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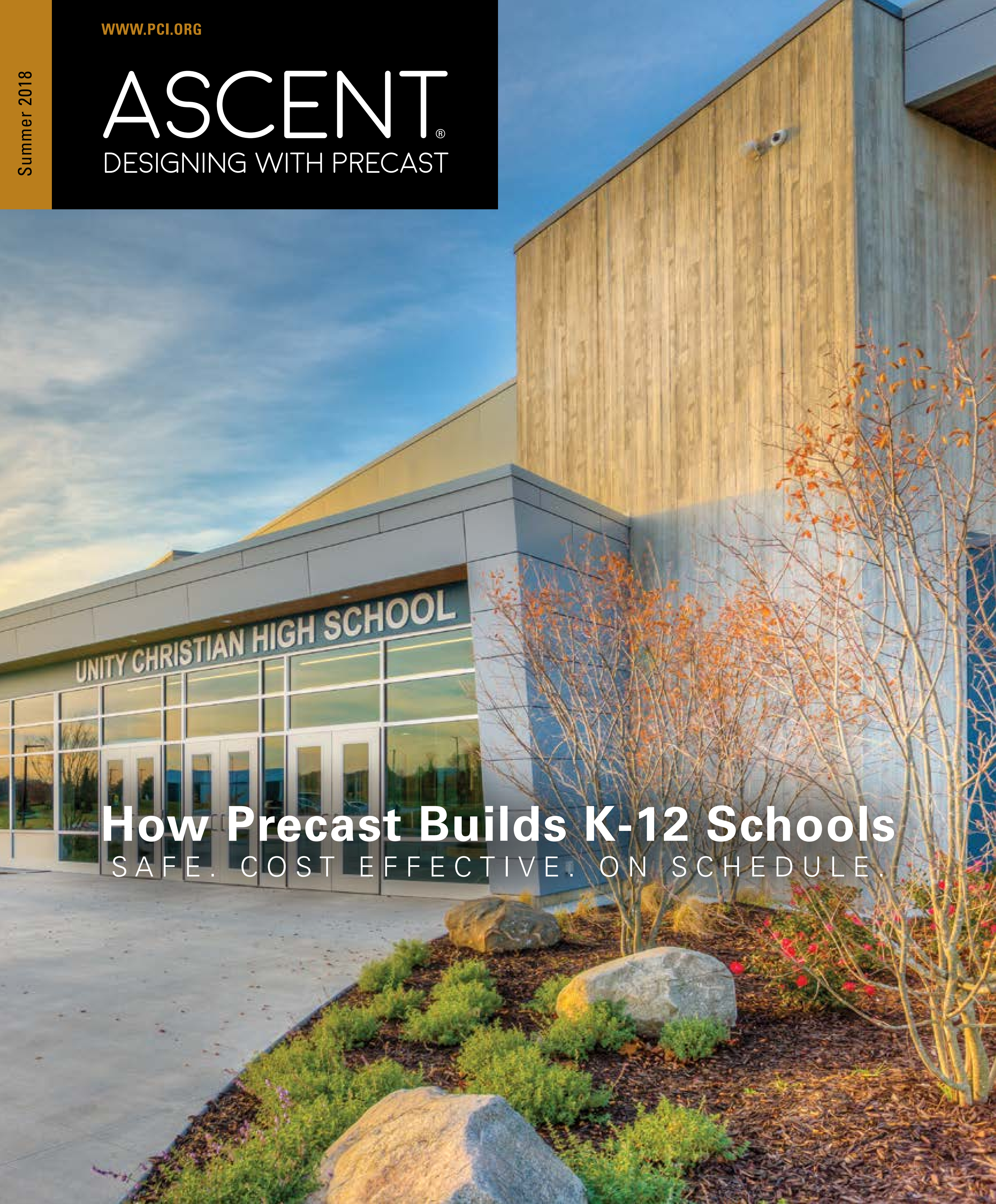

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POSTMASTER: Send address changes to Ascent, 200 W. Adams St., Suite 2100, Chicago, IL 60606.

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

Ascent (Vol. 28, No. 3, ISSN 10796983) is published quarterly by the Precast/Prestressed Concrete Institute, 200 W. Adams St., Suite 2100, Chicago, IL 60606.

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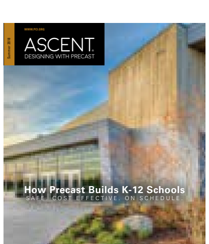

On the cover: Unity Christian High School.
Photo: Craig Van Wieren, Modern[edge]studios.

FEATURES

The Richland Two Institute of Innovation (R2i2) in Columbia, S.C. Photo: LS3P.

DEPARTMENTS

Correction: On page 36 in the Spring issue, the architect of the Alpharetta City Center Parking Deck was misidentified. It should have been listed as Smallwood, Reynold, Stewart, Stewart & Associates Inc. We regret the error.

DAVID A. BELLAMY
STUDIO LEADER, LS3P
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K-12: Past, Present, and Future

I have daily discussions on building with precast concrete. I have three precast buildings right now we are either building or designing. It is a tool in our pallet, but you have to know what you are doing. There is a certain amount of education and myth-busting.

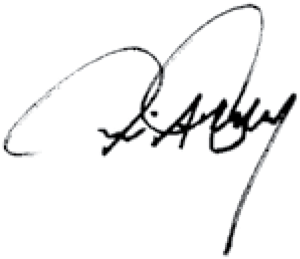
For example, I used to be a huge naysayer of putting thin-brick panels on precast. There were a lot of bad examples to draw from. But today, there is better collaboration between the brick and precast industries. There were so many bad projects, and they were not working. Now, they are seeing that it's a win-win for both of them. Both industries decided to figure out: how do we make it better? The general perception was that precast schools looked like prisons. Through thin brick types of panels, you can get it to the point of looking like a traditional brick and block masonry school without anyone being able to tell that it's precast.

Safety is a great consideration in designing K-12 buildings. Unfortunately, in today's world of school shootings, you have to be able to think about the unthinkable, and there has to be an added layer of security. Precast is very a stable material you may have for 50 years. Essentially, you're building a tank or a vault.

Schedule is a driving factor that brings precast into the discussion. Generally, four months is the number you hear, and which has been validated on what you can pick up on a construction schedule. If you can reduce a 24-month construction schedule by four months, you can save a lot more than just material. After all, time is money.

One thing I did not anticipate a few months ago is a major trade issue. We are hearing a lot about whether steel tariffs are on the horizon, and precast has become more of a discussion item. It does contain some rebar, but, by and large, it is not steel. So that is a bit of an unknown factor in many of our discussions lately: What is the impact of steel tariffs, and how do we react?

David A. Bellamy is studio leader at LS3P in Charleston, S.C., and devotes much of his time to designing K-12 buildings.



INSIGHT

Photos courtesy of Lombard Precast and Advanced Formliners

'21st Century School' Features Precast

CONCORD, NORTH CAROLINA

A new 300,000-ft² high school for Cabarrus County Schools, described by the designers as incorporating "21st century educational models," was planned with three materials cladding its exterior to delineate the various functions. High-efficiency insulated precast concrete panels were specified to clad the main academic building to ensure its construction will meet a tight schedule for completion by the fall of 2019.

The $61.7-million project, which will have an initial capacity of 1600 students and a core capacity of 1850 students, features a two-story main commons area that serves as a central organizing hub, connecting the three building areas via the open cafeteria, dining, and media center. The administrative portion is being clad with structural steel, while the 1284-seat gymnasium and 693-seat auditorium portions are being built with load-bearing masonry.

The school will emphasize "strategically dispersed collaborative areas, flexible classrooms, and flexible teaching stations," according to LS3P, the architectural firm. The three-story academic building features classrooms grouped by similarity to share resources.

The precast concrete panels feature 4 in. of insulation sandwiched between 3-in. exterior and interior wythes, creating a 10-in. panel. Finishes comprise several textures of buff-colored precast concrete accented with thin-brick insets.

Metromont Corp. in Greenville, S.C., fabricated the components for the project, for which Branch & Associates in Richmond, Va., is serving as the general contractor. ARP Engineering in Monroe, N.C., is the structural engineer.

Precast concrete was chosen for the classroom section in part due to its speed of construction and shortages of labor in the market for other material construction, according to LS3P. This approach ensured the schedule was maintained to have classrooms ready on opening day. The project broke ground on October 17, 2017, and is expected to open for the fall 2019 school year, on a 21-month schedule. For more on this project, see the profile article on LS3P in this issue.

Clark Pacific Launches Campus Design Tool

WEST SACRAMENTO, CALIFORNIA

Clark Pacific has launched CP Campus Housing, a set of integrated structural and façade precast concrete components that work together to provide Type I campus housing with maximum design flexibility.

"Traditionally, each new campus housing project is approached as a completely new project, yet when you compare those projects side by side, there is very little variance in the structure and layout," says Roy Griffith, director of corporate development. "With CP Campus Housing, our custom-manufactured systems are designed to work together to provide a cost-competitive and durable building with minimal site disruption."

CP Campus Housing includes the Collaborative Design Interface, a rapid design tool that leverages standardized components and provides schematic student-housing designs. This allows designers to focus on aesthetics and unique project needs. For more information, visit www.clarkpacific.com/solution/cp-campus-housing.

Athletic Center 'Wave Wall'

EVANSTON, ILLINOIS

The new Ryan Walter Athletic Center along Lake Michigan on the campus of Northwestern University offers panoramic views over the water but created a fundamental challenge to protect the building's shoreline from exposure to waves. Designers resolved the issue with a precast concrete wall designed to withstand harsh wave impacts while mirroring the naturally curved layout of the beach.

The wall needed to serve two purposes: stop the powerful waves' horizontal force from causing damage to the building's foundation and to provide a shield to pedestrians passing along the front of the building on a multi-use path. Architectural firm SmithGroupJJR worked with engineering firm Perkins & Will and Walsh Construction, all in Chicago Ill., to design the structure, with Utility Concrete Products LLC in Morris, Ill., fabricating the components.

Their goal was to create an extensive wall with multiple, tapering curves that included integral pigment coloring and an architectural, durable finish, explains Leah Dix, a spokeswoman for Utility Concrete. After reviewing options, the team determined that precast concrete offered the best combination of economics, durability, precise forming, and plasticity to achieve the goals.

The wall consists of 109 5-ft-wide segments standing 20 ft tall at its center and tapering at each end, where it begins to flatten, similar to a wave. The self-consolidating concrete mix included Scofield SG "Sand Buff" liquid integral color, which was altered to match a sample of existing building limestone. The segments

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then were sandblasted to achieve the desired appearance.

Designers paid particular attention to precise placement of epoxy reinforcement, embedded stainless steel angles, and hot-dipped galvanized/epoxy connectors within the high-strength concrete due to the powerful waves crashing against the wall and the area's freeze-thaw conditions.

The precast concrete units sit atop a cast-in-place knee wall that includes both column-base connectors and splice sleeves to complete the connection to the precast segments. The column-base connectors are typically used for precast concrete columns, while the splice sleeves most often are used to speed bridge construction.

The sleeves consist of a mechanical coupler embedded in the precast wall segments that is fit over a cast-in-place concrete dowel bar in the field. The sleeve is grouted through PVC ports extending from the sleeve to the exterior face of the precast wall.

To expedite installation, the contractor bolted the walls at these shoes and continued with the installation rather than using a bracing system and waiting for the grout in the sleeves to set up to expedite installation. This required close tolerances to ensure quick and precise connection.

Getting the wall installed as efficiently and quickly as possible was a top priority for the contractor, Dix explains. The wall's location on the site made it a critical item, since building erection couldn't continue until the wave wall was completed due to a tight site and the necessity for crane space.

With close communication and coordination among team members, the components were fabricated quickly and erected on time and within budget. Construction at the athletic facility is expected to be completed later this summer.

Innovation Studio To Feature Precast Panels

WORCESTER, MASSACHUSETTS

The Foisie Innovation Studio & Messenger Residence Hall at Worcester Polytechnic Institute (WPI), opening this fall, showcases a variety of exterior materials, including architectural precast concrete panels, curtainwall, metal panels, and conventional masonry. In the process, it showcases the ability of precast concrete producers to customize components to meet specific design demands.

The $49-million, 78,000-ft^2 facility includes a 41,000-ft^2 Innovation Studio in the basement and on the first two levels of the five-story, mixed-use academic and residential building. That space serves as a state-of-the-art hub for WPI's project-based approach to science, technology, engineering, and math (STEM) courses. A variety of academic and active learning spaces are designed to foster innovation and creativity while supporting multiple modes of collaborative work.

Above the studio levels are three floors for the Residence Hall, with space for 140 students. The new Messenger Hall will feature coed single and double rooms, with each floor including a laundry room, two tech suites, and two open lounges.

Gensler Architect in Boston, Mass., is the architectural firm on the project, with Shawmut Design & Construction in West Springfield, Mass., serving as general contractor. Lemessurier in Boston is the structural engineer.

Coreslab Structures Inc. in Thomaston, Conn., is fabricating the architectural precast concrete panels, comprising 38 pieces encompassing 5822 ft^2. The uninsulated precast concrete panels are mostly slender, vertical pieces in a horizontal, stacked-panel design. The precast concrete producer used custom polyurethane formliners for the project.

Erection presented several challenges, including a 20-ft cantilever overhang at the third level, which required special rigging considerations and lifting devices to position the panels under the overhang. Crane access also was restricted to three sides on the tight site, which served an active campus during erection. Limited staging area and multiple underground utilities added to the challenges.

The Center replaces a 100-year-old Alumni Gym. The new, steel-framed structure is set on spread footings and is designed to achieve LEED gold certification.

Legacy Precast Names Cariveau President, CEO

BROOKSHIRE, TEXAS

Legacy Precast LLC has named Jay Cariveau its new president and CEO. Cariveau will lead the senior-management team, which includes five ownership partners. Robert Diakiw, the founder, president, and CEO of Legacy, is stepping away from the day-to-day operation but will remain chairman and will spend time on other entrepreneurial initiatives as well.

A registered architect and a LEED-accredited professional, Cariveau has more than 25 years of building industry experience in management, design, manufacturing, construction, business development, and marketing. His experience includes work with multifacility architectural and structural precast concrete manufacturers, serving various market segments.

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Timothy Christian School Upgrades Facilities

ELMHURST, ILLINOIS

As part of a multi-million-dollar investment in campus improvements over a six-year period, administrators at Timothy Christian Schools developed a new junior high school to house seventh and eighth graders and provide upgraded learning facilities. To meet the tight schedule as well as zoning requirements and other needs, designers specified load-bearing architectural precast concrete panels with inset thin brick and an insulated core to clad the façade.

The project consists of classrooms, laboratories, administrative offices, and other facilities, including a spacious lobby that serves as the lunchroom for students during the day and as a mingling area during athletic competitions. A new athletics arena for the adjacent high school seats 1200 people, almost double the current capacity of the existing gym.

The construction manager's familiarity with precast concrete and its fast erection were key factors in its specification over masonry-cavity construction with a brick veneer and other options, according to AMDG Architects. A brick facing was required to meet zoning ordinances, which precast concrete could provide in a panelized system, reducing joints and speeding construction.

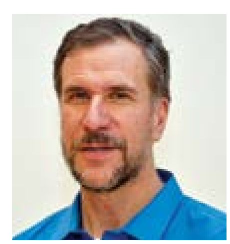
Lombard Architectural Precast Products Co. in Alsip, Ill., was brought onto the project on a design-assist basis early in the design phase after winning the project in a three-way competition. Lombard's team immediately consulted on optimizing panel sizes and design and to provide budget estimates.

A blend of brick colors was chosen to complement other buildings on the campus with a variety of similar brick appearances. The designers worked with Lombard to find the best approach to handling returns on the brick-covered panels.

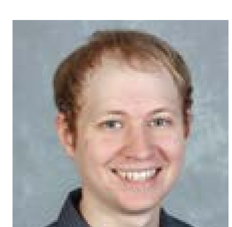
The panels were erected quickly, getting the building enclosed so interior trades could begin work earlier. Most of the erection took place during the school's Christmas break, alleviating congestion at the site and improving access.

PCI Adds Marketing Staff

CHICAGO, ILLINOIS



Tom Bagsarian has joined PCI as editorial content manager, a new position. He will help manage *Ascent*'s editorial and production processes and work to build PCI's media-relations program with trade publications and media outlets. Bagsarian arrived from the Hanley Wood media group, where he worked on *Concrete Construction*, *The Concrete Producer*, *Concrete Surfaces*, and *Public Works* magazines, among others.



In addition, David Anians has been promoted to coordinator of education and publications. In this new role, Anians will independently coordinate materials for the PCI eLearning Center, which now includes transportation modules, and create courses within that software package. Anians joined PCI in 2016 as administrative assistant for education and publications.

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Innovative COLLABORATION

Meeting evolving programming needs, tight budgets, and fast schedules keeps LS3P's K-12 designs on the cutting edge of design for administrators, teachers, and students

— **Craig A. Shutt**

The Richland Two Institute of Innovation (R2i2) in Columbia, S.C., pulls students from five district high schools for specialized courses. LS3P incorporated some of the latest concepts in K-12 school design, including collaborative spaces, flexible classroom use, and high energy efficiency. All photos: LS3P.

Designers need to meet a wider range of challenges with K-12 schools today, as districts find better ways to reach their students with curricula suited both to their futures and to the varied ways in which they learn best. Rapidly evolving technology options, along with higher security demands and other trends, also impact concepts. LS3P meets those needs with cutting-edge designs that other designers and administrators look to adapt for their own programs.

R2i2 PULLOUT SCHOOL

The most exciting of these is the Richland Two Institute of Innovation (R2i2) in Columbia, S.C., which opened in the fall of 2016. The 215,000-ft^2 building pulls students from five district high schools for specialized courses. Classes focus on science, technology, engineering, and math (STEM) courses for college-prep students and specialized career and technical education (CTE) programs. The latter encompasses courses in designing apps, installing solar panels, food-truck management, robotics, and others.

A number of these classes include local business partners, such as Boeing, as well as input from the University of South Carolina and Midlands Technical College. "The goal is to expose students to every opportunity possible and give them real-world projects that help prepare them for the working world," explains Allen Taylor, Capital Studio leader and operations and finance manager for LS3P's Columbia office.

"We went to local businesses and asked what skills were missing from applicants they reviewed, and the school built its curriculum to include their responses. Graduates are confident they can move on to college or into jobs and be prepared."

The school includes 185 offices for district personnel and the school board, an 800-seat conference center (often rented to community groups), and a 30,000-ft^2 relocated branch of the Richland County Library. The school provides class space for up to 800 students, with juniors and seniors in the district currently using the facility.

"The combination of facilities in this model is unique in the country," says Mary Beth Sims Branham, vice president, principal, and leader of the Columbia office since it opened in 2004. "We've never seen anything like it." The goal was to design a "fishbowl of learning," in which students, administrators, community members, and business leaders share space and focus on new learning approaches.

The goal was to design a "fishbowl of learning," in which students, administrators, community members, and business leaders share space and focus on new learning approaches.

Administrators and designers around the country haven't seen its like, either. Many have visited to see how the spaces are used. "They want to emulate parts if not all of it," says Taylor. "They're intrigued by the pull-out concept and want to see if there are ideas they can incorporate into their school programs."

At the building's core is the Open Project Area and classrooms, including outdoor spaces with overhangs to provide weather protection. The two-story space features a flexible, durable envelope with large roll-up doors that provide access for delivery of large equipment. The space was built with a total–precast concrete structural framing system, consisting of wall panels and double tees, with a perimeter second level for more classrooms.

The school includes stair systems built with precast concrete that not only provide easy access but can be incorporated into school lessons.

Precast concrete slabs created stairs at the auditorium, which also are used in projects. "We wanted to create a variety of options to match the learning techniques that students need today," says Branham.

The precast concrete design offered great flexibility, which was critical, as the designers didn't know how the spaces would be used when they planned them. "The district's vision to us didn't specify programming, as they didn't know what would be the hot topics," says Taylor. "We used precast concrete to provide a flexible infrastructure to accommodate whatever came up."

'We used precast concrete to provide a flexible infrastructure to accommodate whatever came up.'

MORE COLLABORATION

Creating flexible spaces in which community groups can help students collaborate on projects has become a key trend with schools today, says Branham. "There is more collaborating among students and fewer times a teacher stands at the front of class lecturing to students at desks," she says. "The new model stresses open-learning areas for hands-on instruction, with more collaboration and adaptability. Each class uses different spaces geared to their lessons. That's changed the entire design concept for the school."

A key portion of the R2i2 school is the Open Project Area that focuses on science, technology, engineering, and math college-prep classes and specialized career and technical education programs. It was constructed with architectural precast concrete panels and a total-precast concrete structural framing system.

Rather than each teacher having a classroom that students visit each period, teachers have a work space and hold classes in rooms geared to their specific requirements that day, explains Marques Moore, an associate in the Charlotte, N.C., office who specializes in K-12 projects. "It's similar to a college professor, who has his own office yet teaches in a different room."

The spaces designed to handle these changes have necessarily evolved, too. Where once designers created large rooms with accordion-like dividers, new concepts have arisen. "We limit that approach due to the amount of annual maintenance those walls require," Moore explains. Instead, designers created classrooms of varying sizes to allow teachers to gather several classes or teach a small group. Furniture also adapts so groupings are customized.

These collaborative approaches have been developing for a decade, Branham notes, but they don't arise automatically. "They represent an idealistic view of how teaching should change to adapt to students, who learn in different ways, especially now that we have technologies that can aid those changes."

Collaborative learning is gaining adherents, but there has to be buy-in from educators, says Eric Aichele, principal in LS3P's Charleston, S.C., office and a designer on many of the firm's K-12 school projects. "Some schools have tried it and it wasn't successful," he notes. In part, that happens because the facilities aren't geared to it, which hinders teachers making it work. "You need both the teachers' support and the facilities to make it successful."

R2i2's features benefit teachers, which aides learning—and helps recruitment. The school's 800-seat conference room serves as a professional-development center for teachers, alleviating the need to rent outside spaces. "It provides an excellent recruiting tool for teachers and administrators," says Branham. "It also attracts community and business partners, who want input with the future workforce."

Flexibility is especially vital when addressing technology issues. "Technology is advancing faster than we can design to it," says Moore. Often, technology packages are released no more than one year ahead of opening and often only six months. With schools often taking four or five years from design concept to grand opening, that's the only approach that works. "We're encouraged to wait because the technological costs go down while the systems get better."

The precast concrete structural system allows the Open Project Area in R2i2 to include open spaces that create large collaboration spaces and the capability to bring in large equipment for various classes, including full food trucks, manufacturing equipment, and robotics.

SPEED BECOMES ESSENTIAL

Another key trend has been the speed with which stakeholders want the schools built, which runs up against the stringent permitting process. "The bureaucratic process to get a school designed and constructed takes longer than stakeholders desire," says Moore. "The regulatory process involves much red tape that at times results in a more aggressive construction schedule to open the school in time."

Designers must then avoid the temptation to cut corners to meet their deadline—which is typically the new school year, which can't be missed. "You can't rush good design or good quality construction," Moore stresses. "We're tasked to be creative to meet the schedule and budget demands, be it through alternative delivery methods or innovative construction techniques. It's an inherent challenge in public projects."

In many cases, precast concrete architectural panels and structural framing help to meet these demands. They provide the aesthetic appearance administrators seek while providing a panelized system that encloses the building quickly while minimizing long-term maintenance needs. Off-site prefabrication allows structural systems to be cast while permitting and site work are underway, allowing the framing system to be erected as soon as possible.

The total–precast concrete framing system for West Cabarrus High School in Concord, N.C., will provide open space for added flexibility in the school.

WEST CABARRUS HIGH SCHOOL

Schedule demands led LS3P architects to specify architectural precast concrete panels and a precast concrete framing system for the new West Cabarrus High School now under construction in Concord, N.C. The 300,000-ft² school, with a capacity of 1850 students, was designed with three distinct building systems, including precast concrete for the main academic building.

The school incorporates 21st-century educational models, with strategically placed collaborative learning areas, flexible classrooms, and flexible teaching stations. "This educational model aims to achieve a higher utilization rate through philosophical design principles," Moore says.

The load-bearing precast concrete wall panels feature 4 in. of insulation sandwiched between two 3-in. concrete wythes that attach to the floor slabs and support double tees for the structural framing. "The structural characteristics are comparable to a parking deck, just a very aesthetically pleasing one," Moore says.

Now under construction, West Cabarrus High School in Concord, N.C., features architectural precast concrete panels and a precast concrete framing system for its classroom sections. Precast concrete's capability to meet the project's schedule was a key factor in its specification.

LS3P chose precast concrete for the new school in response to the local labor market, he explains. "There are real labor shortages of steel erectors and masons. We knew we needed an innovative construction method to maintain the fast schedule and deliver a high-performing building. The precast concrete design achieves those goals."

The three distinct building sections of masonry, steel, and precast concrete were erected simultaneously, with all trades working on the site at once. That also ensured the school could open even if something fell behind. "We anticipated the three-story classroom portion would go up quickly with precast concrete, so the classrooms would get dried in quickly," he explains. "So we could be assured classes could begin even if the auditorium wasn't completed in time."

PRECAST'S KIT OF PARTS

Precast concrete's flexibility as a "kit of parts" can help the pieces in the design jigsaw come together more quickly than with other materials, fitting a tight schedule. That concept helped LS3P create two high schools for the Charlotte-Mecklenburg school district in Charlotte, N.C., one after the other, two years apart. The 300,000-ft² Ardrey Kell High School came first, encompassing classrooms, science and technology labs, an auditorium, gymnasium, cafeteria, media center, and offices to serve 2000 students.

It was built with load-bearing insulated precast concrete wall panels along with double tees and flooring slabs. The panels were 11 in. thick, comprising 5 in. of insulation sandwiched between two 3-in. wythes of concrete. Typically 12 ft wide and 45 ft high, the panels feature reveals and a combination of light, medium, and heavy sandblasting finishes to provide a variety of textures. The interior wythe was provided with a smooth finish and painted.

"The district ranks among the top 20 public school districts in the country, and administrators are always looking for creative ways to meet the challenges of building new schools," explains Scott Dodrill, an architect in LS3P's Charlotte office who worked on the projects. "They knew they would need two schools in rapid succession, and they chose a precast design to help with construction speed and budgeting."

'They knew they would need two schools in rapid succession, and they chose a precast design to help with construction speed and budgeting.'

The school served as a prototype for the Mallard Creek High School, built two years later. The 306,000-ft^2 school includes classrooms, offices, media center, gymnasium, practice gymnasium, and other facilities to serve 2000 students. The precast concrete-clad layout was reused in adapted form.

"We had various precast concrete rectangles that fit together in new ways to accommodate the site variances," explains Roger Attanasio, an architect in the Charlotte office and construction administrator for the projects. "The schools had the same requirements but needed adaptations to fit their locations. It was an interesting design challenge to put the same components together in different ways to create another efficient plan."

The second school's construction moved more efficiently thanks to lessons learned on the earlier project, he notes. "We learned how to detail the connections and coordinate the construction on the Ardrey Kell project, so Mallard Creek came together even smoother, providing an added benefit."

LS3P's design for Ardrey Kell High School served as a prototype for other schools and was reused two years later for the Mallard Creek High School. The 306,000-ft^2 school, which serves 2000 students, features a precast concrete structural system with adaptations to its site.

'School facilities need to be aesthetically pleasing but also secure. They can't look like a prison.'

SECURITY CONCERNS GROW

Precast concrete also is helping with another key topic for schools today: security. "Security is a hot button issue since the Sandy Hook shooting" in 2012, Moore says. "School facilities need to be aesthetically pleasing but also secure. They can't look like a prison, but they need the security of one. We need to devise ways to secure the building while giving it a welcoming appearance for students."

Precast concrete panels, used both inside and out, can help achieve that, along with new design principles, he notes. Generally, that means allowing one or two entrances with additional exit points for safety. "We often design two ways in and 15 ways out," Moore says. A typical design includes a secured vestibule as a first access point with administrative offices nearby to vet visitors.

Schools also are designed with more straight lines rather than angled corridors. "We want two administrators to be able to secure 100,000 ft^2 with clear sight lines and no hidden corners," he explains. That also leads to limiting interior glass, especially in classrooms, to hide occupancy. Designs also are limiting campus layouts and creating more compact, secured buildings with an interior courtyard.

BRICK APPEARANCE DOMINATES

Maintaining that welcoming appearance often results in a masonry or brick appearance which many communities associate with school buildings. "Administrators love red brick," says Moore. "It's a traditional look that people associate with a learning environment." Studies have shown that elementary school children especially expect their school to have red brick, he notes.

The interior side of load-bearing insulated precast concrete panels used on Ardrey Kell High School were cast with a smooth finish and painted after being installed.

"Think of the Three Little Pigs: brick means safety to kids, and when you ask children to draw a school, they draw a red square with a triangular roof." At the high school level, there is more leeway to use other materials. "We like using precast concrete panels because they can provide that traditional appearance, but they also offer efficiency of design and construction."

West Cabarrus High features panels with inset thin brick as accents highlighting several finishes of buff-colored precast concrete. The other segments feature colorful metal panel insets and glass to add a high-tech appearance.

"Precast concrete is an easy sell for the exterior appearance to most administrators if we can show that it reduces costs and scheduling," says Moore. "Those are key priorities: First, does it fit the budget and meet the schedule, and then does it look like a school? If it meets all three criteria, you're golden."

Administrators want to reassure parents, students, and other stakeholders, but they also want to express that they are using contemporary teaching methods. Typically, LS3P presents three aesthetic options: a traditional look, a modern look, and a combination. "They usually choose the combination."

The precast concrete envelope added further benefits at R2i2. "We needed a durable, high-bay space, and we realized we could use precast concrete as a teaching tool as well," says Taylor. The framing is exposed, with each mechanical system color-coded to allow students to see how they run through precast concrete shear walls and other materials. "Keeping the panels exposed allows students to see the concrete and see the connections and how it all fits together."

Mallard Creek High School took the basic "rectangles" used to assemble functional areas for the earlier Ardrey Kell High School and fitted them together in a different format to meet the needs of the site.

ENERGY EFFICIENCY GROWS

Schools continue to pay attention to sustainability, both to keep budgets under control and to serve as another teaching tool for students. R2i2 not only features an array of solar panels on its roof, but it has a second array installed on the ground so students can study it more closely.

"Energy efficiency is a key goal today," says Branham. R2i2 was built in accordance with the Green Globes online assessment protocol, rating system, and guidance program. Many other schools are either certified as LEED projects or follow those guidelines.

LS3P has completed more than 14 million ft^2 of green projects, with a substantial percentage of its designers LEED- and/or Green Globes-accredited. The firm regularly is listed among Engineering News-Record's "Top 100 Green Design Firms."

LS3P's Strategic Expansions

LS3P was founded by Frank Lucas in a one-room office in Charleston, S.C., in 1963. The firm became Lucas & Stubbs the next year when Sidney Stubbs, a Clemson classmate, joined. Their signature project was the Municipal Auditorium & Exhibition Hall for Charleston, which they were awarded in a design competition.

By 1982, new partners comprised Vito Pascullis, Richard Powell, and Thompson E. Penny, adding their names to the firm's title. It was shortened to LS3P in 1991. In 1999, LS3P merged with TBA2 Associates in Charlotte, N.C., and in 2004, it opened an office in Columbia, S.C. In 2005, it merged with Boney Architects, with offices in Wilmington, N.C., and Raleigh, N.C. Another merger in 2011 and two more in 2016 further strengthened the firm's expertise and expanded its reach.

LS3P now has more than 300 employees in eight offices in three states. Its major practice areas comprise K-12 schools, higher education, offices, healthcare, aviation and transportation, hospitality, worship, federal projects, and residential.

LS3P's design for Ardrey Kell High School served as a prototype for other schools and was reused two years later for the Mallard Creek High School. The 306,000-ft² school, which serves 2000 students, features a precast concrete structural system with adaptations to its site.

"Energy efficiency is an area that administrators are keen on attacking," says Aichele. "But it can be hard to fit it into the development budget, which is separate from the operations budget. They realize that if they spend more money early it will save them much more down the road, but those funds take away from something else." At the same time, he notes, they realize that saving money on operating funds every year means those annual funds can be shifted elsewhere, too.

"Some are more into finding ways to fit it into the budget than others, but everyone is aware of the value of not wasting energy. Energy codes force them into some parameters, and some take it further. The level of efficiency varies right now, but once new techniques become more prevalent and the benefits are seen, more districts will put money into their development budgets for it."

'Energy efficiency is an area that administrators are keen on attacking.'

Another reason administrators like precast concrete panels, he notes, is because their low maintenance keeps annual budgets low. "They're very sensitive to where their operating budgets go, and they appreciate that precast concrete offers a durable material inside and out that takes little maintenance. We sometimes limit the palette we use to aid maintenance needs and save costs, but you can see the benefits that precast offers on older buildings that still look good."

Administrators also see the value in sustainable designs, Moore notes, as they can mean lower operating costs. "Schools that are more sustainable are healthier, more efficient, and more conducive to learning," says Aichele. Research shows factors such as better indoor air quality, increased natural light, better temperature control, and improved acoustics are linked to higher student attendance and achievement. Sustainable designs can decrease operational costs, increase attendance for both students and teachers, and increase the quantity and quality of learning that takes place.

"They're tied together, but it can be difficult to get past bottom-line needs," Aichele says. LS3P designers focus especially on finding ways to reduce HVAC needs, through insulation and other efficiencies, such as motion sensors. "Our goal is always to avoid conditioning and lighting unoccupied space."

The Ardrey Kell Road and Mallard Creek High Schools incorporate a variety of sustainable techniques, including site design, water efficiency, recycled materials and resource selection, daylighting efficiency, energy use and recovery, and indoor environmental quality.

Anticipating new technologies and new teaching methods will remain key challenges. But with input from all stakeholders and years of experience, LS3P is positioned to meet evolving needs. "Single-use facilities work well for some functions," says Branham. "In our rapidly changing world, however, success depends on collaboration, real-time communication, and connection. The innovative new model for educational facilities represented by R2i2 demonstrates that multidisciplinary partnerships can help us bridge academia and business, create a nexus of opportunity, serve a diverse community, and build a catalyst for meaningful change."


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Vo-Tech Studies

PRECAST CONCRETE

Precast concrete builds safe and strong career and technical education centers

— **Monica Schultes**

The past decade has seen a resurgence in what has traditionally been called "vo-tech" education. With the increasing demand for skilled workers, businesses have helped create a renewed enthusiasm for vocational and technical education and training. This is in stark contrast with the limited employment opportunities right out of school for recent graduates of four-year programs.

Vocational educators around the country believe trade schools are making a strong comeback because many businesses have a desperate need for journeymen. Many of today's high school graduates and students are learning to be computer science professionals, chefs, graphic designers, mechanics, engineers, nurses, and more, without racking up mountains of student loan debt.

Most of these skills cannot be learned through traditional textbooks. Therefore, educators are essentially starting to focus more on training for employability, as opposed to the typical knowledge-based education or degree.

The buzzword "new collar" is replacing "vo-tech" for technical jobs and reflects the changes in the way schools train students to fit new workforce demands. Hands-on learning in highly technical fields like information technology, computer-aided design, industrial design, and computerized metal machining are common in vo-tech curriculum. It deliberately addresses the skills mismatch in the United States.

The owners, designers, and contractors of these technical and career centers frequently turn to precast concrete for its speed, durability, and low maintenance. The following projects demonstrate how precast concrete can play a part in the new-collar school evolution. These examples of technical schools built with precast concrete examine the design and construction practices that went into them.

Salvaged precast concrete columns and double tees were reused in the new construction. Photos: Simon Hurst Photography.

CANADIAN VALLEY TECHNOLOGY CENTER

LOCATION
El Reno, Okla.

PROJECT TYPE
K-12 school/career technology center

SIZE
230,000 ft^2

COST
$43 million

DESIGNER
MA+ Architecture, Oklahoma City, Okla.

OWNER
Canadian Valley Technology Center,
El Reno, Okla.

STRUCTURAL ENGINEER
KFC Engineering, Oklahoma City, Okla.

CONTRACTOR
CMS Willowbrook, Oklahoma City, Okla.

PCI-CERTIFIED PRECASTER
Coreslab Structures (OKLA), Oklahoma City, Okla.

PRECAST COMPONENTS
Insulated wall panels, double tees

Architectural precast concrete walls are visible from the courtyard looking north.

CANADIAN VALLEY TECHNOLOGY CENTER (BUILDING 100), EL RENO, OKLA.

The community in El Reno, Okla., recently recognized the fifth anniversary of the widest tornado ever recorded in the United States. That tragic event in May 2013, with winds up to 295 mph, devastated numerous homes in the area as well as the Canadian Valley Technology Center (CVTech).

Cory Pivniska, project director at CMS Willowbrook, recalls, "Our owner was on-site that morning to assess the damage. We stayed there from the first day. We helped relocate students to other facilities and retrofitted an old auto dealership for the CVTech auto shop to use during construction."

Coleman Harrison, project consultant for Coreslab Structures (OKLA), recalls, "I was called by the insurance company a few days after the tornado hit to evaluate the damage. I was shocked at the widespread destruction. The areas with the least superstructure damage were the areas constructed out of precast concrete components."

Like many in the local community, Harrison has an emotional attachment to the school. As an alumnus, he was thrilled when Coreslab was asked for recommendations on how best to use precast concrete components.

The tornado received a rating of 5 (the highest) on the Enhanced Fujita (EF) scale of tornado intensity. It left the CVTech campus in ruins, and all nine buildings on campus were heavily damaged or destroyed. Thankfully, all 15 people who were at the school that evening were uninjured. A mere six months later, the school was breaking ground on new construction and a new start. During the rebuilding, CVTech had to lease space in multiple venues to house their diverse ongoing educational programs like health care, computer programming, cosmetology, welding, and automotive.

REBUILDING AND RETHINKING

MA+ Architecture had already completed a master plan for the school district but had not expected to implement it so quickly. The CVTech team took this as an opportunity to start over and rethink how they do things. "They want to do this once, and they want to do it right," says Gary Armbruster, principal architect/partner at MA+ Architecture. He met with all the end users of the building to incorporate their needs into the building design. Goals included building a safe and

'They want to do this once, and they want to do it right.'

There was extensive collaboration with Coreslab to achieve the desired finish on the panel face.

secure facility that meets the needs of all programs, incorporating natural light, creating a facility with maximum flexibility, and redefining the layout to be more collaborative.

The building was gutted, but portions were able to be reused. One of the biggest challenges was to design more than 50% of the new space within an existing structure. "It was a challenge to work within that frame. The shop classes had to be reconfigured into different uses and configurations," recalls Armbruster.

Using the original master plan, they had to quickly evaluate various building systems and focus on how to rebuild as soon as possible. The design team considered masonry, but were concerned by the shortage of available masons as well as the need to fast-track the schedule. "We turned to precast for its speed," explains Armbruster.

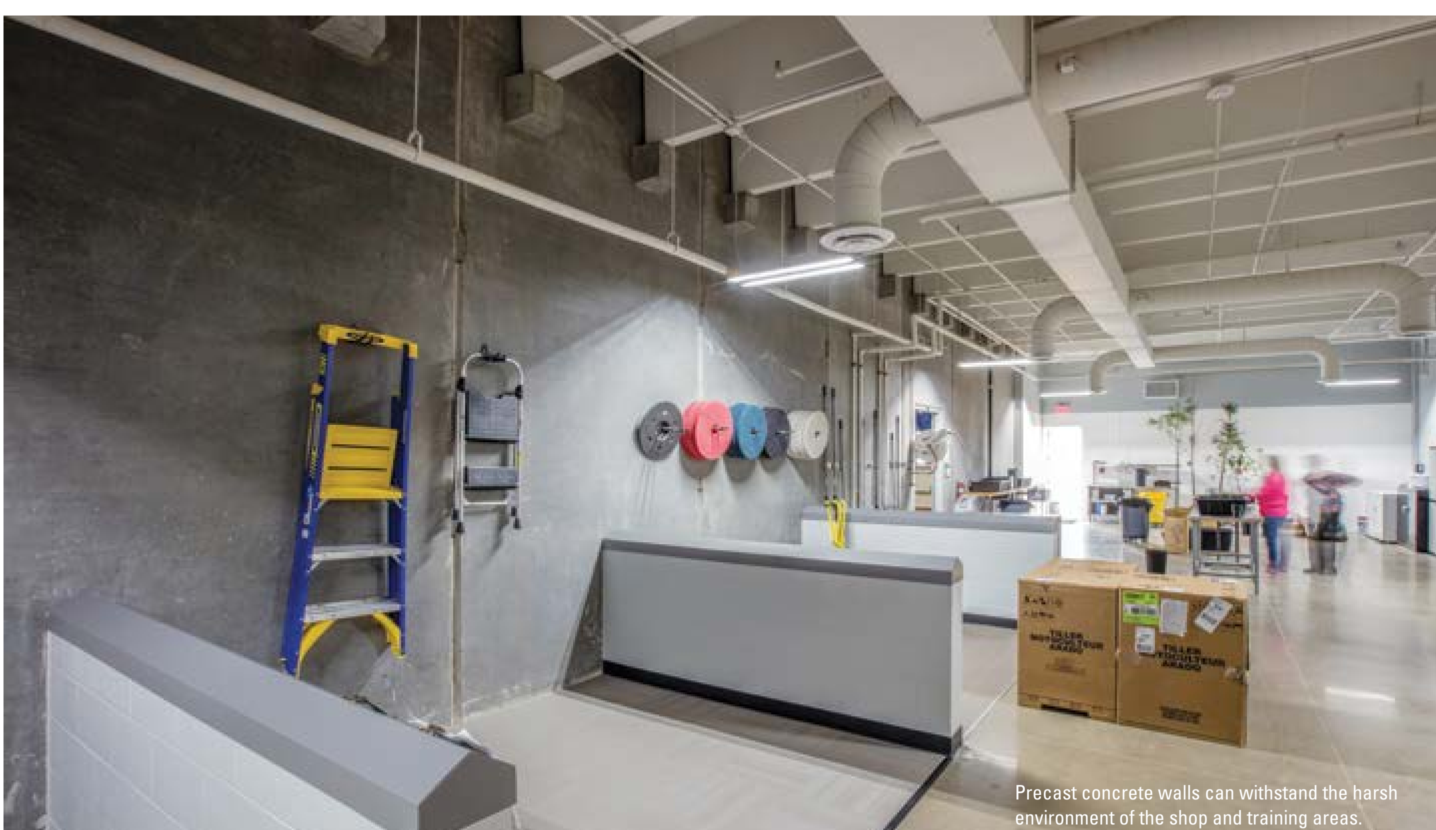
'We turned to precast for its speed.'

Adding to the mix of challenges was the fact that the insurance provider took well over a year to determine the replacement cost. That put the total budget into question. Good stewardship contributed to the success of the project and keeping within the ultimate $44 million budget.

Construction manager CMS Willowbrook had a long-standing relationship with the owner and assisted with the insurance claim. The initial insurance reimbursement would cover only a portion of their loss. CMS Willowbrook helped CVTech make up millions of dollars with a more accurate estimate. "That is something we do as construction manager. We are not just a builder, we are part of the team, and have worked with Canadian Valley since the 1980s," explains Pivniska.

The storm blew out the existing exterior walls and most of the interior walls. Salvaged precast concrete columns and double tees were reused in the new construction. "It was difficult to reconfigure those spaces because the use had changed. We had to work with the original column spacing. Because of the depth of the existing structure, we struggled with how to get daylight into the center. It was difficult, but we were able to accomplish that," says Armbruster.

In addition to bringing in more natural light, MA+ Architecture designed the new facility to be a flexible and collaborative technology center. "When we designed the trade shop portion of Building 100, we selected precast concrete to give it a completely different look and make it more durable. These shops hold training in automobile technology, diesel tech, HVAC [heating, ventilation,



Precast concrete walls can withstand the harsh environment of the shop and training areas.

and air conditioning], and electrical trades. All those shop trades are abrasive and dirty, and so we chose precast because of its durability," recalls Armbruster. Another consideration for the selection was the need for low sound transmission from shop classrooms to adjacent rooms.

To set apart the shop classes from the rest of the campus, MA+ Architecture worked with Coreslab to develop samples and mock-ups to achieve the desired finish. "We wanted something clean and sleek. We visited Coreslab in Oklahoma City to review other panels that they had cast in the past. We looked at color and texture until we came up with what we wanted," explains Armbruster. There was a lot of coordination and collaboration with Coreslab to achieve the desired result.

Coreslab used two different concrete colors and three different finishes to accommodate the architect's vision. Precast concrete walls were painted where exposed inside the facility. "The main goal was to make it as durable as possible for those shop classes," Armbruster says.

"We learned a lot about interior finishes of precast panels, which comes down to understanding what the owner expects. The exterior is super crisp, but there are two sides to the wall panels," says Armbruster. If the wall panels were in an area other than shop class, then a more polished interior would be required.

'The main goal was to make it as durable as possible for those shop classes.'

SAFETY FIRST

Given the circumstances, critical to the new design was the inclusion of safe rooms/storm shelters capable of holding over 1300 people. The storm shelters were designed with precast concrete walls and double tees for an above-ground superstructure designed to withstand the 250 mph winds of an EF5 tornado.

It was determined the best solution would be multiple safe rooms spaced around campus, so students and faculty would not have to travel far to reach shelter. All five storm shelters comply with the International Code Council's *Standard for the Design and Construction of Storm Shelters* (ICC 500) and the Federal Emergency Management Agency's *Safe Rooms for Tornadoes and Hurricanes* (FEMA P-361). The shelter in the early childhood development wing has a bathroom, small storage area, and an area for play. Two of the shelters double as corridors with the main body used as a common area, meeting room, or study space. Two sets of double storm doors are shut in the event of a severe storm. The largest shelter has offices, classrooms, storage room, bathrooms, and a large work area. Each area is painted a different color, so students know where to go if they have to take cover.

Students will also feel more secure with the consolidation to one main building. When there were several buildings across campus, there were multiple egresses. The new campus will be more secure with a front entrance and prominent entryway.

Building 100 was finished and occupied in January 2017. "If that was all CMU [concrete masonry units], it would have taken much longer to get installed," says Pivniska. The new tech center was designed for future expansion, yet less than a year later CVTech came back to MA+ Architecture. "We thought we were designing for future expansion 5 to 10 years down the road. A 40,000-ft^2 precast addition is currently out to bid to enlarge the shop spaces," says Armbruster.

Every space was designed to provide an open and inviting environment that meets the requirements of its program while maintaining the ability to grow and develop with the varied industries. Pivniska concurs that vo-tech projects are very complex because of the varied uses and learning environments. "There were many changes during the construction phase," he recalls. "That is nature of the beast of vo-tech, because they are constantly changing to meet the needs of their students and the marketplace." He concludes, "CVTech liked the way the existing structure was made with precast, since it withstood the EF5 tornado that started them on this journey."

ROGER L. PUTNAM VOCATIONAL TECHNICAL ACADEMY, SPRINGFIELD, MASS.

The new Roger L. Putnam Vocational Technical Academy replaced a 73-year-old facility with a state-of-the-art academy designed to meet the criteria for the Massachusetts Collaborative for High Performance Schools (MA CHPS). Springfield Public Schools had a real need to prepare young people for up-and-coming careers and professions. They emphasize communication, collaboration, and creativity in the curriculum, and wanted to create a real-world, technology-rich environment where learning is rigorous and engaging.

Precast concrete wall panels provide durable exterior and interior surfaces that will require minimum maintenance. All photos: Greg Premru Photography.

ROGER L. PUTNAM VOCATIONAL TECHNICAL ACADEMY

LOCATION
Springfield, Mass.

PROJECT TYPE
K-12 school

SIZE
315,000 ft^2

COST
$114 million

DESIGNER
Drummey Rosane Anderson Inc. (DRA Architects), Waltham, Mass.

OWNER
City of Springfield, Mass.

STRUCTURAL ENGINEER
Engineers Design Group, Medford, Mass.

CONTRACTOR
Consigli/Morganti, Milford, Mass.

PCI-CERTIFIED PRECASTER
Coreslab Structures (CONN) Inc., Thomaston, Conn.

PRECAST COMPONENTS
Architectural precast concrete wall panels

The existing facility, constructed in 1939, no longer served the educational needs of today's career and technical students. After DRA Architects conducted a needs-and-existing-conditions assessment, it became clear that a brand-new facility would be the most cost-effective and best accommodate the desired educational goals.

Due to limited swing space and the lack of relocation options, the team determined that construction had to occur within the existing site while school remained in session. The new 315,000-ft^2 structure, located in the heart of Springfield, was sited on playing fields to avoid disturbing the existing school or parking.

To create smaller learning communities, the school's 1400 students are organized into four academies. Unlike traditional vocational schools, each career academy in Putnam features its own academic classrooms along with their dedicated shops. Grades 9 to 12 can choose from 22 vocational programs, including auto mechanics, carpentry, construction, cosmetology, culinary, commercial arts, electric, graphic arts, hospitality, HVAC, information technology, and robotics.

RESEARCH PROJECT

DRA Architects had investigated precast concrete technology several years prior to the Roger L. Putnam Vocational Technical Academy project. Vladimir Lyubetsky, principal at DRA Architects, recalls the process. "The best application for the high-performance precast panel system would be a large-scale project with significant volumes of space that could benefit from repetition of exterior architectural elements. When this high-profile technical school project came along, we thought it would be a good fit for a precast concrete system."

The new exterior features 37-ft-tall insulated architectural precast concrete wall panels.

Lyubetsky elaborates on why precast

Putnam Hall provides entry to core student spaces and for the public to access student-run services such as a restaurant, beauty salon, and conference center.

concrete was selected. "The high-performance precast panels offered high-energy efficiency and are proven to be durable and cost-effective when applied appropriately. The system also presented unique visual design opportunities that would be difficult and costly to implement using other materials."

There are usually several systems that meet project goals on K-12 projects. DRA has been involved in educational planning and design for vocational technical and education projects for over 60 years. Lyubetsky believes that these are the types of facilities where the wide range of precast concrete structural and architectural elements can be implemented efficiently. "There is an economy of scale that is required to bring the cost down and make these systems affordable and competitive with other exterior envelope and structural systems," says Lyubetsky. Putnam Vo-Tech proved to be a good fit for such an application.

'The high-performance precast panels offered high-energy efficiency and are proven to be durable and cost-effective.'

PRECAST VOCATION

The new school includes controlled lighting, controlled heat sensors, occupancy sensors, and rainwater harvesting, among other energy- and water-saving measures. In keeping with the MA CHPS philosophy, precast concrete was selected for its inherent resiliency and to reduce life cycle costs. Precast concrete panels were exposed to the interior of the building. "This approach allows us to eliminate 'extra' layers of finishes, saves on construction costs, and at the same time provides durable exterior and interior surfaces that will require minimum maintenance over the life of the building," explains Lyubetsky.

The project had its challenges. Given the requirements from the different programs and uses, as well as from after-hours community access, special attention was paid to working within the panelized layout. According to Lyubetsky, there was a significant number of "modular" spaces in the school building that work well with the panelized material systems. "Classroom and gymnasium spaces are often modular in nature. We also design large-scale vocational shop spaces to a module to promote future flexibility. With each project, we try to find unique ways to implement a design concept. Precast construction may not be the

Putnam students are organized into four academies, each with its own academic classrooms along with their dedicated shops.

One of the goals of the new design was to improve indoor air quality and bring in more natural light.

right answer in all cases. DRA Architects strives to find balance between various systems in each project."

The main feature of the design is Putnam Hall, a two-story, main street-like space serving as the central circulation. This main street provides access not only to the core student spaces such as the cafeteria, gym, and library, but also serves as a mall for the public to access student-run services such as a restaurant, beauty salon, school store, and conference center. The building is configured to allow for after-hours community access to all these programs and also features an aluminum rain screen system and metal wall panels.

Precast concrete fabricator Coreslab Structures provided multiple samples and mock-ups to develop final exterior colors and textures for the panels. Coreslab worked with DRA during the design phase to get all finish components tested on the samples. Samples were presented to the school district several times before completion of the construction documents. A final set of samples and the full-size mock-up panels were reviewed and approved early in the construction phase. The insulated panels also included embedded electrical boxes and conduit that required close coordination with the precast producer to address any issues early on.

The project was budgeted at $125 million but came in at $114 million. This substantial cost savings was due to the economic climate when ground broke in 2010.

Lyubetsky believes DRA is ahead of the curve by using precast concrete architectural and structural components in their recent technical high school projects. "We haven't noticed significant increase in the use of these technologies in our region. We do know, however, that the state agencies involved in funding public school construction projects both in Massachusetts and Connecticut have noticed the benefits of this approach, which may lead to more projects being built with precast systems."

The precast concrete panel finishes included light to medium sandblast, deep acid etching, a custom formliner, as well as several color mixtures. All photos: DRA.

TACONIC VOCATIONAL HIGH SCHOOL, PITTSFIELD, MASS.

Facing the same plight as many school across the country, the high schools in Pittsfield, Mass., are aged and worn. Taconic High School, built in 1969, was in dire need of upgrades to heating and ventilation systems, flooring, lighting, technology and electrical systems, plumbing, laboratories, library spaces, cafeterias, and vocational shops. Typical of facilities built five decades ago, the school was not energy efficient.

Taconic selected precast concrete for its vocational shops. The 246,530 ft^2 vocational high school replaces the 1969 structure and will serve the district's 920 students. After completion of the new building, the existing structure will be demolished. This project was also designed by DRA Architects. By applying green technologies, the new school will be more energy efficient. The design team is seeking LEED V4 silver certification.

The success of the Putnam Vocational Academy had a positive influence on DRA Architects and they again selected precast concrete for Taconic High School. Vladimir Lyubetsky elaborates: "Even though the Taconic Comprehensive High School project was slightly smaller in size than the Putnam vo-tech project, it was similar in a few key aspects. The school had several large-scale vocational shops, construction would be adjacent to the existing school, emphasis was on durable and long-lasting materials, and energy efficiency of the new building was a priority. Both projects had these requirements and goals."

Taconic combines both academic and vocational secondary education. The new building is three stories, with the academic classrooms on the top two floors and the vocational shops on

TACONIC HIGH SCHOOL

LOCATION
Pittsfield, Mass.

PROJECT TYPE
K-12 school

SIZE
246,520 ft^2

COST
$120 million

DESIGNER
DRA Architects, Waltham, Mass.

OWNER
Pittsfield School District, Pittsfield, Mass.

STRUCTURAL ENGINEER
Engineer Design Group, Malden, Mass.

CONTRACTOR
Gilbane, Boston, Mass.

PCI-CERTIFIED PRECASTERS
Coreslab Structures (CONN) Inc., Thomaston, Conn.; Unistress Corporation, Pittsfield, Mass.

PRECAST COMPONENTS
Wall panels, beams, columns, double tees, hollow-core slab

Taconic selected precast concrete to withstand the rugged environment in the vocational shops. Illustration: DRA.

the ground floor. The entrance to the building is situated close to the current visitor's parking lot and the main feature will be large glass windows to allow more natural light.

A one-story structural precast concrete podium floor plate will support a two-story steel structure that is clad with insulated architectural precast concrete panels on half of the building's footprint. A series of four mixture designs and various textures were selected, including some with custom formliners.

HOMEWORK

DRA maximized the precast concrete layout on the podium that supported the steel structure above it. According to Lyubetsky, "Using structural precast for the vocational shop areas was a natural progression of the concept of durable and flexible spaces for these areas. We used double tees to provide a clear span over the shops. The design was based on the equal bay spacing for the shop areas. This approach worked well for integration of double tees into the building structure."

'Using structural precast for the vocational shop areas was a natural progression of the concept of durable and flexible spaces for these areas.'

Integration of the steel and precast concrete required very close coordination between the two systems during the shop drawing and erection process. The design had to address the visual impact of the connections between the steel column base plates and the precast concrete structure. Column enclosures at the second floor were sized to conceal the base plates and anchor bolts.

Gilbane suggested that the precast concrete bid package be let early. The construction manager also procured design-assist services from Coreslab Structures as part of the early bid package. "We found that this approach was helpful and resulted in an improved schedule and better coordination and integration of the precast into the design of the building," says Lyubetsky. "The design team, the precast subcontractor and the construction manager had regular weekly meetings to review the progress and address open questions. The process was very cooperative, and we would not hesitate to use the same process on future jobs."

The precast concrete work for the vocational shop section was a tandem effort of Coreslab and Unistress. Coreslab manufactured

a variety of precast concrete components, including structural walls and columns, hollow-core and insulated wall panels, and spandrels. Unistress provided precast concrete beams and double tees for the ceilings of the new technical shop.

The vocational programs are Chapter 74-approved, which means they meet National Occupational Program Approval Standards. Taconic's programs include automotive technology, carpentry, electrical, facilities management, horticulture and landscaping, culinary arts, cosmetology, health and medical assisting, graphic communications, early childhood care, office technology, manufacturing/machine technology, engineering, and information support.

HEAVY-DUTY DURABILITY

The use of precast concrete was expanded into the building for the interior partition walls in the heavy-duty shop areas. Coordination with other trades was minimized by specifying all utilities, including electrical systems, which are face-mounted in the precast concrete walls. Portions of demising walls between the shops were also designed to be removable, providing more flexibility in the future. "That would be harder to achieve with typical concrete masonry units at these locations," explains Lyubetsky.

Even though the school building does not carry an official designation as an emergency shelter, some areas within the building can be used in an emergency. The precast concrete structure does help and fits well into these scenarios. "We incorporated multiple safety features in the design of Taconic High School, as the topic of security for school buildings is very relevant today. We have found that the precast components have helped implement the school's security strategies. The benefits of the precast structure were more of a natural extension of other more significant reasons for selection of the material for the project," says Lyubetsky.

Upon entering the building is a welcome desk with a sight line down each of two long corridors, one leading to the gymnasium, auditorium, and library, and the other to the vocational shops.

'We have found that the precast components have helped implement the school's security strategies.'

The new Taconic High School will include a 600-seat, two-tiered auditorium equipped with the latest technology. This flexible,

The new building is three-stories, with the academic classrooms on the top two floors and the vocational shops on the ground floor. Illustration: DRA.

multiuse venue will be used for a variety of activities such as performances, plays, concerts, and assemblies. The state-of-the-art auditorium will also double as a community space, with public access via a central lobby. Pittsfield Public School district hopes Taconic will be used over the summer and in the evenings as an educational space for the entire community.

Taconic High School features several wall textures and finishes. The panel surfaces included light to medium sandblasting areas, deep acid etching of the surfaces in a few areas, as well as application of the custom formliner, along with variation of the color mixtures for the panels.

According to Lyubetsky, "The city's goal for the new school was to convey a forward-looking and inviting image. The colors and textures of the precast elements were selected to reinforce these goals, while giving a sense of warmth. The site is surrounded by distant hills and the natural environment in the area is spectacular. The combination of all these factors informed the overall design concept, and we believe that the precast elements support that."

The project design did include the concept of potential future expansion. The concept wasn't impacted by use of the precast concrete. Says Lyubetsky, "We believe precast components would be a good choice for any future expansion.

"We had very positive experience in working with Coreslab and their engineering subconsultants during the predesign phase of the project. There was real value added to the project by following this process. We would recommend that if a project involves significant precast design elements, involving the precast subcontractor early during the design phase would only enhance the chances of a successful project."

The team worked well within the restrictions common to school construction projects. Given the proximity of the new facility, there were limitations to schedule and operations as well as shutdowns and noise constraints while school was in session. The project is on schedule and was expected to be completed by June 2018. In the fall, students will occupy the new building while the old one is razed and turned into playing fields.

The new Taconic, with an enhanced vocational/technical course curriculum and modern classrooms, shops, and other school spaces, is considered a key to boosting the city's economy by preparing students for well-paying jobs that are now sometimes going unfilled in the region.

The success of Putnam encouraged DRA to continue to use precast concrete building systems on other large-scale high school projects. They are currently completing construction of a new comprehensive high school for the City of Pittsfield and have two new vocational technical high schools in design, one located on Cape Cod, Mass. and the other in Milford, Conn.

REPORT CARD

These three projects depict how across the country, career tech schools are playing an integral part in educating and training workers. The technical schools are part of the equation to meet the needs of the workforce, and precast concrete is an integral part of meeting their design goals.

Many of the contractors and subcontractors in these projects partner with the vo-tech centers by offering internships and participating in career training. In the near future, students enrolled in construction trade curriculum at career tech centers may be future employees.


SPANCRETE®

Integration of the systems in a high-performance building leads to significant LCCA savings.

Student-centered learning commons at St. James Intermediate School in Horry County, S.C. Photo: Tom Holdsworth Photography, courtesy of SfL+a Architects/Firstfloor.

Life-Cycle COST ANALYSIS

The whole is greater than the sum of its parts

— Robbie Ferris

There are two ways to perform life-cycle cost analysis (LCCA) and they produce very different results. The traditional method of LCCA evaluates the life-cycle cost of specific systems such as heating, ventilation, and air conditioning (HVAC). However, it does not focus on the total cost of ownership for the building. A more comprehensive method of LCCA compares the total cost of owning a specific building against other, similar buildings. Often this is a comparison of a high-performance building to a baseline building. Is this true? Does LCCA only apply to high-performance buildings? Could this analysis be conducted on any building? I would call this whole-building analysis. While each method is valid, the results of the analysis are typically very different. If the results are different, which method is best?

If you are only going to replace the HVAC system in an old building, the traditional method is probably the right choice. If you are trying to decide whether to replace a building or renovate it, looking at the whole building is the method that will produce accurate results. Additionally, if you are comparing the LCCA for renovating with building a baseline building and/or building a high-performance building, then using the whole-building method is essential. Some would argue that both methods allow you to compare the total cost of a baseline building to a high-performance building. While that is partially true, the reality is the integration of the systems in a high-performance building leads to significant LCCA savings. Once again, you must choose the method that is right for your project.

BEGIN WITH THE END IN MIND

The traditional LCCA process has a very narrow perspective. It leaves you with a set of systems that supposedly have the lowest life-cycle cost and, for the most part, those systems don't impact each other. For example, the type of HVAC system has little to nothing to do with the shape of the building in the traditional LCCA process. Whole-building analysis is about selecting systems based on the big-picture goals for the project and the qualities you are looking for, and then optimizing how one system impacts the other. The goals are well established and guide the process. We have

Solar trees at Sandy Grove Middle School. Photo: SfL+a Architects/ Firstfloor.

all heard building owners say something like, "We really wanted to try out a geothermal HVAC system, or solar panels, or a handful of other things, and we just could not make the math work." The problem is that without big-picture goals, the design and implementation are less likely to take into account how these decisions would impact other building systems. The following case study illustrates this point.

The traditional LCCA process has a very narrow perspective.

SANDY GROVE MIDDLE SCHOOL

In 2009, SfL+a Architects began the design of Sandy Grove Middle School in Hoke County, N.C. For this traditional school the owner wanted an "E" plan and had ideas about what the building should look like. As the recession set in, the district reviewed its projected total cost of ownership, estimating the debt service payment combined with the electrical bill to be $1.5 million per year. The project went on hold. In 2011, the district came back to SfL+a and said they desperately needed the new facility but could only afford $450,000 per year for the first 8 to 10 years. We said, if you let us redesign the building to eliminate the electrical bill and you lease the building from us, we can get the payment down to $450,000 per year. Setting the lease payment at what the district could afford was the defining moment in the LCCA process. Our team divided the total cost of ownership into categories: capital cost, interest cost, electricity and other utilities, and tax credits and incentives. We found that maintenance costs would be about the same regardless of the systems selected, so we focused on the things that had the biggest impact. We then realized that electrical costs were almost 30% of the total cost of ownership over the 40-year life expectancy of the systems. We realized that we had the most control over electrical costs and could eliminate them. Knowing that we needed to generate 30% more electricity than we would consume, we factored in the number of solar panels we could install on the roof and their subsequent energy production, and determined that the building needed to achieve an energy use intensity (EUI) of approximately 20. The EUI goal led to our using the most efficient systems we could find, such as a geothermal HVAC system, LED lighting, a super-insulated roof, foam insulation in the cavity wall, and a variety of other energy-conserving measures. Our next focus was the interest costs, which we creatively found a way to eliminate. Additional savings came from tax credits that were available for the project, which made it a win-win for everyone. Over 40 years, Sandy Grove Middle School will save Hoke County Schools $37.2 million.

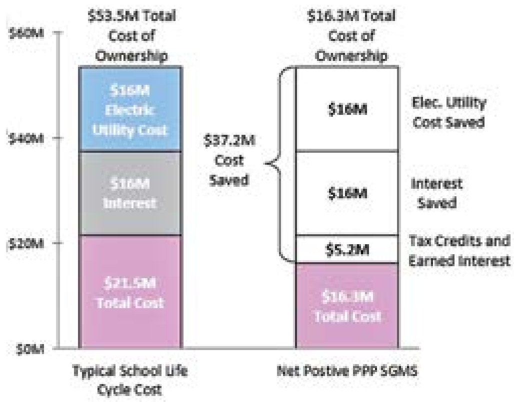
WHOLE-BUILDING LCCA VERSUS TRADITIONAL LCCA

Let's compare this process to the traditional LCCA process, where we invest exhaustive amounts of time comparing HVAC systems, insulation, roofs, etc. If we're doing our job correctly, there are literally hundreds, if not thousands, of combinations of systems that we should compare. In practical terms, comparing combinations of systems rarely, if ever, gets done. Eliminating the electrical cost is typically not a project goal because no one ever stood back and looked at where the real money is being spent. Most design/construction teams do not think this is within their control, thus it is not addressed. Under the traditional LCCA process, the team focuses on the details without looking at the big picture. When looking at the whole building cost for Sandy Grove Middle School, we never even considered systems that would not get us to an EUI of 20, and consequently, we only needed to evaluate two HVAC systems. Under the traditional LCCA process, we never would have decided to add roof insulation because most engineers will tell you that once you have 4 to 5 in. of insulation, the difference in energy consumption is not worth the investment. In our case, we had to get to an EUI of 20 and adding roof insulation needed to be part of it. There were many other decisions we made similar to this, and it's clearly different from the traditional LCCA process.

> Stand back and look at the big picture goals before getting into the weeds analyzing systems.

Anytime you start a project, you should stand back and look at the big picture goals before getting into the weeds analyzing systems. If you use this approach, you will likely eliminate the infinite number of options that usually lead to ordinary buildings. What are we trying to say here? Focus on the big picture goals.

Main entrance at St. James Intermediate School. Photo: Tom Holdsworth Photography, courtesy of SfL+a Architects/Firstfloor.



Over 40 years, Sandy Grove Middle School will save Hoke County Schools $37.2 million.

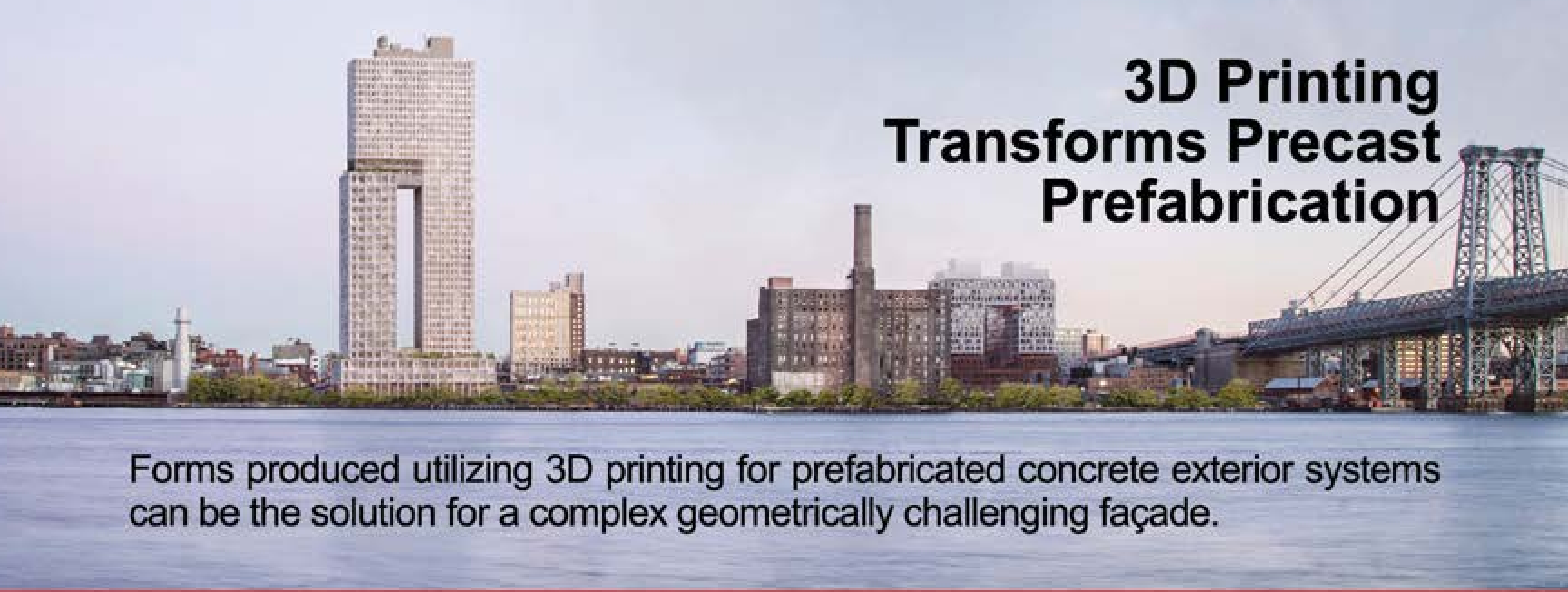
Aerial view of Ten Oaks Middle School, Horry County Schools. Image courtesy of Metcon/TA Loving.

If time is your biggest issue, focus on what can be prefabricated and then analyze the remaining systems. For example, our team designed five new schools for Horry County, S.C., that had a tight 20-month design-permit-build schedule. To meet the schedule, we chose to prefabricate the HVAC penthouse and to use precast concrete for the roof and floor structure. These schedule-driven choices, along with the program requirement to generate more electricity than we consumed, drove most of the system decisions in the building.

> Looking at the whole building produced an exceptional end product.

Our architectural team (SfL+a, Stantec, and Mozingo + Wallace) responded with a compact floor plan that reduced the amount of exterior wall and exterior glazing while maximizing views and daylighting. The compact plan also made for some very dramatic interiors. Reducing exterior walls reduced first cost, as well as energy and maintenance costs. The floor system is a hollow-core concrete, and we used the hollow-core as the ductwork for the building. This allowed us to store thermal energy in the concrete and reduced the height of the building by 6 to 8 ft, thus reducing first cost, electrical costs, and maintenance costs. We used a geothermal HVAC system with a prefabricated HVAC penthouse, which allowed us to use three air handlers for the entire building, resulting in the maximum opportunity for diversity. This system combination reduced HVAC system tonnage and gave the client more control of the building when there are exceptionally large people loads in certain areas like the gym and lobby. Looking at the whole building produced an exceptional end product that would never have been achieved using the traditional LCCA process.

Robbie Ferris is the CEO of SfL+a Architects and Firstfloor.



3D Printing Transforms Precast Prefabrication

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

As part of a research project to verify the transformative possibilities of 3D printing for concrete applications, Gate Precast is using 3D printed forms in the production of a high volume 42-story precast clad mixed-use tower because of the durability and repeatability the forms offer.

Through a design-assist relationship, Gate Precast, Two Trees and architect COOKFOX refined the window profiles on the tower to make it cost effective and practical to use 3D printed forms. The punched windows panels have varying widths and spacing and include aluminum framing and glass pre-assembled and caulked at the plant prior to shipping to the jobsite, which streamlines the installation of the façade.

The 3D printed forms are providing incredibly sharp details with polished and acid etch finishes - a feat that would have been difficult with traditional wood materials.

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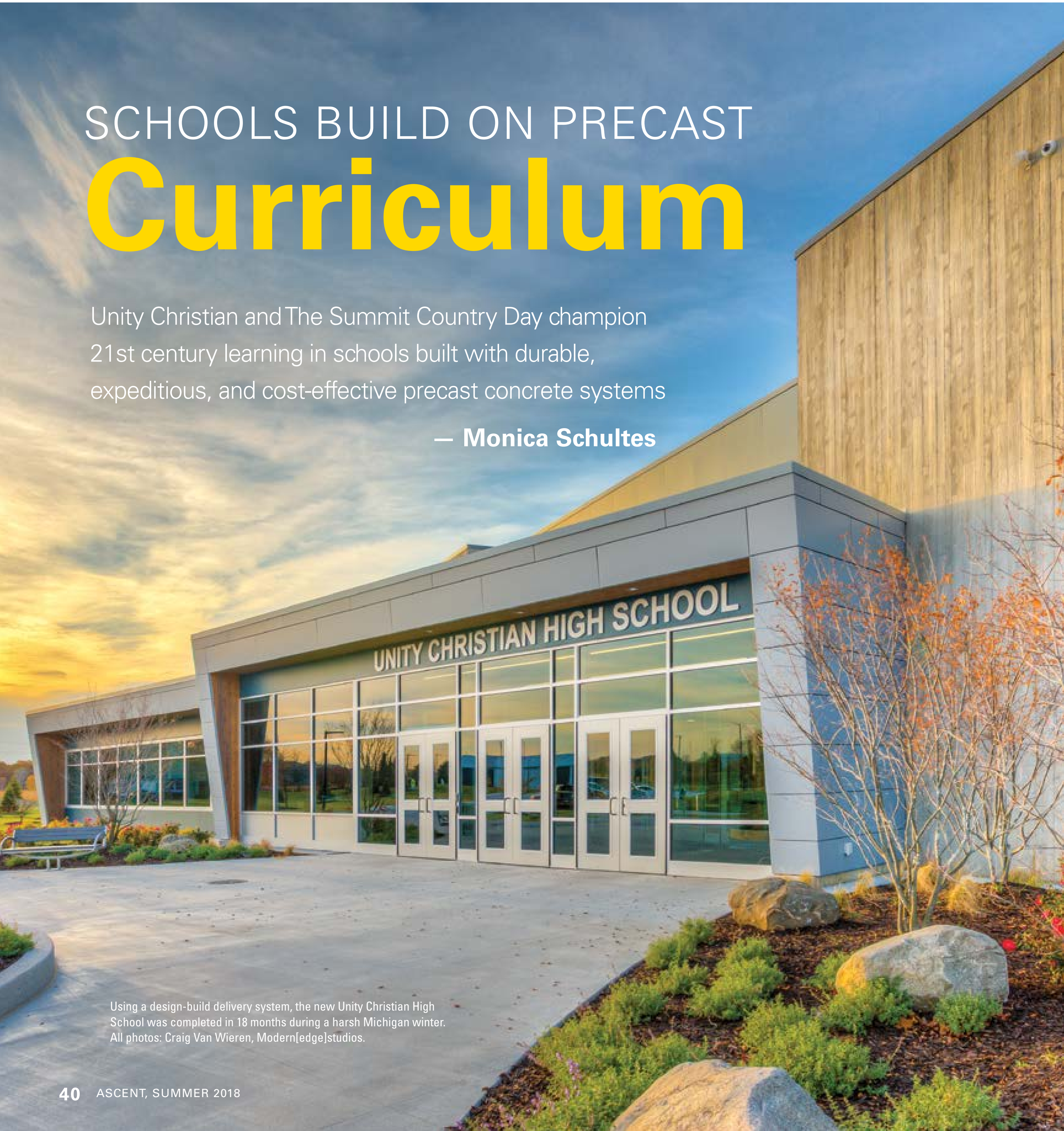


SCHOOLS BUILD ON PRECAST Curriculum

Unity Christian and The Summit Country Day champion 21st century learning in schools built with durable, expeditious, and cost-effective precast concrete systems

— Monica Schultes

Using a design-build delivery system, the new Unity Christian High School was completed in 18 months during a harsh Michigan winter. All photos: Craig Van Wieren, Modern[edge]studios.

It doesn't take an honor student to see that a high school needs to be both a safe haven and an inspiring space, and that it has to withstand the daily wear and tear of hundreds of teenagers. Not only is the design and construction a challenge, but factor in zero public funding for parochial schools and the (lack of) budget is an obstacle all on its own.

Private schools have the onus to raise money for new or renovated school projects through a capital campaign, but they do have the luxury of setting some of their own rules. These owners can forgo the traditional design-bid-build constraints that are required for public schools. Parochial schools also foster long-term relationships in the community that can maximize their construction dollars. From financial endowments to donations of time and materials, many private institutions have the resources to embark on grand construction projects that had been put on hold during the recession.

In addition to sidestepping the traditional bidding process, nonsecular academies can also think outside of the box for their design and construction goals, leading to more creative uses of precast concrete than in traditional public schools. The two projects presented here selected precast concrete systems for their durability, speed of construction, and cost-effectiveness.

UNITY CHRISTIAN HIGH SCHOOL

The Eastern Ottawa Christian Schools serve Ottawa County in western Michigan with a Christian education committed to increasing faith, educational excellence, hospitality, and service. Planning for a new high school began before many of the enrolling students were even born. The entire Unity Project was a 17-year process that started in the late 1990s. Phase I, fundraising for the purchase of land, was completed in 2003.

As a private school, all funds needed to be raised from private donors and families that support Unity Christian High School through tuition payments and donations. Early budgeting estimated $30 million for the project, but the fundraising committee did not think that was going to be feasible. The planning committee was asked to look at different approaches to the building, including reducing the square footage as well as alternative materials and methods of construction.

RECONFIGURED DESIGN GOALS

Kerkstra Precast, GMB Architecture, and Lakewood Construction all support the Unity School system. With their input, the project was reconfigured, square footage reduced, a precast concrete bearing structure implemented, and the project budget was reduced to $23.5 million.

The original design was for a 200,000-ft^2, traditional brick and block masonry high school estimated to cost $30 million. The redesign scaled down the size of the project and turned to a total–precast concrete system. Precast concrete offered the superior fire protection and high sound transmission coefficient (STC) ratings specified by the school, with a significant cost savings and compressed schedule.

Kerkstra showed the team several completed projects that had used a formliner. They selected a texture that simulated wood panels. "Precast concrete was a key component in meeting the goals of the project; not only for its physical properties, but also for its aesthetic capabilities," says Lynn Bolek, senior project manager

'Precast concrete was a key component in meeting the goals of the project–not only for its physical properties, but also for its aesthetic capabilities.'

One of the building's most unique design elements is the application of the wood grain formliner. The insulated precast concrete wall panels are load-bearing with a barn board finish selected to give the concrete a modern appeal and feeling of warmth. Photos: Craig Van Wieren, Modern[edge] studios.

with Kerkstra Precast. "The wood grain texture featured throughout the building was created with a highly reusable elastomeric formliner from Architectural Polymers. The barn board finish was selected to give the concrete a modern appeal and feeling of warmth."

The insulated precast concrete wall panels serve multiple purposes as they bear the gravity and lateral loads imposed on the structure. Another bonus is that maintenance is minimal compared to wood. The concrete was standard gray and the panels were stained on site. That gave the warm finish that emulated wood so closely. Some panels with light and medium sandblast finishes were finished at the plant.

THINKING OUTSIDE THE BOX

"The biggest obstacle in the beginning was to coordinate the mechanical/electrical contractors to lay out the conduit and boxes so that Kerkstra Precast could include them in the shop drawings and cast them into the panels," says Marcel VanderLaan, project manager with Lakewood Construction. "Some finagling had to be done to avoid the internal prestressing strand and embedded connection hardware."

Bolek agrees. "The coordination of electrical boxes that are cast into precast panels is always challenging because there is no real way to keep a product of that size from floating during the concrete pour. You can tie it to the truss framing, but some do shift during production and some have to be patched at the jobsite. We always recommend having a large cover plate to account for that, and to limit the amount of patching."

In addition to the load-bearing wall panels, prestressed hollow-core slab was used for the floors and ceilings in the classrooms. These precast concrete walls and floors provide further protection against fire and also perform well in noisy environments due to their high STC ratings.

UNITY CHRISTIAN HIGH SCHOOL

LOCATION
Hudsonville, Mich.

PROJECT TYPE
K-12 school

SIZE
152,246 ft^2

COST
$23.5 million

DESIGNER
GMB Architecture & Engineering, Grand Rapids, Mich.

OWNER
Unity Christian Schools

STRUCTURAL ENGINEER
GMB Architecture & Engineering, Grand Rapids, Mich.

CONTRACTOR
Lakewood Construction, Holland, Mich.

PCI-CERTIFIED PRECASTER
Kerkstra Precast, Grandville, Mich.

PRECAST COMPONENTS
Hollow-core slab, interior and exterior wall panels, knee walls, spandrel panels, beams, columns, stairs, solid slabs

The 149,000-ft^2, two-story precast concrete building hosts two educational wings with two floors of classrooms, as well as administrative offices, common area, running track, multipurpose room, locker rooms, phys. ed. lab, weight room, and music/band, choir, and art rooms.

TIMING IS EVERYTHING

Because the project needed to be completed by the start of the new school year, the schedule was a major concern to everyone on the project team. This meant the project delivery system had to be design-build with open lines of communication across the project team.

"Given the speed of precast construction, we were confident that we could start construction in the spring of 2014 and have it ready in time for school to start in August of 2015," says VanderLaan. The aggressive 15-month schedule also contributed to cost savings as the project was accelerated. "We only had three to four months of erection versus 12 to 14 months of masonry installation on site." The timing was serendipitous for this project, "because not six months later the market took an upturn and the pent-up demand for precast and general construction took off. The schedule would not have been met and costs would have been 20% higher," says VanderLaan.

FIRST DAY OF SCHOOL

A groundbreaking ceremony was held in May 2014 and students walked into classes for the first time in the new school in August 2015. While site prep was occurring and footings were being placed, Kerkstra fabricated more than 3700 pieces of hollow-core slab, interior and exterior wall panels, columns, beams, and precast concrete stairs. The first panels arrived on site on June 30, 2014. Pioneer Construction erected the precast concrete walls and the structural steel, which streamlined the coordination between the two materials and simplified the enclosure process.

With the exception of a final panel, which remained out for a portion of the project to allow larger equipment access into the building, the last panel was put into place in late October, allowing for enclosure in November of 2014. VanderLaan recalls, "That winter was brutally cold with tons of snow. Our operations would have been shut down had it been block/brick, or else we would have had to spend millions to tent and heat the job. It worked out great to have the precast for the schedule."

VanderLaan adds that "on a traditional project, while you are doing site work you can't do any masonry work. You have to wait for all these steps to be done, but while we were doing site work the precaster was busy fabricating all these panels. Boom! There would be 80 linear feet of walls up in a day."

GIVING BACK AS PART OF THE COMMUNITY

Kerkstra Precast is a second generation, family-owned business that encourages community involvement and instills a culture of volunteerism. Bolek says that "employees receive a paid day of service where they can volunteer with the group of their choice, whether it is a food bank, local school, or Habitat for Humanity. That culture permeates throughout the company and this project exemplifies that community involvement."

"Precast was a great investment for the school," says VanderLaan. "There was a significant cost reduction thanks to the commitment of the Kerkstra family to make this project move forward. Project cost for this building, factoring in many gifts-in-kind from supporters and bidders, allowed this school to be built of durable, lasting materials with a great performance and design for less than $140 per square foot."

'Precast was a great investment for the school.'

The design-build team on the Unity Christian High School proved that you can design and build a new, state-of-the-art facility in 18 months. They worked together to create a structure that communicates a strong, durable environment and sets a tone for safe school culture and innovative learning.

The Unity Christian High School was conceived as a way to provide a safe haven for the local community within a thermally efficient, durable, functional, and attractive structure. All told, the financial support from the community when all phases were complete totaled $30 million. The entire project consists of 100 acres, which include soccer fields, tennis courts, baseball and softball diamonds, and a cross-country course.

"After the success of this project, I think more schools will consider precast concrete in the future. We are currently talking to another school in the design phase and they were inspired by the appearance and achievement of UCHS," says Bolek. "In the past, precast floor systems were common (double tees or hollow-core plank), but the wall systems are starting to be more appealing to schools and we will start seeing more of that in the future."

THE SUMMIT COUNTRY DAY SCHOOL ADDITION

LOCATION
Cincinnati, Ohio

PROJECT TYPE
K-12 school

SIZE
11,000 ft² addition; 80,000 ft² renovation including new science labs

COST
$9 million

DESIGNER
SHP Leading Design, Cincinnati, Ohio

OWNER
The Summit Country Day School, Cincinnati, Ohio

STRUCTURAL ENGINEER
THP Limited Inc., Cincinnati, Ohio

CONTRACTOR
HGC Construction, Cincinnati, Ohio

PCI-CERTIFIED PRECASTER
Gate Precast, Winchester, Ky.

PRECAST SPECIALTY ENGINEER
Ericksen Roed & Associates, Saint Paul, Minn.

PCI-CERTIFIED ERECTOR
E.E. Marr, Baltimore, Md.

PRECAST COMPONENTS
Insulated wall panels, load-bearing walls, beams, columns, hollow-core slab

Precast concrete far exceeded expectations in producing an extraordinary level of detail in the panel profile. Photo: Gate Precast Company.

THE SUMMIT COUNTRY DAY SCHOOL ADDITION, CINCINNATI, OHIO

You can't help but be motivated when you work with a school whose mission is to challenge every student to develop spiritually, academically, physically, socially, and artistically, and to become people of character who value and improve the world they inherit. The Summit Country Day School graduates 100% of its senior class and has a 100% college acceptance rate.

Founded in 1890, The Summit Country Day School is an independent Catholic coeducational college-preparatory school, whose campus covers 24 acres in Cincinnati's Hyde Park neighborhood, with an additional 16-acre athletic complex. They assembled an inspired team that would make them whole again after a partial collapse of a portion of the school in 2004.

The school needed more space because of growing enrollment in the Upper School. In addition to the seven classroom labs, the expansion gave the school room for a lab dedicated to independent study in the sciences. The Summit's new Science Research Institute also holds classes in this space. The need for top-tier facilities to support that program also necessitated building the five-story east wing.

Richard Thomas, vice president of architecture at SHP Leading Design, explains the firm's relationship with the school. "SHP had been working together [with the school] since 2004 when we were brought on board to resolve the collapse of a portion of the structure. In addition to remedying the collapse, we worked with them on smaller projects around campus."

The addition was the final result of putting back what had fallen down. Because of the collapse and other safety concerns, The Summit discourages construction while students are present on campus, leading the design team to face the self-imposed challenge of how to complete the entire $9-million project during a single summer.

TEAM BUILDING

Thomas proposed that, "given enough time and the right team, the project could be planned and executed over the course of the summer." In essence, the five-story, 10,000-ft^2 addition had to be built in a 10-and-a-half-week period. "I wasn't sure at the very start how we were going to do it, but felt with the right team the challenge could be met," recalls Thomas.

The team was assembled: HGC Construction, THP Limited, and key subcontractor trades. "The school gave us free rein to bring on the best of the best who were willing to commit to the project's tight parameters," says Thomas. The integrated project delivery streamlined

Precast concrete panels in the addition reflect the stately architecture of the original, including matching the brick circa 1890. Photo: Gate Precast Company.

the process. Without the collaboration of the architect, contractor, engineer, owner, and precaster in tandem combination with three-dimensional modeling, the results would not have been possible.

The team identified possible systems that could facilitate the schedule, and precast concrete quickly rose to the top of the list. In addition to the time crunch, the expansion was designed to mimic the existing building, which was constructed in 1890.

"From the start, our approach to building the east wing was to honor and respect the traditions of The Summit as reflected by the architecture of the Upper School," says Thomas. "The original architecture is grand, stately, and dominant relative to its surroundings, and yet very approachable. We wanted the architecture of the new construction to continue to reflect those traits."

Gate Precast was selected as the precast concrete fabricator to find a way to develop a total–precast concrete system. They collaborated with Thomas and the rest of the project team. Many designers don't realize how many of these iterative processes are completed upfront. Thomas recalls, "There was a great deal of conversation and that just

The addition to The Summit Country Day School restored a portion of the structure that had collapsed. The total–precast concrete structure was erected in 22 days. Photo: Joe Harrison, JH Photography Inc.

doesn't happen overnight." The collaboration also helped maintain the budget by limiting the piece count. The first iteration consisted of 119 precast concrete pieces. "We whittled that down to less than half of that," explains Thomas.

The team worked with Gate Precast through an exhaustive sample process. Brick on the original building was matched with thin brick embedded in the precast concrete wall panels. Then decisions were made to emulate the ancillary materials. "There were mansard roofs, dormers, detailed windows, dimensional stone—all with multiple material and finish selections. White cement mix was used to emulate limestone for the water table, trim elements, and cornices," says Thomas.

The multistory panels minimize the jointed system and help the new addition blend seamlessly into the older structure. The use of all precast concrete components provided column-free space for design flexibility and future reuse.

SUMMER VACATION

Usually a project of this size could take up to 12 months, but The Summit wanted the project completed without any disruption and altered the school calendar to allow for a longer summer construction period. The team spent more than a year planning a way to build the project in the time allowed.

The precast concrete panels arrived in the typical just-in-time delivery. "There was no laydown area on campus, so it had to be done that way. No panel sat more than two hours once it arrived at the site," Thomas says. Careful planning and sequencing enabled the entire facility to be erected in 22 days.

The private Catholic school did not have to deal with competitive bidding. As a private institution, the school was not bound by traditional public bidding requirements, freeing it up to select on a qualification-based model with a focus not only on cost competitiveness (from prequalified subcontractor teams), but the ability to commit to the schedule. The only requirement was to get it done within budget and within the time frame.

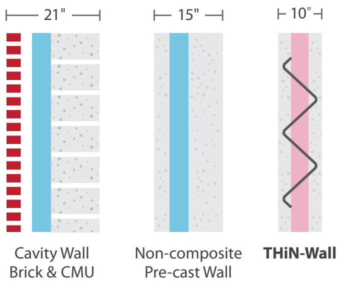
The design team determined that precast concrete was the best solution, but the team still had to determine who provided the best value and could meet the extremely aggressive schedule demands.

Thomas noted that while the first cost of the design was higher than other systems, the speed of installation more than made up the difference. It resulted in a cost-effective solution that met the owner's durability, schedule, aesthetic, and performance criteria in the context of the original architecture. "The intricate design of the existing facility could not have been recreated for the same dollars and certainly in the same time frame by any other construction approach," Thomas says. "Gate Precast's capabilities in design and fabrication far exceeded expectations in producing an extraordinary level of detail in the panel profile and panel performance."

The project resulted in Summit adding a five-story, 11,000-ft^2 east wing on the main building that provides a large library reading room, more classroom space, room for the business office on the first floor, an art studio, and a covered walkway between the main building and the Lower School. The project also created state-of-the-art science labs on the first and second floors of the west wing and main building, and renovated a science lab, administrative offices, and health clinic in the Middle School.

Both Unity Christian High School and The Summit Country Day School experienced the benefits of the accelerated construction schedule and comparative cost reduction provided by the use of total–precast concrete systems. These schools were able to provide an improved educational environment for their students with projects completed in a matter of weeks, allowing the interiors to be completed and ready for the use of faculty and students by the critical first day of school. Neither project would have resulted in the same level of success without the team collaboration and cooperation that is a hallmark of all precast concrete projects. The lessons provided by these examples can be applied to improve countless other projects through the integration of precast concrete.


THERE'S A THiN
WALL BETWEEN
SUSTAINABILITY
AND STRENGTH.


21"
15"
10"
Cavity Wall
Brick & CMU
Non-composite
Pre-cast Wall
THiN-Wall

Quick RECOVERY

After designing a total–precast concrete high school, designers used lessons learned there to build a second facility in rapid order after a nearby school burned to the ground, displacing 1600 students

— Craig Shutt

Administrators in the Guilford County School district in Gibsonville, N.C., had evaluated earlier K-12 schools built with precast concrete architectural panels and framing systems, so they decided to use them on their new high school. That decision paid dividends when another high school in the district burned down, allowing the first school's design to be quickly adapted and constructed to replace the destroyed facility.

For the first school, 1600-student Northern Guilford High School, the key factors in the use of the precast concrete system were energy efficiency, aesthetics, and, most importantly, schedule. "No question, one of the major drivers was schedule and lack of availability of masonry labor," says Robbie Ferris, CEO of SfL+a Architects in Raleigh, N.C., the architectural firm on both projects.

The precast concrete wall panels were designed as insulated, load-bearing panels faced with inset brick. This approach provided a variety of benefits in one panelized system. It also kept prices low by minimizing costs and issues compared to steel framing. "The design produced major savings over the volatile steel prices

NORTHERN GUILFORD HIGH SCHOOL

LOCATION
Greensboro, N.C.

PROJECT TYPE
K-12 school

SIZE
270,568 ft^2 (for 1600 students)

COST
$37.9 million

DESIGNER
SfL+a, Raleigh, N.C.

OWNER
Guilford County School District, Greensboro, N.C.

STRUCTURAL ENGINEER
Fleming & Associates, Fayetteville, N.C.

CONTRACTOR
Barnhill Contracting Co., Rocky Mount, N.C.

PCI-CERTIFIED PRECAST PRODUCER
Tindall Corporation, Spartanburg, N.C.

PRECAST COMPONENTS
Double tees, architectural insulated wall panels, rectangle beams, L beams, columns, and flat slabs

at the time," Ferris says. There was concern that steel specified in the designs could skyrocket in price when materials were purchased later, creating budget overruns. Precast concrete provided steady, secure pricing for a material that could be erected quickly in a panelized system.

The two-story, 270,568-ft^2 school features a large central atrium that serves as a gathering point, a single point of entry to control security, and an auxiliary gymnasium. Classrooms, administrative offices, a computer lab, rooms for career technical education classes, and a dance studio flow off one side of the atrium, while the main gym, a 700-seat auditorium, and a dining area are adjacent to the atrium on the other side.

PRECAST EXPERIENCE

Along with its design concept, SfL+a brought to the project its long experience with designing K-12 schools with precast concrete, having designed the well-known Jack Britt High School in Fayetteville, N.C., in 1996. In that case, Cumberland County Schools wanted a design that provided a contemporary, high-tech appearance that was respectful of academic traditions. SfL+a specified precast concrete panels with inset thin brick, satisfying administrators' request for a masonry building while resolving other challenges.

SfL+a's 1996 design for the Jack Britt High School in Fayetteville, N.C., represented one of the first in the region to use inset thin brick in insulated precast concrete panels. The design garnered positive attention and made precast concrete a strong choice for school façades in the area. Photos: SfL+a.

The design became an obvious choice for the school as material options were reviewed, Ferris notes. A lot of construction activity was taking place at nearby Fort Bragg, sucking up most of the masonry materials and labor in the area. "Costs were getting very high and the schedule wouldn't allow for using masons for all the brickwork. We realized early on that precast concrete was the only material that would be able to meet our schedule."

The panels provided accenting details that could not have been achieved with concrete block and brick cavity walls, Ferris says. The design and attention to detail won accolades, including in the Architectural Portfolio and PCI Design Awards competitions, and from *American School & University* magazine.

'It was really successful and has been incredible from a maintenance standpoint.'

That project, one of the first schools in the region to combine insulated panels with inset brick, garnered positive attention and made precast concrete a strong choice for school façades in the area, Ferris says. "It was really successful and has been incredible from a maintenance standpoint ever since," he says. "There have been no problems at all. That's something administrators all over the region have noted."

Then, in the early 2000s, several additional large, total–precast concrete high schools were built around Greenville, S.C., and Charlotte, N.C. "The availability of local precast fabricators, speed of delivery, and quality of finished product established the precast framing solution as a tested and proven building system for large high school projects," says Stefan Ely, sales engineer for Tindall Corporation, the precast concrete producer of the components for both schools.

SfL+a had also designed several additional schools with precast concrete framing systems, including East and West Bladen High

An aggressive schedule and a shortage of masonry labor led designers of the 1600-student Northern Guilford High School to specify insulated, load-bearing precast concrete panels faced with inset brick to clad the building. The panels also provided a hedge against volatile steel prices and provided a low-maintenance panelized system. Photo: Tindall Corp.

The two-story, 270,568-ft^2 school features a large central atrium that serves as a gathering point for student activities. Photos: Tindall Corp.

Schools in Elizabethtown, N.C. Administrators had local examples to review and liked the range of benefits the precast concrete design offered, including aesthetics, speed of construction, energy efficiency, and cost efficiency.

"One of the reasons they selected us to build the Northern Guilford High School was our experience with precast concrete," Ferris says. "They had seen the results, and they knew the schedule wouldn't be a problem for that approach."

SfL+a went through the proposal process with precast concrete designs to show. "They liked our approach and experience with the material. We didn't need to sell them on it." SfL+a worked with Barnhill Contracting Co. as the general contractor, while Tindall provided design-assist input and fabricated the components.

"Northern was delivered through a traditional design-bid-build method," says Ely. "We provided assistance for the design and budgeting as the project developed, prior to formal bidding. The Carolinas were rapidly growing, and there was a push to build many new schools."

ENERGY-EFFICIENT PANELS

A key benefit administrators liked was the energy efficiency that was inherent in the precast concrete and how it could be designed to enhance those benefits. The insulated sandwich wall panels were cast with 5 in. of insulation with a 4-in.-thick interior structural wythe and a 3-in.-thick exterior architectural wythe. The insulation was installed in two layers of 2 and 3 in.

"The double-insulation wythe allowed for continuous insulation of one wythe with local/spot interruption of other wythes at haunches to support double tees with flat slabs at corridor floors," explains Ely. Adds Ferris, "The panels created a superior thermal envelope to a brick-and-block design, with continuous insulation."

Truss wire girders were used to connect the two insulation wythes. "The insulation type and thickness were selected to meet the overall assembly *R*-value, after consideration of any thermal losses associated with the truss girders," Ely adds.

The insulated precast concrete walls provide more reliable protection than cavity walls, too. "Cavity walls can leak, which becomes nearly impossible to fix with a brick façade," Ferris says. "The precast concrete sandwich wall panels are a panelized system that is predictable, and joints are easy to check. We've seen cavity walls that leak or allow air in at window joints, which creates problems."

A key concern is the joint where the wall meets the roof, he notes. "It's very common for that joint to leak in steel-frame buildings, requiring callbacks. With precast concrete, it's virtually impossible. The building is tied together so tightly and everything is sealed up. It creates a great building."

In addition, the inherent mass of the concrete in the walls, flooring, and roof absorbs heat and releases it slowly, creating thermal efficiencies that reduce heating, ventilation, and air conditioning (HVAC) load and provide better thermal performance. "The concrete reduces thermal demand by storing the energy for later use." The insulation provided an *R*-value in excess of *R*-19, providing a highly efficient thermal envelope.

PRECAST SCOPE EXPANDED

Initially, designers intended to use precast concrete only for the exterior insulated wall panels. But as Tindall worked with the designers on a design-assist basis through design development, that expanded. "We were able to provide a level of comfort and confidence that showed SfL+a that a total–precast framing solution would work well for this project," says Ely.

'We were able to provide a level of comfort and confidence that showed SfL+a that a total–precast framing solution would work well for this project.'

The total–precast concrete framing system provided long-span clearances that added flexibility, especially in designing the central atrium. The school features an "H plan" layout that eases circulation and reduces the amount of unprogrammed space.

The classroom wings consist of a central corridor with double-loaded classrooms on each side. All corridor walls and some classroom demising walls were cast with solid concrete, Ely says. Classroom floor framing used double tees with flat slabs at corridor floors. "The shallow, flat-slab corridor floors allowed for greater clear height to route HVAC, electrical, plumbing, telecom and other services."

It also added versatility by expanding aesthetic options. "The use of precast concrete for interior walls allowed us to do things that added value to the appearance," Ferris says. "We really don't like the aesthetic provided by concrete block, as it makes the school look like a prison. With precast concrete, we could get a smooth finish and add some reveals and wonderful patterning that we usually can't provide. It really added interest and created a great aesthetic to the corridors." The walls were painted in various colors to add further appeal after installation.

With all the hard-wall construction and no exposed electrical conduit in the finished spaces, designers had to create a variety of electrical embeds in the precast concrete drawings. Tindall closely coordinated with the electrical designer and subcontractor, and provided space in its plant for the electrical contractor to install embedded items such as electrical boxes and conduit prior to delivery to the site, speeding up construction.

Blockouts for mechanical ducting and telecommunications cabling were also coordinated in advance and provided in the precast concrete corridor walls to allow the supply runs to reach the classrooms on the other side of the corridor walls. Those activities further aided the expedited schedule and eased the mechanical, electrical, and plumbing installation after the precast concrete frame was in place.

EASTERN GUILFORD RESURRECTION

The finished school was well-received and was at the top of adminstrators' minds when Eastern Guilford High School, constructed in the 1950s, was destroyed by a fire that broke out in one of the chemistry lab offices. Immediately, officials contacted SfL+a and transferred teachers and students to nearby schools to finish the school year.

Over the summer, the school set up a temporary "modular village" on the site to house the 1200 students while the building was demolished and a new high school was designed and constructed. Obviously, speed was of the absolute essence in building the new school.

Eastern Guilford features inset brick on its exterior with some additional accents, along with large windows that take advantage of daylighting to save energy costs. Photos: SfL+a.

EASTERN GUILFORD HIGH SCHOOL

LOCATION
Gibsonville, N.C.

PROJECT TYPE
K-12 school

SIZE
273,195 ft^2 (for 1200 students)

COST
$35.02 million

DESIGNER
SfL+a, Raleigh, N.C.

OWNER
Guilford County School District, Greensboro, N.C.

STRUCTURAL ENGINEER
Fleming & Associates, Fayetteville, N.C.

CONTRACTOR
Barnhill Contracting Co., Rocky Mount, N.C.

PCI-CERTIFIED PRECAST PRODUCER
Tindall Corporation, Spartanburg, N.C.

PRECAST COMPONENTS
Double tees, architectural insulated wall panels, rectangle beams, L beams, columns, and flat slabs

Speed was of the essence when the original Eastern Guilford High School, constructed in the 1950s, was destroyed by a fire. The construction manager used the all–precast concrete design for Northern Guilford to build the new high school on a very aggressive schedule. Photo: SfL+a.

The total–precast concrete framing system allows long expanses and strong structural support for the atrium, which reflects the design used on the earlier Northern Guilford school. Photos: SfL+a.

The project was undertaken with Barnhill Contracting on a construction manager at risk (CMAR) basis, giving the contractor significant involvement in the design prior to bid. That change in project delivery approach from the Northern Guilford High School allowed Barnhill to pick up the earlier design and tweak it quickly for the new location.

"The school district wanted this school back in operation as quickly as possible," Ely says. Administrators gave designers 24 months to design, build, and open the school. "It was very important to the district to expedite the schedule to return a sense of normalcy to the students."

'The school district wanted this school back in operation as quickly as possible.'

The decision to replicate the earlier school with some modifications became critical to meeting that aggressive schedule. "The selection of a precast structural system was a key to responding to that challenge," Ely says. "The architect and construction manager were selected and worked closely together with us from the earliest design phases to design the building and structure so we could begin the fabrication of the precast panels for the structure as quickly as possible."

"We were able to use the Northern Guilford drawings with a few tweaks and begin casting components very quickly," says Ferris. "The permitting process was the biggest obstacle, so we wanted as many parts moving while that progressed as we could get."

ENERGY EFFICIENCY STRESSED

The new school, finished just two years after the first, incorporated more elements with high-energy efficiency, including the most advanced lighting control systems available, water-conservation equipment, and energy-conservation products. Although neither school was submitted for LEED certification, Eastern Guilford upgraded the sustainability approach of the earlier school, which followed LEED silver sustainability standards.

Eastern focused added attention on maximizing daylighting techniques. The school is situated from north to south with straight north-south corridors. Classrooms make use of daylighting, with special skylights in the north- and south-facing classrooms.

The Eastern Guilford High School design allowed more thin brick to be inset into panels than at Northern Gilford, providing more accents and a warmer appearance.

Both schools put extra emphasis on security, with straight, clear corridors making everything visible. "It's very easy to control and lock down if needed," Ferris says. Arriving traffic is funneled to a locked entrance that leads to a secure vestibule with access to administrative offices. "Our designs were based on what we did originally at the Jack Britt High School," he says. "It provided a very effective approach that we could duplicate."

"The challenges were not astronomical from a production standpoint," Ely agrees. "It was standard work for us, with two layers of insulation, truss-wire wythe connectors, thin brick, and a custom mix with light and medium sandblast."

As with Northern, the new building features inset brick on its exterior. The amount was even increased from the Northern design, as budget restraints then had precluded its more liberal use. Eastern added brick accents above and below paired windows, in addition to large panels of brick on accent walls.

"We could add some brick accents that aided the appearance," Ferris says. "We liked the look of the precast concrete, but we wanted to include more brick to soften the appearance and add that traditional school look. Eastern strikes a nice balance that creates a warm look, but they both operate well."

Building Eastern was more complicated than Northern, which had been planned and had an open, accessible site. Eastern was built as rapidly as possible on the site of the original school while temporary buildings were located around the construction. "There was a lot going on at the site," says Ferris. "It was a confined area to work in."

The precast concrete erection was sequenced such that areas with intensive mechanical and electrical systems were erected first and quickly dried in, Ely says. This allowed mechanical and electrical trades to start work quickly and accelerate the schedule beyond what was already provided by the precast concrete fabrication while site work progressed.

The result was an extremely successful project that met its schedule and its budget. "The school district was delighted, and the student population was very proud of their new school," Ely says. "Designing the system with precast concrete provided for design flexibility, year-round construction, environmentally friendly materials, and creative architectural design elements."

Ferris agrees, noting that SfL+a has gone on to use its precast concrete design experience for other schools. "We're using precast in all sorts of additional ways now with school projects, including hollow-core for flooring and roofing, so we can run ductwork through the voids. It's a very versatile material that helps in a variety of ways to meet challenges in aesthetics, schedule, energy efficiency, and tight budgets."

The total–precast concrete structural framing system allowed Eastern Guilford High School to be erected quickly, helping to meet an aggressive schedule after the original building was destroyed. Photo: Tindall Corp.

Fisher Middle School in Greenville, S.C., features a STEAM (science, technology, engineering, arts, and math)-based curriculum. The building features a precast concrete façade with sunshades and large expanses of glass. The precast concrete panels support the oversized windows, delivering natural light into the labs and classrooms. Photo: George Spence, Metromont Corporation.

OUTLOOK ON K-12 CONSTRUCTION

Panel of experts addresses energy efficiency, safety, and speed of construction as they look to the future of this segment.

To gain perspective on how school construction is evolving, we asked a panel of experts who have been involved with thousands of school projects about the future of K-12 school construction. Our contributors:

Bill Clark, principal, Stevens & Wilkinson, Atlanta, Ga. Stevens & Wilkinson celebrates its 100th anniversary next year and the education market has been a core part of its practice since the 1950s. Clark is president of the Atlanta office and has over 37 years of architectural experience.

George Spence, sales and business development manager, Metromont Corporation, Greenville, S.C. Metromont has completed more than 100 precast concrete construction projects for schools in the last 20 years. Spence has been with Metromont for 21 years; prior to that he owned an architectural precast concrete company.

Patrick Glenn, managing principal, Glenn|Partners, Dallas, Tex. Glenn|Partners' core experience and passion is for K-12 education. Glenn has published numerous articles on school design, including "Designing Schools for a Changing Future," in the summer 2011 issue of *Ascent*, and "Integration by Compaction and Subtraction Fostering Blended Work-Sharing Environments in Next-Generation Schools," in the May 2018 issue of *School Planning & Management*.

HOW HAS K-12 SCHOOL CONSTRUCTION EVOLVED OVER THE LAST 20 YEARS?

Clark: I think we are seeing a lot more emphasis on energy efficiency. We are being smarter about project budgets as well as integrating sustainability. Going forward, classrooms and support spaces will be laid out with even more emphasis on transparency and glass. It is no longer the traditional 30-child classroom, but reflects a variety of teaching spaces that accommodate how children learn.

The structure itself has evolved from the traditional school house. In urban Atlanta, the cost of land has driven an increase in vertical construction. That changes the game. From typical load-bearing walls, we now see steel frame and some precast, which changes the dynamic. Outside of the urban core, we still see schools using brick and block. In those suburban districts, where land is relatively inexpensive, schools tend to have more traditional layout.

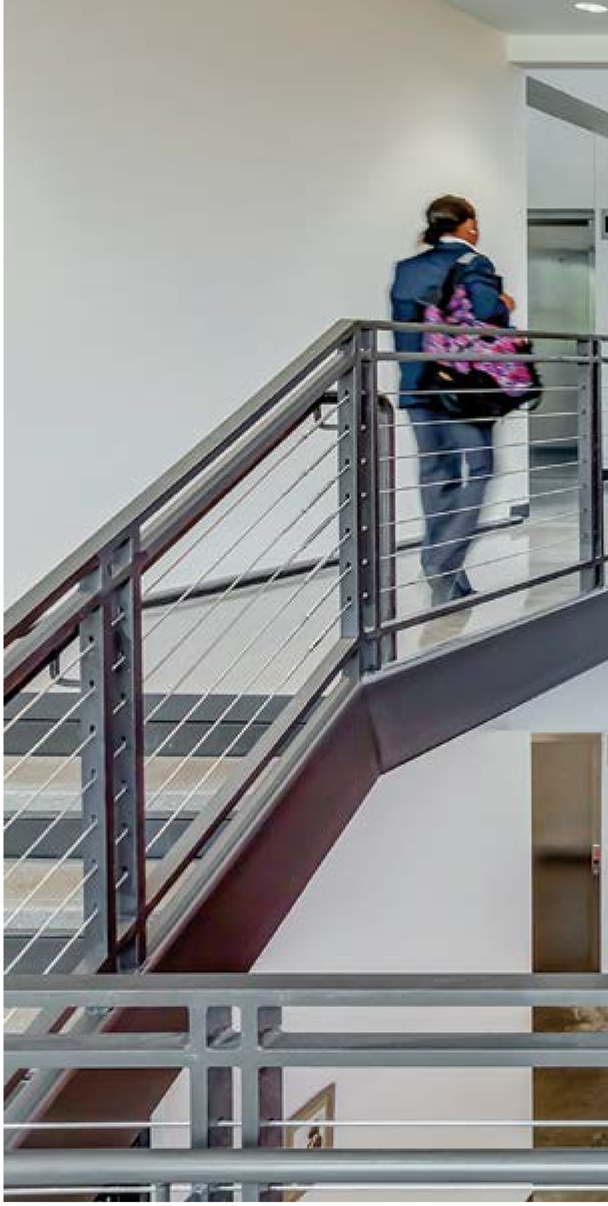
Spence: Although total–precast schools date back at least to the 1970s, the idea didn't catch on until about 2000. One of the factors that reintroduced precast into the K-12 market was large building programs financed by special tax referendums, creating demands for masons that could not be supported by the regional labor pools. For example, the Greenville County, S.C., school system specified that half of the schools in one of its accelerated building programs would be designed total–precast for this reason. Another important factor was the introduction of high-quality insulated wall panels, like the Carbon Cast C-Grid panel. This design allowed designers to make the walls load-bearing with an *R*-value that exceeded the energy code and could be installed with an architectural finish on the face side and hard-troweled on the back, ready to paint. A complete wall system in one unit. The availability of precast brick veneer was a plus for K-12 design because many decision-makers have a "red brick school house" mentality and want a brick finish.

Glenn: Specific to the Midwest, building codes now require schools to include tornado shelters. The 2015 IBC (International Building Code) and ICC (International Code Council Standard) 500-2014 require new K-12 construction to withstand an EF [Enhanced Fujita scale] 5 tornado (250 mph winds) if located within specific wind speed maps. Any new school has to implement this storm shelter requirement. New construction or additions also have to comply. In some municipalities, the storm shelter has to accommodate the maximum number of students on campus. There are only so many methods that you can employ to meet those requirements. Precast is one method, but most commonly we see schools using CIP [cast-in-place], CMU [concrete masonry units], or ICF [insulating concrete forms] for storm shelters. With precast construction, there are some coordination and timing challenges when it comes to the integration of building systems and infrastructure. The time needed to get these elements right in the shop is precious time needed by the contractor on-site. One other trend is buildings being healthier and a little more conscious of selecting healthy building materials. This is not new, but it is an influence, but certainly not as big of a factor as the storm shelter requirement we are seeing today.

J.J. Pearce High School in Richardson, Tex., embraces a collaborative learning environment. Photo: Glenn|Partners and Pixelhead.

In Dallas, Tex., the Alcuin School West Campus features collaborative areas distributed throughout the facility, encouraging student engagement and group projects. Photo: Glenn|Partners and Charles Davis Smith Photography.

The main interior academic corridor at Cristo Rey Dallas College Prep in Dallas, Tex., is filled with natural light through a raised roof area with north-facing clerestory windows. Photo: Glenn|Partners and Charles Davis Smith Photography.



WHAT DO YOU EXPECT TO OCCUR IN THE NEXT 20 YEARS?

Clark: I would expect a continued trend toward transparency and flexible and varied learning environments. High efficiency and daylighting have proven to be positive impacts on teachers and students, which I see continuing. The whole industry is going to have to go to the next level with how we approach design and construction. With the commoditization of our services and cost/budget pressure, how can we be innovative? We need a holistic approach to the K-12 structure. When we consider a precast solution, it is not just the façade. We would like to test how a total–precast approach, including HVAC [heating, ventilation, and air conditioning] systems, can be taken to the next level. I think that is the future, and if we are not doing that we are not going to be viable.

Spence: The future for total–precast K-12 construction looks bright in the coming years. Precast will not replace traditional brick and block cavity wall construction, but it will become more popular because of reduced on-site labor, speed of construction, and its advantage of building on tight jobsites. Furthermore, precast construction is more cost-effective relative to brick and block in taller school structures. The trend in urban areas is to build multistory schools.

Glenn: It is hard to tell where school construction is headed. As a practice, our focus is primarily on the design of K-12 facilities, but we do pay attention to other markets. We are seeing a lot of design-build in other markets, but not much in the K-12 world. It might trend toward a more integrated project delivery, where you get away from traditional design-bid-build. Building information modeling (BIM), such as Revit®, also continues to play an important role in sharing models to design and build the school. Revit will continue to play a big part in school construction.

Regarding school design, we are seeing a major shift away from a typical double-loaded corridor with classrooms on either side. Open spaces are being integrated back into the classroom designs, but we are not going back to the 1970s open plan. I am seeing classrooms evolving and being designed in a slightly different way. We are seeing medium, small, and private study areas that are being integrated into the plan. Students are using those spaces to learn, collaborate, do research, and to present. Millennials have influenced the way office layout is being designed, and that will trickle down to K-12. At work we are getting away from cubicles and private offices and moving to open, huddle, and collaborative spaces. Schools are going in that same direction. Many of the tangible benefits in support of collaboration, critical thinking, knowledge share, and communication begin to cross over in similar environments for schools.

St. Mary of Carmel Catholic School in Dallas, Tex., provides a new outlook on education for pre-K through eighth-grade students. Photo: Glenn|Partners and Charles Davis Smith Photography.

The addition to Wheeler High School in Marietta, Ga., was funded by the Cobb County SPLOST (special purpose local option sales tax) program. SPLOST is an optional 1% county sales tax used to fund capital outlay projects proposed by the county. Photo: George Spence, Metromont Corporation.

HOW DOES K-12 FUNDING AFFECT CONSTRUCTION DECISIONS AND THE USE OF PRECAST CONCRETE?

Clark: If we can hang on to the 1% Georgia sales tax for education, that would be a great help. Then it is up to us to maximize the use of those funds. The fluctuating economy makes it important to be creative. Other states have more pressure to find funding, which makes it even more critical.

Spence: As mentioned above, more and more school systems are financing new construction with large five-year blocks of tax revenue voted in by local referendums. This results in five-year plans and construction cycles.

Glenn: Public schools traditionally depend on bond referendums to pay for construction. In the private school world they rely on private donations. I don't see a lot of precast in schools in the Dallas/Fort Worth area. There is so much volume of school construction around the state of Texas where architects and contractors might influence school districts to rely on fast, tried-and-true traditional design. Construction costs have almost doubled in the past few years, which causes school districts to barely keep up with the pace of those escalations. It would be a hard sell to consider a premium cost for precast concrete.

IS IT MORE DIFFICULT TO MAKE THE LIFE CYCLE COST ANALYSIS ARGUMENT?

Clark: Extremely difficult, since it is a challenge to get past first cost. Some schools recognize the importance of maintenance in their budget. Some schools have incorporated Energy Star. But some school districts can't look past first cost, given the limited funds available. We face that pressure every day.

Spence: I don't think so. The operations and facilities managers in large school systems are very sensitive to life cycle costs and generally appreciate the contributions of total–precast to reducing life cycle costs.

Glenn: We have had trouble; for example, some school districts have tried geothermal systems, which cost more up front to install, but now we are observing a struggle getting past that first up-front cost premium hurdle. It is hard to consider paying that premium. However, there are some "Robin Hood" school districts: because of their financial situation, that have to share their maintenance and operational dollars with neighboring districts. In that situation they might consider higher up-front costs to lower long-term operational and maintenance dollars that might be lost to other districts.

DOES PRECAST CONCRETE MEET RESISTANCE IN THIS SEGMENT, AND HOW CAN THAT BE OVERCOME?

Clark: Some people still have an outdated impression of precast as gray concrete for structural purposes, like a parking deck. I think that is starting to change. We have used precast in other markets that incorporated other materials cast in, like brick and stone. Opinions are changing, and some architects are ahead of the curve, while others stick to the tried and true, especially with conservative owners in the K-12 market.

Spence: There is certainly much inertia in the school system management. They are conservative and accept changes slowly. And some will never change. We'll have to wait until those guys retire. But the track record of total–precast schools over the last 20 years is impressive and most facility planners are aware of and acceptable to the idea of total–precast designs.

Glenn: I don't know how to overcome that resistance. As the marketplace slowly moves toward more collaborative design-build, then contractors and subs can bring the benefits of precast to the table. It is difficult to promote precast to the owner when we don't have extensive experience with it in K-12 or due to the higher premium in cost.

Tucker High School in Tucker, Ga., used insulated wall panels that incorporate thin brick veneer and light sandblast areas to mimic limestone. Photo: George Spence, Metromont Corporation.

At Tucker High School, the stone veneer at the bottom of the media center is granite hand-set in the precast concrete panels. Photo: George Spence, Metromont Corporation.

WHAT ROLE IS SAFETY PLAYING IN CONSTRUCTION DECISIONS, FROM STORMS TO SHOOTINGS?

Clark: It has obviously changed our approach to design and we are working with safety consultants for advice. The focus is on safe zones and hardened areas where children and faculty can go in a crisis. A lot of it is technology, and it is also reflected in the changing building codes with relation to wind loads (tornado, hurricane). When it comes to school safety, it is evolving quickly, and we need to come up with secure safe zones that serve dual purposes.

Spence: It is generally accepted that total–precast design is much more resistant to high winds (tornados, hurricanes, thunderstorms) than conventional construction, more fire-resistant, and has excellent impact resistance including for blast and gunfire. But I haven't seen many cases where these attributes were the determining factor. Some tornado-prone systems in my market area have directed portions of the campus (like gyms) to be constructed with total–precast that is designated as a "safe shelter" in case of storms.

Glenn: I think student safety is a hot topic. Most schools in Texas have secure vestibules where you check in to the office before being granted access. That thinking might be a little outdated, because you are allowing the potential intruder to get through the first set of doors. We might need to think beyond that and not permit them access to campus. Perimeter security might need to be considered rather than just the building. For example, precast bollards out front to prevent vehicles from entering, or sawtooth design footprint would minimize exposure. Designers and architects need to consider pushing intruders to the edge of the property.

WHAT ROLE IS THE LABOR SHORTAGE PLAYING IN SCHOOL CONSTRUCTION?

Clark: It does have an impact. We are seeing elevated prices because of the volume of work. Subs can pick and choose which project they would like to work on. It does put additional price pressure on school projects. GCs are on the front line, and they do their best to advise owners as to real costs.

Spence: The shortage of skilled labor, in particular masons, has had an increasing impact on the delivery system selections. Most contractors today prefer any system of construction that moves labor off the jobsite and to a plant that can operate in all weather. This message is getting through to school facility people and school designers and will result in increased demand for total–precast in the K-12 market and all other construction markets.

Glenn: I see a big labor shortage here in Texas. We have been overwhelmed with construction these past five years, and will probably continue for the next five years. Skilled labor in particular is in short supply, but there are plenty of day laborers. Perhaps the precast industry could take advantage of that lack of skilled craftsmen.

The construction team tried to minimize the impact and focused on the safety of staff and students during the construction of an addition to Wheeler High School.
Photo: George Spence, Metromont Corporation.

DO THE PARTIES (ARCHITECT, ENGINEER, GENERAL CONTRACTOR, PRECASTER) COLLABORATE ON THESE PROJECTS?

Clark: Not so much. We would love to do true integrated design delivery for K-12. The closest we get to that is CMAR (construction manager at risk). We would love to do more collaboration and design-assist with contractors and subs early on in the design process, but typically we see design-bid-build on public projects. If legislators and school districts could embrace CMAR or design-assist, we would achieve better results. In many districts, it is hard to get past that contractually.

Spence: It is always better when we all work as a team, but that's not the usual case. So, one of our marketing efforts is to educate the architects (namely with lunch-and-learn presentations) on the advantages of total–precast. And that effort extends up the line to the school system decision-makers. The contractors and engineers are usually pro-precast and help promote precast design.

Glenn: There are two main delivery methods that we see here in Texas. Fifty percent is CSP (competitive sealed proposal), which is your typical design-bid-build. The other half is CMAR. CMAR is up for debate as to whether the owner is getting the best value. CMs bring cost estimating and preconstruction services, but you take some of the competitive bidding out of the mix. The construction manager might suggest that their ability to collaborate with the design team provides an inherent cost savings. Owners could see a benefit from integrated project delivery, but architects might see a loss of control with that method. Architects don't want to give up that control, and owners like the checks and balances with the more traditional methods.

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Another New Silica Rule

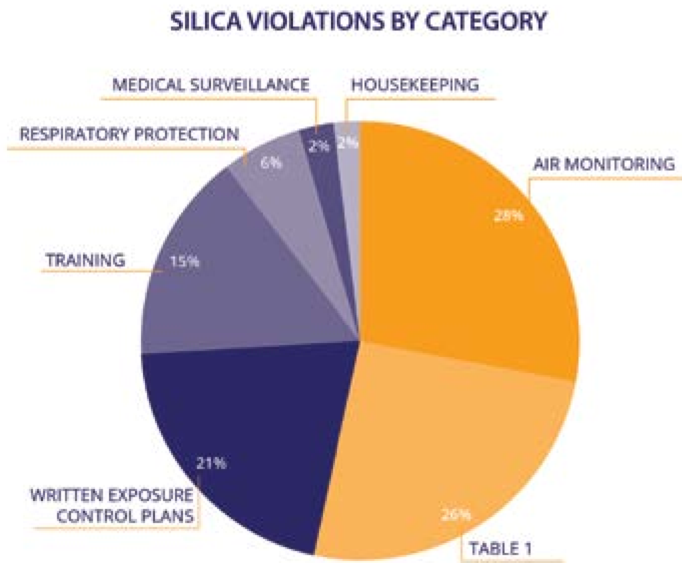
OSHA has already levied fines since the first rule went into effect last year

— **Joshua Ruedin and Drew Page**

Regulations from the Occupational Safety and Health Administration (OSHA) ensure the safety and well-being of people, from plant workers creating and finishing precast concrete products to the tradespeople who transform drawings and blueprints to stunning reality. Regulations also impact project plans and budgets. Consider the impact of OSHA's new Respirable Crystalline Silica Standard for Construction (29 CFR §1926.1153). Project plans must include controls for respirable crystalline silica exposures on jobsites, including additional equipment, services, and contractors, or there is risk of violations and penalties from OSHA. The regulations also affect the production and finishing of precast concrete products, ultimately impacting design decisions. While general contractors and erectors have been forced to comply with the construction version of OSHA's new standard since September 23, 2017, precast concrete manufacturers are preparing to comply with the Respirable Crystalline Silica Standard for General Industry (29 CFR §1910.1053), which OSHA was to begin enforcing on June 23, 2018.

PENALTY PHASE

OSHA's enforcement of the construction silica standard from September 2017 through April 2018 provides a glimpse of what to expect when the general industry silica standards become enforceable. In the first seven months of enforcement, OSHA issued more than $400,000 in initial penalties, according to Department of Labor data. OSHA wasted no time issuing violations and penalties; the first citations were issued at the end of September 2017 to four separate Virginia companies. Three of the companies were cited for work performed on the same project: two were "creating" contractors (masons), and the third was the "controlling" contractor for the project. These citations reinforce the "multi-employer citation policy" discussed in the article, "How OSHA's New Silica Rule Impacts Architects, Construction Managers, and General Contractors," by Optimum Safety Management's CEO Steve Yates, in the Winter 2018 issue of *Ascent*.



Of the violations issued to date, more than half were issued to companies who failed to properly control exposure by using Table 1 or alternative exposure control methods supported by air monitoring. Twenty-one percent of the violations were because written exposure control plans were not established or implemented; the remaining violations were for training, respiratory protection, medical surveillance, and housekeeping-related issues.

Expect similar actions when OSHA begins enforcing the Respirable Crystalline Silica Standard for General Industry in June. Unlike the construction standard, general industry regulations do not have a table of predefined exposure controls. Plants will need to evaluate exposures through air monitoring and implement controls specific to their operations. These controls must reduce employee exposures found to be above the permissible exposure limit (PEL) of 50 $\mu g/m^3$, calculated as an eight-hour time-weighted average, possibly resulting in additional operating costs.

One area that is likely to be impacted by the new regulations is architectural finishes. Air sampling data for dry sandblasting show that it creates exposures up to 25 times the permissible level. Because regulations require employers to use all feasible engineering and work practice controls to reduce respirable crystalline silica exposures below the PEL, or to the lowest feasible level, industry may be forced to consider new architectural finishing techniques.

Each abrasive blasting operation is unique, as are the approaches taken by the precast concrete manufacturers in their facilities. The use of isolation, containment, engineering controls, and respiratory protection are already common practice at many plants that provide sandblast finishes. Because we have yet to see controls implemented that reduce exposure from dry sandblasting to acceptable levels, we anticipate alternative solutions will be developed.

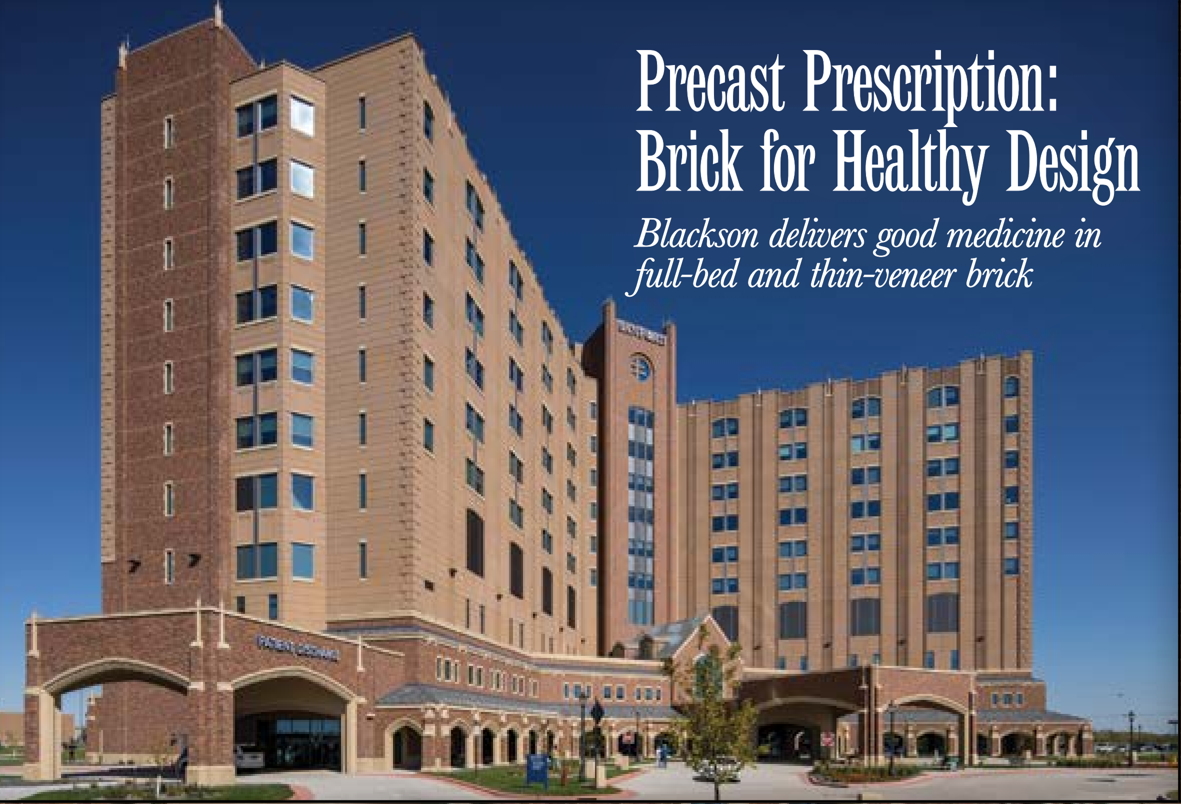
BLASTING CHANGES

Below are alternatives that Optimum Safety Management has observed to be effective at reducing respirable crystalline silica exposures, presented in order of efficacy.

- Eliminating exposures by using alternative finishes such as acid etching, preventing respirable crystalline silica from being generated.
- Substituting sand for a blasting medium with less silica content, such as plastic or glass beads, crushed walnuts, crushed glass, garnet, staurolite, or coal slag. In test data, we have observed exposures reduced by 84%, to four times the PEL, by substituting sand with garnet, crushed glass, or coal slag.
- Implementing engineering controls to incorporate wet or vapor blasting instead of dry blasting. There are various systems that must be evaluated depending on the use case. We have observed exposures lowered to five times the PEL when using sand, by adding wet nozzle systems to existing equipment.
- In some cases, combining different media and vapor nozzles can lower exposures to slightly above the PEL to just below the PEL.

Regardless of the technique used, the finish on the product may be impacted by the new silica standard. Consult with your local precast concrete producers to select finishes that maintain both the architectural beauty of the product and the safety and health of the men and women who produce it. Whether you are the owner, architect, producer, or construction manager, your commitment to embrace and support these changes will have a positive impact on the industry.

Joshua Ruedin and Drew Page are with Optimum Safety Management, a PCI member and safety consulting firm in Naperville, Ill.


Precast Prescription:
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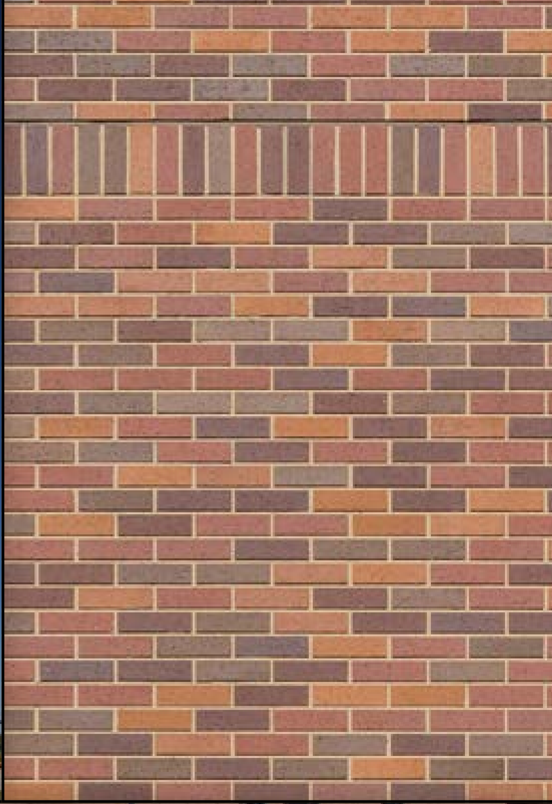

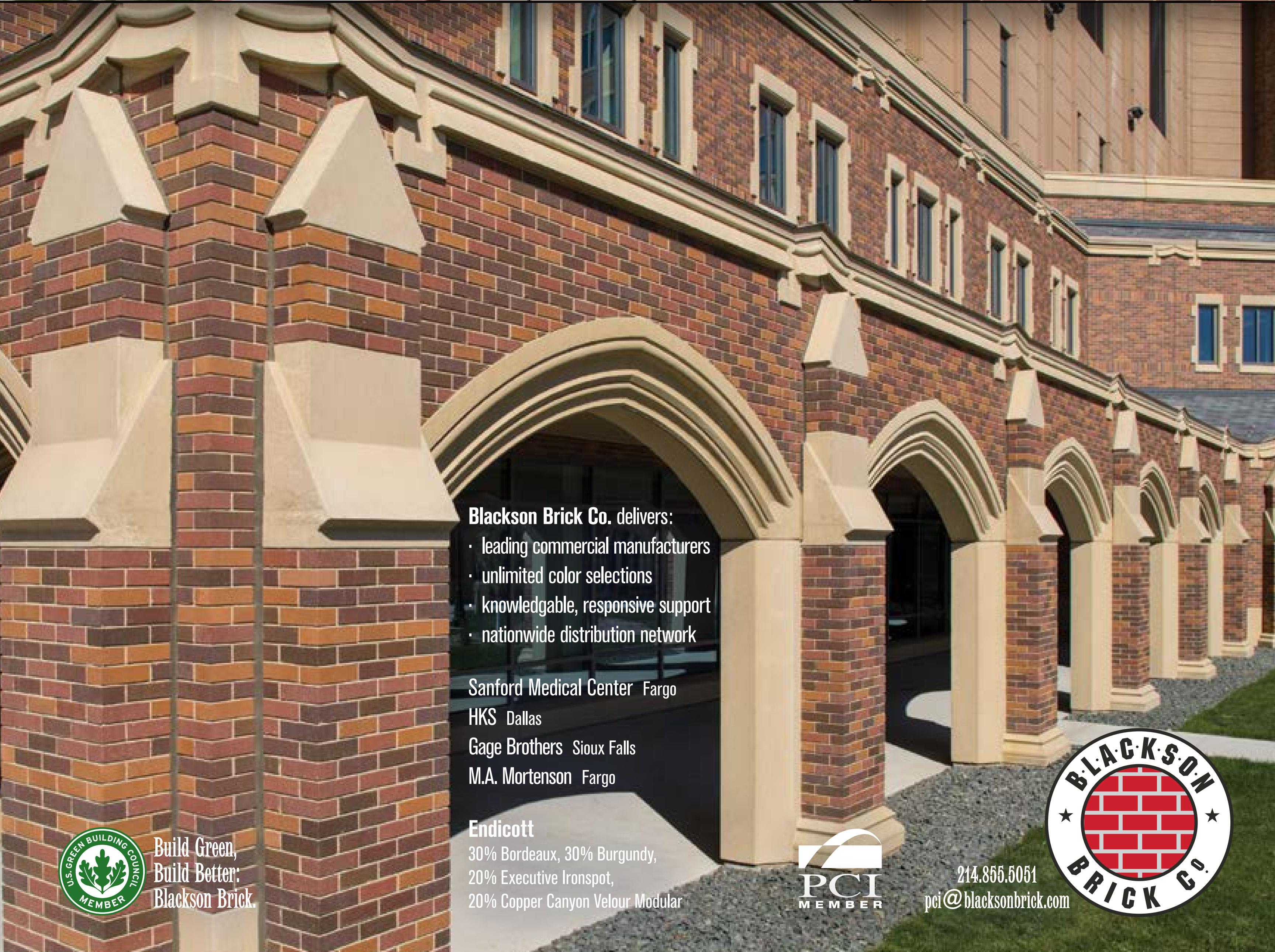
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STRESSCON
Emulative Design and TPS

Stresscon Corp. recently completed a total structural precast system for the Yellowstone Club project that features emulative design and a pre-manufactured approach, allowing for a total–precast structure to be designed for a region with extreme seismic activity requirements. Stresscon participated in the construction of the exclusive and unique Yellowstone Club Village Core project in Montana's Rocky Mountains. Over a 12-month period, five total–precast structures were completed as part of an addition to this exclusive mountain club. The mixed-use space was conceived to act as the heart of this select and vibrant community, offering luxury residences, ski facilities and private ski club access, unique amenities, and a gathering space for the community.

Extensive coordination among the design, engineering, general contractor, and precast teams was necessary to ensure that the rigorous project requirements were met for this private community. With the precast structural components, two on-site cranes for erection and installation, a project team facilitating installation and construction, multiple trade interaction and hundreds of daily workers, the project activities had to avoid any potential disruption to the residents and visitors and meet an expedited schedule.

To meet the aggressive timeline, construction schedules facilitated a fast-track schedule through four seasons, battling extreme temperatures and weather and several severe freeze/thaw cycles. The use of off-site production of precast components limited the cast-in-place concrete requirement. It was very important that all construction work met environmental standards with little impact to the natural surroundings. All the completed structures meet or exceed the International Energy Conservation Code (IECC) guidelines, assuring the community and residents that their units meet stringent energy efficiency requirements.

Stresscon's precast scope and erection included a total of 4,565 premanufactured components, playing a primary role in the project design and construction. The precast pieces used include retaining walls, hollow-core, flat slabs, double tees, spandrels, non-insulated monolithic shear/shaft walls, columns, shallow beams, wallumns (short V–shaped wall), beams, soffit beams and bi-directional balcony slabs. In total, 16,900 yd^3 of concrete were erected over a 12-month period. Using emulative design to convert the project from cast-in-place to precast concrete reduced 24 months off the construction timeline. The precast pieces were shipped in 1,342 delivered truckloads, travelling from Colorado Springs, Colo., to Big Sky, Mont. Stresscon's largest precast piece for the project weighed approximately 86,000 pounds. Other project totals include 1,600 tons of reinforcing steel and 286 miles of prestressing strand.

The project's featured monolithic balcony slabs are a completely new Stresscon product line and required design and installation of a new custom production facility at the Colorado Springs, Colo. plant. The production of 96 unique balcony elements, many with drastically different geometry, required bi-directional pre-stressing of many members. Prestressing during casting of the primary tension member was followed by post-tensioning of the cantilevered slab in order to resolve negative moments.

These members were designed as simply supported, or multi-span beams, with a cantilevered slab member cast monolithically, perpendicular to the beams. Utilizing a coffering solution in the slab portion of the member reduced member weights and created more balance in the finished product for handling and erecting. Coffering was achieved by casting insulation into the underside of the slabs, which reduced many portions of the slab from 10 to 3 in. of concrete.

The team also worked through extremely complex framing geometry and shallow floor plates in the residential units to ensure that stringent clear height requirements were met. The team used emulative design practices to replicate floor depths of a cast-in-place solution, that often resulted in precast structural depths of 13 in. for primary load bearing elements. The shallow floor plates included all levels of framing above the two-story below-grade parking garage. This proved a unique challenge, as many of the product sections did not inherently lend themselves to this type of critical geometry, but were necessary to resolve structural system demands. Continuous beams and fixity at framing intersections was introduced to help achieve the necessary shallow heights.

To overcome framing difficulties created by fixed column locations, shallow and long-span heavily pre-stressed beams (resulting in higher cambers), and multiple locations of transfer framing beams (resulting in cumulative camber), the team took a very deliberate and proactive approach to achieve required top of precast elevations. Solutions included monitoring beam cambers in predicted problem areas and setting vertical framing elements, including columns and walls, at pre-determined elevations.

The Stresscon team worked jointly with EnCon Field Services, FDG, CEG-NM, EnCon Design, GE Johnson Construction, Jackson Contractor Group, Schmueser & Associates, Hart Howerton, Nishkian Menninger, Terracon, Earthworks, Encore Electric, Apollo Plumbing & Mechanical, True North, Sowles, Rooftop Solutions, Advanced Fireproofing, Safeway Scaffolding, SCS Drywall, Patriacca Construction, Gallegos Corporation, Paradigm, Superior Waterproofing, 4G, Western States, Sime Construction, Steel Erection, and various subconsultants and subcontractors on this impressive project.

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

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

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> WEBINARS

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

> PCI ELEARNING CENTER

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

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

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CHICAGO, IL
Tuesday, August 21 – Friday, August 24, 2018

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

> LUNCH-AND-LEARNS

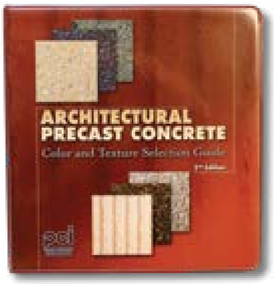
PCI's lunch-and-learn/box-lunch programs are a convenient way for architects, engineers, and design professionals to receive continuing education credit without leaving the office. Industry experts visit your location; provide lunch; and present on topics such as sustainability, institutional construction,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

Photo: LS3P.

PRECAST/PRESTRESSED CONCRETE Design Resources

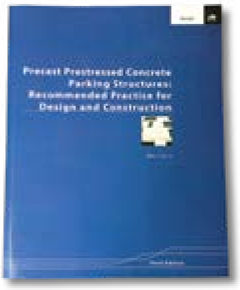
PCI develops, maintains, and disseminates the Body of Knowledge for designing, fabricating, and constructing precast concrete structures and systems. It is from this Body of Knowledge that building codes, design guides, education, and certification programs are derived. Please visit www.pci.org for all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

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



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

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



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

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

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

Designer's Notebooks – Free

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

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

When it comes to quality, why take chances?

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

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

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

Guide Specification

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

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

Product Groups and Categories

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

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

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

GROUPS

> GROUP A – ARCHITECTURAL PRODUCTS

CATEGORY AT – ARCHITECTURAL TRIM UNITS

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

CATEGORY A1 – ARCHITECTURAL CLADDING AND LOAD-BEARING UNITS

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

> GROUP B – BRIDGES

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

CATEGORY B1 – PRECAST CONCRETE BRIDGE PRODUCTS

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

CATEGORY B2 – PRESTRESSED MISCELLANEOUS BRIDGE PRODUCTS

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

CATEGORY B3 – PRESTRESSED STRAIGHT-STRAND BRIDGE MEMBERS

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

CATEGORY B4 – PRESTRESSED DEFLECTED-STRAND BRIDGE MEMBERS

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

GROUP BA – BRIDGE PRODUCTS WITH AN ARCHITECTURAL FINISH

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

> GROUP C – COMMERCIAL (STRUCTURAL)

CATEGORY C1 – PRECAST CONCRETE PRODUCTS

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

CATEGORY C2 – PRESTRESSED HOLLOW-CORE AND REPETITIVE PRODUCTS

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

CATEGORY C3 – PRESTRESSED STRAIGHT-STRAND STRUCTURAL MEMBERS

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

CATEGORY C4 – PRESTRESSED DEFLECTED-STRAND STRUCTURAL MEMBERS

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

GROUP CA – COMMERCIAL PRODUCTS WITH AN ARCHITECTURAL FINISH

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

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

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

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

> ALABAMA

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

> ARIZONA

Coreslab Structures (ARIZ) Inc. A1, B4, C4, C4A
Phoenix, (602) 237-3875
Rocla Concrete Tie Inc. C2
Tucson, (520) 447-8257
Stinger Bridge & Iron B4
Coolidge, (520) 723-5383
Tpac, An EnCon Company A1, B4, C4, C4A
Phoenix, (602) 262-1360

> ARKANSAS

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

> CALIFORNIA

Bethlehem Construction Inc. C3, C3A
Wasco, (661) 391-9704
Clark Pacific A1, C3, C3A, G
Fontana, (909) 823-1433
Clark Pacific C4, C4A
Adelanto, (626) 962-8751
Clark Pacific A1, B3, C4, C4A, G
Woodland, (530) 207-4100
Con-Fab California, LLC B4, C4
Lathrop, (209) 249-4700
Con-Fab California, LLC B4, C4
Shafter, (661) 630-7162
Coreslab Structures (LA) Inc. A1, B4, C4, C4A
Perris, (951) 943-9119
KIE-CON Inc. B4, C3
Antioch, (925) 754-9494
Midstate Precast, LP A1, C3, C3A
Corcoran, (559) 992-8180
Oldcastle Precast Inc. B4, B4A, C2, C2A
Perris, (951) 657-6093
Oldcastle Precast Inc. C2
Stockton, (209) 466-4215
Precast Concrete Technology Unlimited dba CTU Precast A1, C3, C3A
Olivehurst, (530) 749-6501
StructureCast A1, B3, C3, C3A
Bakersfield, (661) 833-4490
Universal Precast Concrete Inc. A1, B1, C1
Redding, (530) 243-6477
Walters & Wolf Precast A1, G
Fremont, (510) 226-9800
Willis Construction Co. Inc. A1, C1
Hollister, (831) 623-2900
Willis Construction Co. Inc. A1, C1, G
San Juan Bautista, (831) 623-2900

> COLORADO

EnCon Colorado B4, C3
Denver, (303) 287-4312
Plum Creek Structures B4, C3, C3A
Littleton, (303) 471-1569
Rocky Mountain Prestress LLC Architectural Plant A1, C3, C3A
Denver, (303) 480-1111
Rocky Mountain Prestress LLC Structural Plant B4, C4
Denver, (303) 480-1111
Rocla Concrete Tie Inc. C2
Pueblo, (719) 569-4003
Stresscon Corporation A1, B4, B4A, C4, C4A
Colorado Springs, (719) 390-5041

> CONNECTICUT

Blakeslee Prestress Inc. A1, B4, C4, C4A
Branford, (203) 481-5306
Coreslab Structures (CONN) Inc. A1, B1, C1
Thomaston, (860) 283-8281
Oldcastle Precast B2, C2, C2A
Avon, (860) 673-3291
United Concrete Products Inc. B3, C3
Yalesville, (203) 269-3119

> DELAWARE

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

> FLORIDA

Building Blocks GFRC, LLC G
Kissimmee, (214) 289-9737
Cement Industries Inc. C3
Fort Myers, (800) 332-1440
Colonial Precast Concrete LLC C2
Placida, (941) 698-4180
Coreslab Structures (MIAMI) Inc. A1, C4, C4A
Medley, (305) 823-8950
Coreslab Structures (TAMPA) Inc. A1, B3, C3, C3A
Tampa, (813) 626-1141
Dura-Stress Inc. A1, B4, B4A, C4, C4A
Leesburg, (352) 787-1422
Finfrock Industries Inc. A1, C3
Apopka, (407) 293-4000
Gate Precast Company A1, B4, C3, C3A
Jacksonville, (904) 757-0860
Gate Precast Company A1, C3
Kissimmee, (407) 847-5285
International Casting Corporation C4
Hialeah, (305) 558-3515
Leesburg Concrete Co. Inc. C1A
Leesburg, (352) 787-4177
Metromont Corporation A1, C3, C3A
Bartow, (863) 440-5400
Precast Specialties LLC C4
Fort Pierce, (772) 266-5701
Skanska USA Civil SE B3
Pensacola, (757) 578-4147
Spancrete C2
Sebring, (863) 655-1515
Stabil Concrete Products LLC A1
St. Petersburg, (727) 321-6000
Standard Concrete Products Inc. B4, C3
Tampa, (813) 831-9520
Structural Prestressed Industries Inc. C4
Medley, (305) 556-6699

> GEORGIA

Atlanta Structural Concrete Co. C4, C4A
Buchanan, (770) 646-1888
Coreslab Structures (ATLANTA) Inc. C2
Jonesboro, (770) 471-1150
Metromont Corporation A1, C3, C3A
Hiram, (770) 943-8688
Standard Concrete Products Inc. B4
Atlanta, (404) 792-1600
Standard Concrete Products Inc. B4, C4
Savannah, (912) 233-8263
Tindall Corporation, Georgia Division C4, C4A
Conley, (404) 366-6270

> HAWAII

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

> IDAHO

Forterra Building Products A1, B4, C4
Caldwell, (208) 454-8116
Teton Prestress Concrete LLC B4, C3
Idaho Falls, (208) 552-6606

> ILLINOIS

ATMI Precast A1, C3, C3A
Aurora, (630) 896-4679
AVAN Precast Concrete Products Inc. A1, C3
Lynwood, (708) 757-6200
County Materials Corporation B4, B4-IL, C4
Salem, (618) 548-1190
Dukane Precast Inc. A1, B3, B3-IL, C3, C3A
Aurora, (630) 355-8118
Dukane Precast Inc. A1, C3A
Naperville, (630) 355-8118
Dukane Precast Inc. A1, C3A
Plainfield, (815) 230-4760
ICCI Illini Concrete LLC B3, B3-IL
Tremont, (309) 925-2376
Illini Precast LLC B4, B4-IL, C3
Marseilles, (815) 795-6161
Lombard Architectural Precast Products Co. A1, C2, C2A
Alsip, (708) 389-1060
Mid-States Concrete Industries LLC A1, B3, B3-IL, C3, C3A
South Beloit, (815) 389-2277
Spancrete C2
Crystal Lake, (815) 215-8230
St. Louis Prestress Inc. B3, B3-IL, C3
Glen Carbon, (618) 656-8934
Utility Concrete Products LLC B1, B1A, C1, C1A
Morris, (815) 416-1000

> INDIANA

ATMI Indy A1, C2, C2A
Greenfield, (317) 891-6280
Coreslab Structures (INDIANAPOLIS) Inc. A1, C4, C4A
Indianapolis, (317) 353-2118
Hoosier Precast LLC B3, C1, C1A
Salem, (815) 459-4545
Illini Precast-Speed, LLC C3
Charlestown (708) 562-7700
Precast Specialties A1, B1
Monroeville, (260) 623-6131
Prestress Services Industries LLC B4, B4-IL, C4, C4A
Decatur, (260) 724-7117
StresCore Inc. C2
South Bend, (574) 233-1117

> IOWA

Advanced Precast Co. A1, C1, C1A
Dyersville, (563) 744-3909
Forterra Pipe & Precast B4, C4, C4A
Iowa Falls, (641) 648-2579
MPC Enterprises Inc. A1, C3, C3A
Mount Pleasant, (319) 986-2226
PDM Precast Inc. A1, C3, C3A
Des Moines, (515) 243-5118
Rail One USA C2
Clinton, (563) 522-2795

> KANSAS

Coreslab Structures (KANSAS) Inc. B4, C4
Kansas City, (913) 287-5725
Crossland Prefab LLC C1
Columbus, (620) 249-1414
Fabcon Precast, LLC C3, C3A
Pleasanton, (913) 937-3021
Prestressed Concrete Construction LLC A1, B4, C4, C4A
Newton, (316) 283-2277
Stress-Cast Inc. C3, C3A
Assaria, (785) 667-3905

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

KENTUCKY

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

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

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

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

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

LOUISIANA

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

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

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

dp Concrete Products LLC — B2, C2
Vinton, (337) 515-7368

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

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

MAINE

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

MARYLAND

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

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

MASSACHUSETTS

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

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

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

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

MICHIGAN

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

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

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

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

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

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

MINNESOTA

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

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

Forterra Building Products — B4, C2
Elk River, (763) 441-2124

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

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

Taracon Precast — A1, C3, C3A
Hawley, (218) 216-8260

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

Wells Concrete — C3
Rosemount, (507) 380-6772

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

MISSISSIPPI

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

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

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

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

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

MISSOURI

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

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

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

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

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

MONTANA

Forterra Building Products — B4, C3
Billings, (406) 656-1601

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

NEBRASKA

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

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

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

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

NEVADA

Western Pacific Precast — B4, C3
Sloan, (702) 623-4484

NEW HAMPSHIRE

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

NEW JERSEY

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

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

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

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

NEW MEXICO

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

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

NEW YORK

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

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

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

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

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

NORTH CAROLINA

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

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

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

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

NORTH DAKOTA

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

OHIO

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

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

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

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

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

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

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

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

Sidley Precast Group, a division of R.W. Sidley Inc. — A1, C4, C4A
Thompson, (440) 298-3232

OKLAHOMA

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

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

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

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

OREGON

Knife River Corporation Northwest — A1, B4, C4, C4A
Harrisburg, (541) 995-4100

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

PENNSYLVANIA

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

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

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

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

Dutchland Inc. — C3
Gap, (717) 442-8282

Fabcon Precast LLC — A1, B1, B1A, C3, C3A
Mahanoy City, (952) 890-4444

High Concrete Group LLC — A1, B3, C3, C3A
Denver, (717) 336-9300

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J & R Slaw Inc. A1, B4, C3, C3A
Lehighton, (610) 852-2020
Nitterhouse Concrete Products Inc. A1, C4, C4A
Chambersburg, (717) 267-4505
Northeast Prestressed Products LLC B4, C3
Cressona, (570) 385-2352
PENNSTRESS, a division of MacInnis Group, LLC A1, B4, C4
Roaring Spring, (814) 695-2016
Say-Core Inc. C2
Portage, (814) 736-8018
Sidley Precast Group C3
Youngwood, (724) 755-0205
Universal Concrete Products Corporation A1, C3, C3A
Stowe, (610) 323-0700

> RHODE ISLAND

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

> SOUTH CAROLINA

Florence Concrete Products Inc. B4, C3, C3A
Sumter, (803) 775-4372
Metromont Corporation A1, C4, C4A
Greenville, (864) 605-5000
Metromont Corporation C3
Spartanburg, (864) 605-5063
Smith-Columbia B2, C1
Hopkins, (803) 708-2222
Tekna Corporation B4, C3
Charleston, (843) 853-9118
Tindall Corporation, South Carolina Division A1, C4, C4A
Spartanburg, (864) 576-3230

> SOUTH DAKOTA

Forterra Building Products B4
Rapid City, (605) 343-1450
Gage Brothers Concrete Products Inc. A1, B4, C4, C4A
Sioux Falls, (605) 336-1180

> TENNESSEE

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

> TEXAS

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

> UTAH

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

> VERMONT

Joseph P. Carrara & Sons Inc. A1, B4, B4A, C4, C4A
Middlebury, (802) 775-2301
William E. Dailey Precast LLC A1, B4, B4A, C3, C3A
Shaftsbury, (802) 442-4418

> VIRGINIA

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

> WASHINGTON

Bellingham Marine Industries Inc. B3, C2
Ferndale, (360) 380-2142
Bethlehem Construction Inc. B1, C3, C3A
Cashmere, (509) 782-1001
Concrete Technology Corporation B4, C4
Tacoma, (253) 383-3545
CXT Inc., Precast Division B1, C1, C1A
Spokane, (509) 921-8766
CXT Inc., Rail Division B2, C2
Spokane, (509) 921-7878
EnCon Northwest LLC B1, B1A
Camas, (360) 834-3459
Oldcastle Precast Inc. A1, B4, C4A
Spokane Valley, (509) 536-3300
Wilbert Precast Inc. B3, C3, C3A
Yakima, (509) 325-4573

> WEST VIRGINIA

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

> WISCONSIN

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

> WYOMING

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

> MEXICO

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

> CANADA

BRITISH COLUMBIA

APS Precast, a division of C&S Group Operations Ltd. A1, B4, C3, C3A
Langley, (604) 888-1968

NEW BRUNSWICK

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

NOVA SCOTIA

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

ONTARIO

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

QUEBEC

Betons Prefabriques Trans. Canada Inc. A1, B4, C3, C3A
St-Eugene De Grantham, (819) 396-2624
Betons Prefabriques (Bombadier Plant), A1, C2
Alma, (418) 668-6161
Betons Prefabriques (Papeterie Plant), A1, C3, C3A, G
Alma, (418) 668-6161
Prefab de Beauce Inc. A1, C3
Sainte-Marie-de-Beauce, (418) 387-7152
Saramac 9229-0188 Quebec, Inc. A1
Terrebonne, PQ, (450) 966-1001

> UAE

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

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

When it comes to quality, why take chances?

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

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

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

Guide Specification

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

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

Erector Classifications

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

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

GROUPS

> CATEGORY S1– SIMPLE STRUCTURAL SYSTEMS

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

> CATEGORY S2– COMPLEX STRUCTURAL SYSTEMS

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

> CATEGORY A– ARCHITECTURAL SYSTEMS

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

> ARIZONA

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

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

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

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

> CALIFORNIA

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

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

> COLORADO

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

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

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

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

> CONNECTICUT

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

> FLORIDA

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

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

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

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

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

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

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

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

> GEORGIA

Bass Precast Erecting Inc. S2
Cleveland, (706) 809-7583

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

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

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

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

> IDAHO

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

> ILLINOIS

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

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

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

> INDIANA

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

> IOWA

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

Industrial Steel Erectors S1
Davenport, (800) 236-1072

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

US Erectors Inc. A, S2
Pleasant Hill, (515) 243-8450

> KANSAS

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

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

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

> LOUISIANA

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

> MAINE

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

> MARYLAND

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

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

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

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

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

> MASSACHUSETTS

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

> MICHIGAN

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

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

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

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

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

> MINNESOTA

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

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

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

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

> MISSISSIPPI

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

> MISSOURI

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

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

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

> NEBRASKA

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

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

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

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

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

> NEW HAMPSHIRE

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

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

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

> NEW JERSEY

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

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

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

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

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

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

> NEW YORK

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

New York Installation A, S2
Selkirk (518) 767-7116

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

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

> NORTH DAKOTA

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

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

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

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

> OHIO

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

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

> OKLAHOMA

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

> PENNSYLVANIA

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

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

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

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

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

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

> SOUTH CAROLINA

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

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

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

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

> SOUTH DAKOTA

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

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

> TENNESSEE

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

> TEXAS

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

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

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

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

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

> UTAH

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

IMS Masonry Inc. A
Lindon, (801) 796-8420

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

> VERMONT

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

> VIRGINIA

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

> WISCONSIN

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

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

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

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

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




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

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

THE NEW SHAPE OF PRECAST

Photograpy © Rasmus Hjortshøj—COAST

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

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