airport CONCRAC structure, which features a total precast concrete structure. The technique was still being discussed when the structure was constructed, so designers had embeds placed into the precast concrete that the final decorative pieces could use for installation. Photos: Clark Pacific.

Most parking structures provide 10- to 12-foot floor-to-floor heights, while CONRACs usually provide floor heights greater than 15 feet. That height provides space for equipment, increased daylight, and better ventilation to help meet emissions needs without having to provide mechanical ventilation. In San Jose, rental-car levels have heights of 12'2", while QTA floor levels were placed 24'4" apart (leaving out one intermediate level). Precast concrete is fairly easy to adjust the floor-to-floor heights, and use higher floor heights, whereas other systems, such as cast-in-place, typically require additional shoring and support.

'Even though they all rent and process vehicles, each company has its own procedures, so we have to provide a design with enough flexibility.'

In addition to taller spaces, designers also need to create open floor plans so each company can plan their spaces as they want and adapt them over time. "Even though they all rent and process vehicles, each company has its own procedures, so we have to provide a design with enough flexibility to meet each company's specific needs," says Wong. Variations also occur based on the location's climate and the type of business, such as if it's predominantly for business or vacations.

To maximize flexibility, Wong prefers to design with 60- by 60-foot bays. "A 60- by 40-foot grid can work, but the larger bay size offers more flexibility," says Wong. The CONRAC facility at Logan International Airport in Boston, Mass., used precast concrete components to achieve the 60- by 60-foot bays, with structural H-frames supporting loads along the perimeter and interior moment frames used between columns and tees. "We liked the flexibility that the precast concrete framing system could provide to give each company complete freedom in designing its layout," says Camille

Bechara, project manager and lead designer on the project with Parsons Brinckeroff. "Each has exclusive rights to lay out its space because there are no columns to impede them."

QTA Services

QTA Services require special attention, especially refueling areas and car washing. In most cases, these are located on the ground floor so concerns over elevating flammable materials and supporting heavy weights are mitigated.

"QTA areas can't be placed just anywhere, they must be organized and planned closely," says Lin. They and other areas require mapping out specific necessities and working with the precaster to ensure all openings and penetrations for any service lines are cut in advance and align properly. "Everything has to be systematized. It can become a nightmare if they aren't planned in advance."

In San Jose, a four-level QTA was created in a stand-alone structure adjacent to the parking structure. This allowed refueling stations and car washes to be created at intermediate levels with tall ceilings, so each QTA could service two rental-car parking levels, designers explained. Wash and rinse services were provided in multiple 2,000-gallon tanks on each level, including a reverse-osmosis system for spot-free rinsing. To protect against moisture penetration with such high water use, the floors feature added water resistance in the form of a 3 ½-inch topping on the double tees, followed by a hot-asphaltic waterproofing layer, and another 4-inch topping.

Refueling areas require even more attention due to the higher concerns for fire control. "We work very closely with fire marshals on all of our projects to show how we'll meet prescriptive code requirements with performance-based analysis," says Wong. That coordination allowed the firm to receive 100% approval for a CONRAC facility under design in Miami, Fla., that will feature approximately 150 refueling stations on three levels.

"Multilevel refueling is a new concept, and Miami was the first for us," he says. "It's the latest innovation for CONRACs, and car companies like it—it expands the refueling service especially with buildings that have smaller footprints." That's often the case, as rental-car companies want the CONRAC located close to the terminal to avoid transporting customers, but those are in-demand locations for parking, too. "Designers are always looking to add extra floors when the footprint is small, so expanding services to these levels provides added efficiency."

Nashville's refueling and washing services are located on the first floor, and officials worked closely with fire officials to meet all requirements. "We have the only CONRAC facility in the state, so the fire marshals were unfamiliar with the design and the needs," Holton explains. "We worked closely with them to make sure every requirement was met."

In San Jose, a number of objections to the original plan were raised. A key concern was protecting the pumps on each level from accidental vehicle damage that could spill gasoline and cause an explosion. This was met by adding shear valves to the pumps to stop the flow if equipment was hit. Additional concrete bollards were added around the fuel pumps delineated with striping. Eight-inch curbs separate inbound and outbound car lanes to eliminate chances for drifting into the wrong lanes.

Aesthetics Are Key

Because these large buildings are usually located close to terminals, they become a key landmark for airports, requiring attention to aesthetics. "Aesthetics are important to CONRACs because they are highly visible," says Wong. "They are usually one of the first and last buildings that visitors see, so they leave a lasting impression, even if they aren't using them directly."

Designers work with the client and local groups to define the image that is to be presented. Typically, these include nods to regional imagery and other customized touches. "They offer a unique opportunity to provide a distinctive look that reflects the region and offer a signature appearance for the airport," says Wong.

'They offer a unique opportunity to provide a distinctive look that reflects the region.'

Precast Concrete Benefits

High-performance precast concrete can provide a variety of benefits to a CONRAC project. Among its advantages are:

Design Flexibility. Double tees provide long-span capabilities, with the potential to create 60- by 60-foot bays with special engineering. They can eliminate columns to ensure each rental car company can design its space as it needs.

Durability. The inherent high strength and low permeability of precast concrete allows for easy maintenance and protection against water penetration or chemical washing agents.

Fire protection. The inherent inorganic composition of precast concrete prevents it from catching fire, and it can slow the spread of flame from any accident that occurs.

Accelerated Construction. Casting components off-site while site-preparation and foundation work is underway ensures the building can be erected quickly, saving time and allowing interior trades faster access. Also, precast concrete components can be erected through harsh winter weather, expanding the construction season and keeping projects on schedule.

Minimized congestion. By casting components off-site, fewer trades are required in high-activity areas near working runways and terminals.

Aesthetic versatility. Precast concrete's plasticity allows it to blend with existing buildings or create a singular statement in its design. Veneer can be embedded or formliners used to create texture, reveals, and other treatments.

High quality control. By casting under controlled conditions off-site, precast concrete components achieve high levels of quality assurance and create tight tolerances.

Sustainable design. Precast concrete contributes to multiple LEED points through its use of local materials and manufacture, recycled components, reduced construction waste, and other features.

Precast concrete components created 60- by 60-foot bays for the CONRAC facility at Logan International Airport in Boston , Mass. Structural H-frames supported loads along the perimeter, with interior moment frames used between columns and tees. Terra cotta veneer was applied to the exterior, its first use in North America on structural components. Photo: Fennick McCredie Architecture.

The Logan CONRAC facility used terra cotta embedded precast concrete panels, which were also part of the structural system. This was the first use in the country of load bearing panels with embedded terra cotta. The original plan called for inset brick to complement historic residential buildings facing the structure on two sides. But owners wanted a more contemporary look to blend with other modern airport buildings on the other sides.

The terra cotta provided warmth and texture while creating a panelized system that was easy to erect. The larger sizes of the masonry pieces provided the contemporary feel the owners sought. The panels feature ¾-inch terra-cotta veneer sheets measuring 2 by 3 feet embedded into the panels, which are large as 51-feet tall, 12-feet wide and 10.5-inches thick. The terra cotta was set into formliners and the concrete was cast over them, with added haunches on the reverse side of the panels to support the structure's double tees. Using embedded terra cotta saved about $1 million, Bechara estimates.

'Using embedded terra cotta saved about $1 million.'

In San Jose, city officials considered a variety of options for façade treatments up to the last minute, so precast concrete spandrels were installed that serve as car-impact shields as well as a base skin. Metal mesh and metal panels were later applied to these spandrels on three sides, while a unique large public-artwork mural was applied to the final side, featuring a photographic depiction of local citizens' hands waving greetings and farewells.

In Nashville, a kinetic sculpture was commissioned following a review of submitted options by the Airport Authority's Arts at the Airport Board. The winning design, "Wind Reeds" by Ned Kahn Studios in San Francisco, Calif., consists of more than 500 hinged-aluminum projections that sway with the wind's direction. The pieces are continuously moving and create new shadow lines and reflections throughout the day. They were installed on the helical ramp structure, which was clad with 40-foot-tall precast concrete panels cast with embeds so the sculptural elements could be added. "The ramp can be seen from different directions as passengers approach the terminal, so it's a very visible location," says Holton.

Sustainable Design Concepts

The Nashville CONRAC also features a green screen wall covered in vegetation, one of a variety of environmental elements that were added. "Incorporating sustainable-design concepts is a key initiative of the airport authority," says Holton. The project was not designed to be LEED-certified, she notes, but sustainable elements were incorporated where possible.

A key element of that was inherent in the CONRAC concept, she notes. Previously, car-rental companies had to drive two miles to refuel and wash cars. Now, with the services located in the building, the companies reduce their driving needs each year by more than 800,000 miles, saving gasoline and minimizing emissions. The building also includes water-reclamation systems, energy-efficient lighting, and a lighting-management system that adjusts lighting levels based on available natural light.

The Logan CONRAC achieved LEED Gold certification, the first major CONRAC in the nation to achieve this level of certification, using many of these same concepts. At the San Jose facility, cost savings accrued during construction led to the installation of a 1.12-mw modular system of 4,680 monocrystalline solar panels on 3.4 acres of the roof. The panels will produce an annual output of 1.7 million kWh, which will offset about 20% of the facility's electrical needs.

The precast concrete designs helped achieved sustainable-design goals through its use of local materials and local manufacturing, use of recycled materials and being recyclable after its service life, minimizing construction waste, and other features. (For more precast concrete benefits, see the sidebar.)

Working with Tight Project Sites

Environmental concerns and customer service are key reasons that

Photo: Fennick McCredie Architecture.

Photo: Blakeslee Prestress.

The terra cotta panels used on the Logan CONRAC project provided warmth and texture in a panelized system that was easy to erect. The sheets were ¾-inches thick and measured 2 by 3 feet. Using embedded terra cotta saved about $1 million, according to the architects. The project achieved LEED Gold certification.

Photo: Fennick McCredie Architecture.

CONRAC facilities are being placed as close to terminals as possible. "Airports want to look at more remote locations to avoid disruptions and avoid losing short-term parking, but rental-car companies want them close to make them more convenient," says Wong. "Rental car companies don't want to have to coordinate busing people to the location or using people movers. That's too costly, so they're putting pressure on to build them closer."

Trucking in precast concrete components for quick erection can speed up the schedule while eliminating site congestion. "We brought in our precast concrete along normal access and had no difficulties," Holton reports.

At the San Jose International Airport, the CONRAC facility was placed near the terminal on a very tight site, says Lin. "It was very condensed, so we had to work out access to the site and how we would bring in the precast concrete. We had to closely coordinate deliveries and how to place the cranes." A key challenge came from one of the control towers being adjacent to the site, requiring precise control of the three or four cranes working at once.

"Precast concrete can be easier to work with, but it also has to be coordinated with other activities around the site," he says. Some pieces were split up and reduced in size to make them more maneuverable around the tower.

In Nashville, 40-foot-tall panels used at the helix ramp, and in some other locations, were erected with cranes set up at night with four-hour road closures. "We had to shut down traffic to certain levels of the terminal for those few hours to get them set, but it went very quickly," Holton says.

In San Jose, construction roadways were built to allow the components to be delivered to the needed locations. "Using precast allowed much of the structural work to take place off-site, which greatly aided maneuvering on the congested site." Because of tight site constraints in some locations, parking bays were left out to facilitate crane and truck access. Construction sequencing allowed the double tees in those locations to be backfilled to complete the bay once the rest of the structure was erected.

As more CONRAC facilities are constructed, designers become more adept at creating efficiencies and using materials to their advantage. "We try to create a better design with each one we do, and more and more are being built all the time," says Wong. "Airports are land-poor and need space for parking and terminal expansions, so finding ways to provide all of the functions in more efficient ways is critical."

Nashville's Holton agrees. "The rental-car companies have told us since the first day the CONRAC opened that they need more space, and that need continues to grow," she says. "The space they have is very efficient, but they always want more so they can expand their business."

Those additions will come, Wong says. "We keep getting smarter with our systems and how we can make the projects more efficient. We can't take one design and use it anywhere else, as each has unique needs and challenges. But we can learn from each and incorporate the best ideas."

Precast concrete components often will be a consideration, as specifiers look at the benefits it offers and the challenges new projects must meet. "I did not have any experience with precast concrete prior to this project, and I learned a lot about using it," says Holton. "There are a lot of challenges with a CONRAC project, and a lot of coordination is needed working around an active airport. But from a construction professional's perspective, it's also a lot of fun."

METROBRICK, Built on 150 Years of Excellence

Park Place.

This year is a special one for METROBRICK's parent company Ironrock. This year—2016—marks the anniversary of 150 years of high-quality brick and tile manufacturing.

In 1866, Jacob Renkert, the company's founder, began his career in brick manufacturing. Today, Ironrock remains a fifth generation, family-owned company located in Canton, Ohio. The company is now under the direction of Guy Renkert, president and CEO.

As is likely to happen in a span of time that includes two world wars and a great depression, the product focus has changed over the years to meet the demands of the day. For example, Jacob Renkert began his career making fire brick for the iron industry. By 1889, he turned his attention to making paving bricks for an ever expanding roadway system. Metropolitan Paving Brick was used to pave sections of the Lincoln Highway. At one time, the Metropolitan Paving Brick Company was the largest road paving brick manufacturer in the world. The company's heritage also includes the production of structural glazed facing tile and refractory brick.

In the 1970s the company saw the need for a durable slip resisting tile product for demanding applications and began to focus on the production of extruded quarry tile. Today Ironrock is well known, under the Metropolitan Ceramics brand, as the largest quarry tile manufacturer in the United States. It was also at this time that the company began its first inroads into manufacturing thin brick with the development of a thin-brick panel system that may have been a bit ahead of its time.

With the introduction of METROBRICK in 2002, Ironrock built on its heritage and returned to the production of thin brick. This time, Ironrock found the market ready for thin-brick solutions, especially in combination with precast construction. Back when Ironrock entered into quarry tile manufacturing they did so with a brand new production facility, one that was designed to extrude and fire thin material. Having a plant that was designed to extrude thin was a great advantage in manufacturing thin brick.

Lincoln Highway.

REMC Utility.

Ironrock Robot Harry.

The system was already in place to give the precast market the type of thin brick it required, one that would meet the tight tolerances for corners and flats needed to fit form-liners. Today, METROBRICK is specified on precast buildings throughout the country, and continues to add to its product offering with additional colors and finishes. The most recent examples are a charcoal color and a vertical wire cut finish available in modular size on both flats and corners.

Ironrock is able to celebrate 150 years in brick and tile manufacturing because of a commitment to doing things the right way combined with a willingness to adapt to the needs of a changing market. METROBRICK is the culmination of those years of experience and dedication.

One visible example of Ironrock's commitment has been the addition of automation and robotics over the last number of years at key intervals throughout the production process. And as a visible way to pay homage to generations of family leadership over the years, the company has taken to naming various robots on the production floor after key figures. Names such as Hal, Steve, Harry, Amy, and, of course, Jacob can be seen in bold block letters on various robotic arms. Ironrock continues to provide quality products like METROBRICK because of this commitment to look forward while still honoring the past.

For more information: www.metrothinbrick.com.

The Landings.

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Celebrating

150 YEARS

of history

IRONROCK

Brick and Tile Makers Since 1866

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PCI Precast/Prestressed Concrete Institute

CONTINUING EDUCATION AIA

Terra Cotta-Faced Precast Concrete

PCI designer's notebook

TERRA COTTA-FACED PRECAST CONCRETE

Terra cotta tiles have been used to clad buildings in the United States for several decades, providing a distinctive aesthetic touch. Today, designers are discovering they can embed terra cotta into architectural and structural precast concrete panels as a means to more efficiently use terra cotta on projects. There are also several additional benefits, including aesthetic versatility, accelerated construction, reducing the number of joints and maintenance costs, and high thermal performance.

Many architectural firms have used terra cotta with rainscreens on a number of overseas projects. Hand-setting the material into a traditional rainscreen application in the United States is not as economical as overseas as it leads to higher material and labor costs. A rainscreen design requires stud backing, sheathing, membrane, and aluminum extrusions (a complicated detailing process). Whereas, a terra cotta embedded precast concrete panel can achieve the same look, but provide a more cost-effective solution because of precast concrete's ability to provide multiple functions.

The following discussion on design concepts and details for terra cotta cladding is taken from a presentation by Kristen Vican, RTKL Associates Inc., Washington, D.C., on the 16-story Hyatt Regency expansion at Tysons Corner, McClean, Va., **Fig. 1a and 1b.**

Early collaboration during schematic design is key. Discussions about design concepts,

Figure 1a Hyatt Regency expansion, Tysons Corner, McClean, Va. All figures and photos: RTKL Associates.

Figure 1b Typical precast panel elevation.

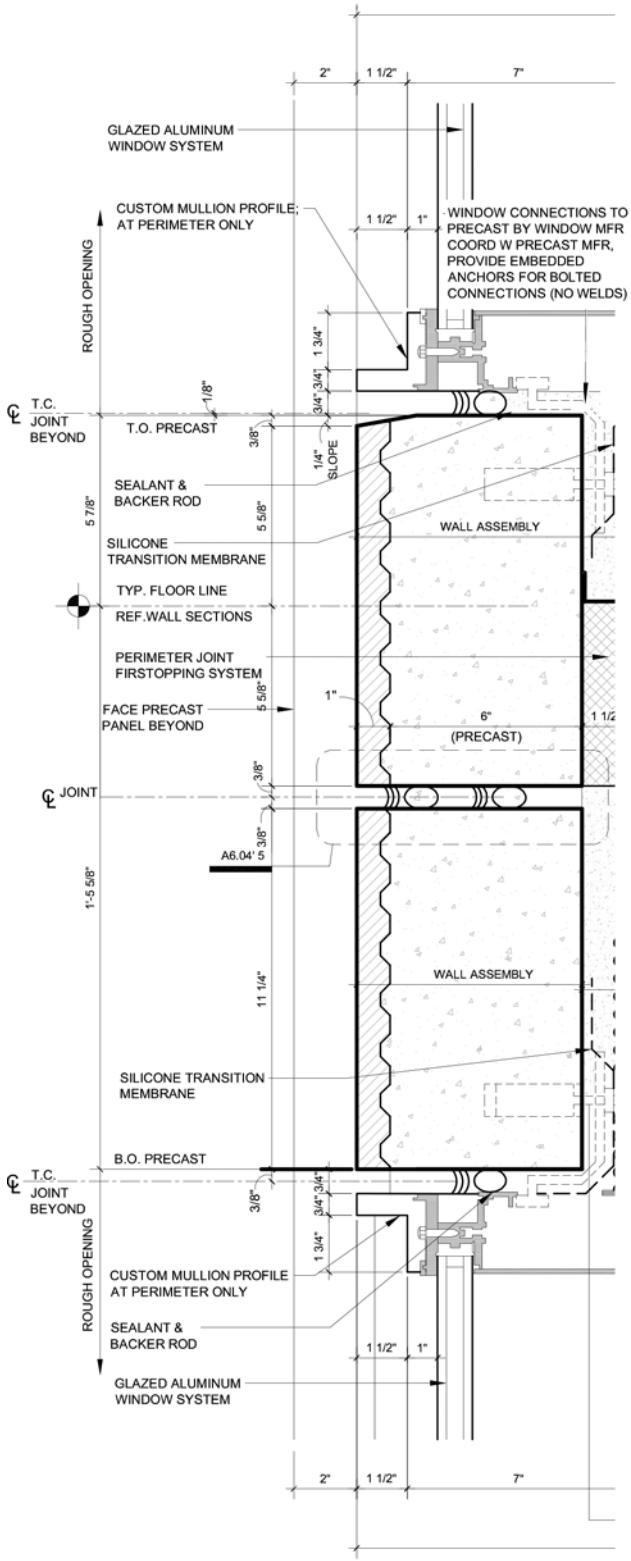

Figure 1c Wall section showing custom mullion to conceal terra cotta edge.

such as panelization, and detailing concerns need to be addressed with the precaster and terra cotta tile manufacturer, and the plants should be visited to understand the material and fabrication restraints. Specifications should include testing and full-size, visual mock-up requirements.

Possibly the biggest challenge involves detailing to ensure the floor-to-floor heights work with the tile dimensions to avoid having to cut the tile and leave an exposed edge. Horizontal dimensions are more critical than vertical ones, as these tiles can be more easily modified. Punched windows also must be coordinated to ensure the tile joints align. Punched windows are more challenging to do with terra cotta because of the need to cut the tile. To resolve this, the design team for the Hyatt Regency designed a custom mullion that covers the edges of panels at window openings to avoid needing returns on panels, **Fig. 1c**. It is desirable to consider window placement depth or mullion profiles to conceal edges. The concern with creating metal frames and trim is that the design still needs to allow tolerances for each material, which creates a wider gap. It is preferable to extend the edges of the precast panel past the edges of the terra cotta tiles to cover the ends.

Vertical joints should be kept shallow to minimize water infiltration behind tile at ship-lap joints. Horizontal joints are less problematic because they typically are ship-lapped, **Fig. 1d**. To ensure

continuity of the terra cotta between panels without changing the joint width, joints should be the governing factor and the width at the overlap should accommodate the tile lip.

Custom tiles with finished edges and no ship-lap extension may be required between precast panels and at the top and bottom of rough openings. Angled tiles should be used at sill conditions.

Full-size mock-up panels are essential to ensure all conditions and situations are considered and reviewed prior to the start of precast erection. An aesthetic review should include the location and color of face mixes, selection of reveal depths, and selection of sealant colors. A review of patch and repair procedures also should be undertaken, including the process for replacing a full tile and for repairing minor damage, **Fig. 1e**. Tests performed on the materials, at an independent facility, should include tests for tensile bond strength (pull out tests) and freeze-thaw resistance. See PCI Specification for Embedded Architectural Terra Cotta in Precast Concrete Systems.

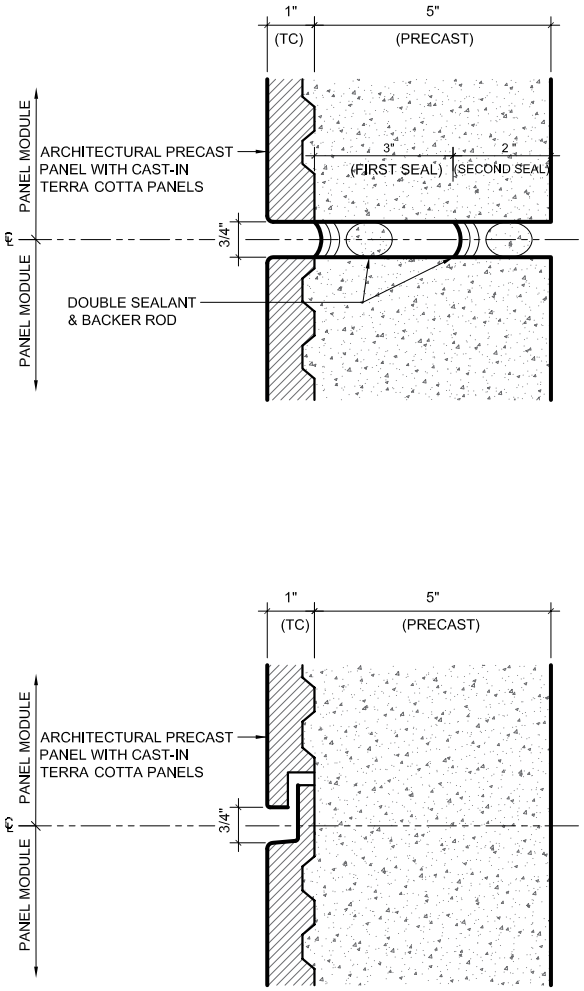

Figure 1d Typical joint and reveal at terra cotta.

The objective of the PCI Specification is to outline material standards and specification criteria for terra cotta manufacturers to meet when supplying materials to precast concrete manufacturers. The intent is to establish acceptable dimensional tolerances and consistent testing standards for terra cotta embedded in precast concrete systems.

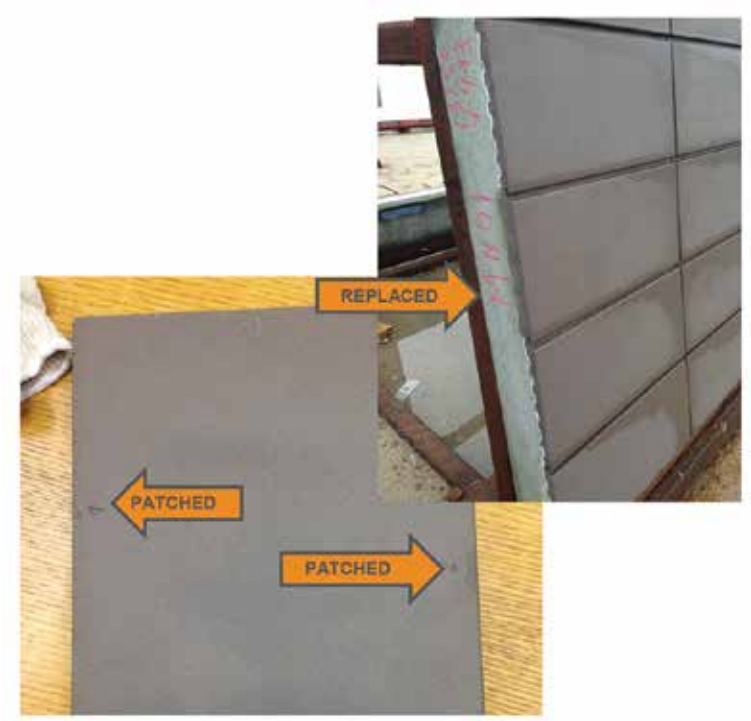

Figure 1e Patch and repair.

The terra cotta manufacturers must confirm through the provision of independent test results that their terra cotta products comply with the PCI Specification. The PCI Specification should appear in all project specifications for terra cotta to be embedded in precast concrete. Terra cotta manufacturers have agreed to promote the compliance of their terra cotta with this specification.

The established parameters are based on the successful use of embedded terra cotta in precast concrete projects. The parameters set forth for use in this specification are attainable terra cotta properties that have been derived with input from terra cotta manufacturers, precasters, engineers, and architects, as well as consideration of existing test results.

Suggested Visual Mock-up Requirements

Erect on site, at location directed by architect, typical prototype installation of precast concrete and terra cotta-faced precast concrete complete with adjacent building systems interfaces as shown on architect's drawings.

1. Simulate final wall conditions including joint conditions, flashings, sealants including two-stage seal conditions, anchorage, supports and other features used in final work.
2. Construct mock-ups prior to ordering final materials and after acceptance of samples.
3. Display full, accepted color range and texture. Replace rejected panels until acceptable color range is achieved.
4. Show types of surface defects expected to be encountered, including repair procedures and workmanship. If acceptable repair procedures cannot be achieved on mock-up for specific defects and deficiencies, those defects and deficiencies shall be considered as cause for rejection of panels.
    a. Show patching for minor damage to a tile.
    b. Show replacement technique for one typical full terra cotta tile.
    c. Before commencing mock-up patching, confirm patching procedures with architect and establish by trial mix formula for patching of finish. Demonstrate patching techniques on mock-up panels prior to actual use on any project units.
5. Incorporate transitions to related primary materials specified in other sections per the mock-up panels described on architect's drawings.
6. Maintain approved mock-up until completion of precast work.

Pre-production sample mock-up: Construct typical precast panels for inspection and approval at precast plant by architect prior to full production release.

PCI Specification for Embedded Architectural Terra Cotta in Precast Concrete Systems

A. Terra Cotta Units: Thickness, not less than 3/4 in. (19 mm) nor more than 1-1/2 in. (38 mm)

1. Size-Dimensional Tolerances:

   a. Width: Plus or minus 0.039 in. (±1 mm) for any length up to 60 in. (1.5 m).

   b. Height: Plus or minus 0.0625 in. (±1.6 mm) up to 10 in. (250 mm).

      Plus or minus 0.09375 in. (±2.4 mm) up to 15 in. (380 mm).

      Plus or minus 0.125 in. (±3.2 mm) up to 20 in. (500 mm).

      Plus or minus 0.156 in. (±4 mm) up to 24 in. (0.6 m).

   c. Thickness: Plus or minus 0.0625 in. (±1.6 mm).

2. Color and Texture: **[Match Architect's approved samples]**.

   [Match existing adjacent terra cotta]

   a. **<Insert information on existing terra cotta if known>**

3. Special Shapes: Include corners, edge corners, and end edge corners.

4. Cold Water Absorption at 24 hours: Maximum 6.0% when tested in accordance with ASTM C 67.

5. Efflorescence: Rated "not effloresced" when tested in accordance with ASTM C 67.

6. Out of Square: Plus or minus 1/16 in. (±1.6 mm) when measured in accordance with ASTM C 67.

7. Warpage Tolerances:

   a. Straightness (sweep): Plus or minus 0.25% of length

   b. Diagonal Flatness: Plus or minus 0.25% of diagonal

   c. Vertical Flatness: Plus or minus 0.5% of height

8. Variation of Shape from Specified Angle: Plus or minus 1 degree.

9. Tensile Bond Strength: Not less than 150 psi (1 MPa), before and after freeze-

thaw testing, when tested in accordance with modified ASTM E 488. Epoxy steel plate with welded rod on total terra cotta surface for each test.

10. Freeze-Thaw Resistance: No detectable deterioration (spalling, cracking, or chafing) after 300 cycles when tested in accordance with ASTM C 666 Method A or B.

11. Modulus of Rupture: Not less than 2000 psi (13.8 MPa) when tested in accordance with ASTM C 67.

12. Compressive Strength: Not less than 6000 psi (41.4 MPa) when tested in accordance with ASTM C 67.

13. Chemical Resistance: Rated "not affected" when tested in accordance with ASTM C 126.

14. Glaze Resistance to Crazing: Rated "not affected" when tested in accordance with ASTM C 126.

15. Back Surface: Dovetail.

B. Test sample size and configuration shall conform to the following parameters in order to validate compliance by terra cotta manufacturer with PCI Specification for use in embedded terra cotta precast concrete systems:

1. Minimum number of test specimens: Comply with appropriate specifications except for freeze-thaw and tensile bond strength tests on assembled systems.

2. Minimum number of test specimens for freeze-thaw and tensile bond strength test: Ten (10) assembled systems measuring 18 in. x 10 in. (450 mm x 250 mm) long with a 16 in. x 8 in. (400 mm x 200 mm) piece of terra cotta embedded into the concrete substrate (assembled system). Note the piece of terra cotta shall have a dovetail back surface geometry. The 10 assembled systems are divided into five Sample **A** assemblies and five Sample **B** assemblies. The precast concrete substrates shall have a minimum thickness of 2-1/2 in. (63 mm) plus an embedded maximum 1-1/2 -in. (38 mm) -thick piece of terra cotta. The precast concrete shall have a minimum compressive strength of at least 5000 psi (34.5 MPa) and 4% to 6% entrained air. The 16 in. x 8 in. (400 mm x 200 mm) embedded terra cotta piece shall be centered in the 18 in. x 10 in. (450 mm x 250 mm) sample.

About AIA Learning Units

Please visit www.pci.org/elearning to read the complete article, as well as to take the test to qualify for 1.0 HSW Learning Unit.

The Precast/Prestressed Concrete Institute (PCI) is a Registered Provider with both the American Institute of Architects (AIA) and the National Council of Examiners for Engineers and Surveyors (NCEES). Continuing education credit is reported to both agencies.

All certificates of completion, for architects and for engineers, will be available from the Registered Continuing Education Provider (RCEP) web site at www.rcep.net. PCI reports data twice per month so you should see your credits appear (and your certificate will be ready) within 30 days of our receiving your completed quiz.

If you are new to the Registered Continuing Education Provider system, www.rcep.net will email you a welcome email when PCI uploads your data. That email will contain your account password. Your login name at www.rcep.net will be your email address, so you must include it when submitting your completed quiz.

Instructions

Review the learning objectives below.

Read the AIA Learning Units article. Note: The complete article is available at www.pci.org/elearning.

Complete the online test. You will need to answer at least 80% of the questions correctly to receive the 1.0 HSW Learning Units associated with this educational program.

Learning Objectives:

After reading this article, readers will be able to:

1. Describe the design considerations for the application of terra cotta on precast concrete.
2. Explain how terra cotta is used in precast concrete.
3. Describe the benefits of using terra cotta-faced precast concrete.
4. Explain the specification and requirements when using terra cotta with precast concrete.

Questions: contact Education Dept. - Alex Morales, (312) 786-0300, Email amorales@pci.org

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 www.pci.org/education.

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 www.pci.org/webinars for the full webinar schedule and registration information.

Upcoming Webinars

January 26 and 28: Building High-Performance Educational Facilities–K-12 schools are a vital part of the fabric of our society that directly contribute to what our future will be. These are places where future generations learn more than just math and science, they learn about people, life, and develop key life skills. Today's schools are more than just buildings, they are interactive learning environments. They are gathering places. They are safe havens for a community. This presentation will discuss recommendations on how to design and build high-performance schools, which provide energy efficiency, safety, and resiliency, as well as reduce life-cycle costs. Aesthetics, acoustics, schedule, and fire protection will also be discussed. Case studies will be used to highlight topics discussed.

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. Visit this resource at www.pci.org/elearning.

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 www.pci.org/education for up-to-date seminar listings, additional information, and registration.

Upcoming Seminars and Workshops:

Quality Control Schools

Level I/II
February 1-3, Las Vegas, Nev.
February 16-18, Toronto, ON, Canada
May 9-11, Charlotte, N.C.
June 20-22, Harrisburg, Pa.

Level III
May 11-14, Charlotte, N.C.

CFA
February 1-3, Las Vegas, Nev.

CCA
February 4, Las Vegas, Nev.

Visit www.pci.org/schools 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 www.pci.org/education/box_lunches for a list of lunch-and-learn offerings and to submit a program request.

PCI Online Academy

PCI's Online Academy offers weekly, 90-minute evening sessions focused on helping working professionals earn their continuing education credit without impacting their work day. This February PCI's Online Academy returns with a unique program for all professionals involved in the special inspection of precast concrete structures.

PCI's Special Inspector's Program is a one-of-a-kind program designed to help special inspectors comply with the training requirement of the building code. Inspection of precast concrete construction requires the expertise of an approved special inspector in order to ensure compliance with the International Building Code and approved construction documents. Special inspectors are required to provide written documentation to building officials demonstrating competence and relevant experience or training, and this program uniquely fits the bill for special inspector of precast concrete structures.

This three-week course is scheduled for Thursday evenings February 11, 18, and 25 and will be presented by the programs principle author. Each session will include a post-course assessment to measure learning and participants will earn a total of 4.5 professional development hours. Visit us online for special rate information at http://www.pci.org/Education/Online_Academy/.

PCI-Certified Plants

(as of January, 2016)

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 PCI plant that is 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 Precast and Prestressed Concrete Products*
- MNL–117 *Manual for Quality Control for Plants and Production of Architectural Precast Concrete*
- 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.

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

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 non-load-bearing wall panels, spandrels, beams, mullions, columns, column covers, and miscellaneous shapes. This category includes Category AT.

GROUP B – *Bridges*

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 (while it is 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 (while it is not certified to produce any products in Groups 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

Gate Precast Company, Monroeville (251) 575-2803 — **A1, C4, C4A**
Forterra Building Products (Pelham Prestress), Pelham (205) 663-4681 — **B4, C4**

ARIZONA

Coreslab Structures (ARIZ) Inc., Phoenix (602) 237-3875 — **A1, B4, C4, C4A**
Green Fuel Technologies LLC dba Royden Precast, Phoenix (602) 484-0028 — **B4**
LB Foster/CXT Concrete Ties, Tuscon (520) 882-3995 — **C2**
Stringer Bridge & Iron, Coolidge (520) 723-5383 — **B4**
Tpac, An EnCon Company, Phoenix (602) 262-1360 — **A1, B4, C4, C4A**

ARKANSAS

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

CALIFORNIA

Bethlehem Construction, Inc., Wasco (661) 391-9704 — **C3, C3A**
Clark Pacific, Fontana (909) 823-1433 — **A1, C3, C3A, G**
Clark Pacific, Irwindale (626) 962-8751 — **C4A**
Clark Pacific, West Sacramento (916) 371-0305 — **A1, C3, C3A**
Clark Pacific, Woodland (503) 207-4100 — **A1, B3, C4, C4A**
Con-Fab California Corporation, Lathrop (209) 249-4700 — **B4, C4**
Con-Fab California Corporation, Shafter (661) 630-7162 — **B4, C4**
Coreslab Structures (L.A.) Inc., Perris (951) 943-9119 — **A1, B4, C4, C4A**
KIE-CON, Inc., Antioch (925) 754-9494 — **B4, C3**
Mid-State Precast, L.P., Corcoran (559) 992-8180 — **A1, C3, C3A**
Oldcastle Precast, Inc., Perris (951) 657-6093 — **B4, B4A, C2, C2A**
Oldcastle Precast Inc., Stockton (209) 466-4215 — **C2**
Precast Concrete Technology dba CTU Precast, Olivehurst (530) 749-6501 — **A1, C3, C3A**
StructureCast, Bakersfield (661) 833-4490 — **A1, B3, C3, C3A**
Universal Precast Concrete, Inc., Redding (530) 243-6477 — **A1**
Walters & Wolf Precast, Fremont (510) 226-9800 — **A1, G**
Willis Construction Co., Inc., San Juan Bautista (831) 623-2900 — **A1, C1, G**

COLORADO

EnCon Colorado, Denver (303) 287-4312 — **B4, C2**
Plum Creek Structures, Littleton (303) 471-1569 — **B4, C3, C3A**
Rocky Mountain Prestress LLC, Architectural Plant Denver (303) 480-1111 — **A1, C3, C3A**
Rocky Mountain Prestress LLC, Structural Plant, Denver (303) 480-1111 — **B4, C4**
Rocla Concrete Tie, Inc., Pueblo (303) 296-3500 — **C2**
Stresscon Corporation, Colorado Springs (719) 390-5041 — **A1, B4, B4A, C4, C4A**

CONNECTICUT

Blakeslee Prestress Inc., Branford (203) 481-5306 — **A1, B4, C4, C4A**
Coreslab Structures (CONN) Inc., Thomaston (860) 283-8281 — **A1, B1, C1**
Oldcastle Precast, Avon (860) 673-3291 — **B2, C1, C1A**
United Concrete Products, Inc., Yalesville (203) 269-3119 — **B3, C3**

DELAWARE

Concrete Building Systems of Delaware, Inc., Delmar (302) 846-3645 — **B3, C4**
Rocla Concrete Tie, Inc., Bear (302) 836-5304 — **C2**

FLORIDA

Cement Industries, Inc., Fort Myers (800) 332-1440 — **B3, C3**
Colonial Construction, Concrete, Precast, LLC, Placida (941) 698-4180 — **C2**
Coreslab Structures (MIAMI) Inc., Medley (305) 823-8950 — **A1, C4, C4A**
Coreslab Structures (ORLANDO) Inc., Orlando (407) 855-3190 — **C2**
Coreslab Structures (TAMPA) Inc., Tampa (813) 626-1141 — **A1, B3, C3, C3A**
Dura-Stress, Inc., Leesburg (352) 787-1422 — **A1, B4, B4A, C4, C4A**
Finfrock Industries, Inc., Orlando (407) 293-4000 — **A1, C3**
Gate Precast Company, Jacksonville (904) 757-0860 — **A1, B4, C3, C3A**
Gate Precast Company, Kissimmee (407) 847-5285 — **A1, C3**
International Casting Corporation, Miami Lakes (305) 558-3515 — **C3**
Metromont Corporation, Bartow (863) 440-5400 — **A1, C3, C3A**
Pre-Cast Specialties Inc., Pompano Beach (954) 781-4040 — **C4**
Spancrete Southeast Inc., Sebring (863) 655-1515 — **C2**
Stabil Concrete Products, LLC, St. Petersburg (727) 321-6000 — **A1**
Standard Concrete Products, Inc., Tampa (813) 831-9520 — **B4, C3**
Structural Prestressed Industries, Medley (305) 556-6699 — **C4**

GEORGIA

Atlanta Structural Concrete Co., Buchanan (770) 646-1888 — **C4, C4A**
Coreslab Structures (ATLANTA) Inc., Jonesboro (770) 471-1150 — **C2**
Metromont Corporation, Hiram (770) 943-8688 — **A1, C4, C4A**
Spancrete, Newnan (770) 252-8944 — **C2**
Standard Concrete Products, Inc., Atlanta (404) 792-1600 — **B4**
Standard Concrete Products, Inc., Savannah (912) 233-8263 — **B4, C4**
Tindall Corporation, Georgia Division, Conley (404) 366-6270 — **C4, C4A**

HAWAII

GPRM Prestress, LLC, Honolulu (808) 682-6000 — **A1, B4, C4**

IDAHO

Forterra Structural Precast, Caldwell (208) 454-8116 — **A1, B4, C4**
Teton Prestress Concrete, LLC., Idaho Falls (208) 523-6410 — **B4, C3**

ILLINOIS

ATMI Precast, Aurora (630) 896-4679 — **A1, C3, C3A**
AVAN Precast Concrete Products, Lynwood (708) 757-6200 — **A1, C3**
County Materials Corporation, Champaign (217) 352-4181 — **B3, B3-IL**
County Materials Corporation, Salem (618) 548-1190 — **A1, B4, B4-IL, C4**
Dukane Precast, Inc., Aurora (630) 355-8118 — **A1, B3, B3-IL, C3, C3A**
Dukane Precast, Inc., Naperville (630) 355-8118 — **A1, B3, C3, C3A**
Dukane Precast, Inc., Plainfield, (815) 230-4760 — **C3**
ICCI Illini Concrete, LLC, Tremont (309) 925-2376 — **B3, B3-IL**
Illini Precast, LLC, Westchester (815) 795-6161 — **B4, B4-IL, C3**
KW Precast LLC, Westchester (708) 562-7770 — **B4, B4-IL, C4**
Lombard Architectural Precast Products Co., Alsip (708) 389-1060 — **A1, C2, C2A**
Mid-States Concrete Industries, South Beloit (815) 389-2277 — **A1, B3, B3-IL, C3, C3A**
St. Louis Prestress, Inc., Glen Carbon (618) 656-8934 — **B3, B3-IL, C3**
Utility Concrete Products, LLC, Morris (815) 416-1000 — **B1, B1A, C1, C1A**

INDIANA

ATMI Indy, LLC, Greenfield (317) 891-6280 — **A1, C2, C2A**
Coreslab Structures (INDIANAPOLIS) Inc., Indianapolis (317) 353-2118 — **A1, C4, C4A**
Hoosier Precast LLC, Salem (815) 459-4545 — **B3, C1, C1A**
Precast, LLC dba Precast Specialties, Monroeville (260) 623-6131 — **A1, B1**
Prestress Services Industries LLC, Decatur (260) 724-7117 — **B4, B4-IL, C4, C4A**
StresCore, Inc., South Bend (574) 233-1117 — **C2**

IOWA

Advanced Precast Co., Farley (563) 744-3909 — **A1, C1, C1A**
Cretex Concrete Products Midwest, Inc., Iowa Falls (641) 648-2579 — **A1, B4, B4-IL, C4, C4A**
MPC Enterprises, Inc., Mount Pleasant (319) 986-2226 — **A1, C3, C3A**
PDM Precast, Inc., Des Moines (515) 243-5118 — **A1, C3, C3A**

KANSAS

Coreslab Structures (KANSAS) Inc., Kansas City (913) 287-5725 — **B4, C4**
Prestressed Concrete, Inc., Newton (316) 283-2277 — **A1, B4, C4, C4A**
Stress-Cast, Inc., Assaria (785) 667-3905 — **C3, C3A**

KENTUCKY

Bristol Group, Inc., Lexington (859) 233-9050 — **A1, B3, B3A, C3, C3A**
de AM - RON Building Systems LLC, Owensboro (270) 684-6226 — **B3, C3, C3A**
Gate Precast Company, Winchester (859) 744-9481 — **A1, C3, C3A**
Prestress Services Industries LLC, Lexington (601) 856-4135 — **A1, B4, C4, C4A**
Prestress Services Industries LLC, Melbourne (859) 441-0068 — **B4, C3**

LOUISIANA

Atlantic Metrocast, Inc., New Orleans (504) 941-3152 — **C2**
Boykin Brothers, Inc./Louisiana Concrete, Baton Rouge (225) 753-8722 — **A1, B4, C3, C3A**
F-S Prestress, LLC, Princeton (318) 949-2444 — **B4, C3**

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

MAINE

Superior Concrete, LLC, Auburn (207) 784-9144 — **B2, C1**

MARYLAND

Larry E. Knight, Inc., Glyndon (410) 833-7800 — **C2**
Oldcastle Precast Building Systems Div., Edgewood (800) 523-3747 — **A1, C3, C3A**

MASSACHUSETTS

Oldcastle Precast, Inc., Rehoboth (508) 336-7600 — **B4, C3**
Precast Specialties Corp., Abington (781) 878-7220 — **A1**
Unistress Corporation, Pittsfield (413) 629-2039 — **A1, B4, C4, C4A**
Vynorius Prestress, Inc., Salisbury (978) 462-7765 — **B3, C2**

MICHIGAN

International Precast Solutions, LLC, River Rouge (313) 843-0073 — **A1, B3, C3, C3A**
Kerkstra Precast Inc., Grandville (616) 224-6176 — **A1, B3, C3, C3A**
M.E.G.A. Precast, Inc., Shelby Township (586) 294-6430 — **A1, C3, C3A**
Nucon Schokbeton/Stress-Con Industries, Inc.,
Kalamazoo (269) 381-1550 — **A1, B4, C3, C3A**
Peninsula Prestress Company, Grand Rapids (517) 206-4775 — **B4, C1**
Stress-Con Industries, Inc., Saginaw (989) 239-2447 — **B4, C3**

MINNESOTA

Crest Precast, Inc., La Crescent (800) 658-9045 — **B3, B3A, C3, C3A**
Cretex Concrete Products Midwest, Inc., Elk River (763) 441-2124 — **B4, C2**
Fabcon Precast, LLC, Savage (952) 890-4444 — **A1, B1, C3, C3A**
Molin Concrete Products Co., Lino Lakes (651) 786-7722 — **C3, C3A**
Wells Concrete, Albany (320) 845-2299 — **A1, C3, C3A**
Wells Concrete, Wells (800) 658-7049 — **A1, C4, C4A**
Wells Concrete–Maple Grove, Osseo (763) 425-5555 — **A1, C4, C4A**

MISSISSIPPI

F-S Prestress, LLC, Hattiesburg (601) 268-2006 — **B4, C4**
Gulf Coast Pre-Stress, Inc., Pass Christian (228) 452-9486 — **B4, C4**
J.J. Ferguson Prestress-Precast Company, Inc., Greenwood (662) 453-5451 — **B4**
Jackson Precast, Inc., Jackson (601) 321-8787 — **A1, C2, C2A**
Tindall Corporation, Moss Point (228) 246-0800 — **A1, C4, C4A**

MISSOURI

Coreslab Structures (MISSOURI) Inc., Marshall (660) 886-3306 — **A1, B4, C4, C4A**
County Materials Corporation, Bonne Terre (636) 432-0225 — **B4**
Mid America Precast, Inc., Fulton (573) 642-6400 — **A1, B1, C1**
Prestressed Casting Co., Ozark (417) 581-7009 — **C4**
Prestressed Casting Co., Springfield (417) 869-7350 — **A1, C3, C3A**

MONTANA

BC Concrete, Inc. dba Missoula Concrete Construction,
Missoula (406) 549-9682 — **A1, B3, C3, C3A**
Cretex Concrete Products, Inc., Billings (406) 656-1601 — **B4, C3**
Montana Prestressed Concrete - MT City Plant, Helena (406) 442-6503 — **B4**

NEBRASKA

American Concrete Products Co., Omaha (402) 331-5775 — **B1, B1A, C1, C1A**
Concrete Industries, Inc., Lincoln (402) 434-1800 — **B4, C4, C4A**
Coreslab Structures (OMAHA) Inc., Bellevue (402) 291-0733 — **A1, B4, C4, C4A**
Enterprise Precast Concrete, Inc., Omaha (402) 895-3848 — **A1, C2, C2A**

NEVADA

Precast Management Corporation, Sloan (702) 370-5217 — **B4, C2**

NEW HAMPSHIRE

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

NEW JERSEY

Boccella Precast LLC, Berlin (856) 767-3861 — **C2**
Jersey Precast, Hamilton (609) 689-3700 — **B4, C4**
Northeast Precast, Millville (856) 765-9088 — **A1, B3, C3, C3A**
Precast Systems, Inc., Allentown (609) 208-1987 — **B4, C4**

NEW MEXICO

Castillo Prestress, Belen (505) 864-0238 — **B4, C4**
Coreslab Structures (ALBUQUERQUE) Inc.,
Albuquerque (505) 247-3725 — **A1, B4, C4, C4A**
Ferreri Concrete Structures Inc., Albuquerque (505) 344-8823 — **A1, C4, C4A**

NEW YORK

David Kucera Inc., Gardiner (845) 255-1044 — **A1, G**
Lakelands Concrete Products, Inc., Lima (585) 624-1990 — **A1, B3, B3A, C3, C3A**
Oldcastle Precast Building Systems Div., Selkirk (518) 767-2116 — **B3, C3, C3A**
The Fort Miller Company, Inc., Schuylerville (518) 695-4970 — **B3, B3A, C1**
The L.C. Whitford Materials Co., Inc., Wellsville (585) 593-2741 — **B4, C3**

NORTH CAROLINA

Coastal Precast Systems , LLC, Wilmington (910) 604-2249 — **B2, C2**
Gate Precast Company, Oxford (919) 603-1633 — **A1, C2**
Metromont Corporation, Charlotte (704) 372-1080 — **A1, C3, C3A**
Prestress of the Carolinas, Pineville (704) 587-4273 — **B4, C4**
Utility Precast, Inc., Concord (704) 721-0106 — **B3, B3A**

NORTH DAKOTA

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

OHIO

DBS Prestress of Ohio, Huber Heights (937) 878-8232 — **C3**
Fabcon Precast, LLC, Grove City (952) 890-4444 — **A1, C3, C3A**
High Concrete Group LLC, Springboro (937) 748-2412 — **A1, C3, C3A**
Mack Industries, Inc., Valley City (330) 483-3111 — **C2**
Prestress Services Industries of Ohio, LLC, (I-Beam),
Mt. Vernon (800) 366-8740 — **A1, B4, C3**
Prestress Services Industries of Ohio, LLC,, (Box Beam),
Mt. Vernon (740) 393-1121 — **B3, C3**
Rocla Concrete Tie, Inc., Sciotoville (740) 776-3238 — **C2**
Sidley Precast, Thompson (440) 298-3232 — **A1, C4, C4A**

OKLAHOMA

Arrowhead Precast, LLC, Broken Arrow (918) 995-2227 — **A1, C3, C3A**
Coreslab Structures (OKLA) Inc. (Plant No.1),
Oklahoma City (405) 632-4944 — **A1, C4, C4A**
Coreslab Structures (OKLA) Inc. (Plant No.2), Oklahoma City (405) 672-2325 — **B4, C1**
Coreslab Structures (TULSA) Inc., Tulsa (918) 438-0230 — **B4, C4**

OREGON

Knife River Corporation, Harrisburg (541) 995-6327 — **A1, B4, C4, C4A**
R.B. Johnson Co., McMinnville (503) 472-2430 — **B4, C3**

PENNSYLVANIA

Architectural Precast Innovations, Inc., Middleburg (570) 837-1774 — **A1, C3, C3A**
Brayman Precast, LLC, Saxonburg (724) 352-5600 — **B1, C1**
Brayman Precast, LLC, Speers Plant, Belle Vernon (724) 352-5600 — **B1, C1**
Concrete Safety Systems, LLC, Bethel (717) 933-4107 — **A1, B1, B1A, C1, C1A**
Conewago Precast Building Systems, Hanover (717) 632-7722 — **A1, C3,C3A**
Dutchland, Inc., Gap (717) 442-8282 — **C3**
Fabcon Precast, LLC, Mahanoy City (952) 890-4444 — **A1, B1, B1A, C3, C3A**
High Concrete Group LLC, Denver (717) 336-9300 — **A1, B3, C3, C3A**
J & R Slaw, Inc., Lehighton (610) 852-2020 — **A1, B4, C3, C3A**
Nitterhouse Concrete Products, Inc., Chambersburg (717) 267-4505 — **A1, C4, C4A**
Northeast Prestressed Products, LLC, Cressona (570) 385-2352 — **B4, C3**
PENNSTRESS, Roaring Spring (814) 224-2121 — **A1, B4, C4**
Say-Core, Inc., Portage (814) 736-8018 — **C2**
Sidley Precast, Youngwood (724) 755-0205 — **C3**
Universal Concrete Products Corporation, Stowe (610) 323-0700 — **A1, C3, C3A**
US Concrete Precast Group Mid-Atlantic, Middleburg (570) 837-1774 — **A1, C3, C3A**

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RHODE ISLAND

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

SOUTH CAROLINA

Florence Concrete Products, Inc., Sumter (803) 775-4372 — **B4, C3, C3A**
Metromont Corporation, Greenville (864) 605-5000 — **A1, C4, C4A**
Tekna Corporation, Charleston (843) 853-9118 — **B3, C3**
Tindall Corporation, Spartanburg (864) 576-3230 — **A1, C4, C4A**

SOUTH DAKOTA

Gage Brothers, Sioux Falls (605) 336-1180 — **A1, B4, C4, C4A**

TENNESSEE

Construction Products, Inc. of Tennessee, Jackson (731) 668-7305 — **B4, C4**
Gate Precast Company, Ashland City (615) 792-7608 — **A1, C3, C3A**
Mid South Prestress, LLC, Pleasant View (615) 746-6606 — **C3**
Ross Prestressed Concrete, Inc., Bristol (423) 323-1777 — **B4, C3**
Ross Prestressed Concrete, Inc., Knoxville (865) 524-1485 — **B4, C4**

TEXAS

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

UTAH

Forterra Structural Precast, Salt Lake City (801) 966-1060 — **A1, B4, C4, C4A, G**
Granite Construction Company, Salt Lake City (801) 526-6000 — **B1**
Harper Precast, Salt Lake City (801) 326-1016 — **B2, C1**
Olympus Precast, LLC, Sandy (801) 571-5041 — **A1, B3, B3A, C3, C3A**

VERMONT

J. P. Carrara & Sons, Inc., Middlebury (802) 388-6363 — **A1, B4, B4A, C3, C3A**
S.D. Ireland Companies, Williston (802) 863-6222 — **A1, B1, C1**
William E. Dailey Precast, LLC, Shaftsbury (802) 442-4418 — **A1, B4, B4A, C3, C3A**

VIRGINIA

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

WASHINGTON

Bellingham Marine Industries, Inc., Ferndale (360) 380-2142 — **B3, C2**
Bethlehem Construction, Inc., Cashmere (509) 782-1001 — **B1, C3, C3A**
Concrete Technology Corporation, Tacoma (253) 383-3545 — **B4, C4**
CXT, Inc., Precast Division, Spokane (509) 921-8766 — **B1, C1, C1A**
CXT, Inc., Rail Division, Spokane (509) 921-7878 — **C2**
EnCon Northwest, LLC, Camas (360) 834-3459 — **B1, B1A**
EnCon Washington, LLC, Puyallup (253) 846-2774 — **B1, B1A, C2, C2A**
Oldcastle Precast, Inc., Spokane, Spokane Valley (509) 536-3300 — **A1, B4, C4**
Wilbert Precast, Inc., Yakima (509) 325-4573 — **B3, C3**

WEST VIRGINIA

Carr Concrete Corporation, Waverly (304) 464-4441 — **B4, C3**
Eastern Vault Company, Inc., Princeton (304) 425-8955 — **B3, C3**

WISCONSIN

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

WYOMING

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

MEXICO

PRETECSA, S.A. DE C.V., Atizapan De Zaragoza 52 (555) 077-0071 — **A1, G**
Willis De Mexico S.A. de C.V., Tecate 52 (665) 655-2222 — **A1, C1, G**

CANADA

BRITISH COLUMBIA

APS Architectural Precast Structures LTD, Langley (604) 888-1968 — **A1, B4, C3, C3A**
Armtec Limited Partnership, Richmond (604) 214-3243 — **A1, B4, C3**

NEW BRUNSWICK

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

NOVA SCOTIA

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

ONTARIO

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

QUEBEC

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

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PCI Certified Erectors

(as of January, 2016)

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., Phoenix (602) 237-3875 — **A, S2**
RJC Contracting, Inc., Mesa (480) 357-0868 — **A, S2**
Tpac, An EnCon Company, Phoenix (602) 262-1360 — **A, S2**

COLORADO

EnCon Field Services, LLC, Denver (303) 287-4312 — **S2**
Rocky Mountain Prestress,LLC, Denver (303) 480-1111 — **A, S2**

CONNECTICUT

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

FLORIDA

Concrete Erectors, Inc., Altamonte Springs (407) 862-7100 — **A, S2**
Florida Builders Group, Inc., Miami (305) 278-0098 — **S2**
Jacob Erecting & Construction, LLC, Jupiter (561) 741-1818 — **A, S2**
James Toffoli Construction Company, Inc., Fort Myers (239) 479-5100 — **A, S2**
Pre-Con Construction of Tampa Inc./Pre-Con Construction, Inc., Tampa (813) 626-2545 — **A, S2**
Prestressed Contractors Inc., West Palm Beach (561) 741-4369 — **S2**
Solar Erectors U.S. Inc., Medley (305) 825-2514 — **A, S2**
Spancrete Southeast, Sebring (863) 655-1515 — **S1**
Specialty Concrete Services, Inc., Umatilla (352) 669-8888 — **A, S2**
W.W. Gay Mechanical Contractor, Inc., Jacksonville (904) 388-2696 — **S2**

GEORGIA

Bass Precast Erecting, Inc., Cleveland (706) 809-2718 — **S1**
Jack Stevens Welding LLP, Murrayville (770) 534-3809 — **S2**
Precision Stone Setting Co., Inc., Hiram (770) 439-1068 — **A, S2**
Rutledge & Sons, Inc., Canton (770) 592-0380 — **S2**
Southeastern Precast Erectors Inc. (SPE Inc.), Roswell (770) 722-9212 — **A**

IDAHO

Precision Precast Erectors, LLC, Worley (208) 231-5650 — **A, S2**

ILLINOIS

Area Erectors, Inc., Rochelle (815) 562-4000 — **A, S2**
Mid-States Concrete Industries, South Beloit (815) 389-2277 — **S2**

IOWA

Cedar Valley Steel, Cedar Rapids (319) 373-0291 — **A, S2**
Northwest Steel Erection, Inc., Grimes (515) 986-0380 — **A, S2**
US Erectors, Inc., Des Moines (515) 243-8450 — **S2**

KANSAS

Carl Harris Co., Inc., Wichita (316) 267-8700 — **A, S2**
Crossland Construction Company, Inc., Columbus (620) 442-1414 — **S2**
Ferco, Inc., Salina (785) 825-6380 — **A, S2**

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MARYLAND
DLM Contractors, LLC, Cheltenham (301) 877-0000 — **A, S2**
E & B Erectors, Inc., Elkridge (410) 360-7800 — **A, S2**
E.E. Marr Erectors, Inc., Baltimore (410) 837-1641 — **A, S2**
L.R. Willson & Sons, Inc., Gambrills (410) 987-5414 — **A, S2**

MASSACHUSETTS
Atlantic Bridge & Engineering, Salisbury (978) 465-4337 — **S1**
Prime Steel Erecting, Inc., North Billerica (978) 671-0111 — **A, S2**

MICHIGAN
Assemblers Precast & Steel Services, Inc., Saline (734) 368-6147 — **A, S2**
Devon Contracting, Inc., Detroit (313) 221-1550 — **S2**
G2 Inc., Cedar Springs (616) 696-9581 — **A, S2**
Pioneer Construction Inc., Grand Rapids (616) 247-6966 — **A, S2**

MINNESOTA
Amerect, Inc., Newport (651) 459-9909 — **A**
Fabcon Precast, LLC, Savage (952) 890-4444 — **S2**
Landwehr Construction Inc., St. Cloud (320) 252-1494 — **A, S2**
Molin Concrete Products Company, Lino Lakes (651) 786-7722 — **A, S2**
Wells Concrete, Maple Grove (800) 658-7049 — **A, S2**

MISSISSIPPI
Bracken Construction Company, Inc., Jackson (601) 922-8413 — **A, S2**

MISSOURI
JE Dunn Construction, Kansas City (816) 292-8762 — **A, S2**
Prestressed Casting Co., Springfield (417) 869-7350 — **A, S2**

NEBRASKA
Structural Enterprises Inc., Lincoln (402) 423-3469 — **A, S2**
Topping Out Inc. dba Davis Erection–Omaha, Omaha (800) 279-1201 — **A, S2**

NEW HAMPSHIRE
American Steel & Precast Erectors, Greenfield (603) 547-6311 — **S2**
Newstress, Inc., Epsom (603) 736-9000 — **S2**

NEW JERSEY
CRV Precast Construction LLC, Eastampton (609) 518-6810 — **A, S2**
J. L. Erectors, Inc., Blackwood (856) 232-9400 — **A, S2**
JEMCO-Erectors, Inc., Shamong (609) 268-0332 — **S2**
Jonasz Precast, Inc., Westville (856) 456-7788 — **A, S2**

NEW YORK
Koehler Masonry Corp., Farmingdale (631) 694-4720 — **A, S2**
Oldcastle Building Systems Div. / Project Services, Selkirk (518) 767-2116 — **A, S2**
The L.C. Whitford Co., Inc., Wellsville (585) 593-2741 — **S2**

NORTH DAKOTA
PKG Contracting, Inc., Fargo (701) 232-3878 — **S2**

OHIO
Precast Services, Inc., Twinsburg (330) 425-2880 — **A, S2**
Sidley Precast Group, A Division of R.W. Sidley, Inc., Thompson (440) 298-3232 — **S2**

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

PENNSYLVANIA
Century Steel Erectors, Kittanning (724) 545-3444 — **A, S2**
Conewago Precast Building Systems, Hanover (717) 632-7722 — **S2**
High Structural Erectors, LLC, Lancaster (717) 390-9203 — **S2**
Kinsley Construction Inc. t/a Kinsley Manufacturing, York (717) 757-8761 — **S1**
Maccabee Industrial, Inc., Belle Vernon (724) 930-7557 — **A, S2**
Nitterhouse Concrete Products, Inc., Chambersburg (717) 267-4505 — **A, S2**

SOUTH CAROLINA
Davis Erecting & Finishing, Inc., Greenville (864) 220-0490 — **A, S2**
Florence Concrete Products, Inc., Florence (843) 662-2549 — **S2**
Tindall Corporation, Spartanburg (864) 576-3230 — **A, S2**

SOUTH DAKOTA
Henry Carlson Company, Sioux Falls (605) 336-2410 — **A, S2**

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

TEXAS
Coreslab Structures (TEXAS) Inc., Cedar Park (512) 250-0755 — **A, S2**
Derr and Isbell Construction, LLC, Euless (817) 571-4044 — **A, S2**
Precast Erectors, Inc., Hurst (817) 684-9080 — **A, S2**

UTAH
Forterra Structural Precast, Salt Lake City (801) 966-1060 — **A, S2**
IMS Masonry, Lindon (801) 796-8420 — **A**
OutWest C & E Inc., Bluffdale (801) 446-5673 — **A, S2**

VERMONT
CCS Constructors Inc., Morrisville (802) 888-7701 — **A, S2**

VIRGINIA
The Shockey Precast Group, Winchester (540) 667-7700 — **A, S2**

WISCONSIN
J.P. Cullen, Janesville (608) 754-6601 — **A, S1**
Miron Construction Co., Inc., Neenah (920) 969-7000 — **A, S2**
Spancrete, Valders (920) 775-4121 — **A, S2**

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PCI certification is the industry's most proven, comprehensive, trusted, and specified certification program. PCI certification offers a complete regimen that covers personnel, plant, and field operations. This assures owners, specifiers, and designers that precast concrete products are manufactured by companies that subscribe to nationally accepted standards and that are audited to ensure compliance.

PCI certification is more than just inspections and documentation. It is based on, and integrated with the precast concrete industry's Body of Knowledge. For over 60 years, PCI has set the standards and developed, maintained and disseminated the body of knowledge for the design and construction of precast concrete structures. This feat is set on the foundation of millions of dollars of research, dozens of technical guides and manuals, a network of over 70 committees, PCI's professional and experienced staff, and support of over 2000 PCI members.

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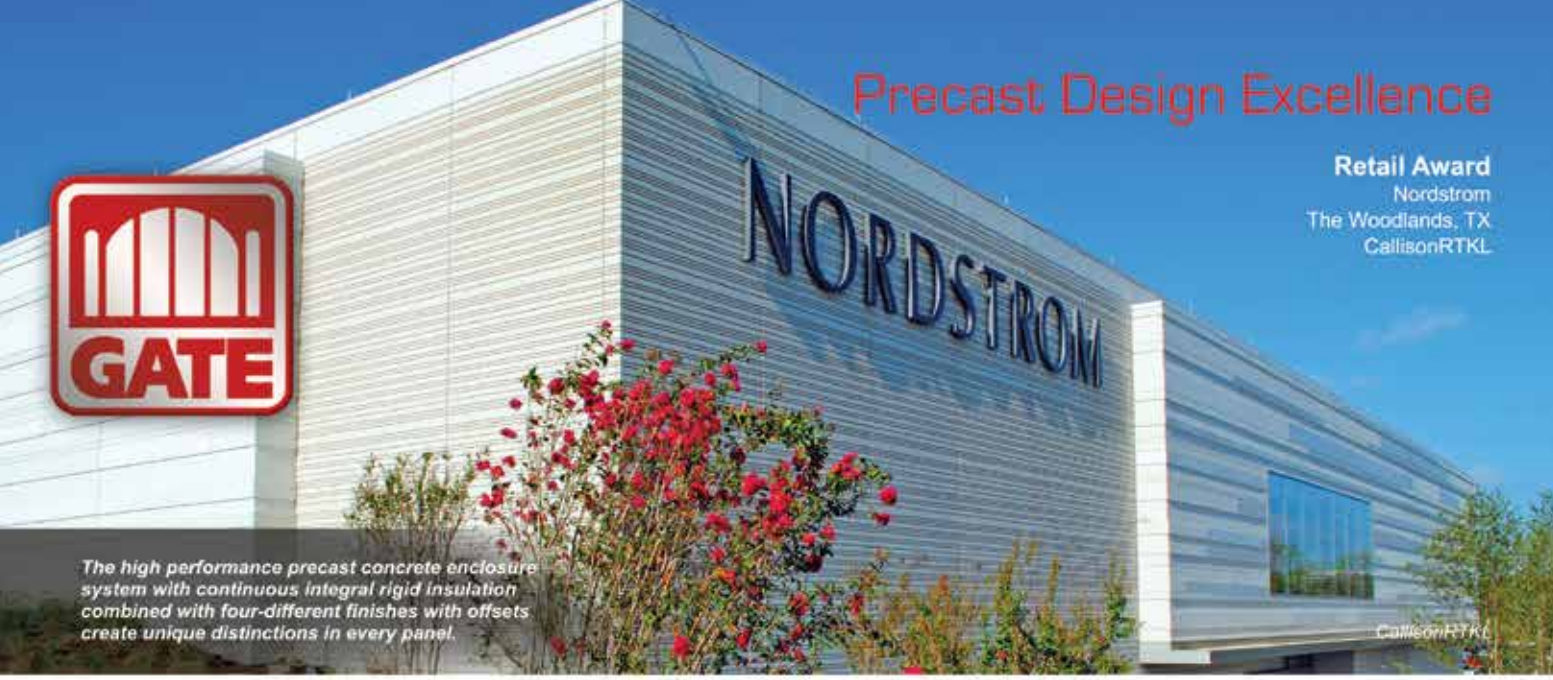

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Nordstrom
The Woodlands, TX
CallisonRTKL

All Precast Solution Award
Gordon Food Service Home Office - Wyoming, MI
Integrated Architecture, Inc. | Precast Structure, Kerkstra Precast

Higher Education/Universities Award
St. Edwards Univ. - John Brooks Williams Natural Science - Austin, TX
Moore Ruble Yudell

Government and Public Buildings Award
Maritime & Seafood Industry Museum, Biloxi, MS
H3 Hardy Collaboration Architecture, LLC

Higher Education/Universities Award
FIU Science Classroom Complex, Miami, FL
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