EFFICIENCY ISSUE

SPRING 2013

# ASCENT®

DESIGNING WITH PRECAST


CONTINUING EDUCATION AIA

## AIA Education Program Inside

page 49

- Improving Thermal Performance
- Architect's Profile: Scott Powell
- Reducing Your Risk

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## Features

### Precast Provides High Performance—Efficiently

A wide range of projects can benefit from the speed, thermal performance, integration of systems, aesthetic versatility and other efficiencies offered by precast concrete.

# CONTENTS

*Ascent* is a publication of PCI Precast/Prestressed Concrete Institute

### Continuing Education

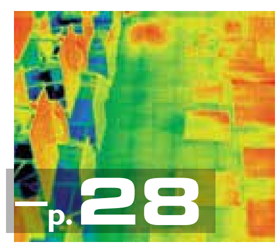
Craig Gaulden Davis' Scott Powell keeps abreast of trends in school design by gaining feedback from administrators, teachers, parents, and students—some of which are close to home.


### Precast Helps Dorm Exceed Expectations

Insulated panels provide speed, durability, and aesthetics—and offer significantly improved energy efficiency.

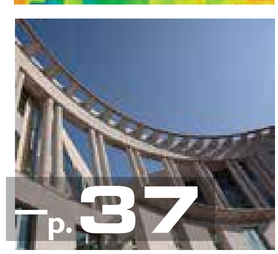

### Designing Precast Envelopes for Thermal and Moisture Efficiency

Thermal performance and moisture management are two of the most important and complex roles of the building envelope.




### Veneers–Tradition Meets High Performance

Embedding, or veneering, stone, brick, and other natural materials into precast concrete panels speeds construction while providing efficiency, reducing costs, and improving thermal performance.

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# High Performance Requires Efficiency

*Brian Miller,*
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*Executive Editor*
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The concept of high performance challenges us to design and build structures that integrate and optimize all the relevant attributes of high performance and sustainability on a life-cycle basis. A main part of this is the optimization of a project, which requires efficiency in design, construction, and operations.

The first step is to look for ways to optimize the design, reducing both the amount of materials used and the construction complexity, as complex projects usually have greater costs and associated risks. Reducing complexity involves minimizing interfaces and related details. These are usually locations where installation of the details may be performed incorrectly and/or require more maintenance. These are also locations where buildings leak air, moisture, and consequently heat, which reduces efficiency and overall building performance while increasing life-cycle costs.

Integrating systems can boost efficiency. For example, precast concrete can combine several finishes into one panel—such as brick, stone, and trim (lintels, window sills, etc.). Instead of joining three materials that require interface detailing, they are monolithically combined into one high-strength concrete panel during the casting process. Also, since precast concrete is a continuous air and vapor barrier and can include continuous insulation, six building components have been combined into one unit. That's pretty efficient.

The construction process should also be optimized, speeding construction and minimizing the project's footprint. Optimization can help reduce negative effects to the environment as well as to the project. Systems such as precast concrete that are fabricated offsite and installed quickly facilitate fast project completion and, in some cases, generate revenue faster.

Building operations really consume costs, through electricity and other resources. Therefore, high performance buildings are designed to perform beyond baseline code requirements. Materials used in construction should contribute to reducing the consumption of energy and other resources related to operations. When you combine the thermal mass, continuous insulation, and negligible thermal bridging of precast concrete envelopes, the result is a reduction in energy used to heat and cool a structure, as well as a potential to reduce initial costs of HVAC equipment.

The articles in this issue provide examples and details on these topics and highlight ways that designers have taken advantage of precast concrete's efficiency. Precast is one of the fastest building systems—it reduces materials, trades, detailing, and associated risks, and it improves a building's thermal performance. It serves as a great example of a high-performance material that integrates and optimizes many attributes into one system efficiently. Let's *Discover High Performance Precast!*

**ASCENT** **On the cover: Georgia State's University Commons 2000-bed residential hall**

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- If you have a project to be considered, send information to Whitney Stephens, PCI Communications Manager, (312) 428-4945, wstephens@pci.org

## Gage Brothers Completes Erection of Precast Concrete for 4th Street Residences

MINNEAPOLIS, MINNESOTA

Gage Brothers Concrete, Inc. has finished erecting the architectural precast concrete for the University of Minnesota's 4th Street Residences. This project includes 76,600 square feet of insulated precast panels with cast-in thin brick and architectural precast for a main entrance canopy and site retaining walls. With the project in jeopardy of not being built, Gage Brothers was brought in during the design development of the project and was instrumental in converting the project from traditional handset block/brick cavity wall construction to an insulated precast panel. By utilizing precast, this solution created substantial schedule improvements as well as significant savings on the construction budget.

## Thermomass Expands U.S. Sales Team

BOONE, IOWA

Jon Cobb has joined Thermomass as a regional sales manager. Cobb will have the primary responsibility of managing Thermomass' Southeast Region, which includes the states of Florida, Georgia, Alabama, Tennessee, and North and South Carolina.

## PCI Design Awards Submissions Due May 20

CHICAGO, ILLINOIS

The PCI Design Awards program recognizes design excellence and construction quality using precast concrete. All winning projects will be showcased at the PCI Convention and National Bridge Conference and be included in a summary article that appears in the *PCI Journal*, *Aspire,* and *Ascent* magazines. Together, these publications reach over 65,000 industry stakeholders. Visit www.pci.org and click on the Design Awards icon for more details and to make a submission. To view the 2012 winners, visit www.pci.org/2012designawards.

## Finfrock Begins Work on Parking for More Than 1000 Cars

APOPKA, FLORIDA

Finfrock has signed design-build contracts for two new garages in Florida. Parking for the 4th Avenue South Residences in St. Petersburg will be designed, manufactured, and constructed by Finfrock. The project, on the corner of 4th Avenue and 4th Street, provides 624 stalls in five levels for a new multi-unit residential complex. In addition, 468 spaces will also be designed, manufactured, and constructed by Finfrock for SkyHouse Orlando, a new high-rise residential complex being built in downtown Orlando, Fla. The 7-level garage also includes 980 square feet of retail space. Both contracts total in excess of $10,000,000 and are expected to be complete this year.

## Elematic Gets Contract for Iraq Plant

BROOKFIELD, WISCONSIN

The parent company of Milwaukee, Wis.-based precast concrete producer Elematic Inc. has secured a contract with South Korea's Hanwha Engineering and Construction for a massive plant in Iraq.

It calls for a precast concrete production line with a daily component output the equivalent of 80,000 $ft^2$ of housing units. Hanwha Engineering, a part of South Korea's largest business conglomerate, is under contract with the Iraqi government to lead construction of 100,000 housing units in Bismaya, a satellite city near Baghdad. The development is part of extensive reconstruction and infrastructure modernization underway in Iraq.

Precast concrete construction was chosen for its quality, speed, and cost efficiency. The deal is valued at more than $54 million.

## Meadow Burke Announces New Website with User Enhancements and Added Product Information

TAMPA, FLORIDA

Meadow Burke, LLC, announced the launch of its new and greatly enhanced company website at www.meadowburke.com. The website sports a clean new design with more in-depth product information that engineers, architects and contractors will find useful. It also features an e-literature section powered by interactive viewing software that includes a full array of product manuals, brochures, and technical fact sheets available for on-demand viewing.

Submit your headline news for consideration in a future issue of *Ascent* to Whitney Stephens at wstephens@pci.org.

*Avera Cancer Center – Sioux Falls, SD*

# Prefabrication Provides Built-In Benefits.

— Randy Simmons


***The Publix GreenWise in Tampa, Florida used architectural and structural precast in order to build the upscale, grocery store on a tight construction sight, as well as completed the project in about 2/3 the time as conventional construction.*** *Top photo courtesy of Nino Giannotti. Bottom photo courtesy of Ariel Innovations, Inc.*

Prefabricated systems offer many well-recognized benefits including improved speed and quality control. With the growing focus on high performance structures, other less well-known attributes, including human resource management and sustainability, may soon be equally as important. As a time-tested prefabricated system, precast concrete inherently provides versatility, efficiency, and resiliency resulting in improved quality, performance, and sustainability.

## Increased Speed

Precast concrete accelerates construction in many ways. First, it is manufactured off site, which allows other work to begin sooner. Excavation, footings, and foundations can often be constructed while precast is being manufactured. With site-built systems, such as cast-in-place concrete, the prerequisite work must be in place before construction can

*– Randy Simmons is CEO of R.R. Simmons Construction. He has more than 35 years of experience in construction, construction management, and design build.*

begin. For example, forming cannot commence until the foundations are cast, cured, and available.

The fast erection process for precast also provides schedule benefits. Precast is typically installed with a crane and a relatively small crew. With a single thin-brick embedded wall panel, 400 sq.ft. of brick wall can be installed in about 15 minutes. Compare this to the time it would take masons to hand lay a similar wall section. Moreover, increased wall heights do not affect erection time for precast panels. However, with hand installation of brick, increased wall heights require additional scaffolding, structural support or anchorage, expansion and control joints, and other preparation that may affect the schedule.

In addition, precast concrete can be erected in almost any weather, so weather delays are essentially non-existent. Since precast concrete arrives to the project ready for installation, it does not require protection from weather such as rain, snow, or wind. Most site-built systems, such as cast-in-place and masonry systems, require additional resources and time to protect them during construction and are often delayed by cold temperatures.

## Increased Quality

Prefabrication typically elevates the quality control process. To ensure high quality, concrete must be mixed, placed, consolidated, and cured correctly and under a specified set of conditions. Precast production plants tightly manage the manufacturing process with buildings, protective systems, and monitoring to control the production environment. Duplicating these controlled conditions on a project site is more difficult, more expensive, and sometimes even impossible.

PCI–Certified Plants have extensive quality assurance programs and quality control procedures in place. Certified and dedicated quality personnel assure that products meet or exceed project specifications. Precast producers also employ a trained and consistent labor force. With other systems, field labor forces can be different from project-to-project, or even day-to-day. In addition, precast plants undergo unannounced inspections each year performed by independent engineers. Factory inspection and quality control standards reduce flawed materials from being delivered to a project site and installed only to be removed later in a costly and time-wasting delay. This enhanced oversight of the entire process results in a high quality product, which inherently provides several superior performance attributes, including high strength, low permeability, and long-term durability.

## Human Resources

Precast concrete can be manufactured and erected in a fraction of the time and with a fraction of the manpower required of cast-in-place concrete. For example, a mid-rise residential tower composed of cast-in-place flooring and structural systems requires an astounding amount of sheer manpower to construct. In addition, a small army of craftspeople on scaffolding is necessary for the vertical installation of the accompanying metal stud and stucco veneer system, with inherent safety risks. It is a slow process fraught with opportunity for system failure. Utilizing a precast solution minimizes the human resources required for successful project delivery by smartly shifting the construction process away from the "bigger hammer" theory of more labor, to a delivery system that is more reliant on highly skilled professionals and lean delivery.

## Sustainability

Sustainability requires the consideration of how construction will affect the project site and the surrounding environment both during and after construction. In sharp contrast to systems which require significant staging and lay-down space, precast concrete minimizes negative effects to a project site. Utilizing a "build within a bubble" approach, precast construction requires only a small site footprint. With "just in time" delivery, precast construction nearly eliminates lay-down and staging areas, as many concrete components can be erected and staged off the bed of the delivery truck.

For proof, take a look at the award-winning, large-scale gourmet grocery store on the ground floor of a parking structure recently designed and built by R.R. Simmons. With the limited availability of land in this specific hip, urban market, the team harnessed a precast concrete structural and architectural solution to deliver the unique project without the use of ground floor parking space. Erecting the project from the inside out, the team virtually eliminated interruptions to the daily lives of those in the neighborhood while delivering a building that is highly practical, functional, and attractive.

Other important aspects of sustainability include waste reduction and local sourcing. Many precasters recycle waste materials such as water, aggregate, and steel at their plants. PCI recently launched a Sustainable Plant Program with the goal of reducing precast plant waste and energy consumption. Precast also does not contribute to waste at the project site since it arrives ready for installation. More importantly in the long-run, precast itself can be recycled or, better yet, reused. In addition to waste reduction, precast construction reduces the cost and pollution associated with transportation. Precast concrete is essentially an abundant "natural" resource available locally which offers many advantages over materials such as structural steel that must be trekked across long distances to reach a local service area.

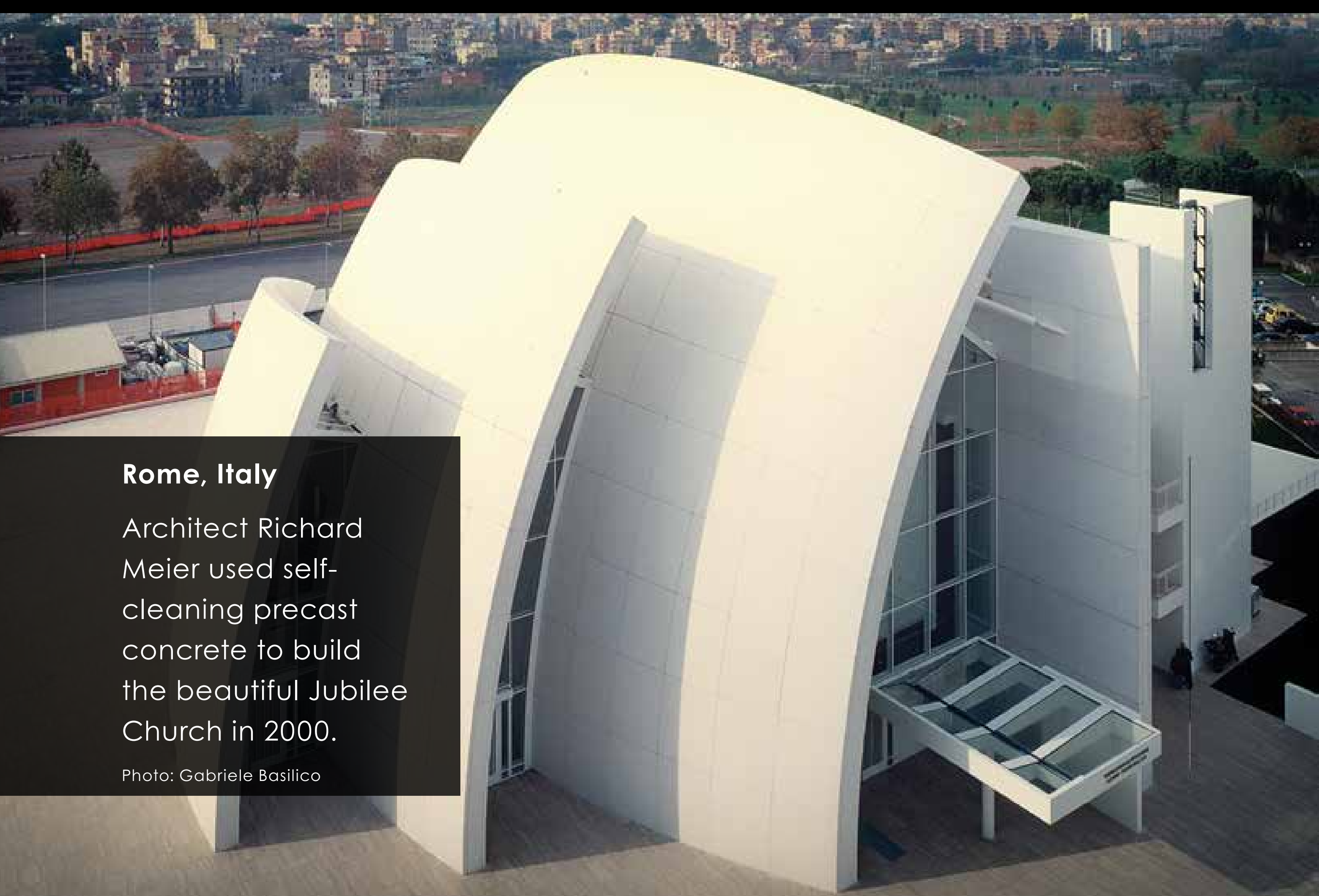
As a Design/Builder, we have a fiduciary responsibility to provide our clients with solutions that make sense in terms of long-term investment, serviceability, and sustainability. We must consider the cost of capital measured in time and delivery to market while building value for the client. Precast concrete checks the boxes on each of these critical project points. The advantages of precast are clear; it is quicker, more weather-resistant, more affordable, and more sustainable. Most importantly, precast concrete allows us to offer architecturally stunning solutions while keeping the project budget on target.

**Wilmette, IL**

Completed in 1953, the Baha'i House of Worship showcases the intricate details that can be achieved with precast concrete.

Photo: This file is licensed under the Creative Commons

## WHAT DO THESE BUILDINGS HAVE IN COMMON?



**Rome, Italy**

Architect Richard Meier used self-cleaning precast concrete to build the beautiful Jubilee Church in 2000.

Photo: Gabriele Basilico

# Precast Provides High Performance—Efficiently

A wide range of projects can benefit from the speed, thermal performance, integration of systems, aesthetic versatility and other efficiencies offered by precast concrete

— Craig A. Shutt

High performance structures require integration and optimization of many attributes, adding challenges for designers and contractors. Precast concrete architectural and structural systems inherently provide efficiencies that integrate several components and systems, reduce complexity and risks, cut costs and time, improve performance, and provide an aesthetically pleasing design.

The efficiencies precast concrete offers arise from its high-performance capabilities, which derive from a variety of its inherent attributes and manufacturing processes.

Among these are:

- Offsite manufacturing under controlled conditions, minimizing the site area required for construction, while maximizing quality.
- Combination architectural/structural elements, which allow faster enclosure of the structure, reduced onsite activities, and focused responsibility in a single-source supplier.
- Multiple finishes cast in individual panels, reducing detailing, joints, flashing, onsite labor, and maintenance costs.
- Fast erection, requiring no staging area for just-in-time deliveries and no delays, or change order requests for harsh weather conditions.
- High thermal mass, which improves thermal efficiency and reduces the amount of energy used to heat and cool a building.
- Reduced life-cycle costs due to excellent durability and lower costs for maintenance and utilities.
- Contributions to achieving sustainable-design goals through many inherent attributes such as use of recycled materials, nearby manufacturing, and improving an envelope's thermal performance.

The following projects are examples of how precast concrete can efficiently meet multiple-project-requirements, in all regions and throughout all building types.

## Center for Performing Arts – Mansfield Independent School District

Architectural precast concrete high-performance wall panels opened up new possibilities for administrators at the Mansfield Independent School District when they considered ways to push the energy performance of their new Center for the Performing Arts in Mansfield, Texas. The thermally efficient, pre-insulated panels cut energy costs while providing a maintenance-free exterior envelope.

The $40-million, 142,000-square-foot center, which is used for events ranging from graduation ceremonies to school plays, had to present an attractive, institutional look while meeting high-performance needs, explains Doug Bensen, director of design for Huckabee, a Texas-based engineering and architecture firm. Designers considered several options of traditional exterior wall systems before deciding on load-bearing, insulated precast concrete panels.

"The high-performance precast concrete option was a little more expensive in initial costs than other systems, but the long-range planning and operational costs were much better, due to the reduced heating costs and low maintenance," he says.

A key factor was the height of the theater, which seats 6,000 people. To achieve the proper acoustics, a 90-foot-tall ceiling was required—but finishing and heating that space was going to be a waste of time and money, and continue to be a drain on resources through the building's life. "We didn't want to eat up the budget by having crews have to get up there to finish those spaces and then ineffectively heat and cool that space," he explains.

The height precluded a solid masonry wall, he notes. "We knew we couldn't take that approach, as it would be too expensive. When we looked at options, the precaster showed us the benefits of sandwich wall panels and how a continuous-insulation system could be created to efficiently control costs."

### Continuous Insulation Aids Efficiency

A key element was the continuous insulation that the precast concrete


*The Center for Performing Arts in Mansfield, Texas, features thermally efficient, pre-insulated precast concrete panels that cut energy costs while providing a maintenance-free exterior envelope. Photos courtesy of Gate Precast Co.*

## PROJECT SPOTLIGHT

**Mansfield ISD Center for the Performing Arts**

**Location:** Mansfield, Texas

**Project Type:** Performing arts center

**Size:** 142,000 square feet

**Cost:** $40.4 million

**Designer:** Huckabee, Fort Worth, Texas

**Owner:** Mansfield Independent School District, Mansfield, Texas

**Structural Engineer:** Jaster Quintanilla, Dallas, Texas

**Contractor:** Byrne Construction Services, Fort Worth, Texas

**PCI-Certified Precaster:** Gate Precast Co., Hillsboro, Texas

**Precast Components:** Insulated sandwich wall panels


panels could provide. "Other construction methods would have been really inefficient at insulating that high in the air, both initially and over the course of the building's life," he explains. The panels were designed with a 3-inch exterior wythe containing the concrete face mix and architectural features, 2 inches of continuous insulation, and a 5-inch interior wythe of structural concrete. The assembly minimizes wall thickness, providing a system several inches thinner than a traditional block and brick cavity wall construction.

The edge-to-edge insulation, combined with the nonconductive connectors between the interior and exterior concrete wythes, creates an efficient thermal break that prevents heat and moisture from penetrating the building. "By specifying a high-performance system incorporating edge-to-edge insulation rather than the traditional 6 inches of solid concrete at the top and bottom of each panel, we completely eliminated thermal loss and vapor transmissions present in other wall assemblies," he says.

The insulated precast wall panels also met the ASHRAE 90.1 standard for a mass wall. That means the assembly can store heat energy and performs better than the sum of its parts. While the components of the wall individually added up to an 11.39 R-value, because of the mass wall, it actually performs at an R-value greater than R-20. Conversely, in a non-mass wall, the sum of the parts is lower than the individual R-values, due to the thermal bridging that occurs with materials such as studs, masonry ties and discontinuous insulation.

"The continuous insulation was a significant benefit, especially as the panels butt against each other and maintain the thermal break," Bensen says. "With no thermal bridging between the interior and exterior panels, there is no heat loss, and that's worth a few percentage points in energy costs. That was what we were looking for and drove us to the precast concrete system."


*The load-bearing architectural panels used to clad the new 1,000-bed freshman dormitory at Northern Illinois University in Dekalb, Ill., feature Endicott Brick colors of Coppertone Velour and Desert Ironspot Light Wirecut along with exposed areas of white cement with an acid-etched finish. The panels are part of the total-precast concrete structural system, which includes shear walls, stair and elevator shafts, stair units, and hollowcore plank. Photos courtesy of Paul Grigonis.*

## PROJECT SPOTLIGHT

### First-Year Residence Halls

**Location:** Northern Illinois University, Dekalb, Ill.

**Project Type:** Dormitory

**Size:** 390,000 square feet

**Cost:** $80 million

**Designer:** HKM Architects + Planners

**Owner:** Northern Illinois University, Dekalb, Ill.

**Structural Engineer:** SCA Consulting Engineers, Sugar Land, Tex.

**Contractor:** Pepper Construction, Barrington, Ill.

**PCI-Certified Precaster:** ATMI Precast, Aurora, Ill.

**Precast Specialty Engineer:** PEC Precast Engineering Company, Waukesha, Wis.

**Precast Components:** 1822 structural pieces, including exterior walls, bearing walls, shaft walls and stairs, plus 3178 hollow-core planks

Self-supporting stacked panels comprise the majority of the building's exterior shell. The panels bear on the foundation grade-beam footing, with multiple self-supporting panels stacked on top of each other, rising to the building's full height. The combination cast-in-place concrete and steel framing serve to handle the lateral wind loads. None of the weight of the panels is carried by the structure itself.

### Three Finishes Used

Many of the panels, most of which are 15 feet wide by 30 feet tall, feature radius profiles to follow the convex curve from the entry. Three complementary finishes were selected: a delicate acid-etch texture, a secondary brown pigment on some panels, and a proprietary finish that simulates large slabs of quarried stone. This custom feature was created with a retarder applied to the mold prior to pouring the concrete. Most of the panels also received a light sandblasting.

"Our goal was to create interest by using a lighter color to frame the glazing, creating an implied shadow line," Bensen explains. The third color highlights the entry and creates contrast with the radiused facade. Reveals also were used to help break up the mass of the building visually.

Samples and mockup panels were created for the desired choices, including full-size pieces. Those led to changes in the finish, with the goal of deepening the texturing. "Once we saw them at full size, we wanted to ensure we got a consistent finish across the panels and that the texture would 'read' from out at the street." Several cycles of samples were needed to achieve the long-range perspective that was desired.

The panels with radiused edges were cast in forms to create the required edging. These required no additional casting time and were erected smoothly. Corners were designed with a vertical 45-degree angle to create a mitered look. "The corners closed out nicely and provide a strong appearance at what can be a challenge." One crane was used to erect the entire project. "It was amazing to watch the panels go up so rapidly. The large size of the panels enclosed the space very quickly."

The beauty, durability, and energy-saving performance of the high-performance precast concrete panels provide a strong first and last impression for visitors to the center. They also help acoustically during performances. The insulated panels provide sound-damping properties that prevent outside noise from disrupting activities, providing a comfortable and quiet environment, while providing sound attenuation to enhance performances.

## Dormitory – Northern Illinois University

When Northern Illinois University looked to expand its housing options for freshmen, it created a plan for a 1000-bed, 390,000 square-foot, two-building complex on a site at their campus in Dekalb, Illinois. To create an attractive, welcoming appearance that also met schedule and energy-performance goals, designers at HKM Architects + Planners specified an integrated precast concrete structural and architectural system (often referred to as total precast) embedded with thin brick.

The structural system consists of exterior load-bearing walls, interior demising walls, shear walls, stair and elevator shafts, stair units, and hollow-core plank. The exposed areas feature a mix of white cement with an acid-etch finish. All exterior walls were cast with embedded thin brick consisting of a blend of colors to create the mix desired by administrators.

The administrators' vision for the appearance of the new dormitory required it to aesthetically blend with other nearby buildings. A variety of styles are present on the campus, including brick buildings but also precast concrete structures with buff-colored finishes and even some buildings with embedded thin brick in precast concrete panels. This provided considerable leeway in creating the best system and aesthetic appeal.

The bricks were laid out to ensure separation between colors to create a random appearance. A "frame" of white cement was created around the edges of the panels beyond the brick forms, creating thicker horizontal bands across the building with thinner vertical bands through the vertical joints.

The design featured a number of projections and setbacks, requiring many returns, some as wide as 3 feet, on the precast concrete panels to avoid joints at the corners. This aesthetic demand reduced some of the benefits provided by repetition in panels. But by creating such long returns, the precaster was able to minimize the number of pieces to be picked, which sped up construction even on the more complicated portions of the building.

Another key challenge involved erecting the gables along the roof line. These were cast as one-piece units and connected to the steel roof. A thermal break was provided at the roof line by providing insulation between the hollow-core ceiling and the exterior wall panels.

### Tight Schedule Drives Plan

The design was driven by a tight schedule that required the buildings to be ready for the new school semester 16 months away. Initially, administrators considered opening one of the buildings for the new term and phase the second to open later. To that end, one building was begun one month earlier than the other, with the team's efforts focused on completing it first. But the speed with which precast concrete panels were made and erected helped enclose both buildings quickly enough that interior tradespeople could complete their work faster than expected—enabling both buildings to be opened at the same time. "Precast concrete was the only option to meet the tight schedule," says Mark Hopkins, HKM.

Erection of the pieces began in June 2011 and ended for both buildings in November 2011. Production of the panels began four months earlier, in February, while other site-preparation work proceeded. This advanced production provided a significant inventory of panels on-hand when the site was ready, so 40 loads of panels and structural components could be delivered to the site each day for erection. They were delivered to the site on flat-bed trucks with A-frames that protected the brick facing from damage.

Two cranes erected the complex, one on each building. The upfront time spent casting panels prior to the site being ready ensured the plant could feed enough pieces to the cranes to keep them busy once construction began. Only 90 erection days were required to complete both buildings, with two crews working on each building, one securing panels and the other sealing 8-inch-thick hollow-core planks on each level. Installing precast concrete stairs between floors also sped construction and enhanced construction safety, as easy access was provided immediately between levels.

With both buildings ready for students when the new academic year began, the fast-track approach proved successful. The precast concrete structural and architectural systems provided the appearance demanded by Northern Illinois University while meeting the schedule and offering a durable, low-maintenance complex for future classes of students.

## Operations Center – Sacramento Municipal Utility District

Administrators at the Sacramento Municipal Utility District (SMUD) set high goals for its new Operations Center to replace a variety of aging facilities spread around at various locations. A key goal was to ensure the buildings produced as much energy as they used, resulting in net-zero energy use. This required taking full advantage of highly efficient mechanical systems, photovoltaic panels, natural

*The design-build team on the new Operations Center for the Sacramento Municipal Utility District used a new type of lightweight precast concrete composite panel to help it achieve its goal of Net Zero Energy use. The three-layer panels feature a mesh-reinforced concrete skin, spray-foam insulation, and a tube-steel framing system. Photos courtesy of Clark Pacific.*

### PROJECT SPOTLIGHT

**Operations Center–Sacramento Municipal Utility District**

**Location:** Sacramento, Calif.

**Project Type:** Office building

**Size:** 203,000 square feet

**Cost:** $110 million

**Design-Build Team:** Stantec and Turner Construction, both in Sacramento, Calif.

**Owner:** Sacramento Municipal Utility District, Sacramento, Calif.

**Structural Engineer:** Buehler & Buehler, Sacramento, Calif.

**PCI-Certified Precaster:** Clark Pacific, West Sacramento, Calif.

**Precast Components:** 153 Clark Pacific Architectural Precast Concrete Panels lighting, and utilizing an aggressive energy-management system. A new type of lightweight precast concrete composite panel helped the District reach its goals.

"The East Campus Operations Center is a much-needed and important step that will allow us to better and more safely serve our customers, while also building a facility that is as environmentally friendly and cost-effective as possible," said Gary King, chief workforce officer at SMUD to Pacific Builder.

The $110-million building includes spaces for distribution services, business technology, general services, and electrical-utility field support in a six-story, 203,000-square-foot office complex. Additional yard buildings contain shops, tool-distribution cleaning and storage, vehicle maintenance, warehouses, transformer shops, fueling, and a vehicle wash. Many unique shops were designed to handle specialized electrical and yard needs, including the storage of hazardous materials.

Stantec Architects and Turner Construction served as a design-build team to create the design plan for the campus. The team compiled an updated program and master plan to properly size the building and bring the variety of functions together into one location. "The new site provided many challenges to this effort, as it had grade changes of more than 60 feet in places, due to its former use as a gravel quarry," says a spokesman for the design-build team.

Although the grade change created obstacles, it also proved advantageous. Designers were able to place the office complex at the high point on the site and locate other buildings lower on the slope, hiding them from view. As a result, the building has a high profile that administrators wanted to ensure provided a contemporary, high-tech look that complimented the facility's energy goals.

A new type of composite precast concrete panel was chosen to clad the building to help meet the energy requirements while minimizing the steel and other material required for the structural framing. The system consists of lightweight, high-performance precast concrete panels that consist of three layers: 3 inches of integrated three-color and multi-finished mesh-reinforced concrete skin; 2 inches of NCFI spray-foam insulation, comprising self-adhering polyurethane closed-cell foam insulation and a vapor barrier; and a 4-inch light-gauge and tube steel frame system. The framing contains galvanized pins to connect the skin to the frame.

SMUD represented the first use for the panels. Tests were conducted on performance mockups to determine their capabilities to handle air infiltration, structural wind loading, cyclic static and dynamic water penetration, elastic and inelastic in-plane seismic movement, and vertical live-load deflection. No structural damage to the mockups occurred during the testing, according to Construction Consulting Laboratory West, which conducted the tests.

The panels, most of which measured 15 by 30 feet, provided benefits to the project by offering a durable, attractive finish on the exterior while providing an R-value of 6.8, an air and vapor barrier, and high sound transmission coefficient (STC) rating all in one precast component. The panelized approach reduced construction time, with no scaffolding needed as with other systems. The panels were transported to the site and erected quickly, using one crane, with easy access provided to the site.

With a precast concrete finish on the exterior face, a variety of aesthetic designs were available to the design team. These include granite, red brick, simulated stone, and limestone options. SMUD features a buff-colored hue with a light sandblast finish. Interiors were framed out and drywalled, with the process sped up due to the continuous insulation already installed in the precast panel. The precast concrete panels also offer inherent protection against mold and fire, and can be cleaned with only a water wash.

The precast panels help to reduce energy needs, which are minimized by the use of displacement and evaporative-cooling techniques, external shading and light louvers for windows, geothermal energy storage, radiant-slab heating and cooling, use of exhaust air to precondition incoming air, and a heat-recovery heat-pump system.

The project is aiming for LEED Platinum certification when it is completed later this year. "The project will serve as a nationwide model for customers and public-utility leadership peers in the ongoing sustainability movement," says SMUD's King.

## St. Jude Retirement Residences

It wasn't difficult for the precast manufacturer to determine what the owner of the Résidence Le Saint-Jude in Alma, Quebec, was looking for since they also own the building and served as the general contractor. They worked with architect Eric Painchaud Architect & Associates (EPA) to design the structure with a decorative exterior and a high level of safety, provided with the help of an insulated architectural precast concrete envelope and structural system.

The project consists of a six-story, 125-unit retirement residence along with commercial areas and a restaurant. It was designed to withstand cold Quebec winters and ensure the safety of residents by providing strong seismic and wind-force protection. The 115,175-square-foot building features precast concrete beams, columns, slabs, balconies, and stairs, and was clad with architectural precast concrete panels in three distinct finishes and multiple curving shapes.

"We wanted to innovate and show what precast concrete could accomplish in this area," explains Eric Painchaud. "Concrete has a cold and gray reputation here, so we took this opportunity to work with the owner, who builds buildings worldwide with creative precast concrete designs. The approach we took allowed the use of typical molds to create curves and colors that facilitated quick assembly on the site."

The project was brought to the owner by a developer looking for a partner, explains Guy Bouchard, vice president at the precast company. The firm owns other buildings in the


*The six-story Residence Le Saint-Jude retirement residence in Quebec in Alma, Quebec, features a striking exterior comprising architectural precast concrete panels in three finishes and multiple curving shapes. Its total-precast concrete structural system was designed to provide strong seismic and wind-force protection and features precast concrete beams, columns, slabs, balconies, and stairs. Photos courtesy of BPDL.*

## PROJECT SPOTLIGHT

**Résidence Le Saint-Jude**

**Location:** Alma, Quebec

**Project Type:** Retirement Center

**Size:** 115,175 square feet

**Cost:** CAD$15 million

**Architect:** Eric Painchaud Architect & Associates, Chicoutimi, Quebec

**Owner/Contractor/PCI-Certified Precaster:** Bétons Préfabriqués du Lac, Alma, Quebec

**Mechanical Engineer:** Gémel Experts Conseils, Alma, Quebec

**Structural Engineer:** Axys Consultants Inc., Sainte-Marie de Beauce

**Precast Components:** 1770 insulated architectural panels, plus beams, columns, slabs, stairs, and balcony units

area but hadn't built one from scratch previously. "Since our plant was in the city and this project played to precast concrete's strengths with its needs for aesthetics, speed, and safety, it was a natural for us to partner with the developer and to use this system."

## Precast Speeds Construction

The schedule benefitted from the total-precast concrete system, Bouchard says. The first floor was rapidly enclosed, allowing trades to begin interior work quickly. The L-shaped building was built in two phases, focusing on one leg of the "L" first and completing it in nine months. The second leg followed three months later, with the entire project being completed in one year.

Several techniques sped up the construction process, he notes. Windows were installed in the panels at the precaster's plant prior to shipping to the site, eliminating the need to have a window contractor on-site. "That provided a huge savings," Bouchard says. The use of full prestressed slabs for flooring units allowed electrical work and plumbing lines to be run quickly once the supporting walls were in place and the slabs were laid.

"If we had not used precast concrete on this project, we would have had to deliver it in a different way, as the construction techniques would not have been as advantageous with other materials," he says. The components were transported to the site using specially-outfitted trailers to protect the fenestration already installed. One tower crane on the site erected the entire project, picking panels and other components directly from the trucks as they arrived.

The insulated panels provided thermal efficiency as well as sound attenuation, Painchaud notes. "The insulation ensures the concrete allows the interiors to retain heat in cold weather and stay cool during hot weather." The panels feature xx inches of interior insulation. "Fabricating the panels in the plant with insulation already installed allowed us to better control the quality of the parts, giving us maximum performance and energy savings."

The building meets regional seismic codes and provides strong wind resistance due to its precast concrete frame. "With a six-story building, the loads can be impressive, so we needed to pay close attention to the seismic design," Bouchard says. Grouted sleeves were used at the bottom of shear walls to help absorb loads. "We had to locate these perfectly at the foundation so the walls would fit exactly into them."

The precast concrete wall panels also aid fire safety, as their inorganic composition won't support combustion. The interior walls along the corridor were given a light sandblast finish, saving on time not needed to fur out and drywall these walls. Interior demising walls are also part of the precast concrete structure, providing good sound isolation between interior and exterior spaces as well as between units.

## Curved Balconies

Each unit features a curved balcony, either concave or convex, providing a wave pattern across the building's façade. These ensure access for all residents to fresh air every day. The balconies vary in depth between 5 and 12 feet and include flower boxes that encourage gardening.

The balconies were cast as single-unit pieces. "There were only a few molds for the periphery of the building, which repeated," Painchaud says. "We integrated as many curves, lines, and shapes as we wanted into those molds. By using them repeatedly, we created uniformity and saved costs."

The balcony units sit on the exterior wall and bears on a precast concrete column. This required the column to be erected first and then the balcony units to be grouted and bolted to the supports. "This was not a standard connection that we typically use, and it required some adjustments at the plant to support the balconies' weight," Bouchard explains.

To provide a creative look for the facility, the precaster used a variety of shapes, finishes, and colors. The precast concrete balcony units feature a red hammered finish, with a brick appearance created through the use of a formliner, while the units' main façades feature a buff, sandblasted finish. At ground level, a mosaic-like appearance was created by adding false joints and installing cast stone in random locations, with different abrasive treatments applied to achieve three contrasting looks.

"With all three treatments, the warm colors are guaranteed to retain their appearance in the precast concrete," says Painchaud. "Concrete is highly durable, and we wanted to take advantage of that with these colors. What is wonderful about the precast concrete finishes is that they are integrated in a uniform manner."

Special lighting was attached to the building exterior in strategic locations to highlight the building's curves and finishes at night, casting eye-catching shadows. "The lighting was designed in-house to wash the walls but not make them too bright, so we could keep the shadows and showcase the curving shapes," Bouchard says.

The project started construction in April 2011, and the first tenants moved into the facility in December. The second leg opened in March 2012, with no delays due to winter weather. The project not only provides a contemporary, attractive, comfortable, and safe facility for residents, but it stands as an example of the strong aesthetic values that high-performance precast concrete panels can provide.

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

# Continuing Education

Craig Gaulden Davis' Scott Powell keeps abreast of trends in school design by gaining feedback from administrators, teachers, parents and students—some of which are close to home

— Craig A. Shutt

*Scott Powell, AIA, LEED AP*

Scott Powell has had close relationships with schools throughout his life, from his days as a school athlete to his teacher relatives and his presidency of his kids' PTA. Today, as leader of the K-12 Education Design group at Craig Gaulden Davis (CGD), he uses those experiences to help create more functional, cost-effective and attractive schools for new generations of students, teachers and administrators.

"Education is critical to our future," says Powell, vice president and secretary at the Greenville, South Carolina based firm. "The key to success is the teachers, but the environment affects everyone greatly. Whatever we can do as architects to create an inspiring space enhances the learning opportunity."

Powell has considerable background for his perspective on educational facilities today. He played football, basketball and ran track in high school, while his wife and sister both teach school. "I'm really the only one in my family who went to college and didn't become a teacher," he says.

Today, he and his wife are raising two high-school aged boys who play varsity basketball, while their younger son is an all-state cross-country runner and plays on the state-champion baseball team. "It's fun to follow them playing so many things and having such success," he says.

Greenville's one-county school district is the 49th largest in the country and the largest in South Carolina. Their facilities were boosted by a massive $1-billion capital-construction program that began in 2002, aimed at upgrading the entire district's school facilities. It involved 70 schools, including construction of 20 new schools and revamping or expanding another 50. CGD received the largest contract in that program, a $100-million commission to design three new schools.

By the time that commission arrived, Powell had begun designing schools and discovered it was where his passion lay. After graduating from Clemson University in 1987 with a bachelor's degree in design, he began his career at CRS Sirrine in Greenville. There he helped design a huge military base in another region. "I realized that wasn't what I was meant to do," he says.

A year later, he moved to Odell's Greenville office, where a number of projects, such as hospitals for Shriners International, encouraged more creativity. Even so, something was missing. "As a young guy, I was doing the drawings for the projects, which were in other states, so I didn't see how they turned out," he explains. "I realized I wanted to work for a locally based firm doing local projects and show my children what I did."

He joined CGD in 1993 and worked on a variety of projects—libraries, religious facilities, performing arts, even residential. "It was a little bit of everything," he says. The first school commission came in 1998. The firm had done school designs early in its formation, but that work had tapered off some years earlier. Today, after a number of high-profile designs, schools account for about 70% of CGD's commissions.

*The A.J. Whittenberg Elementary School of Engineering in Greenville, S.C., features a variety of sustainable-design features aimed at achieving Silver LEED certification. They include precast concrete insulated sandwich wall panels, which are left exposed on the inside to show students how buildings are constructed.*

Powell's work with the projects began to grow, as did his involvement on the personal side. As his children entered school, he quickly involved himself in their programs, becoming the first male president of the PTA in 22 years. "It was very important to me to get involved with my children's schools and know what was going on, both personally and professionally," he says. "You become familiar with the teachers and can offer support."

But there comes a time when kids would prefer not to run into their parents at school. So Powell shifted his efforts to related professional organizations. "It's also important to get involved with professional groups to promote the profession and perpetuate it," he says. He has served with the American Institute of Architects' Greenville chapter as well as the AIA state board.

*The Salvation Army's Kroc Center shares the site of the AJ Whittenberg Elementary School. Also constructed with precast concrete wall panels, the center provides a pool for students and houses a Boys and Girls Club with after-school and summer activities. Powell calls it "the best-looking precast concrete building in Greenville."*

"There are so many opportunities that you really have to look at where your passions lie," he says. "I've found that I really enjoy designing schools, so I wanted to be involved in that work on a larger scale." As a result, he serves on the board of the South Carolina Chapter of the Council of Educational Facilities Planners International (CEFPI) and has run its School Design Awards program for the past two years. "It's fun," he says. "I get to see a lot of different ways to overcome challenges."

## Designs Evolve

Through the years, Powell has seen changes in what administrators, teachers, parents, and students need from schools. "It's important to understand all of those roles and how they function," he says. That becomes challenging, he notes, as curricula are adapting to student's individual needs. "No two teachers teach the same way, and they sometimes teach two different students in different ways," he says.

Flexibility in design has become important, as schools differentiate by knowledge levels rather than grades. "Classrooms have to be more flexible to fit more stations into the space." That creates challenges, as South Carolina dictates a minimum classroom size of 800 square feet, he notes.

"We emphasize making rooms multipurpose, but that requires a lot of storage space so they can be adapted for each use, and administrators don't like to pay for storage," he says. "But it makes the rooms flexible if there are teaching walls and cubbies for each activity rather than different rooms for each."

Much of his direction comes from the administrators and teachers, and some are more open to new ideas. "Some administrators are focused on what has worked for them in the past, while others are anxious to try new ideas as soon as possible and experiment more."

Powell thrives on the programming stage of design, getting involved in the intensive process of figuring out how the building is going to work, how people will use it, and how well it flows from space to space, he says. "A school is much more than just a building. It's an innovative, functional space that engages people—opening their eyes, stimulating their senses and, in some cases, changing their lives."

Educational efforts often carry over to the building's design, especially in the use of sustainable-design techniques. Those efforts have been focused on higher-education facilities rather than K-12 buildings, he notes, but the interest is there. "They want sustainable-design concepts but don't want to pay for the certification, even if they could get it," he explains.

As a result, he encourages schools to add green roofs, water-conservation equipment, and thermal-performance techniques wherever possible. "They become not only functional parts of the school but learning tools, too. We can teach the children about these ideas and they can go home and teach their parents."

Precast concrete can aid with those thermal techniques in particular, and Powell has incorporated those on several projects. The three major school projects designed under the Greenville program, done in conjunction with Perkins+Will's Chicago and Charlotte offices, featured precast concrete insulated sandwich wall panels with a variety of façade treatments, including the traditional red brick, which was embedded into some of the panels.

Another example is the A.J. Whittenberg Elementary School of Engineering in Greenville, where administrators asked for a precast concrete façade. "That was fine with us, as we had experience with it and knew it would work well," he says. The school is the first engineering technology elementary school in South Carolina, a trend Powell is seeing more often. "Parents have more choices today, especially in specialized magnet schools like this."

The school's insulated precast concrete walls, with rows of punched ribbon windows, are attached to a steel frame, which has been left exposed on the inside. "It helps explain architecture and construction to kids interested in engineering," he explains.

## Security Demands Increase

Another key interest of administrators these days, unfortunately, is increased security and how school designs can enhance student safety. "Critics say schools have too much glass area for security purposes, but you can't have a school looking like a prison," he says. "You can't send that message. The school has to interact with the community. It can be frustrating. You can't design to stop every crazy person who might be out there."

With the firm's strong educational background, commissions are coming from further afield today, including a series of three schools in Charleston, about three hours away. Projects also are underway in Aiken and in upstate South Carolina.

"I hope to continue to design schools, and I'm encouraged by the amount of work we're getting with libraries, especially in Georgia," he says. Two have recently been completed, with three more planned in Fulton County, Ga. "It's very different work from schools, but there are similarities in the educational purpose and the variety of activities used."

As a result of the changing demands and expansion of project types, Powell continues to look for feedback from all sources. That includes those closest to home. "It's great listening in when we take our kids to basketball games with their friends," he says. "I listen to them arguing over which gym they like best, Woodmont or Carolina. I enjoy hearing what points they pull out as important to them."

The source of their satisfaction doesn't remain a mystery for long, he notes. "My kids are usually pretty quick to point out that I designed both of them. So I can't lose in that discussion."

# Precast Helps Dorm Exceed Expectations

Insulated panels provide speed, durability, and aesthetics—and offer significantly improved energy efficiency as a bonus

— Craig A. Shutt

Dormitories create a unique combination of design challenges, as they not only require typical housing needs but also must absolutely, positively meet their deadline and provide even higher durability than typical rental units. These needs were met at the University Commons student housing at Georgia State University in downtown Atlanta with the help of architectural precast concrete insulated sandwich wall panels. They not only provided speed, durability, and the desired strong, permanent appearance but helped reduce energy costs by more than 33%.

University Commons, the largest privately funded student-housing complex in the country, consists of four buildings ranging from eight to 14 stories tall and housing 2,000 students. This massive structure, containing 778,000 square feet of floor space, was clad with precast concrete panels containing 2-inch interior and 3-inch exterior architectural wythes of concrete, sandwiching 4 inches of continuous insulation and carbon-fiber connectors. The interior wythe of concrete also served as the finish face. The panels were anchored to a cast-in-place concrete post-tensioned frame.

A variety of requirements led the design team to precast concrete panels, says Dale McClain, principal at Niles Bolton Associates, the architectural firm on the project. The original plan was to use precast concrete panels at the base and steel framing with brick veneer above. But the steel and brick veneer proved costly and time-consuming. "The project ran into trouble when we priced these out, because we had a fixed budget, fixed project scope, and fixed delivery date. It created real challenges," he explains.

Officials at Hardin Construction Co., the general contractor, suggested the precast concrete design. "We under-

*Georgia State's University Commons 2000-bed residential hall features insulated precast concrete wall panels that provided a strong, permanent appearance, allowed the building to be completed earlier than scheduled, saved $1 million in construction costs and maximized energy savings over the building's life. All photos courtesy of Metromont Corp..*

stood the technology, but we'd used it only on smaller, one- and two-story projects," says Robert Kochansky, senior manager at Hardin. "We worked closely with the precaster during the conceptual stages and throughout construction to coordinate drawings to ensure accuracy."

"It was a new concept for us on this type of project," says McClain. "It appealed to us because we could do away with so much labor and material, especially the intensive brickwork that would be needed. That was going to be expensive." Designers reviewed the concepts and consulted with the precaster on a regular basis as it was considered. "We had to be sure we could stand behind it so we could recommend it to the client," he says.

In addition to the savings in time and money, administrators like the appearance the panels provided, says Paul Morgan, vice president at Ambling University Development Group, the project's developer. "They wanted a durable appearance that provided a sense of permanence. That was important on a high-profile, high-rise building like this."

**Speed Was Key**

'It appealed to us because we could do away with so much labor and material, especially the intensive brickwork that would be needed.'

Speed was a key factor for both the university and the developer, McClain notes. "We were looking for ways to save dollars anywhere we could while meeting the tight deadline that was set. The precast concrete panels ensured we could get the building dried in quickly, which was a great way to accelerate the schedule. Once the panels were installed and connected, we could start working to put in finishes, much earlier than with other systems."

Meeting the schedule was critical, he stresses. "There were huge dam-

*One of the administration's goals for University Commons was to create a durable structure that projected an image of permanence. That was put to the test in 2008 when a tornado hit downtown Atlanta, leaving the building unscathed while damaging others nearby.*

*The interior wythe of concrete on the sandwich wall panels serve as the building's interior wall surface. Windows were framed out and prepped at the plant so windows could be popped into place at the site and erected intact, saving time.*

*The building sits on a four-story cast-in-place parking structure on a sloping grade. The general contractor worked closely with the precaster to ensure the foundations matched perfectly, allowing the walls to be erected quickly.*

## PROJECT SPOTLIGHT

**University Commons, Georgia State University**

**Location:** Atlanta

**Project Type:** Dormitory

**Size:** 778,000 square feet

**Cost:** $165 million

**Designer:** Niles Bolton Associates, Atlanta

**Owner:** Ambling University Development Group, Atlanta

**Structural Engineer:** Browder + LeGuizamon and Associates, Atlanta

**Contractor:** Hardin Construction Co., Atlanta

**PCI-Certified Precaster:** Metromont, Hiram, Ga.

**Precast Components:** 2500 insulated sandwich wall panels with expanded polystyrene insulation and carbon-fiber connectors

*Three finishes were used on the precast concrete panels, comprising a white sandblast finish across the top of the majority of the buildings; a buff sandblasted finish below that on the bulk of the buildings; and inset thin bricks, used at pedestrian level.*

ages incurred if delivery dates weren't met." University dormitories are unique in their need for scheduling, he notes. "They're a real phenomenon. Students show up to move in within a small time frame, and they all arrive at once. You can't be finishing one part of it while another opens, which you can sometimes do with other types of housing."

The precast system helped ensure the schedule demands were met, but also offered other advantages, he adds. "We liked what the general contractor showed us with savings in metal, backup studs, drywall, and other materials. We also liked that we could use the interior face of the concrete as the interior side of the exterior walls, which meant as soon as it was in place, we could paint it and have durable interior walls."

Enclosing the building offered more than quick access for interior trades, adds McClain. "With other systems, buildings stay open longer, which leaves them susceptible to taking on water. A big advantage to enclosing the project quickly that's often overlooked is that you don't have to deal with a lot of moisture in the building as it's being built."

The rapid speed of construction was aided by preparing openings for fenestration. The windows were blocked out and framing anchors were installed at the plant, so when the panels arrived at the site, the windows could be popped into place and erected. "It worked very smoothly," says McClain.

'With other systems, buildings stay open longer, which leaves them susceptible to taking on water.'

Long-term maintenance also was a key concern, McClain says. "Administrators were focused on creating as low-maintenance a façade as possible. Universities have so few funds to maintain buildings in the way that they'd like to, especially large, complicated buildings like this one."

The precast concrete panels offered significant benefits over brick in that regard, he explains. "It greatly reduced the number of joints and changed the types of sealants that we'd need to use. The high-quality sealants and caulk we could use and the small amounts we'd need for maintenance were major selling points for the precast system." The panels also reduce the risk of mildew that could develop in the cavity of a traditional metal stud-framed wall with fiberglass insulation and drywall, as concrete's inorganic composition won't support mold growth, and the panels are impervious to exterior water penetration.

### Multiple Finishes Used

The building features embedded thin brick on the first level and two textured finishes on upper levels. "The university wanted to warm up the building's base for visitors and pedestrians," McClain says. "They originally asked us to use field-laid brick, but we found that the embedded thin brick in precast concrete panels provided a better option. It worked great. It provided a sense of warmth and comfort at street level and set the building off while providing a low-budget approach."

"The inlaid brick looked fantastic," says Hardin's Kochansky. The panels went up quickly, and the brick was "as clean as a whistle," thanks to the face of the brick being coated with wax before being installed face down in a casting bed. Only a power-washing at the factory was needed to clean the panels prior to transporting them, he notes.

A white sandblast finish was used across the top of the majority of the connected buildings, while a buff sandblasted finish was used below. "We wanted to reduce the visual scale of the project with color and projections," McClain explains. A variety of six-foot setbacks along the faces of the structure create smaller building segments that help minimize its massive scale. A courtyard at the center of the building was designed to allow daylight to penetrate into the residential units throughout the buildings, helping to reduce lighting needs.

The interior side of the panels received a hard-troweled finish and was painted. "These walls really should have no maintenance needs," McClain says. Paul Morgan, vice president of the project's developer, Ambling University Development Group, notes that saving the drywall and other materials needed to insulate and fur out the walls provided a significant cost and time savings.

## High Energy Efficiency

With all these benefits provided, administrators were especially pleased to find they had achieved significant long-term advantages through energy savings along the way. "Maximized energy efficiency wasn't as much a part of the motive for using the precast concrete panels as speed and appearance," Morgan says. "But as we put them together, we discovered we could achieve high insulation values. And the performance has exceeded expectations. There is excellent energy efficiency and no thermal loss."

In-field application of construction products often can create different realities than thermal calculations may anticipate, McClain says. Initially, when we considered using metal studs and brick veneer, designers calculated a theoretical R-18 wall value. However, because the insulation would have to be installed between the metal studs, thermal breaks would occur frequently along the building's face. As a result, the R-18 theoretical rating actually provided the wall with an effective R 7.1 value (per ASHRAE).

The precast concrete wall system featured continuous insulation held in place between two wythes of concrete using low-conductive carbon mesh to connect the wythes. These connectors and the continuous layer of insulation eliminated thermal bridging between the exterior and interior concrete walls. The insulated precast concrete panels provided an effective, or performance value, of R-13.8.

"This was a dramatic improvement in the efficiency that we could achieve that wasn't planned in the initial proposal," McClain notes. In fact, once the precast concrete wall's effective R-value was determined, the designers went back through the project and adjusted assumptions. As a result, the HVAC system was downsized due to the higher energy efficiency provided. "We went back through everything once we realized how effective the insulation would be for the building," says McClain.

The improvement in energy efficiency not only saved initial equipment costs of approximately $750,000, but will continue throughout the building's service life, resulting in much lower life-cycle costs through reduced energy consumption. The results surpassed even the calculations for what the improved efficiency could provide. Estimators had forecast an energy cost of $1.24 million during the first year of operation. In actuality, the cost was $838,000, 33% less. During its second year of operation, actual energy operating costs were even lower, at $750,000, 40% less than expected.

"That's a significant savings that will continue to help the operating budget," says Morgan. "We were very pleased to find that there would be substantial energy savings over time in addition to the first-cost savings that the panels provided. We'll definitely use this system on other projects in the future."

## Erection in 10 Months

The panels' erection process moved quickly, with several crews working concurrently on different sections of the buildings. The 2500 panels were erected in 10 months using tower cranes. The erection was done at night, allowing the tower cranes to be used by other crews during the day to move materials into position. This also alleviated congestion at the downtown site while the erection proceeded.

The panels were staged in a parking lot across the street and brought to the site for erection as needed. "By doing it at night, we were able to eliminate a lot of coordination issues," says Kochansky. The panels were erected for each building segment, moving one floor at a time and connecting the panels column-to-column. Each of the buildings was finished ahead of their anticipated schedule, ranging from 2 to 45 days early.

Infrared thermal-imaging studies of University Commons show the high efficiency of the precast concrete panels, with a consistent low-heat green throughout. Red spots are lights and bathroom vents.


*The four buildings making up the complex were designed to create a large courtyard at their center to help pull daylight into all of the housing units, brightening the spaces and saving on lighting costs.*

*The buildings were erected one at a time, using several cranes. The erection proceeded at night, with each of the buildings completed in less time than scheduled. The project was completed six months earlier than estimated.*

"It was a very fast system," he says. "All that was needed was a fire stop and closure plate once the panel was in place." They were caulked tightly, with crews moving quickly, he adds. "They didn't wait for the final weld, they just kept moving to the next panels to caulk. They were chasing the crane around the building really closely. It was incredible to see."

The buildings sit on a four-story, 780-space underground cast-in-place concrete parking structure, which required close coordination for foundations, he notes. The site drops down toward the back, creating different grades across the site. "We did an extensive review of shop drawings to ensure everything was accurate prior to placement," he says.

The result is a dramatic building with significant cost and times savings. McClain estimates that the precast concrete panels saved $1 million in costs compared to the brick and steel alternative, not including the additional long-term energy cost savings. The panels also reduced the project's schedule by six months, providing plenty of time for interior trades to prepare for students' arrival.

'The precast concrete panels saved $1 million in costs compared to the brick and steel alternative, not including the additional long-term energy cost savings.'

## Withstands Tornado

Another advantage of the precast panels became evident in March 2008, when a tornado hit downtown Atlanta. The storm did significant damage to many major downtown buildings, including tearing off part of the roof of the Georgia Dome. The nearby Omni Hotel was evacuated after many of its windows were blown out, as were windows in many other high-rises. But the University Commons building suffered no damage.

McClain says. "The building held up extremely well." Morgan agrees. "The precast concrete panels performed excellently at high wind loads, especially on a high-rise building like this. It withstood the storm beautifully."

The building also has revitalized the area, especially with the inclusion of 18,000 square feet of retail space on the southwest corner. The space has been used for an ancillary dining room, health center, campus police station, and several shops. At the time, the building was separated from the campus by several blocks, but that real estate has since been purchased by the university for use as administrative buildings, creating a closer connection between University Commons and the campus.

"It's a close part of the campus now, and it's great to see," McClain says. "That part of downtown was not especially active before, and this has really added activity and energy to the area."

Students agree that their dorm rates highly. In 2011, University Commons was named "Best Overall Dorm in the Country" by the website CampusSplash.com, which provides high-school and college students with news about college life. The building also was ranked fourth on the site's list of "Best 14 Dorms" based on 7100 reviews.

"Our vision has always been to provide students with premiere housing on our campus," says Dr. Marilyn De LaRoche, director of student housing for Georgia State University. "Students who like their residence hall's environment graduate at higher rates, have higher grade-point averages, and are more connected with their university community."

The design and construction team also have strong feelings for their work. McClain proposed this design for another recent student-housing project where speed was a critical factor. "Speed was the key driver for us on University Commons, and the energy benefits we received, which weren't even on our radar as we began the project, provided a strong added benefit."

Kochansky agrees. "This was the first and only project I've done this way, and I'd like to do more," he says. "It was a great project. After we finished it, I had PPD—post project depression."

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

*The residential building includes 18,000 square feet of retail space, helping to bring activity to the area at all hours. The dorm has been rated one of the best in the country by students.*

# Designing Precast Envelopes for Thermal and Moisture Efficiency

— by Brad Nesset and Emily Lorenz, P.E., LEED AP

The design of the building envelope and the performance of the exterior wall system are critical to a structure's performance and longevity, as well as the quality of the interior environment for those living and working inside.

It is paramount that designers and contractors understand the fundamentals of thermal and moisture management. As Joe Lstiburek, P.Eng. from Building Science Corporation said, "Good materials and good workmanship no longer constitute a high quality structure…we must now understand how buildings work."

*– Brad is Vice President at Thermomass, a manufacturer of insulation systems for the concrete industry. He has a Bachelor of Science degree in Construction Management from the University of Northern Iowa and is an expert in wall panel applications, rigid foam insulations, and insulated concrete wall panels. Brad has 13 years of experience in the specification, design, testing, and construction of insulated concrete wall systems and is a member of several PCI Committees, including Sustainability and Sandwich Wall Panels.*

*– Emily Lorenz is an independent consultant in the areas of life cycle assessment; environmental product declarations; product category rules; and sustainability rating systems, standards, and codes.*

How well buildings perform depends on how well, and in what manner, their exterior wall systems perform. In addition to serving as an architectural façade or a structural element, precast concrete wall systems can also serve as both thermal and moisture protection. These can be great benefits to a project if they are properly accounted for in the design.

Thermal performance and moisture management are two of the most important and complex roles of the building envelope. Thermal efficiency and moisture control are interdependent, and both need careful consideration to make a building envelope perform efficiently. With approximately 70% of generated electricity being consumed by buildings, thermal performance has become a focal point for many building owners as they want to control heating, ventilation, and air conditioning (HVAC) costs and contribute to a sustainable environment. However, it is equally important to understand and control moisture migration, a topic that is gaining importance as more people begin to understand the long term damage possible if moisture transfer is not considered during design.

These topics can best be summarized by the acronym WAVE: Water, Air, Vapor, and Energy. All four areas must be addressed in order to properly design a building envelope.

## Water

There are a number of different types of enclosure types used in building design, including rain screens, drainscreens, and double-skin facades. This article will explore the differences between the two most common types of enclosures: cavity walls and barrier systems. When assessing the available means of controlling water ingress through the building envelope, the initial question is whether the exterior walls act as a cavity or a barrier system.

A cavity system is essentially two wall elements separated by a hollow space or cavity. The outer wall element provides the finish and an initial defense against bulk rain water, either by shedding or absorption. The cavity or air space between the two wall elements is designed to collect any bulk water that penetrates the outer wall element and redirect it to the building exterior. This draining plane is the primary moisture defense system. Given its concealed nature, it is often difficult to determine if there is a construction defect until damages are severe and expensive to fix. Connections and components are also hidden inside the cavity, where issues may go undetected for years.

Alternatively, a barrier system, or face-sealed system, relies on the integrity of the outermost wall system to resist bulk water and moisture ingress. This is typically more cost effective, and if problems occur they are easier to detect. The key to a barrier system's performance is correct detailing. Besides

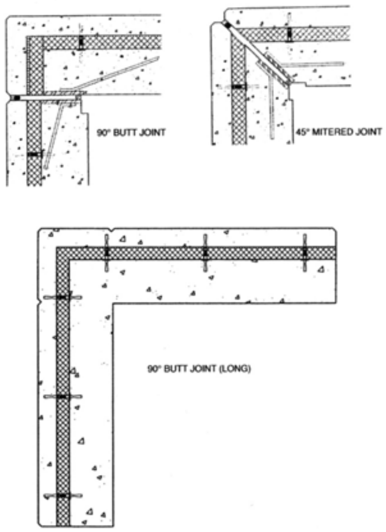



*Figure 1– Example of corner butt joints.*

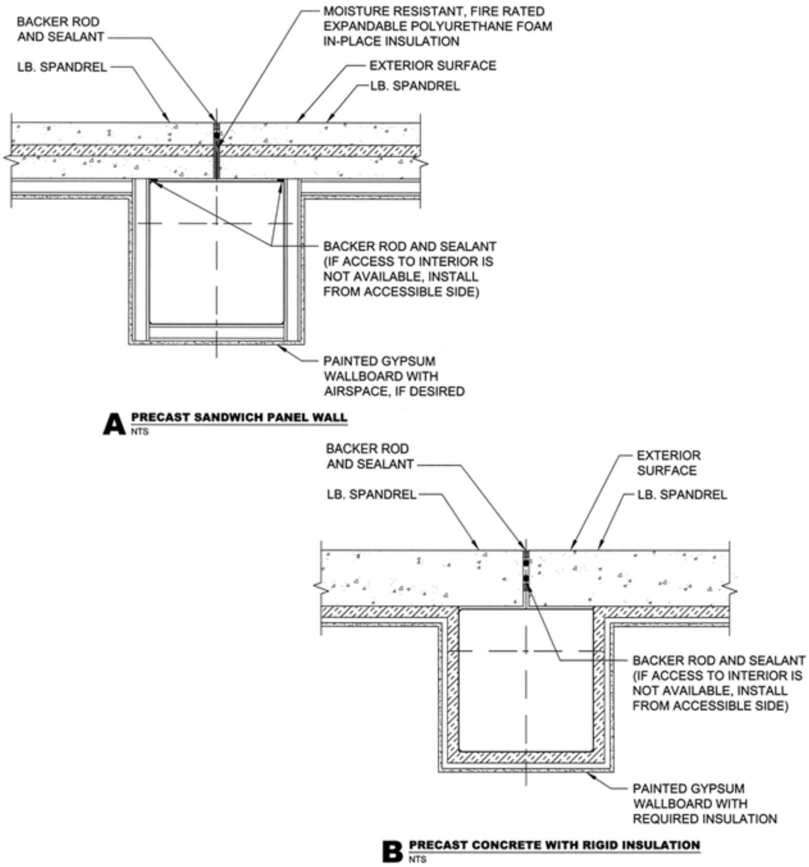



*Figure 2– Example of panel to panel joints..*

precast wall systems, other barrier systems include glass curtain walls and metal systems.

## Air

Building envelopes are often constructed of many materials, some of which allow a certain amount of air the pass through them. Unsealed joints, window openings, flashings, and other similar cavities can allow air movement through the building envelope system. Together, the amount of air that can pass through a building's envelope can be significant. Studies have shown that 5% to 20% of air leakage in buildings occurs at doors and windows, while 20% to 50% occurs at the walls.

Air movement from the inside of the building to the outside through gaps, openings, and joints in the building materials is known as exfiltration and is usually caused by a difference in air pressure as a result of stack and wind effects. Similarly, infiltration is the movement of air into a building from the outside. In addition to stack and wind effects, infiltration can also be caused by depressurization from ventilation.

When not properly dealt with, the physical movement of air through the building envelope can carry with it significant amounts of moisture, which can severely impact the overall performance of the building.

Table 1 lists several building ma-

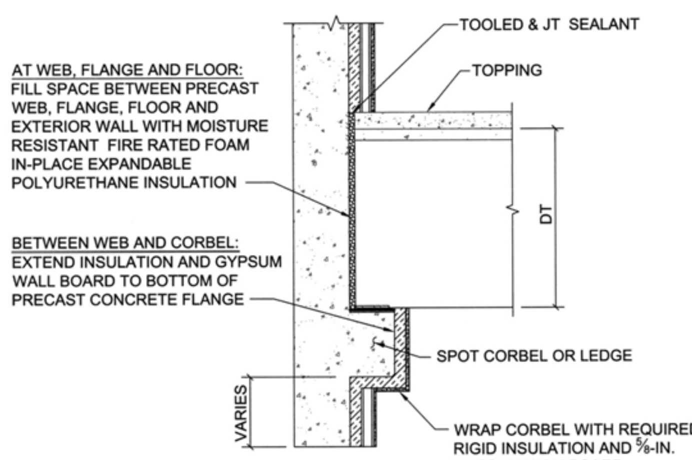



*Figure 3– Example of floor connection.*

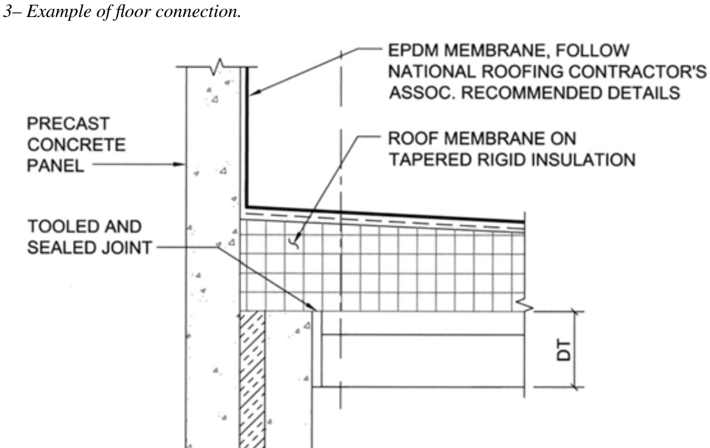



*Figure 4– Example of parapet connection.*

**Table 1 – Air leakage of various materials**

| Material | Average leakage, cfm/ft$^2$ of surface at 0.3 in. $H_2O$ |
|---|---|
| Solid precast concrete wall | No measurable leakage |
| Aluminum foil vapor barrier | No measurable leakage |
| Extruded polystyrene insulation | No measurable leakage |
| Closed cell spray foam insulation | 0.0002 |
| ½ in. fibreboard sheathing | 0.31 |
| Breather-type building membranes | 0.0022–0.71 |
| Uncoated brick wall | 0.31 |
| Uncoated concrete block | 0.41 |
| 1 in. expanded polystyrene | 0.93 |

terials and their average air-leakage ratings. Sheathing products show a measurable amount or air leakage, whereas concrete shows no measurable leakage. This is important because a precast concrete wall can serve as a continuous air barrier, as required by the 2012 International Energy Conservation Code.

In panelized construction like precast concrete wall systems, the panels' connectivity, joint treatment, and continuity of insulation materials are critical not only to designing for water and air, but also for vapor and energy. Figs 1-4 are examples of a few key details of various interfaces and treatments.

The key item here is the continuity of the insulation and the treatment of the joint, both inside and out. Goals to be achieved in detailing this type of construction are:

- a panel that is free of thermal bridges,
- joints that are secure and free of gaps or cracks that would allow for moisture to enter the building, and
- materials that will not allow vapor to transfer.

### Vapor

With its direct path into a wall assembly, air movement transfers more moisture than vapor, but vapor transfer shouldn't be overlooked.

Water vapor spreads through a wall assembly through a process known as diffusion. In vapor diffusion, moisture migrates from areas of high vapor pressure to areas of lower vapor pressure. This means that the moisture on the wet, exterior face of a wall assembly will attempt to spread into the dryer, interior materials in an attempt to equalize the vapor pressure. Achieving equilibrium is a fundamental force of nature and must be considered in building design and construction.

During cold winter months, warm indoor air migrates towards the colder exterior of a building. During the warmer months, warm exterior air is driven toward the air-conditioned interior of a building. Warmer air is able to hold more moisture than cooler air, so vapor diffusion dictates that the excess moisture looks to spread to the drier spaces in the wall assembly.

The key to stopping this migration lies in careful selection of the materials that comprise a particular wall system. Each component has a perm rating. Generally speaking, the lower the perm number, the better the ability to stop the migration of moisture.

According to the International Building Code, a material with a perm rating of 1.0 or less is considered a vapor retarder. A material with a lower perm rating, such as poly sheeting with a perm rating of 0.04, is typically considered a vapor barrier. One of the most common materials used to control moisture in wall assemblies is rigid insulation. The type of material and its detailing is important for vapor control.

Below are several common building materials and their respective perm ratings. As Table 2 illustrates, certain materials qualify as a vapor retarder, some act like a barrier, and others will need some additional detailing to stop the migration of moisture. The critical issue then is which materials should be used and in what manner.

The question of whether a vapor retarder or a vapor barrier will be needed in the assembly greatly depends on the building's intended use and the part of the country in which it is being constructed. To help guide the design process, the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) had developed a regional hygrothermal chart that divides the United States into eight zones and five climate types. They are:

- Severe Cold (Alaska and Northern Minnesota)
- Cold (Chicago and the majority of the country above the Mason/Dixon line)
- Mixed/Humid (Which is the Southeast and Pacific Northwest)
- Hot/Dry/Mixed (Desert South West)
- Hot/Humid (Florida and Gulf Coast)

Depending on the building's intended use and the materials selected for the wall assembly, the inclusion of a vapor barrier will be guided by which of the climate zones the building is located within.

As an example, consider a cold climate like Chicago, where walls are typically designed for the heating season. If there are any inconsistencies or thermal bridges in the wall insulation or, if the wall makeup doesn't have a low perm rating, there is a chance that vapor diffusion will occur. In that situation, the warm, moisture laden, interior air may eventually meet with a colder surface near the exterior of the wall. If that happens, condensation is likely and water will build up inside the wall.

Fig 5 illustrates this phenomenon. This is a brick/block cavity wall school in the Cincinnati area. In the bottom photo, where the control joints and brick ledge are shown,

**Table 2 – Perm Ratings of Various Materials**

| Material | M Perms | Perm-in. |
|---|---|---|
| Concrete | - | 3.2 |
| Wood | - | 0.4–5.4 |
| Extruded Polystyrene | - | 1.1 |
| Expanded Polystyrene | - | 2.0–5.8 |
| Polyisocyanurate | - | 0.02–6.6 |
| Glass fiber batt | - | 120 |
| Kraft batt | 1 | |
| Gypsum wallboard (0.375 in.) | 50 | |
| Polyethylene (6 mil) | 0.06 | |

moisture has migrated into these areas and impacted the thermal efficiency of the insulation. This creates an unequal thermal array and ultimately impacts the interior temperature of the CMUs.

The thermal image on the top is the interior of that wall. Looking past the desks in this class room, it is clear that the base of the wall is very cold, while the top remains quite warm. This is the unfortunate result of the insulation value being significantly reduced by the presence of water.

Warmer climates also require proper consideration to avoid similar moisture issues. In a hot/mixed climate, diffusion commonly occurs when wind-driven rain is absorbed by the wall's exterior material and stored. When the sun later comes out, this hot, wet air is pulled through the assembly to the cool, dry, interior air. Just as in the colder climate example above, it is critical that a defense mechanism be in place within the wall assembly to stop this migration.

The actual selection, detailing and placement of the vapor retarding material is a process that involves a number of decisions, but ultimately, the key is how it is being integrated into the assembly. Simply put, the ideal material must have a low perm rating to slow vapor diffusion and be continuous, with no penetrations, so as to not allow air exfiltration and infiltration.

## Energy

There are several variables that affect thermal performance and energy efficiency of building envelope systems. Some of these include the exterior surface color (solar absorptivity), the heat capacity of the envelope system components (including thermal mass, if applicable), and the type, amount, and position of the insulation. But before further explanation of those elements, we must understand heat flow.

Heat flows in three ways: conduction, convention, and radiation. Conduction is the flow of heat by direct contact. Convection is the flow of heat by air movement. Radiation is the transfer of heat energy only

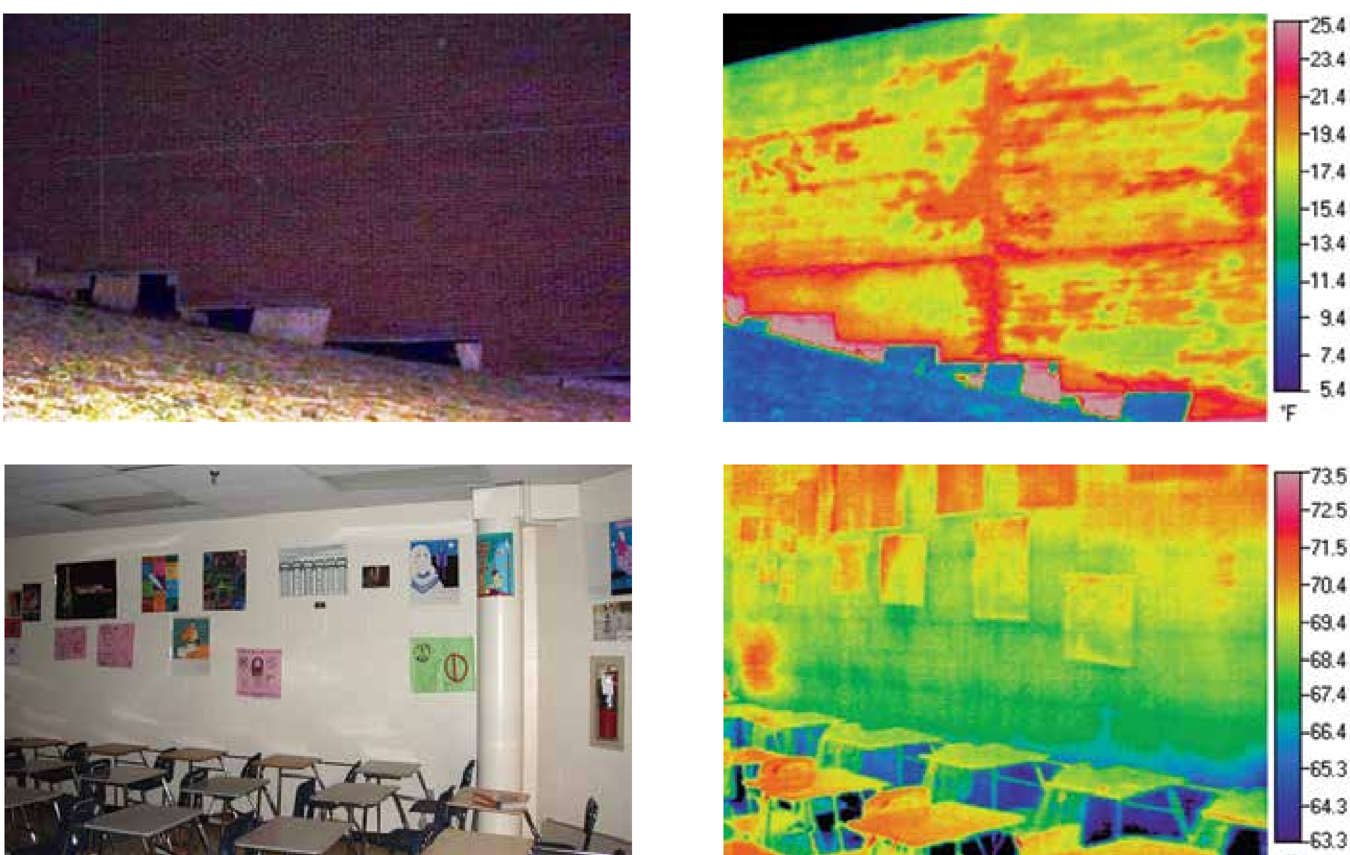
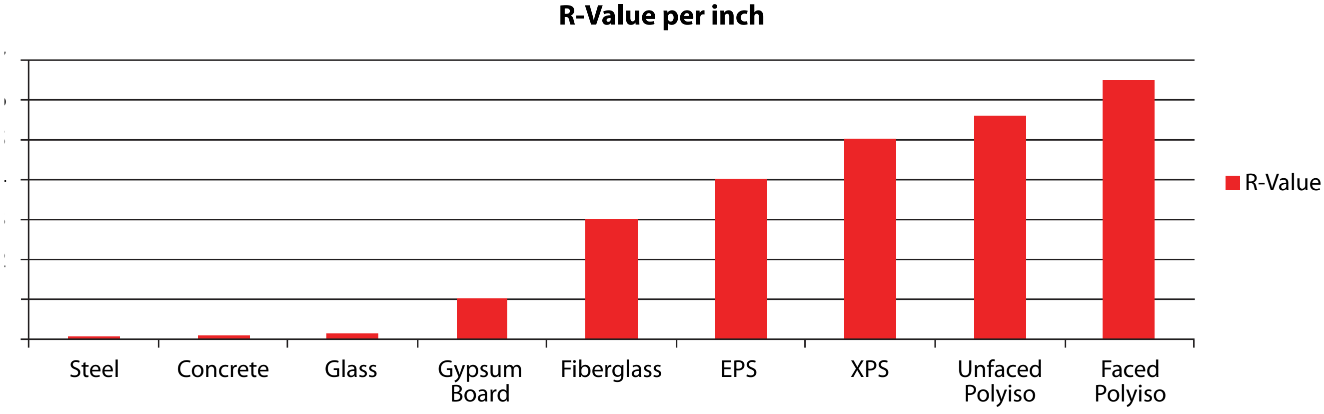



*Figure 5–Thermal imaging of block and brick walls.*

**Table 3 – Typical R-value of Materials**




through the molecules between two objects some distance apart. For transfer of heat energy to occur, a temperature differential must exist. In those cases, the heat energy travels from the direction of high energy (warmer) to an area of lower energy (cooler).

Of course, it is often desirable to limit the flow of heat energy. During summer, people try to keep the heat from coming into their homes, and in the winter, they strive to keep it from leaving. This is accomplished through insulation.

The fundamental metric of insulation is its steady-state resistance to heat flow. This metric is typically referred to as R-value. In general, a higher the R-value means more resistance to heat flow and a better the insulating power for the material in question.

As a point of comparison, table 3 some typical construction materials and their respective R-values per inch.

It is interesting to note that concrete is comparable to glass from an R-value perspective, and would seem to be a poor material choice when discussing energy-efficiency in construction. However, that is only part of the equation. Concrete also possesses tremendous heat capacity, or the ability to store heat. Heat capacity is used by energy codes to determine if a material has enough thermal mass to use the mass criteria.

When properly integrated into a structure, thermal mass moderates the interior temperatures producing a comfortable space while significantly reducing energy demand needed to heat and cool a structure. How is this accomplished? When heat energy strikes a wall, it warms its surface. Depending on the heat capacity of the material, a portion of this heat flows into the material, where it is temporarily stored and some continues through the insulation and into the building. The rest either re-radiates back out of the material or warms the adjacent air. The greater the heat capacity (more thermal mass) of a material, the more heat energy it can temporarily store.

By slowing or temporarily storing this heat energy (in the case of precast concrete and integrally insulated wall systems), some of these heat gains can be released into the conditioned space during off-peak times of cooling, or discharged to the cooler, exterior air at night. In simple terms, the natural tendency for materials to achieve thermal equilibrium can be used to lower the energy consumption of a building.

The thermal mass effect is recognized in ASHRAE 90.1, which allows for a reduction in the effective R-value (and thus the amount of insulation) in mass wall systems. The benefits of thermal mass, coupled with minimal thermal bridging and continuous insulation, result in a very energy-efficient wall system. Often, precast concrete wall systems provide performance, or effective R-values, which are greater than the material R-value. In other words, a precast concrete wall system may have a material R-value of R-11, but an effective R-value of R-20. The effective R-value can be used in calculating heating and cooling loads, which can reduce the size of the HVAC equipment, and the associated initial costs. This is the opposite of what occurs with most stud and cavity wall systems. For example, a steel stud and batt insulation wall may have material R-value of R-19, but an effective R-value of only R-8.

## Summary

As energy codes increase in stringency, understanding building science is increasingly important to properly design a high-performance building.

Those with a deeper understanding of sustainable construction know that it is not just about high-tech components and quality materials, but the interactions among those components that ensures whether a building performs well or not. In the long run, the constant influence of water and heat play perhaps an even more critical role in the success or failure of any construction project. Understanding how to use and control their effects may also prove the deciding factor in the long term success of the designers and contractors building them.

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

# Reduce Risk Through High-Performance Precast

— By Greg Winkler, AIA, LEED AP and Brad Parrot, Attorney at Law

Designing and constructing our environment is exciting. We make monuments and efficient work spaces, heighten learning experiences, house, entertain, heal, and the list goes on, benefiting many generations to come. While the rewards are great, there are risks however. Construction participants seem too slow to embrace change, too quick to point fingers, and too myopic in our individual views of our work. Often, this leaves design professionals as the sole catalysts for change. Design professionals move the industry with little outside help and, at times, in the face of great opposition. It is time for tradesmen to join the design team and help propel our industry into the next century. The precast concrete industry is doing just that.

*– Greg Winkler, AIA, LEED AP is the executive director of the Mid-Atlantic Precast Association (MAPA), a precast concrete trade organization representing twelve diverse manufacturers in six states and the District of Columbia. A graduate of Georgia Tech with a Master of Architecture degree, Greg has over 27 years of experience as an architect and project manager. He is the author of three construction-related books, and is currently writing a book on the International Green Construction Code for McGraw-Hill Professional.*

*– Brad Parrot has more than 14 years experience in the legal profession and is a partner with Hudson Parrot Walker in Atlanta, Georgia. He specializes in construction law and has served as lead counsel in over 20 trials and arbitrations throughout the United States and is national trial counsel for several of the construction industries largest participants.*

### How does a designer effectively transfer some of the risk of the design?

According to professional liability insurer CNA/Schinnerer, 64% of professional liability claims against architects and engineers are filed by the clients who employ them. Only about 13% of such claims stem from contractors and their subs.[1] Managing client expectations for design professional services, therefore, should be a central driver in any architect's desire to reduce professional liability. A few years back, *Architectural Record* summed up the situation well: "In general, professional liability claims are more likely to be the result of a failure to manage expectations than due to a spectacular construction failure, particularly where the client has little experience with other construction projects. Their understanding of what comprises an architect's scope of work and the quality and timing of the final product may be unrealistic, but that does not prevent claims from being filed and even going to trial or arbitration."[2] After a designer issues drawings for construction, control transfers to the construction team to execute the design. Control also transfers to the fabricator to successfully execute a given scope of work. Risk transfer is only successful when the downstream party is able to withstand the risk (i.e. you can't get blood from a turnip).

Precast concrete producers provide early design assistance to architects and engineers. Because of the nature of the product and how it is produced and erected, precasters provide detailed schematic or preliminary design phase input on budget and schedule conformance. Early involvement of the precaster is beneficial to both owner and the design professional, as it allows them to consult on the factors that affect the erection of the panels and their overall performance and costs. Further, precasters tend to have sophisticated in-house engineering departments, sophisticated production facilities, and professional management. In short, Precasters reduce risk because they are able to successfully and competently execute the Owner's project goals and the design team's design intent. Couple these abilities with the fact that precast is widely recognized as the fastest construction system, and project risks are reduced in terms of design risk transfer, product quality,

Precasters reduce risk because they are able to successfully and competently execute the Owner's project goals and the design team's design intent.

and time/schedule.

**How does a designer avoid change order claims?**

In the construction industry, the reality is that each participant seeks to build walls around its scope, sometimes going so far as to view the project with tunnel vision. Lawyers coach construction firms to refuse to comment on, consider, or acknowledge the existence of any other trade. In recent years, fantastically low margins—or negative margins—have served only to exacerbate this reality. In many instances, a subcontractor will 'fold his tent' rather than perform a scope of work at tremendous loss. This environment creates an incentive to call out every design imperfection and seek change orders.

What we as an industry need is greater collaboration. A precaster is ideally situated to do so. For example, compared to a cast-in-place parking garage builder, a precaster will design, fabricate, and install the garage from the footings up. All that the design team needs to design are corollary items like footings/foundations, approach ramps, stairs, railings, signage, etc. A precaster is not likely to seek a change order due to design, because they largely execute their own designs for parking structures.

**Multi-trade facades create unnecessary risk.**

The façades of most buildings are comprised of a number of products from different manufacturers, often installed by various trades. Consider a typical cavity wall envelope:

- Light-gage steel framing and exterior sheathing (carpentry sub)
- Cavity wall insulation (insulation sub)
- Interior gypsum board finish (drywall sub)
- Exterior brick veneer (masonry sub)
- Flashings, waterproofing membranes (carpentry or waterproofing sub)
- Sealants (painting or waterproofing sub)

Cavity walls, in particular, require multiple trades, each with their own

*This precast concrete panel combines three finishes into one efficient element saving time, material and money.*

submittals, product substitution requests, and Requests for Information (RFIs). The dilemma with cavity wall construction is that the large number of trades places a burden on the architect to detail completely, and requires the contractor to ensure that all the work represented in the documents is covered by the various trades and well-coordinated. The use of multiple products requires careful attention to differential movement and expansion joint requirements to ensure that cracking and other problems do not occur after the work is completed. Masonry products may expand or contract (brick vs. concrete masonry), and require slip joints to accommodate differential movement. Low masonry base walls require more frequent expansion joints to accommodate their movement.

Precast concrete can provide the same aesthetic treatments, including brick, window and door surrounds, bullnose treatments, and other effects, without the detailing issues present in built-up construction. And in most cases, it all comes from a single-source provider. Precasters are normally classified as "Tier One" subcontractors, meaning they hold a large portion of the construction contract. Where the envelope of a building is entirely composed of precast, the architectural detailing is predominantly aesthetic in nature, with the precaster handling the details of how the aesthetic intent is carried out in the precast. High-performance precast insulated wall panels allow the architect to adjust the interior and exterior thicknesses of concrete, as well as the thickness of the embedded insulation, to accommodate specific project needs.

Dew point analysis can be used to determine where within the wall assembly the dew point will occur. Typically this is within the exterior wythe of the insulated concrete unit and is exfiltrated out the exterior wall, causing none of the insulation damage or mold threat typical found in aging cavity walls. Often, precast concrete insulated sandwich wall panels can also be used as the finished interior, reducing the need for drywall, and the related materials, labor, and mold potential associated. The high-strength concrete (typically 5000 psi and greater) does not expand or contract significantly, and the dimensional change that does occur is accommodated in the sealant between panels. A concrete wythe of 3 inches or greater constitutes a code-compliant vapor barrier, and is a rain barrier rather than a rain screen, and thus does not require a cavity air space or drainage. In short, collaborating with and using precast brings to bear a decrease in risk with an increase in performance.

## How does Precast help deliver Green/Sustainable Structures?

Professional liability for green, or sustainable design, has been evolving over the past few years to where design professionals may face greater liability if the buildings they design fail to meet energy or operational performance expectations (i.e. a performance guaranty). The International Green Construction Code, for instance, includes an optional ordinance that may be adopted by code jurisdictions specifying that the general contractor must provide a bond to the code jurisdiction that can be used to pay for modifications should the building fail to meet performance standards specified in the code compliance documents. This new risk, though aimed at contractors, will inevitably affect design professionals as well. Again, collaboration with a Precaster presents an advantage. Precasters have the ability to handle delegation of design duties, offering an effective sharing of risks. As long as the delegated duties are clear, collaboration should render reduced risk and a better delivered product.

Another aspect of green design that may represent a growing liability risk for architects is that of poor indoor environmental quality (IEQ). CNA/Schinnerer relates one example of this liability risk in a sustainable design guide they publish for policyholders:

*Lured by the promise of "healthier and more productive occupants" basic to LEED publicity, a tenant rented space in a LEED Silver-certified building. At the end of the year, the tenant's records indicated a greater use of sick leave, increased complaints by employees of eyestrain and drafts, and reduced output from the clerical staff. The tenant demanded a rent rebate from the project owner based on a false promise of a healthful workplace and increased productivity. The owner sued the architect for not designing a healthful workplace and the tenant sued the architect for bodily injury based on poor indoor air quality.*[3]

Mold is a common culprit in IEQ claims (representing 1% of CNA/Schinnerer claims overall), but offgassing of volatile organic compounds (VOCs) and excessive ambient noise may well be future subjects of claims against architects.

This is why design professionals should take care in specifying and detailing envelope systems that prevent moisture intrusion beyond the face barrier, or create dew-point conditions that allow moisture to collect in cavity situations where it can foster mold growth. Similarly, architects must exercise even more care in the design of interior finishes to minimize VOC issues and create an interior environment that is free from harsh lighting, noise, or thermal distractions that can reasonably be argued do not meet the standard of care for a productive and safe indoor environment.

Precast concrete offers some strong advantages in both of these areas. Concrete has virtually no VOC offgassing. When used as the interior finish of a building, a painted or pigmented precast wall can easily allow an architect to meet the increased VOC requirements of LEED and the International Green Construction Code. Because precast is typically not stored on the site prior to erection (and has low moisture permeability), building flushout prior to occupancy is more easily accomplished. Precast insulated panels also do not provide any food source for mold growth, or contain a cavity where hidden moisture can generate IEQ problems.

Overall, risks associated with construction are changing. High-performance precast concrete offers many ways to help reduce these risks both short and long-term.

**Notes:**


1. "From Risk to Profit: Benchmarking and Claims Studies." Victor O. Schinnerer and Company. Inc., 2011.
2. Peeler, Casius. "Professional liability insurance: When to get serious. "*Architectural Record*, December 2007. http://archrecord.construction.com/practice/startUps/0712insurance-1.asp
3. Ballobin, Kristin. "Sustainable Design Risk Management." Victor O. Schinnerer and Company, Inc., 2008.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# Veneers–Tradition Meets High Performance

Embedding, or veneering, stone, brick, and other natural materials into precast concrete panels speeds construction while providing efficiency, reducing costs, and improving thermal performance

— Craig A. Shutt

Precast concrete offers aesthetic versatility and efficiency by replicating a range of masonry and natural-stone appearances. But for some projects, authentic materials are required. Embedded or veneered precast concrete allows for all the beauty of these natural materials, but with the added quality, speed, durability, reduced maintenance, and cost savings associated with precast. Since precast is manufactured offsite, it also reduces negative effects at the project site such as staging and storage requirements, scaffolding for installation, and protection from inclement weather—plus it requires fewer trades.

"The aesthetic choice always comes down to the client's priorities, preferences and budget," says Marsha Hoffman, principal at SFS Architecture in Kansas City, Mo. "There sometimes are unique requests that can only be met by using the materials that precast concrete might otherwise replicate."

That's especially true for buildings' bases, where owners sometimes want authentic stone materials at eye level. Higher up, precast concrete's capabilities to reproduce those colors and textures often make it a more cost-effective choice.

The following projects show some of the ways that stone, tile and other natural materials have been embedded, or veneered, to precast concrete.

## Federal Courthouse

The U.S. General Services Administration had specific concepts and concerns when it commissioned the design and construction of the Christopher S. Bond U.S. Courthouse in Jefferson City, Mo. "Budget and constructability were the key factors in how the project was designed," says SFS's Hoffman. "But aesthetically, they wanted limestone and granite used to project the image they sought."

The courthouse was sited adjacent to historic buildings on an abandoned state penitentiary site. It sits back from one of the oldest remaining buildings, with an outdoor plaza providing public gathering space between the two structures. Administrators wanted the new courthouse to blend with those buildings while projecting a durable, institutional appearance. "The new courthouse needed to reflect the civic dignity and importance of the building's judicial function, while meeting the goal of a 100-year building," says Hoffman. To achieve this, they used precast concrete panels with a limestone and granite veneer on their face.

> Budget and constructability were the key factors in how the project was designed.

Designers initially considered a CMU backup with installed limestone. "That would have created a very labor-intensive and expensive approach," says Hoffman. "When we looked at using precast panels, we found that it would be considerably faster and more economical while meeting the aesthetic needs and constructability requirements. Once we explained the concept to the client and they understood the advantages, they readily agreed to the approach. It worked out best for all factors."

The conceptual design centered on placing the building on the corner of the site, with the entrance opening onto a large courtyard/park stretching across the other three corners. The courthouse sits on a bluff above the river. The structure features a concave design, with both ends curving out toward visitors as they approach through the plaza. A trellised cornice with a light and airy appearance rings the top of the building.

A special suction-cup vacuum system was created for use in the production facility to pick up the stone veneer and set each piece into the forms to avoid damage. The limestone pieces varied in thickness from 3 to 6½ inches, with some as large as 8 by 10 feet, and weighing as much as 1,400 pounds apiece. The thin stone was veneered to the precast panels, which were as large as 10 by 40 feet

*The Christopher S. Bond U.S. Courthouse in Jefferson City, Mo., features architectural precast concrete panels embedded with limestone veneers. The building's concave shape creates a strong entry space across a large courtyard. The structure is embellished with a precast concrete trellised cornice across the building's top, which is lit at night with strategic placed fixtures. The project achieved a LEED Gold rating. Photos courtesy of Aaron Dougherty Photography.*

## PROJECT SPOTLIGHT

### Christopher S. Bond U.S. Courthouse

**Location:** Jefferson City, Mo.

**Project Type:** Government building

**Size:** 118,000 square feet

**Cost:** $67.7 million

**Design Architect:** Kallmann McKinnell & Wood Architects, Boston, Mass.

**Associate Architect:** SFS Architecture, Kansas City, Mo.

**Owner:** General Services Administration, Washington, D.C.

**Structural Engineer:** Walter P. Moore & Associates, Kansas City, Mo.

**Contractor:** J.E. Dunn Construction, Kansas City, Mo.

**PCI-Certified Precaster:** Enterprise Precast Concrete Inc., Omaha, Neb.

**Precast Speciality Engineer:** Rupprecht Engineering, Omaha, Neb.

**Precast Components:** 381 components with thin-set granite and limestone, including wall panels, cladding, columns, and cornices

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in overall size, using stainless steel anchoring pins. These allowed for differential movement of the concrete and stone veneers.

Particularly challenging were the curved pieces along the building's front façade and trellised cornice. Lettering for building identification was also precisely cast into the panels to look as engraved letters.

Additional detailing was used to direct water flow off the cornice and other areas to ensure water would not infiltrate into the building. Lighting also was embedded into the upper areas to highlight the trellis and cast shadows onto it at night. "There were significant complications in the detailing on the project, but its constructability remained the foremost goal to ensure fast construction on the budget we had," Hoffman says.

### LEED Gold Certification

Another key goal was to incorporate sustainable-design features, which allowed the project to achieve LEED Gold certification. The precast concrete panels contributed in a variety of ways. These included providing regional materials and manufacturing, lowering construction-site waste by consolidating trades, aiding energy efficiency through its high thermal mass, and using recycled materials in the panels' composition. The building's orientation on the site also played a role, as it helps emphasize daylighting and reduce lighting needs.


*Speed, aesthetics, and economy were the key reasons designers chose precast concrete panels embedded with manganese ironspot thin brick for the façade of Lucas Oil Stadium in Indianapolis, home to the NFL's Colts. The total-precast concrete structural system helped ensure the project could be built on a tight 36-month schedule and open for the new season on time. Photos courtesy of HKS Inc.*


## PROJECT SPOTLIGHT

### Lucas Oil Stadium

**Location:** Indianapolis, Ind.

**Project Type:** Football/basketball indoor arena

**Size:** 1.847 million square feet

**Cost:** $720 million

**Designer:** HKS Inc., Dallas

**Owner:** Indiana Stadium and Convention Building Authority, Indianapolis

**Structural Engineer:** Walter P. Moore, Houston

**Contractor:** Hunt Construction Group, Indianapolis

**PCI-Certified Precaster (architectural components):** Gate Precast Co., Ashland City, Tenn., and High Concrete Group LLC, Springboro, Ohio

**PCI-Certified Precaster (structural components):** Coreslab Structures Inc., Indianapolis

**Precast Components:** 1,548 architectural pieces, including thermally efficient insulated wall panels, and 3,637 structural pieces, including slabs, stairs, risers (single, double, and triple), tubs, load-bearing panels, and vomitory walls

The overall project was a great success facilitated by combining prefabricated materials into a panelized system. "Combined materials could go up into place immediately, and once those panels were in place, we basically had an enclosed project," she says. It also significantly simplified the construction and saved money. The project came in $3.5 million under budget.

Hoffman notes that SFS has used precast concrete on other projects to achieve similar looks without veneer cladding, using precast's capability to replicate the look of limestone. "That's often a viable alternative, but it depends on the client's goals," she says. "This project was very well executed and has been well received in the community and by the client. Everyone is very pleased with the results."

## Lucas Oil Stadium

Stadiums represent another large, high impact type of building that often has to project a strong appearance using stone or other high-end materials. For Lucas Oil Stadium in Indianapolis, home to the National Football League's Colts, speed of construction and long-term durability were just as important as the structure's aesthetics. That meant using a rain-barrier system rather than a traditional rainscreen. Many consider rain barrier systems easier to install and maintain. Because they have no cavity to collect moisture, they usually reduce the potential for mold and other long-term moisture-related issues.

The stadium seats 73,000 and converts sightlines from football to NCAA's basketball tournaments. It also contains 150,000 square feet of convention floor area. The stadium was oriented to align with the original radial street pattern designed for the city, and the brick facade was intended to tie the facility to the historic brick buildings in the downtown area's garment district. It also provides a sympathetic nod to Indiana's original basketball fieldhouses.

The schedule was tight because the owners needed the stadium ready for the beginning of the 2008 football season in August. Erection of the precast began in September 2006 and took 18 months in all. That schedule included the erection of 1,548 precast architectural pieces, including the insulated sandwich wall panels embedded with thin brick, along with 3,637 structural components, such as stairs, risers, and load-bearing panels. "The 36-month overall construction schedule was tight for a stadium with a large, retractable roof in the Midwest," says project designer John Hutchings, principal at HKS Inc. in Dallas. "Precast concrete panels embedded with thin brick afforded the construction team the comfort that the exterior skin would not be any cause for construction delays on the project. This approach allowed critical finishes to meet the proposed completion date."

The seven-level facility used a total-precast concrete structural design to provide speed, aesthetics, and economy, Hutchings says. The embedded manganese ironspot jumbo thin brick compliments the traditional hand-laid brick used on other buildings in the downtown area.

The arched entrances into the stadium used thin brick that was corbelled to enhance its visual expression. The brick mortar lines, which are actually 6000+ psi precast concrete, tapered from ¼ to ³/₈ inch from one side to the other to create the arched appearance. The panels adjacent to the arched entrances incorporated limestone detailing within the precast to add a decorative touch. Several mockups were created of the panels with careful detailing of the brick coursing to indicate how they would appear on the façade.

The large vertical pre-insulated column covers were sequentially poured, allowing them to be erected as one large piece versus three pieces. This reduction meant fewer pieces needed to be transported and erected, while also reducing the number of sealant joints to maintain and providing a more energy-efficient envelope. The precaster paid special attention to detailing and locating seams from sequential casts in the least visible locations. A unique gravity connection was used to support the arched soffit added on the east and west main entrances.

At more than 200 feet to the top of the building, it would have proven time-consuming to hand lay masonry and construct a back-up system, Hutchings notes. By contrast, the brick panels were lifted into place with a crane in a fraction of the time. The insulated panels consisted of a 3-inch exterior wythe with embedded thin brick, 2 inches of continuous insulation and a 3-inch interior wythe that served as a structural wall. The precast walls thus provided the exterior brick envelope, insulation, vapor and air barriers, and paintable interior surface in one piece, which accelerated the schedule, reduced trades and risk, and saved material and money.

"The energy-efficient precast concrete insulated wall panels with thin jumbo bricks created a detailed and elegant exterior façade," says Hutchings.

## Target Field

Another Midwestern stadium took a different approach to its veneer exterior, incorporating large, dramatic, rock-faced limestone onto precast concrete panels. The owners of Target Field in Minneapolis felt so strongly about the use of the stone that they added its cost into their budget, says Bruce Miller, principal at Populous, the architectural firm for the project. "The owners felt so passionate about using this local stone that they willingly paid the overage from the state's fixed contribution to ensure it could be used."

The stadium serves as the home to Major League Baseball's Minnesota Twins and sits on one of the league's smallest sites. The stadium's aesthetic design was created to reflect its position in nature and the outdoors, Miller notes. But the site proved challenging, as it offered immediate access to light rail and commuter rail in an urban environment, meaning it was surrounded by immovable obstacles.

The stadium's construction progressed on a fast-track basis to ensure it was ready for the beginning of the 2010 season in April. "The legislation authorizing construction allowed for a best-value selection process,"

*Target Field in Minneapolis features a veneer of scraped-earth limestone on its precast concrete panels, which create a distinctive, rugged appearance. The precaster provided a design assist on the stadium, the home to Major League Baseball's Minnesota Twins, to help complete the project on a fast-track basis. The panels helped contribute to the building's LEED Silver rating.*
*Photos: Christy Radecic, Bob Perzel, Paul Crosby, Gage Brothers Concrete Products*

## PROJECT SPOTLIGHT

### Target Field

**Location:** Minneapolis, Minn.

**Project Type:** Baseball stadium

**Size:** 980,000 square feet

**Cost:** $544 million

**Designer:** Populous, Kansas City, Mo.

**Owner:** Minnesota Ballpark Authority, Minneapolis

**Contractor:** Mortenson Construction, Minneapolis

**PCI-Certified Precaster (architectural components):** Gage Brothers Concrete Products, Sioux Falls, S.Dak.

**PCI-Certified Precaster (structural components):** Hanson Structural Precast, Maple Grove, Minn.

**Precast Components:** 1779 pieces, including limestone-clad wall panels, thin-brick clad wall panels, acid-etched components, risers, slabs, tubs, stairs, and vomitory walls

explains Miller. That meant the construction manager could work with the precaster to figure out details prior to having the design package for the entire facility completed.

"The precaster worked hand-in-glove with us on a design-assist basis as the project progressed, so we were finishing design drawings as they were finishing shop drawings," Miller says. Having the contractor and precaster on board during the design process was helpful, he adds. "They could ensure the panels were going to align and would create an efficient panelization."

### Scraped-Earth Veneers Used

"Our goal was to create the look of a limestone outcropping along the Mississippi River valley but keep it fairly smooth in appearance," Miller says. The aesthetic design focused on large, stacked blocks of rough-faced limestone native to the area.

This "scraped-earth" facing consists of the top strata in the quarry that in earlier times was thrown out to allow the smoother underlying face to be used. These were thin pieces, 2½ to 4½ inches in depth, that were honed and cast into the precast concrete wall system.

"These pieces created challenges for the precaster to manufacture, as they had to cast pieces of limestone with non-uniform surfaces that varied in thickness by 2 inches within one piece," he explains. The pieces could not project outward by that much variation, he notes, as it might create handholds that visitors might use to try to climb the façade.

The limestone pieces, which varied in width from 3 feet 9 inches to 5 feet, were cast face down in the form, with ¾-inch joints between them. Stainless-steel ties anchor the blocks to the front of the precast panel, and a 6-mil bond breaker was used to prevent concrete from entering the joints. It also accommodated thermal expansion of the dissimilar materials.

"We could not accept a wall system that had the appearance of panelization," he says. Mockups were created that were two bays wide and several panels high to see the large-scale appearance in advance.

The design also called for gradations in the stone color from darker hues at the base to lighter at the top, to visually "ground" the structure and reduce its scale. The stone was graded into eight colors and tones and the shop tickets for the panels were sent to the stone supplier for detailing with the color selection and instructions for cutting the stone to the proper size. Smooth accent bands run through the façade, which were designated in the shop drawings. A pattern in the design was created,(to speed the design), but it repeats so seldom that it is imperceptible, notes Miller.

"There was nothing square, straight, or plumb about the 88-foot-tall wall system," he says. Many walls were battered a variety of different degrees, while each corner intersected at a different angle. A number of canted walls and articulations added to the depth and unusual shapes. "Ballparks by their nature aren't square, and this one maintained that design. These different interfaces provided some real challenging geometry, but precast gave us the versatility to meet them."

Because of the tight site, the façade was erected from within the footprint of the stadium and then reached across to complete it as the shell was completed. "It was a blind pick on the backside of the building because there was no outside access," he says. "It was a logistical feat."

The project also received LEED Silver certification, only the second MLB stadium to achieve that designation. The overall cost to achieve this certification was estimated to be less than 0.5% of the ballpark's $545-million budget.

The precast concrete components contributed to a variety of the points achieved. These included 30% of all installed materials made from recycled content, 60% of the building's exterior offering regionally sourced materials, and an 80% reduction in the amount of extracted clay used. Miller says "The stone-faced precast concrete wall panels definitely played into our LEED strategy."

The result is a dramatic appearance that saved time and money while achieving sustainable-design goals. "The precaster did a superb job coordinating the design, fabrication, and installation of the limestone-clad wall system." The company joined the design process two years prior to construction to assist with the project.

The project has been well received, he notes. "We really like the stone face this approach provided," Miller says. "You can see skeletons of ancient creatures in the stone if you look closely. It creates a unique look for a baseball stadium." They are not alone in their admiration of the facility. In 2010, ESPN voted the venue as the best "sports experience" in the country.

## Mercy Health – West Hospital

Some veneers can't be replicated with precast concrete textures or formliners. That was the case with the dramatic exterior for the 250-bed Mercy Health – West Hospital in Cincinnati, Ohio. This facility included precast concrete insulated sandwich wall panels embedded with 167,000 8-inch-square glazed bricks in 19 shapes and 11 colors, varying from light green to dark blue.

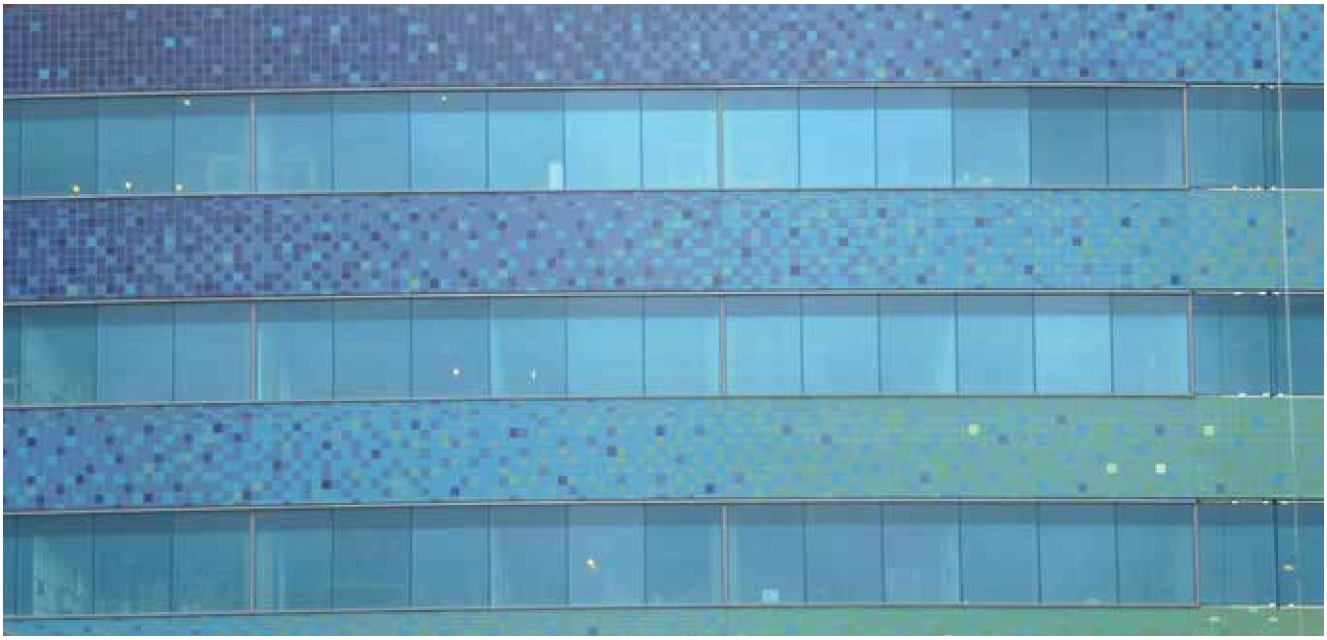
"The building design provides a strong visual statement that gives the new hospital a unique presence in its community," says Mic Johnson, design principal with architectural firm AECOM in Minneapolis. The inspiration came from the history of the area, which served as home for a number of the world's best ceramics companies during the first half of the 20th century.

The building features a long, low two-story base consisting of diagnostic and treatment facilities, flanked by two towers of patient bedrooms. The roof of this base is covered with native plant materials, making a 100,000-square-foot green roof. Building support services, including mechanical, loading/material management, and staff parking, were located below the grade of the entry, hiding them from view.

"We used the local history as a starting point for our concept, as we looked at how the building sat on the site and related to the hills and valleys of the area," Johnson explains. "The strong connection between architecture and landscape, including the green roof, will enhance the healing environment." To complement that feeling, the building was designed to emphasize visual transparency, offering continuity from the entry atrium through the hospital with easy wayfinding systems and visual connections.

This sense of welcome and transparency begins with the calming, vibrant exterior that blends the greens of the landscape with the blues of the sky. Johnson spent nine hours at the glazing plant selecting the exact colors desired. Once the colors were chosen, the manufacturer created samples, and the precast producer produced mockup panels demonstrating the architect's vision.

Composition was critical, as the firing had to retain uniformity and consistency in the bricks to ensure they



*Some 167,000 8-inch-square glazed bricks in 19 shapes and 11 colors, varying from light green to dark blue, were embedded in the precast concrete panels used to clad the Mercy Health – West Hospital in Cincinnati, Ohio. The building features two towers of beds with a 100,000-square-foot base with diagnostic and treatment facilities with a roof of native plant materials. Photos courtesy of Select Thin Brick.*

### PROJECT SPOTLIGHT

**Mercy Health – West Hospital**

**Location:** Cincinnati, Ohio

**Project Type:** Healthcare facility

**Size:** 645,000 square feet

**Cost:** $173 million

**Architect of Record:** Champlin Architecture, Cincinnati

**Conceptual and Healthcare Designer:** AECOM, Minneapolis

**Owner:** Mercy Health, Cincinnati

**Structural Engineer:** THP Limited, Inc., Cincinnati

**Contractor:** Turner Construction Company, Cincinnati

**PCI-Certified Precaster:** High Concrete Group LLC, Springboro, Ohio

**Precast Components:** Architectural panels embedded with 167,000 glazed bricks

could be embedded into the precast concrete formliners without any discrepancies. "Our goal was to work with the precaster to ensure the manufacturing process was controlled and that we didn't have to use cut tiles, while avoiding a panelized appearance," Johnson says.

The designer used acrylic paints to color a scale model of the project and then scanned and translated that model into digital breakdowns for the drawings. Autodesk's Revit software design program was used to model the tiles and lay out the variety to provide the gradation sequencing that was desired. Each color was given a name and number, and these were applied across the façade.

The numbers then were printed onto the tiles by the thin-brick supplier and onto the shop drawings, so the precaster could follow the layout to place the proper tiles into the forms by color number. The numbering was critical, as the backs of the tiles were all the same color. Once the brick was face down in the form, the production crew could not check the color positions, so they checked the numbers on the bricks' backside to the shop drawings.

### One Pallet Per Panel

Each pallet contained the precise number of thin bricks in the required colors for each panel's production. This allowed the plant to place a pallet of tiles on the casting bed that contained the exact quantity, size and color of thin bricks needed for each precast concrete component. The result was significant labor hours saved compared to pulling the appropriate bricks from all the color and size choices.

The designers considered other choices, he notes, including rainscreen options with a variety of larger tile sizes up to 16 inches. "We found that the 8-inch tiles gave us the look we wanted, and on the rainscreen designs, the price became too expensive to install. Precast concrete gave us an economical approach and was the most durable option as well. We wanted to look at a service life of up to 100 years for this building."

The precaster noted that it was critical to use a thin-brick body that met the PCI standard for size tolerance, offered a thickness greater than ½ inch to create an acceptable bond, and to include a dovetail backing that provided a mechanical bond to the precast concrete. The most important characteristic of the glazed thin brick was its low water-absorption quality. This characteristic prevented water from being trapped in the brick and causing long term performance issues.

The panels average about 35 by 7 feet, with an interior 4-inch wythe of concrete, a 2-inch layer of insulation, and an exterior 3-inch concrete wythe. The result is a dramatic appearance that also provides energy efficiency while offering a unique and welcoming design. "The architecture will continually provide a new experience to building users, changing with the quality of light, the time of the day, and the seasons," says, architect Johnson.

## Logan-CONRAC Parking

The new ConRAC (Consolidated Rental Car Facility) at Logan International Airport in Boston features a unique façade consisting of terra cotta veneer panels embedded in structural precast concrete walls. The design provides a dramatic and complementary appearance, but it posed challenges as the first use of terra cotta on structural panels in North America and one of the few in the world.

"Given that it had never been done before, the owners and everyone on the construction team had to ask if the benefits of using it in this way were worth the risks." explains Camille Bechara, project manager and lead designer with Parsons Brinckeroff, the architectural and engineering firm on the project. "We worked through everything carefully and found that they were."

The project is designed to handle approximately 5000 vehicles and consists of a four-level, 1.2-million square-foot precast parking garage to consolidate rental car facilities. It also includes an 111,000 square feet Customer Service Center (CSC) building, as well as maintenance and storage areas for rental car operations, often referred to as Quick Turnaround Areas (QTAs). The project will consolidate the existing car rental shuttle buses into a shared common bus system, and will feature a reconfigured taxi pool, roadway and intersection improvements, site access improvements, landscaping, and new pedestrian and bicycle facilities.

Initially, designers intended to use inset thin brick on precast concrete structural panels as the dominant material because it complemented local buildings. Officials at Massport, the owners, liked the concept but wanted a more contemporary design overall to provide a balance between the old historic neighboring houses and the modernized airport, and the use of terra cotta came to mind as being the appropriate material, Bechara says. The garage façade architect, Fennick & McCredie, developed the terra cotta option, and a manufacturer with quarries near Florence, Italy, was selected to provide the material. "The terra cotta provided the warmth and color of brick but also the modern look as it could be used in larger pieces and different sizes that appealed more than the smaller, standard brick sizes," he explains.

The original concept was to construct precast concrete walls for the structural needs and then provide a metal frame to serve as a rainscreen, with the terra cotta panels set into that. As they worked with the precaster, however, the team realized that embedding the terra cotta into the precast panels, as more typically was done with thin bricks, could save a substantial amount of money—about $1 million.

"We focused our efforts on constructability to minimize the risk for everyone," says Bechara. The panels were cast 51 feet tall, 12 feet wide, and 10½ inches thick, with 2- by 3-foot, ¾-inch-thick terra cotta pieces set into the panels. Haunches also had to be cast into the panels' reverse sides to support three levels of double tees for the four-story building.

### Prototype Test System

Prior to approving the system, a variety of prototypes and mockups were created and tested. "We had to identify the issues and test the impact of everything: humidity, elasticity, movement between materials, maintenance needs, and others," Bechara says. "We wanted to see what the chances were for cracking and how easily panels could be repaired or replaced if needed."

Small sample panels were created to guide color selection and jointing, followed by the creation of full-size prototypes. These life-size mockups were even driven around the plant on bumpy roads to simulate worst-case delivery conditions. Some were deliberately cracked to see how easily they could be repaired. The panels passed all of the tests. "The panels worked very well," he says. "Their response to the tests really made this approach attractive to the owners."

Risk on the project was spread through each function, he notes. The terra cotta supplier agreed to assume responsibility for the terra cotta delivery and for its 30-year warranty once it was erected. The precaster took responsibility for the panel safety during casting, transportation, and erection, to ensure no handling, deflection, or other erection issues arose outside the control of the terra cotta manufacturer.

Embedding the terra cotta into structural components was one of the critical factors to the design because the nine rental-car companies that will operate the structure wanted complete flexibility in laying out their spaces and directing customers through their tenant area, he explains. That required a wide-open expanse with lateral load resisting elements moved to the perimeter to eliminate interior shearwalls or bracing. Precast concrete's structural versatility was the perfect solution. The structure features 60- by 60-foot

*The new Consolidated Rental Car Facility at Logan International Airport in Boston is the first project in North America to feature structural precast concrete panels faced with terra cotta veneer. Structural panels were used to shift loads to the parking structure's perimeter, allowing open access for the eight rental-car companies to layout their individual spaces efficiently. Photos courtesy of Parsons Brinckerhoff.*

## PROJECT SPOTLIGHT

### CONRAC Parking Structure

**Location:** Logan International Airport, Boston

**Project Type:** Parking structure and support facilities

**Size:** 1.2 million square feet garage

**Cost:** $236 million

**Designer/Structural Engineer:** Parsons Brinckerhoff, Boston

**Garage Façade Architect:** Fennick McCredie Architecture, Boston

**Customer Service Center Architect:** PGAL

**Owner:** Massport, Boston

**Contractor:** Suffolk Construction, Boston

**PCI-Certified Precaster:** Blakeslee Prestress Inc., Branford, Conn.

**Precast Components:** 2,215 double tees, girders, columns, seismic H- and moment frames, wall columns, spandrels, stairs, solid slabs, and wall panels

bays consisting of precast concrete columns and double tees. H-frames were used to support loads along the perimeter, with interior moment frames provided between columns and girders.

"We liked the flexibility that the precast concrete framing system provides to give each rental car company complete flexibility in designing its layout," he says. "Each has exclusive rights to lay out its space and direct cars as they want because there are no columns to impede them." The terra cotta material also provides a noise buffer that helps prevent noise from reverberating through the area, Bechara notes.

The structure also was designed to achieve LEED Silver certification. Precast concrete aided this goal through its use of local materials and manufacturing, recycled materials, minimal construction waste, and other features.

The project is scheduled to open later this summer and has been receiving acclaim from the owners, car companies and rental customers. "It provides the masonry look that complements the residential buildings while also creating a contemporary appearance that suits the airport facilities," Bechara says. "Everyone on the team took some risks to ensure this could be done, but they proved to be well worth it. Embedding the terra cotta veneer offered significant savings, and we made it work."

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



ASCENT, SPRING 2013 | 45

# Designers, Precasters Agree: Thermomass Is Ideal For High-Performance Construction

Each and every industry faces a unique set of challenges in terms of the varied environmental requirements of its buildings. The comfortable working conditions in a modern office would, of course, be completely inappropriate for a warehouse space. Similarly, the standard humidity levels found in agriculture facilities would be devastating to those in the paper and textile industries.

With decades of experience designing buildings in specialty markets, FORUM Architects knew that those specific constraints would be critical to the success of a planned expansion for the Wyoming Tribune-Eagle, a newspaper based in Cheyenne, Wyoming.

Providing expertise for the project was Charles A. Rosati, Principal Architect at FORUM with over 25 years of experience designing facilities of this nature.

"Newspaper facilities are a complex marriage between building and industrial processes," said Mr. Rosati. "With specialty projects like this, we explore the best use of materials and design to create a building not only capable of performing, but one that looks strong and has a presence in the community."

Since this project was an addition to an existing structure built in the mid-1980s, FORUM relied on architectural precast concrete in order to match the texture of the existing building while accenting the appearance with modern elements.

"Precast allowed us to blend the new additions in with the existing facility, giving us a solid, durable structure with an aesthetically pleasing exterior wall system that gives it a sense of permanence," said Rosati.

Early in the design process, FORUM teamed with Denver-based Rocky Mountain Prestress. "The decision to partner with Rocky Mountain was made because their plant was within 2-hours of the site, they have a great history in the area and they were able to expedite construction", said Scott Rhoades, Senior Associate at FORUM.

Rocky Mountain Prestress (RMP) has been a staple in the architectural precast market for more than 50 years. With a staff of more than 300, including engineers, designers and sales professionals, RMP prides themselves on pre-construction and design assistance.

"We were contacted by FORUM early in the project, a necessity in specialty buildings like this," said Dan Parker of RMP. "This enabled us to provide them with a look that reflected their desires as well as the necessary details and thermal performance to allow the building to operate as intended," Parker continued. "Once the scope was outlined, we turned to Thermomass for design assistance with the wall panels".

Thermomass insulation systems are an ideal fit for buildings that require specific indoor air temperatures and humidity levels and have been used in many media facilities, including newspaper presses such as this project, to rare libraries and public archives. The key to the use of architectural precast sandwich wall panels in the Tribune-Eagle expansion was System SC from Thermomass.

The FORUM/RMP design allowed for an 8-in exterior wall assembly comprised of two, 3-in layers of mild-reinforced concrete sandwiching 2-in of System SC. Combined with Thermomass' CC Series connectors,

the two layers of concrete were able to act compositely, creating a composite precast wall panel with edge-to-edge insulation and the moisture performance necessary for successful interior conditions. "If those conditions are too dry during the printing process, the newsprint will tend to tear," said Rhoades. "Therefore, we have to keep the press room humidified. If we are not able to keep the outside air - often cold and dry - separate from our warm, moist inside air the interior of the building will sweat. We want humidity, but not water."

To accomplish this in a precast assembly, a continuous layer of insulation is needed, free of thermal bridges and solid sections of concrete. "We look for continuity and R-value in our insulation systems. Without continuous insulation, cold spots develop, you get condensation, mold, and a deterioration of systems," said Rhoades. "With Thermomass, we were able to keep the dewpoint in the insulation itself, providing a more efficient solution than a conventional CMU, cavity wall assembly."

Detailed, specific, and sometimes complex environmental conditions are critical to the success of every structure. From the comfort of office employees to the storage of perishable goods, proper temperature and moisture management is essential. With over thirty years of experience in insulating high performance walls, Thermomass understands the challenges in providing optimal conditions for paper to people, and everything in between.

### Contact

Thermomass is a manufacturer of insulation systems for integrally insulated concrete walls. With systems in use world-wide, Thermomass has a solution for all thermal and moisture challenges. Call Thermomass, 800-232-1748, to help with your next insulated project or visit them online at www.thermomass.com.

### Polly Rosenbaum State Archives Building

The Polly Rosenbaum State Archives and History Building is a unique, 125,000 square foot archive facility for state documents, artifacts and public records requiring precise climate controlled storage environments.

Because of the delicate nature of these items, extensive research was conducted to ensure that the new facility would remain a cutting-edge sanctuary designed to protect against any conceivable threat, from theft and rodent infiltration to fire and water damage and even terrorist activity. A number of expert consultants advised on every aspect of construction, from lab equipment to the individual building materials.

Precast concrete panels insulated with Thermomass System NC were selected for the exterior walls, and Arizona precaster, T-Pac, constructed each of the 10' by 32' sandwich panels using a 3-in. architectural concrete layer, 3-in. thick insulation and a 6-in. inner structural concrete layer. Tied together with Thermomass MC/MS series connectors, this envelope provides wind shear and seismic support, 4-hour fire protection, and also contributes to the archive facility's strict controlled atmosphere requirements.

### University of Kentucky Patient Care Hospital

When University of Kentucky Healthcare (UKH) set out to construct a new facility, it had a list of special requirements that needed to be met along with the requisite expectations of a high quality finished project.

On the outside, UKH wanted to match the exterior brick aesthetic already present on campus. Inside, the walls needed to feature an insulation system capable of meeting strict energy codes while also providing a continuous air barrier and vapor retarder. Finally, this entire multi-year project needed to be constructed in a manner that provided minimal disruption to the local campus life.

To make these complex requirements a reality, Thermomass teamed with Gate Precast to provide UKH and its architectural partner, GBBN, a solution comprised of insulated architectural precast cladding panels designed to meet every need.

PCI Precast/Prestressed Concrete Institute



# Design and Construction Responsibilities for Architectural Precast Concrete

PCI designer's notebook

# Design and Construction Responsibilities for Architectural Precast Concrete

Design and construction with architectural precast concrete are simplified when all parties are working as cooperative partners. Clearly defining the scope of work and the responsibilities of the involved parties by means of the contract documents is critical to achieving a high-quality structure. This article provides a guide for all parties involved in a precast concrete project and defines the responsibilities of each party. These responsibilities and relationships between the parties should be defined in the contract documents for a particular project.

A successful precast concrete project requires teamwork—close cooperation and coordination among all of the participants, including the owner, architect, structural engineer of record (SER), precast concrete manufacturer, erector, general contractor (GC)/construction manager (CM), and all other parties involved. The scope of the precast concrete work and the responsibilities of each party should be established at an early stage in the development of a project to achieve the desired quality and keep the project on schedule (see Table 1). During construction, each party is responsible for communicating with all other parties through the GC/CM or architect. This helps prevent misunderstandings and confusion. When authority and responsibility roles are coordinated, consistent, and clearly defined by the contract documents, problems and conflicts are avoided. Local practices regarding the assignment and acceptance of responsibility in design and construction can vary.

One of the basic principles of the construction industry is that with the responsibility for any aspect of design or construction must go the authority for that aspect. Another principle is that every entity should be responsible for its own work. These principles are frequently not followed in practice. There have been cases where owners have sued architects or engineers for approving nonconforming work without giving them authority to monitor the work as it progressed. Safety enforcement agencies (OSHA) and plaintiffs' lawyers have charged engineers or architects with the responsibility for construction accidents contrary to language and responsibilities in the contract documents. These last two situations typically are cases of responsibility without authority, although there could be instances

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where a design team's work or direction can affect jobsite safety. If the design team is involved with construction-management functions, they could be making decisions affecting worker safety as well as quality of construction. When agents of the owner give instructions directly to the construction workforce regarding how work is to be performed, they step over the line into the contractor's area of responsibility.

In order for architects to design economical structures for their clients, it is imperative that the designer become familiar with architectural precast concrete and obtain design input from a local precaster early in the schematic design process. The precaster will help inform the design and construction team regarding economical fabrication, delivery, and erection processes. In the event alternatives are approved, the design team retains responsibility for properly interfacing with other materials in contact with or adjacent to the precast concrete.

The SER always has to take overall responsibility for the structural design of the completed structure. However, certain aspects of the design are often delegated to specialty structural engineers (SSEs) working for the material suppliers or subcontractors. When any of this delegated structural design work for a portion of the structure involves engineering (as opposed to simply detailing), the design work should be reviewed and approved by the SER registered in the same state as the project or as required by the local jurisdiction. The SER then accepts responsibility for the overall structural design. Additionally, local regulatory authorities should be consulted for their specific requirements. Contract documents typically require the structural design be the responsibility of a professional engineer, regardless of conflicts with other governmental requirements.

# Responsibilities of the Architect

The architect develops the project design concept, establishes overall structure geometry, selects the wall materials for appearance and function, provides details and tolerances for proper material interfacing and weatherproofing, and specifies performance and quality characteristics, as well as inspection and testing requirements in the contract documents.

# Table 1 Design Responsibilities

| Contract Information Supplied by Design Team | Responsibility of the Precaster |
|---|---|
| Option I | |
| Provide complete drawings and specifications detailing all aesthetic, functional, and structural requirements, including design criteria, plus dimensions. | The precaster should make shop drawings (erection and production drawings) as required, with details as shown by the designer. Modifications may be suggested that, in precaster's estimation, would improve the economics, structural soundness, or performance of the precast concrete installation. The precaster should obtain specific approval for such modifications. Full responsibility for the precast concrete design, including such modifications, remains with the designer. Alternative proposals from a precaster should match the required quality and remain within the parameters established for the project. It is particularly advisable to give favorable consideration to such proposals if the modifications are suggested so as to conform to the precaster's normal and proven procedures. |
| Option II | |
| Detail all aesthetic and functional requirements but specify only the required structural performance of the precast concrete units. Specified performance should include all limiting combinations of loads together with their points of application. This information should be supplied in such a way that all details of the unit can be designed without reference to the behavior of other parts of the structure. The division of responsibility for the design should be clearly stated in the contract documents. | The precaster has two alternatives:<br>(a) Submit erection and shape drawings with all necessary details and design information for the approval and ultimate responsibility of the designer.<br>(b) Submit erection and shape drawings and design information for approval and assume responsibility for the panel structural design; that is, the individual units, but not their effect on the building. Precasters accepting this practice may either stamp (seal) drawings themselves, or commission engineering firms to perform the design and stamp the drawings.<br>The choice between alternatives (a) and (b) should be decided between the designer and the precaster prior to bidding, with either approach clearly stated in the specifications for proper allocation of design responsibility.<br>Experience has shown that divided design responsibility can create contractual problems. It is essential that the allocation of design responsibility is understood and clearly expressed in the contract documents. |
| Option III | |
| Cover general aesthetic and performance requirements only and provide sufficient detail to define the scope of the precast concrete work. | The precaster should participate in the preliminary design stage and the development of the final details and specifications for the precast concrete units and should work with the design team to provide an efficient design. The precaster provides the engineering design of the precast concrete units and their connections to the structure and should work with the design team to coordinate the interfacing work. The precaster should submit design information for approval and shop drawings at various stages of completion for coordination with other work. |

The architect and SER have a responsibility to coordinate the design aspects of the precast concrete panels, such as aesthetics, dimensions, and loads to structure. The architect or SER may specify in the contract documents that design services for portions of the work are to be provided by the precaster. Typically design services are performed for the precaster by a licensed engineer who can be an employee of the precaster or an independent structural engineer, who serves as the SSE. The contract documents should clearly define the scope of the precast concrete design requirements and review responsibilities, as well as the responsibilities of other parties providing design services.

The contract drawings prepared by the design team should provide the overall geometry and dimensions of the structure, member or panel dimensions and cross sections, typical connection locations and details, and concepts so all precasters are estimating based on the same information. The architect's drawings may only show reveals or design articulation, allowing the precaster to determine panel sizes suitable to their handling and erection capabilities. In addition, the contract documents (specifications and design drawings) also should provide the general performance criteria, design loads (including concrete strength requirements), deflection requirements, temperature considerations, and any tolerance or clearance requirements for proper interfacing with other elements of the structure.

The order in which the project contract, specifications, or drawings prevail in the event of conflicts should be clearly defined. All aesthetic, functional, and structural requirements should be detailed.

The design team should provide complete, clear, and concise drawings and specifications. Contract documents should clearly define: (1) precast concrete components that are to be designed by the precaster (state who takes responsibility for design of elements at interfaces with other parts of the structure, such as the secondary steel bracing of the structure, to prevent rotation of beams or columns); (2) details or concepts of supports, connections, and clearances that are part of the structure designed by the design team and that will interface with the precast concrete components; and (3) permissible design load transfer points, indicating generic connection types to avoid having the precaster make assumptions on connection types and piece counts during bidding and design. It is preferable to leave specific panel and connection design to precasters so they can design details and connections suitable for their production and erection techniques.

The architect and SER should review designs, calculations, and shop drawings submitted by the precaster for conformance with design criteria, loading requirements, connection points, and design concepts as specified in the contract documents. This review, however, does not relieve the precaster and the precast concrete engineer of their design responsibilities.

# Key Design Issues for the Design Team

The contract drawings prepared by the design team should provide a clear representation of the configurations and dimensions of individual precast concrete units and their relationship to the structure and to other materials. Contract documents that are unclear and lack detail may extend shop drawing preparation time, lead to confusion over work scope, and impact the project schedule.

The contract documents should supply the following information:

- Governing building codes, design loads, deflection limitations and temperature considerations;
- Elevations, wall sections, and dimensions necessary to define the sizes and shapes (profiles) of each different type of precast concrete element;
- Locations of joints and reveals, real (functional) or false (aesthetic), and drips;
- Required materials, color and finish treatment for all surfaces with a clear indication of the extent of all surfaces to be exposed to view when installed;
- Corner and return details;
- Details for jointing and interfacing with other materials (coordinated with the general contractor), including windows, roofing, and other wall systems;
- Insulated panel construction and insulation systems independent of the precast concrete;
- Openings for services and equipment, with their rough opening size and location;
- Details for special or unusual conditions including fire endurance requirements;
- Specified dimensional tolerances for the precast concrete and the supporting structure, location tolerances for the contractors' hardware, clearance requirements, and erection tolerances for the precast concrete. Exceptions to PCI MNL-117 or MNL-135 tolerances are not recommended;
- Support locations for gravity and lateral loads, as well as supplemental framing or bracing to support the precast concrete;
- Building location and site access; and
- Delineation of lateral bracing for structural beams.

The precaster uses the information from the contract drawings and documents to generate shape and erection drawings and design calculations. These drawings should detail elevations showing panel sizes, surface features, and panel relationships; detail sheets should show panel cross sections, special edge conditions, and feature details and should specify connection details showing mechanisms and locations of load transfers to the supporting structure. Allowing the precaster to suggest configurations of the precast concrete units and to select which joints are false and which are real (panelization) will achieve greater economy and flexibility in production and erection.

The design team should review shop drawings in a timely manner to ensure their general conformance with the contract documents, to avoid delay in the project schedule, and to respond to aesthetic questions raised by the construction team. Architectural and structural review and clarification of dimensions and detailing should be anticipated. Following this review, the precaster will make the appropriate revisions to the shop drawings. Open discussion between the architect and precaster should be allowed and encouraged in order to achieve the best possible design for the project.

Producing small mockups is encouraged to help verify the appearance of the completed facade and clarify actual field-construction techniques and material interface issues. If the units have returns, the same size return should appear in the mockup panels.

The architect establishes the standards of acceptability for surface finish, color range, and remedial procedures for production and construction defects and damage. This can be best accomplished by the precaster producing at least three sample panels, 15 to 20 ft2 (1.4 to 1.9 m2) each, before the initial production to establish the range of acceptability with respect to color and texture variations, surface blemishes, and overall appearance. In addition the architect should visit the plant early in production to evaluate conformance with approved samples.

Panel-to-panel joint design and the proper sealing at windows and other penetrations in the exterior wall are necessary to prevent air and water infiltration. The architect is responsible for providing these designs and details. Precast concrete is inherently watertight and impermeable and therefore it is important to have watertight joints at the window-to-precast concrete interface to prevent water leaks. The architect should examine and modify these details as required. The contract documents should require that the same sealant contractor seal all joints in order to provide sealant continuity and avoid incompatibility, thereby providing single source responsibility.

**To continue this article and take the test, visit www.pci.org/elearning.**

# Ascent 2013 – DN-28: Design Factors Affecting Aesthetics of Architectural Precast Concrete

## About AIA Learning Units

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

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

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

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

## Instructions

**Review the learning objectives below.**

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

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

## Learning Objectives:

1. Discuss the three options for the design team to provide contract information to the precaster.
2. Describe the key information the contract documents should supply.
3. Discuss the sample and approval process for architectural precast.
4. Explain the design and construction responsibilities of each team member.

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

# PCI Continuing Education

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

# Distance Learning Opportunities

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## Upcoming Webinars:

- **Building Survivability: Designing for Seismic and Blast Resistance**
  May 28 and 30
- **Driving Profitability through High Performance Parking Structures**
  June 25 and 27
- **It's the Law: High Performance through Envelope Code Requirements**
  July 23 and 25
- **Back to the Future: Relearning Passive Fire Resistant Design**
  August 27 and 29
- **Artist's Palette: The Aesthetic Versatility of Precast Concrete**
  October 22 and 24
- **The New Sound of IEQ: Indoor Comfort and Acoustic Design**
  November 19 and 21

**PCI eLearning Center**

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

# In-Person Learning Opportunities

**Seminars**

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

## Upcoming Seminars:

- **Quality Control Schools**

  Level I/II
  May 20–22, Nashville, Tenn.
  October 23–25, Chicago, Ill.
  December 9–11, Nashville, Tenn.

  Level I–III
  May 19–25, Nashville, Tenn.
  December 9–14, Nashville, Tenn.

  Level III
  May 22–25, Nashville, Tenn.
  October 22–25, Chicago, Ill.
  December 11–14, Nashville, Tenn.
- **CFA/IES**
  May 20–22, Nashville, Tenn.
  December 9–11, Nashville, Tenn.
- **CCA**
  May 22, Nashville, Tenn.

**Lunch-and-Learns**

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

# PCI-Certified Plants

*(as of April 2013)*

When it comes to quality, why take chances? When you need precast or precast, prestressed concrete products, choose a PCI-Certified plant. You'll get confirmed capability—a proven plant with a quality assurance program you can count on.

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

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

## Guide Specification

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

"***Manufacturer Qualification***: The precast concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. Manufacturer shall be certified at time of bidding.

Certification shall be in the following product group(s) and category(ies): [Select appropriate groups and categories (AT or A1), (B1,2,3, or 4), (C1,2,3, or 4), (G)]."

## Product Groups and Categories

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

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

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

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

# GROUPS

### GROUP A – *Architectural Products*

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

*Category A1 – Architectural Cladding and Load-Bearing Units*
Precast or precast, prestressed concrete building elements such as exterior cladding, load-bearing and non-load-bearing wall panels, spandrels, beams, mullions, columns, column covers, and miscellaneous shapes. This category includes Category AT.

### GROUP B – *Bridges*

*Category B1 – Precast Concrete Bridge Products*
Mild-steel-reinforced precast concrete elements that include some types of bridge beams or slabs, sheet piling, pile caps, retaining-wall elements, parapet walls, sound barriers, and box culverts.

*Category B2 – Prestressed Miscellaneous Bridge Products*
Any precast, prestressed element excluding super-structure beams. Includes piling, sheet piling, retaining-wall elements, stay-in-place bridge deck panels, and products in Category B1.

*Category B3 – Prestressed Straight-Strand Bridge Members*
Includes all superstructure elements such as box beams, I-beams, bulb-tees, stemmed members, solid slabs, full-depth bridge deck slabs, and products in Categories B1 and B2.

*Category B4 – Prestressed Deflected-Strand Bridge Members*
*Includes all products covered in Categories B1, B2, and B3.*

### GROUP BA – *Bridge Products with an Architectural Finish*

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

### GROUP C – *Commercial (Structural)*

*Category C1 – Precast Concrete Products*
Mild-steel-reinforced precast concrete elements including sheet piling, pile caps, piling, retaining-wall elements, floor and roof slabs, joists, stairs, seating members, columns, beams, walls, spandrels, etc.

*Category C2 – Prestressed Hollow-Core and Repetitive Products*
Standard shapes made in a repetitive process prestressed with straight strands. Included are hollow-core slabs, railroad ties, flat slabs, poles, wall panels, and products in Category C1.

*Category C3 – Prestressed Straight-Strand Structural Members*
Includes stemmed members, beams, columns, joists, seating members, and products in Categories C1 and C2.

*Category C4 – Prestressed Deflected-Strand Structural Members*
Includes stemmed members, beams, joists, and products in Categories C1, C2, and C3.

### GROUP CA – *Commercial Products with an Architectural Finish*

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

### Group G – *Glass-Fiber-Reinforced Concrete (GFRC)*

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



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## ALABAMA

**Gate Precast Company,** Monroeville (251) 575-2803 .......... **A1, C4A**
**Hanson Pipe and Precast Southeast,** Pelham (205) 663-4681 .......... **B4, C4**
**Standard Concrete Products,** Theodore (251) 443-1113 .......... **B4, C2**

## ARIZONA

**Coreslab Structures (ARIZ) Inc.,** Phoenix (602) 237-3875 .......... **A1, B4, C4A**
**CXT Concrete Ties,** Tucson (520) 644-5703 .......... **C2**
**Royden Construction Company (*),** Phoenix (602) 484-0028 .......... **B4**
**TPAC,** Phoenix (602) 262-1360 .......... **A1, B4, C4A**

## ARKANSAS

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

## CALIFORNIA

**Bethlehem Construction, Inc.,** Shafter (661) 391-9704 .......... **C3A**
**Clark Pacific,** Fontana (909) 823-1433 .......... **A1, C3A, G**
**Clark Pacific,** Irwindale (626) 962-8751 .......... **C4**
**Clark Pacific,** West Sacramento (916) 371-0305 .......... **A1, C3A**
**Clark Pacific,** Woodland (916) 371-0305 .......... **B3, C3**
**Con-Fab California Corporation,** Lathrop (209) 249-4700 .......... **B4, C4**
**Con-Fab California Corporation,** Shafter (661) 630-7162 .......... **B4**
**Coreslab Structures (L.A.) Inc.,** Perris (951) 943-9119 .......... **A1, B4, C4A**
**CTU Precast,** Olivehurst (530) 749-6501 .......... **C3A**
**KIE-CON, Inc.,** Antioch (925) 754-9494 .......... **B4, C3**
**Mid-State Precast, L.P.,** Corcoran (559) 992-8180 .......... **A1, C3A**
**Oldcastle Precast Inc. (*),** Stockton (209) 466-4212 .......... **C2**
**Oldcastle Precast, Inc.,** Perris (951) 657-6093 .......... **B4, C2A**
**StructureCast,** Bakersfield (661) 833-4490 .......... **A1, B3, C3A**
**Universal Precast Concrete, Inc.,** Redding (530) 243-6477 .......... **A1**
**Walters & Wolf Precast,** Fremont (510) 226-5162 .......... **A1, G**
**Willis Construction Co., Inc.,** San Juan Bautista (831) 623-2900 .......... **A1, C1, G**

## COLORADO

**EnCon Colorado,** Denver (303) 287-4312 .......... **B4, C2**
**Plum Creek Structures,** Littleton (303) 471-1569 .......... **B4, C3A**
**Rocky Mountain Prestress LLC,** Denver (303) 480-1111 .......... **B4, C4**
**Rocky Mountain Prestress LLC,** Denver (303) 480-1111 .......... **A1, C3A**
**Rocla Concrete Tie, Inc.,** Pueblo (303) 296-3505 .......... **C2**
**Stresscon Corporation,** Colorado Springs (719) 390-5041 .......... **A1, B4A, C4A**

## CONNECTICUT

**Blakeslee Prestress Inc.,** Branford (203) 481-5306 .......... **A1, B4, C4A**
**Coreslab Structures (CONN) Inc.,** Thomaston (860) 283-8281 .......... **A1, B1, C1**
**Oldcastle Precast, Inc./dba Rotondo Precast,** Avon (860) 673-3291 .......... **B2, C1A**
**United Concrete Products Inc.,** Yalesville (203) 269-3119 .......... **B3, C2**

## DELAWARE

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

## FLORIDA

**Cement Industries, Inc.,** Fort Myers (239) 332-1440 .......... **B3, C3**
**Colonial Construction, Concrete, Precast, LLC,** Placida (941) 698-4180 .......... **C2**
**Coreslab Structures (MIAMI) Inc.,** Medley (305) 823-8950 .......... **A1, C4A**
**Coreslab Structures (ORLANDO) Inc.,** Orlando (407) 855-3191 .......... **C2**
**Coreslab Structures (TAMPA) Inc.,** Tampa (813) 626-1141 .......... **A1, B3, C3A**
**Dura-Stress, Inc.,** Leesburg (800) 342-9239 .......... **A1, B4A, C4A**
**Finfrock Industries, Inc.,** Orlando (407) 293-4000 .......... **A1, C3**
**Florida Precast Industries, Inc.,** Sebring (863) 655-1515 .......... **C2**
**Gate Precast Company,** Jacksonville (904) 757-0860 .......... **A1, B4, C3A**
**Gate Precast Company,** Kissimmee (407) 847-5285 .......... **A1, C2**
**Metromont Corporation,** Bartow (863) 440-5400 .......... **A1, C3A**
**Pre-Cast Specialties Inc. (*),** Pompano Beach (800) 749-4041 .......... **C4**
**Stabil Concrete Products, LLC,** St. Petersburg (727) 321-6000 .......... **A1**
**Standard Concrete Products, Inc.,** Tampa (813) 831-9520 .......... **B4, C3**
**Structural Prestressed Industries,** Medley (305) 556-6699 .......... **C4**

## GEORGIA

**Atlanta Structural Concrete Co.,** Buchanan (770) 646-1888 .......... **C4A**
**Colonial Construction, Concrete, Precast, LLC,** Elberton (941) 698-4180 .......... **C2**
**ConArt Precast, LLC,** Cobb (229) 853-5000 .......... **A1, AT, C3**
**Coreslab Structures (ATLANTA) Inc.,** Jonesboro (770) 471-1150 .......... **C3A**
**Gulf Coast Pre-Stress, Inc.,** Jonesboro (228) 234-7866 .......... **B4**
**Metromont Corporation,** Hiram (770) 943-8688 .......... **A1, C4A**
**Standard Concrete Products, Inc.,** Atlanta (404) 792-1600 .......... **B4**
**Standard Concrete Products, Inc.,** Savannah (912) 233-8263 .......... **B4, C4**
**Tindall Corporation,** Conley (800) 849-6383 .......... **C4A**
**Tindall Corporation,** Conley (800) 849-6383 .......... **C2A**

## HAWAII

**GPRM Prestress, LLC,** Kapolei (808) 682-6000 .......... **A1, B3, C4**

## IDAHO

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

## ILLINOIS

**ATMI Precast,** Aurora (630) 896-4679 .......... **A1, C3A**
**AVAN Precast Concrete Products,** Lynwood (708) 757-6200 .......... **A1, C3**
**County Materials Corporation,** Champaign (217) 352-4181 .......... **B3, B3-IL,**
**County Materials Corporation,** Salem (618) 548-1190 .......... **A1, B4, B4-IL, C4,**
**Dukane Precast, Inc.,** Aurora (630) 355-8118 .......... **A1, B3, B3-IL, C3**
**Illini Concrete Company of Illinois, LLC,** Tremont (309) 925-5290 **B3, B3-IL**
**Illini Precast, LLC,** Marseilles (708) 562-7700 .......... **B4, B4-IL, C3**
**Lombard Architectural Precast Products Co.,** Alsip (708) 389-1060 .......... **A1**
**Mid-States Concrete Industries,** South Beloit (608) 364-1072 .. **A1, B3, B3-IL, C3A**
**Prestress Engineering Corporation,** Blackstone (815) 586-4239 .......... **B4, B4-IL, C4**
**St. Louis Prestress, Inc.,** Glen Carbon (618) 656-8934 .......... **B3, B3-IL, C3**
**Utility Concrete Products, LLC,** Morris (815) 416-1000 .......... **B1A, C1A**

## INDIANA

**ATMI Indy, LLC,** Greenfield (317) 891-6280 .......... **A1, C2A**
**Coreslab Structures (INDIANAPOLIS) Inc.,**
Indianapolis (317) 353-2118 .......... **A1, C4A**
**Hoosier Precast LLC,** Salem (812) 883-4665 .......... **B3, C1A**
**Precast, LLC dba Precast Specialties,** Monroeville (260) 623-6131 .......... **A1, B1**
**StresCore, Inc.,** South Bend (574) 233-1117 .......... **C2**

## IOWA

**Advanced Precast Co.,** Farley (563) 744-3909 .......... **A1, C1A**
**Andrews Prestressed Concrete, Inc.,** Clear Lake (641) 357-5217 .......... **B4, C4**
**Cretex Concrete Products Midwest, Inc.,**
Iowa Falls (515) 243-5118 .......... **A1, B4, B4-IL, C4A**
**MPC Enterprises, Inc.,** Mount Pleasant (319) 986-2226 .......... **A1, C3A**
**PDM Precast, Inc.,** Des Moines (515) 243-5118 .......... **B3, C4**

## KANSAS

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

## KENTUCKY

**Bristol Group, Inc.,** Lexington (859) 233-9050 .......... **A1, B3A, C3A**
**de AM - RON Building Systems LLC,** Owensboro (270) 684-6226 .......... **B3, C3A**
**Gate Precast Company,** Winchester (859) 744-9481 .......... **A1, C1**
**Prestress Services Industries LLC,** Lexington (859) 299-0461 .......... **A1, B4, C4A**
**Prestress Services Industries LLC,** Lexington (260) 724-7117 .......... **B4, B4-IL, C4A**
**Prestress Services Industries LLC,** Melbourne (859) 441-0068 .......... **B4, C3**

## LOUISIANA

**Atlantic Metrocast, Inc.,** New Orleans (504) 941-3152 .......... **C2**
**Boykin Brothers, Inc./Louisiana Concrete Products,**
Baton Rouge (225) 753-8722 .......... **A1, B4, C3A**
**F-S Prestress, LLC,** Princeton (318) 949-2444 .......... **B4, C3**
**Fibrebond Corporation,** Minden (318) 377-1030 .......... **A1, C1A**

## MAINE

**Oldcastle Precast,** Auburn (207) 784-9144 .......... **B2, C1**

## MARYLAND

**Larry E. Knight, Inc.,** Glyndon (410) 833-7800 .......... **C2**
**Oldcastle Precast Building Systems Div.,** Edgewood (410) 612-1213 .......... **A1, C3A**

## MASSACHUSETTS

**Oldcastle Precast, Inc./dba Rotondo Precast,**
Rehoboth (508) 336-7600........................................................B4, C3
**Unistress Corporation,** Pittsfield (413) 499-1441 ..............................A1, B4, C4A
**Vynorius Prestress, Inc.,** Salisbury (978) 462-7765 ..............................B3, C2

## MICHIGAN

**International Precast Solution, LLC,** River Rouge (313) 843-0073.... A1, B3, C3
**Kerkstra Precast Inc.,** Grandville (800) 434-5830 ..............................A1, B3, C3A
**M.E.G.A. Precast, Inc.,** Roseville (586) 294-6430.............................. A1, C3A
**M.E.G.A. Precast, Inc.,** Shelby Township (586) 294-6430..............................C3
**Nucon Schokbeton / Stress-Con Industries, Inc.,**
Kalamazoo (269) 381-1550 ..............................A1, B4, C3A
**Peninsula Prestress Company,** Grand Rapids (616) 437-9618................ B4, C1
**Stress-Con Industries, Inc.,** Saginaw (989) 239-2447..............................B4, C3

## MINNESOTA

**Crest Precast, Inc.,** La Crescent (507) 895-8083.............................. B3A, C1A
**Cretex Concrete Products Midwest, Inc.,** Maple Grove (763) 545-7473.....B4, C2
**Fabcon,** Savage (800) 727-4444 ..............................A1, B1, C3A
**Hanson Structural Precast Midwest, Inc.,**
Maple Grove (763) 425-5555 .............................. A1, C4A
**Molin Concrete Products Co.,** Lino Lakes (651) 786-7722 .............................. C3A
**Wells Concrete Products,** Albany (320) 845-2299.............................. A1, C3A
**Wells Concrete Products Co.,** Wells (507) 553-3138 .............................. A1, C4A

## MISSISSIPPI

**F-S Prestress, LLC,** Hattiesburg (601) 268-2006 ..............................B4, C4
**Gulf Coast Pre-Stress, Inc.,** Pass Christian (228) 452-9486 ..............................B4, C4
**J.J. Ferguson Prestress-Precast Company, Inc.,**
Greenwood (662) 453-5451 ..............................B4
**Jackson Precast, Inc.,** Jackson (601) 321-8787.............................. A1, C2A
**Tindall Corporation,** Moss Point (228) 435-0160.............................. A1, C4A

## MISSOURI

**Coreslab Structures (MISSOURI) Inc.,** Marshall (660) 886-3306...A1, B4, C4A
**County Materials Corporation,** Bonne Terre (573) 358-2773..............................B4
**Mid America Precast, Inc.,** Fulton (573) 642-6400..............................A1, B1, C1
**Prestressed Casting Co.,** Ozark (417) 581-7009.............................. C4
**Prestressed Casting Co.,** Springfield (417) 869-1263 .............................. A1, C3A

## MONTANA

**Missoula Concrete Construction,** Missoula (406) 549-9682 ..........A1, B3, C3A
**Montana Prestressed Concrete,** Billings (605) 718-4111 ..............................B4, C3
**Montana Prestressed Concrete - MT City Plant,**
Montana City (406) 442-6503..............................B4

## NEBRASKA

**Concrete Industries, Inc.,** Lincoln (402) 434-1800.............................. B4, C4A
**Coreslab Structures (OMAHA) Inc.,** LaPlatte (402) 291-0733 ........A1, B4, C4A
**Enterprise Precast Concrete, Inc.,** Omaha (402) 895-3848.................. A1, C2A
**Stonco, Inc.,** Omaha (402) 556-5544 .............................. A1

## NEW HAMPSHIRE

**Newstress Inc.,** Epsom (603) 736-9348 ..............................B3, C3

## NEW JERSEY

**Boccella Precast LLC,** Berlin (856) 767-3861..............................C2
**Jersey Precast,** Hamilton Township (609) 689-3700 ..............................B4, C4
**Northeast Precast*,** Millville (856) 765-9088 ..............................A1, B2, C3A
**Precast Systems, Inc.,** Allentown (609) 208-1987 ..............................B4, C4

## NEW MEXICO

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

## NEW YORK

**David Kucera Inc.,** Gardiner (845) 255-1044..............................A1, G
**Lakelands Concrete Products, Inc.,** Lima (585) 624-1990........... A1, B3A, C3A
**Oldcastle Precast Building Systems Div.,** Selkirk (518) 767-2116.......B3, C3A
**The Fort Miller Co., Inc.,** Greenwich (518) 695-5000..............................B3, C1
**The L.C. Whitford Materials Co., Inc.,** Wellsville (585) 593-2741 .............B4, C3

## NORTH CAROLINA

**Gate Precast Company,** Oxford (919) 603-1633 ..............................A1, C2
**International Precast Inc.,** Siler City (919) 742-3132 .............................. A1, C3A
**Metromont Corporation,** Charlotte (704) 372-1080.............................. A1, C3A
**Prestress of the Carolinas,** Charlotte (704) 587-4273 ..............................B4, C4
**Utility Precast, Inc.,** Concord (704) 721-0106 .............................. B3A

## NORTH DAKOTA

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

## OHIO

**DBS Prestress of Ohio,** Huber Heights (937) 878-8232..............................C3
**Fabcon LLC,** Grove City (614) 875-8601 .............................. A1, C3A
**High Concrete Group LLC,** Springboro (937) 748-2412.............................. A1, C3A
**KSA,** Sciotoville (740) 776-3238..............................C2
**Mack Industries, Inc.,** Valley City (330) 483-3111 ..............................C3
**Prestress Services Industries LLC,** Grove City (614) 871-2900..................B4, C1
**Prestress Services Industries of Ohio, LLC,** Mt. Vernon (800) 366-8740.....B4, C3
**Prestress Services Industries of Ohio, LLC,** Mt. Vernon (740) 393-1121.....B3, C1
**Sidley Precast,** Thompson (440) 298-3232.............................. A1, C4A

## OKLAHOMA

**Coreslab Structures (OKLA) Inc. (Plant No.1),**
Oklahoma City (405) 632-4944.............................. A1, C4A
**Coreslab Structures (OKLA) Inc. (Plant No.2),**
Oklahoma City (405) 672-2325..............................B4, C1
**Coreslab Structures (TULSA) Inc.,** Tulsa (918) 438-0230 ..............................B4, C4
**Tulsa Dynaspan, Inc.,** Broken Arrow (918) 258-1549 ..............................A1, C3

## OREGON

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

## PENNSYLVANIA

**Brayman Precast, LLC,** Saxonburg (724) 352-5600..............................C1
**Concrete Safety Systems, LLC,** Bethel (717) 933-4107 .............................. B1A, C1A
**Conewago Precast Building Systems,** Hanover (717) 632-7722......... A1, C2A
**Dutchland, Inc.,** Gap (717) 442-8282..............................C3
**Fabcon East, LLC,** Mahanoy City (570) 773-2480 .............................. A1, B1A, C3A
**High Concrete Group LLC,** Denver (717) 336-9300..............................A1, B3, C3A
**J & R Slaw, Inc.,** Lehighton (610) 852-2020..............................A1, B4, C3
**Newcrete Products,** Roaring Spring (814) 224-2121 ..............................B4, C4
**Nitterhouse Concrete Products, Inc.,** Chambersburg (717) 267-4505....A1, C4A
**Northeast Prestressed Products, LLC,** Cressona (570) 385-2352...........B4, C3
**Pittsburgh Flexicore Company, Inc.,** Donora (724) 258-4450..............................C2
**Say-Core, Inc.,** Portage (814) 736-8018 ..............................C2
**Sidley Precast,** Youngwood (724) 755-0205..............................C3
**Universal Concrete Products Corporation,** Stowe (610) 323-0700... A1, C3A
**US Concrete Precast Group Mid-Atlantic,**
Middleburg (570) 837-1774.............................. A1, C3A

## SOUTH CAROLINA

**Florence Concrete Products, Inc.,** Sumter (803) 775-4372....................B4, C3A
**Metromont Corporation,** Greenville (864) 295-0295 .............................. A1, C4A
**Tekna Corporation,** Charleston (843) 853-9118..............................B4, C2
**Tindall Corporation,** Fairforest (864) 576-3230.............................. A1, C4A

## SOUTH DAKOTA

**Gage Brothers Concrete Products Inc.,**
Sioux Falls (605) 336-1180..............................A1, B4, C4A

## TENNESSEE

**Construction Products, Inc. of Tennessee,** Jackson (731) 668-7305.....B4, C4
**Gate Precast Company,** Ashland City (615) 792-4871 .............................. A1, C3A
**Mid South Prestress, LLC,** Pleasant View (615) 746-6606 ..............................C3
**Prestress Services Industries of TN, LLC,** Memphis (901) 775-9880......B4, C4
**Ross Prestressed Concrete, Inc.,** Bristol (423) 323-1777..............................B4, C3
**Ross Prestressed Concrete, Inc.,** Knoxville (865) 524-1485 ..............................B4, C4
**Sequatchie Concrete Service, Inc.,** Chattanooga (423) 867-4510 ..............................C2



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## TEXAS

**Coreslab Structures (TEXAS) Inc.,** Cedar Park (512) 250-0755 ............ **A1, C4A**
**CXT, Inc.,** Hillsboro (254) 580-9100 ............ **B1, C1A**
**Eagle Precast Corporation,** Decatur (940) 626-8020 ............ **A1, C3**
**East Texas Precast Co., LTD.,** Hempstead (936) 857-5077 ............ **C4A**
**Enterprise Concrete Products, LLC,** Dallas (214) 631-7006 ............ **B3, C3**
**Enterprise Precast Concrete of Texas, LLC,** Corsicana (903) 875-1077 .... **A1, C1**
**Gate Precast Company,** Hillsboro (254) 582-7200 ............ **A1**
**Gate Precast Company,** Pearland (281) 485-3273 ............ **C2**
**GFRC Cladding Systems, LLC,** Garland (972) 494-9000 ............ **G**
**Heldenfels Enterprises, Inc.,** Corpus Christi (361) 883-9334 ............ **B4, C4**
**Heldenfels Enterprises, Inc.,** San Marcos (512) 396-2376 ............ **B4, C4**
**Lowe Precast, Inc.,** Waco (254) 776-9690 ............ **A1, C3A**
**Manco Structures, Ltd.,** Schertz (210) 690-1705 ............ **C4A**
**NAPCO PRECAST, LLC,** San Antonio (210) 509-9100 ............ **A1, C3A**
**Rocla Concrete Tie, Inc.,** Amarillo (806) 383-7071 ............ **C2**
**Tindall Corporation,** San Antonio (210) 248-2345 ............ **A1, C3A**

## UTAH

**Hanson Structural Precast Eagle,** Salt Lake City (801) 966-1060 ... **A1, B4, C4A, G**
**Harper Contracting,** Salt Lake City (801) 326-1016 ............ **B2, C1**
**Owell Precast LLC,** Bluffdale (801) 571-5041 ............ **A1, B3A, C3A**
**The Shockey Precast Group, LLC,** Harriman (540) 667-7700 ............ **C3**

## VERMONT

**Dailey Precast,** Shaftsbury (802) 442-4418 ............ **A1, B4A, C3A**
**J. P. Carrara & Sons, Inc.,** Middlebury (802) 388-6363 ............ **A1, B4A, C3A**
**S.D. Ireland Companies,** South Burlington (802) 658-0201 ............ **A1**

## VIRGINIA

**Atlantic Metrocast, Inc.,** Portsmouth (757) 397-2317 ............ **B4, C4**
**Bayshore Concrete Products Corporation,**
Cape Charles (757) 331-2300 ............ **B4, C4**
**Bayshore Concrete Products/Chesapeake, Inc.,**
Chesapeake (757) 549-1630 ............ **B4, C3**
**Coastal Precast Systems, LLC,** Chesapeake (757) 545-5215 ............ **A1, B4, C3**
**Metromont Corporation,** Richmond (804) 222-8111 ............ **A1, C3A**
**Smith-Midland Corporation,** Midland (540) 439-3266 ............ **A1, B2, C3**
**The Shockey Precast Group,** Fredericksburg (540) 898-1221 ............ **A1, C3A**
**The Shockey Precast Group,** Winchester (540) 667-7700 ............ **A1, C4A**
**Tindall Corporation,** Petersburg (804) 861-8447 ............ **A1, C4A**

## WASHINGTON

**Bellingham Marine Industries, Inc.,** Ferndale (360) 676-2800 ............ **B3, C2**
**Bethlehem Construction, Inc.,** Cashmere (509) 782-1001 ............ **B1, C3A**
**Central Pre-Mix Prestress Co.,** Spokane (509) 533-0267 ............ **A1, B4, C4**
**Concrete Technology Corporation,** Tacoma (253) 383-3545 ............ **B4, C4**
**CXT, Inc.,** Spokane (509) 921-7878 ............ **C2**
**CXT, Inc.,** Spokane (509) 921-8716 ............ **B1**
**EnCon Northwest, LLC,** Camas (360) 834-3459 ............ **B1**
**EnCon Washington, LLC,** Puyallup (253) 846-2774 ............ **B1, C2**
**Wilbert Precast, Inc.,** Yakima (509) 248-1984 ............ **B3, C3**

## WEST VIRGINIA

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

## WISCONSIN

**County Materials Corporation,** Eau Claire (800) 729-7701 ............ **B4**
**County Materials Corporation,** Janesville (608) 373-0950 ............ **B4**
**County Materials Corporation,** Roberts (800) 426-1126 ............ **B4, C3**
**International Concrete Products, Inc.,** Germantown (262) 242-7840 .. **A1, C1**
**MidCon Products, Inc.,** Hortonville (920) 779-4032 ............ **A1, C1**
**Spancrete, Inc.,** Valders (920) 775-4121 ............ **B4, C3**
**Stonecast Products, Inc.,** Germantown (262) 253-6600 ............ **A1, C1**
**Wausau Tile Inc.,** Rothschild (715) 359-3121 ............ **AT**

## WYOMING

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

## CANADA

### BRITISH COLUMBIA

**Armtec Limited Partnership,** Richmond (604) 278-9766 ............ **A1, B4, C3**

### NEW BRUNSWICK

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

### NOVA SCOTIA

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

### ONTARIO

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

### QUEBEC

**Betons Prefabriques du Lac Inc.,** Alma (418) 668-6161 ............ **A1, C3AG**
**Betons Prefabriques du Lac, Inc.,** Alma (418) 668-6161 ............ **A1, C2**
**Betons Prefabriques Trans. Canada Inc.,**
St. Eugene De Grantham (819) 396-2624 ............ **A1, B4, C3A**
**Prefab De Beauce,** Sainte-Marie De Beauce (418) 387-7152 ............ **A1, C3**

## MEXICO

**PRETECSA, S.A. DE C.V.,** Atizapan De Zaragoza (011) 52-10360777 ......... **A1, G**
**Willis De Mexico S.A. de C.V.,** Tecate (011) 52-665-655-2222 ............ **A1, C1, G**

# PCI-Qualified & PCI-Certified Erectors

*(as of December 2012*

When it comes to quality, why take chances? When you need precast or precast, prestressed concrete products, choose a PCI-Qualified/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 Qualified/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-Qualified/Certified Erector is the first step toward getting the job done right the first time, thus keeping labor costs down.
- PCI-Qualified/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 qualified or certified by the Precast/Prestressed Concrete Institute (PCI) prior to the beginning of any work at the jobsite. The precast concrete erector shall be qualified or 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.

Certified erectors are listed in blue.

### ALABAMA
**Masonry Arts, Inc.,** Bessemer (205) 428-0780 ........ A

### ARKANSAS
**Coreslab Structures (ARK) Inc.,** Conway (501) 329-3763........ S2

### ARIZONA
**Coreslab Structures (ARIZ), Inc.,** Phoenix (602) 237-3875........ S2, A
**TPAC,** Phoenix (602) 262-1360........ S2, A

### CALIFORNIA
**Coreslab Structures (L.A.), Inc.,** Perris (951) 943-9119........ S2, A
**Walters & Wolf Precast,** Fremont (510) 226-9800 ........ A

### COLORADO
**Encon Field Services, LLC,** Denver (303) 287-4312 ........ S2, A
**Gibbons Erectors, Inc.,** Englewood (303) 841-0457........ S2, A
**Rocky Mountain Prestress,** Denver (303) 480-1111 ........ S2, A
**S. F. Erectors Inc.,** Elizabeth (303) 646-6411 ........ S2, A

### CONNECTICUT
**Blakeslee Prestress, Inc.,** Branford (203) 481-5306 ........ S2
**Jacob Erecting & Construction LLC,** Durham (860) 788-2676 ........ S2, A
**The Middlesex Corporation,** West Hart Ford (860) 206-4404........ S2

### FLORIDA
**All Florida Erectors and Welding, Inc.,** Apopka (407) 466-8556 ........ S2
**Concrete Erectors, Inc.,** Altamonte Springs (407) 862-7100........ S2, A
**Finfrock Industries, Inc.,** Orlando (407) 293-4000........ S2, A
**Florida Builders Group, Inc.,** Miami (305) 278-0098........ S2
**Florida Precast Industries,** Sebring (863) 655-1515 ........ S1
**Gate Precast Erection Co.,** Kissimmee (407) 847-5285 ........ A
**James Toffoli Construction Company, Inc.,** Fort Myers (239) 479-5100 .. S2, A
**Pre-Con Construction of Tampa Inc.,** Tampa (813) 626-2545........ S2, A
**Prestressed Contractors Inc.,** Palm Beach Gardens (561) 741-4369........ S1
**Solar Erectors U. S. Inc.,** Medley (305) 825-2514........ S2, A
**Specialty Concrete Services, Inc.,** Altoona (352) 669-8888 ........ S2, A
**Structural Prestressed Industries, Inc.,** Medley (305) 556-6699........ S2
**Summit Erectors, Inc.,** Jacksonville (904) 783-6002 ........ S2, A

### GEORGIA
**Big Red Erectors Inc.,** Covington (770) 385-2928........ S2, A
**ConArt Precast, LLC,** Cobb (229) 853-5000........ S2, A
**Precision Stone Setting Co., Inc.,** Hiram (770) 439-1068........ S2, A
**Rutledge & Son's,** Woodstock (770) 592-0380........ S2

### IDAHO
**Precision Precast Erectors, LLC,** Worley (208) 660-5223 ........ S2, A

### ILLINOIS
**Area Erectors, Inc.,** Rockford (815) 562-4000........ S2, A
**Creative Erectors, LLC,** Rockford (815) 229-8303 ........ S2, A
**Mid-States Concrete Industries,** South Beloit (800) 236-1072........ S2
**Spancrete of Illinois, Inc.,** Crystal Lake (815) 459-5580........ S2
**Trinity Roofing Service Inc,** Blue Island (708) 385-7830........ S1

### INDIANA
**Stres Core Inc.,** South Bend (574) 233-1117 ........ S1



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## IOWA

**Cedar Valley Steel, Inc.,** Cedar Rapids (319) 373-0291 ..................................**S2, A**
**Topping Out Inc. / dba Northwest Steel Erection,**
Des Moines (800) 247-5409 ..................................**S2**

## KANSAS

**Carl Harris Co., Inc.,** Wichita (316) 267-8700 ..................................**S2, A**
**Crossland Construction Company, Inc.,** Columbus (620) 429-1414..........**S2, A**
**Ferco, Inc.,** Salina (785) 825-6380..................................**S2**
**Topping Out Inc. / dba Davis Erection Kansas City,**
Kansas City (800) 613-9547 ..................................**S2**

## MAINE

**American Aerial Services, Inc.,** Falmouth (207) 797-8987 ..................................**S1**
**Cianbro Corporation,** Pittsfield (207) 679-2435..................................**S2**
**Reed & Reed, Inc.,** Woolwich (207) 443-9747..................................**S2, A**

## MARYLAND

**DLM Contractors, LLC,** Upper Marlboro (301) 877-0000 ..................................**S2, A**
**E & B Erectors, Inc.,** Pasadena (410) 360-7800..................................**S2, A**
**E.E. Marr Erectors, Inc.,** Baltimore (410) 837-1641 ..................................**S2, A**
**L.R. Willson & Sons, Inc.,** Gambrills (410) 987-5414 ..................................**S2, A**
**Mid Atlantic Precast Erectors, Inc.,** Baltimore (410) 837-1641..................................**A**
**Oldcastle Building Systems Div. / Project Services,**
Baltimore (518) 767-2116 ..................................**S2, A**

## MASSACHUSETTS

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

## MICHIGAN

**Assemblers Precast & Steel Services, Inc.,** Saline (734) 429-1358 ............**S2, A**
**Devon Contracting, Inc.,** Detroit (313) 221-1550..................................**S2, A**
**G2 Inc.,** Cedar Springs (616) 696-9581..................................**S2, A**
**Pioneer Construction Inc.,** Grand Rapids (616) 247-6966 ..................................**S2**

## MINNESOTA

**Amerect, Inc.,** Newport (651) 459-9909..................................**A**
**Fabcon, Inc.,** Savage (952) 890-4444 ..................................**S2**
**Hanson Structural Precast Midwest, Inc.,** Maple Grove (763) 425-5555....**S2, A**
**Landwehr Construction Inc.,** St. Cloud, MN (320) 252-1494..................................**S2, A**
**Molin Concrete Products Company,** Lino Lakes (651) 786-7722 ...............**S2, A**
**Wells Concrete,** Wells (507) 553-3138..................................**S2**

## MISSISSIPPI

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

## MISSOURI

**Acme Erectors, Inc.,** St. Louis (314) 647-1923 ..................................**S2, A**
**JE Dunn Construction Company,** Kansas City (816) 474-8600 ....................**S2, A**
**Prestressed Casting Co.,** Springfield (417) 869-7350..................................**S2, A**

## NEBRASKA

**Moen Steel Erection, Inc.,** Omaha (402) 884-0925..................................**S2**
**Structural Enterprises Incorporated,** Lincoln (402) 423-3469........................**S2**
**Topping Out Inc. / dba Davis Erection Lincoln,** Lincoln (800) 881-2931 .........**S2**
**Topping Out Inc. / dba Davis Erection Omaha,** Omaha (800) 279-1201 ....**S2, A**

## NEW HAMPSHIRE

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

## NEW JERSEY

**CRV Precast Construction LLC,** Eastampton (800) 352-1523 .......................**S2, A**
**J. L. Erectors, Inc.,** Blackwood (856) 232-9400..................................**S2, A**
**JEMCO-Erectors, Inc.,** Shamong (609) 268-0332..................................**S2, A**
**Jonasz Precast, Inc.,** Westville (856) 456-7788 ..................................**S2, A**

## NEW MEXICO

**Ferreri Concrete Structures, Inc.,** Albuquerque (505) 344-8823 .....................**S2**
**Structural Services, Inc.,** Albuquerque (505) 345-0838..................................**S2, A**

## NEW YORK

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**Koehler Masonry,** Farmingdale (631) 694-4720..................................**S2**
**Oldcastle Building Systems Div. / Project Services,**
Manchester (518) 767-2116..................................**S2, A**
**Oldcastle Building Systems Div. / Project Services,**
Selkirk (518) 767-2116 ..................................**S2, A**
**The L.C. Whitford Co., Inc.,** Wellsville (585) 593-2741..................................**S2**
**Yonkers Contracting Company, Inc.,** Yonkers (914) 636-2301 ........................**S1**

## NORTH CAROLINA

**Buckner Steel Erection Inc.,** Graham (336) 376-8888 ..................................**S2**
**Carolina Precast Erectors, Inc.,** Taylorsville (828) 635-1721 .........................**S2, A**

## NORTH DAKOTA

**Comstock Construction,** Wahpeton (701) 642-3207 ..................................**S2**
**PKG Contracting, Inc.,** Fargo (701) 232-3878..................................**S2**
**Wells Concrete,** Grand Forks (701) 772-6687..................................**S2**

## OHIO

**Precast Services, Inc.,** Twinsburg (330) 425-2880..................................**S2, A**
**Sidley Precast Group,** Thompson (440) 298-3232 ..................................**S2**
**Sofco Erectors, Inc.,** Cincinnati (513) 771-1600..................................**S2, A**

## OKLAHOMA

**Allied Steel Construction Co., LLC,** Oklahoma City (405) 232-7531 ...........**S2, A**
**Bennett Steel, Inc.,** Sapulpa (918) 260-0773 ..................................**S1**
**Coreslab Structures (OKLA), Inc.,** Oklahoma City (405) 632-4944.............**S2, A**

## PENNSYLVANIA

**Century Steel Erectors,** Kittanning (724) 545-3444..................................**S2, A**
**Conewago Enterprises, Inc.,** Hanover (717) 632-7722 ..................................**S2**
**High Concrete Group,** Denver (717) 336-9300..................................**S2, A**
**Kinsley Construction Inc.,** York (717) 757-8761..................................**S1**
**Maccabee Industrial, Inc.,** Belle Vernon (724) 930-7557..................................**S2, A**
**Nitterhouse Concrete Products, Inc.,** Chambersburg (717) 267-4505 .....**S2, A**
**Patterson Construction Company, Inc.,** Monongahela (724) 258-4450 .......**S1**

## SOUTH CAROLINA

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

## SOUTH DAKOTA

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

## TENNESSEE

**Mid South Prestress, LLC,** Pleasant View (615) 746-6606 ..................................**S2**
**River City Erectors, LLC,** Rossville (901) 861-6174..................................**A**

## TEXAS

**Derr and Isbell Construction, LLC,** Euless (817) 571-4044............................**S2, A**
**Empire Steel Erectors LP,** Humble (281) 548-7377..................................**A**
**Gate Precast Company,** Pearland (281) 485-3273..................................**S1**
**Gulf Coast Precast Erectors, LLC,** Hempstead (832) 451-4395........................**S2**
**Precast Erectors, Inc.,** Hurst (817) 684-9080 ..................................**S2, A**

## UTAH

**Hanson Structural Precast Eagle,** Salt Lake City (801) 966-1060 ...............**S2, A**
**OutWest C & E Inc.,** Bluffdale (801) 446-5673..................................**S2, A**

## VERMONT

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

## VIRGINIA

**Sprinkle Masonry Inc.,** Chesapeake (757) 545-8435..................................**A**
**The Shockey Precast Group,** Winchester (540) 665-3253..............................**S2, A**

## WASHINGTON

**Central Pre-Mix Prestress Co.,** Spokane Valley (509) 536-3334...................**S2, A**

## WISCONSIN

**Miron Construction Co. Inc.,** Neenah (920) 969-7000..................................**S2, A**
**Spancrete,** Valders (920) 775-4121 ..................................**S2, A**
**Spancrete,** Waukesha (414) 290-9000..................................**S2, A**
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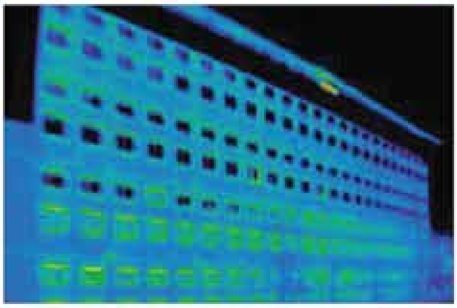

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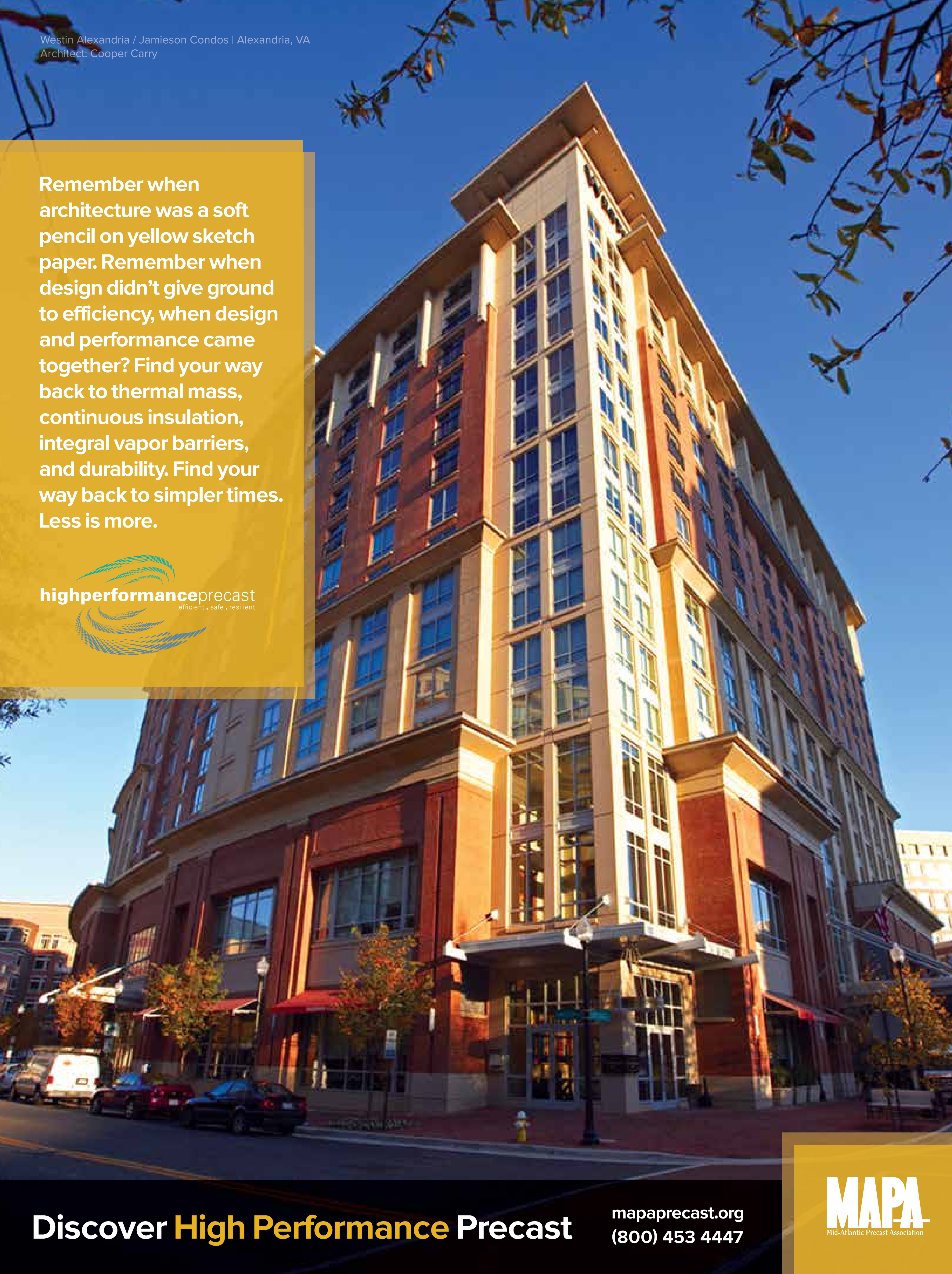
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