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ASCENT®

DESIGNING WITH PRECAST

PROJECT DELIVERY

COLLABORATION + EXPERTISE


MY VISION.
OUR EXPERTISE.

CONTENTS

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FEATURES

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DEPARTMENTS

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New.
Fresh.
Visionary.

New. Fresh. Visionary. Changing. Innovating. Collaborating.

Welcome to the first issue of a new look for *Ascent* magazine. A couple of issues ago, as I started with PCI as executive editor of *Ascent*, I hinted at changes to come for our publication and they have arrived. This fresh format allows us to illustrate for you everything that is possible with precast concrete construction. Whether you are an architect, engineer, owner, developer, general contractor, specifier, construction manager, student or professor we want everything within these pages to help you envision how precast concrete can be used in your construction projects.

As we focus on project delivery methods in this issue, one common theme that you will notice is regardless of what project delivery method is used, precast concrete producers are an integral part of your team. The precaster can determine which method will suit your needs by taking into consideration the size of the project, complexity of the project and the delivery schedule by collaborating and selecting the best project delivery method to make your job successful. One significant point I want to make, is to always involve your precaster in the beginning stages of project planning, as their expertise in engineering, fabricating and installing precast concrete will assist in overcoming any design and construction challenges.

Add to that precaster's expertise, the assurance of PCI's Certification programs to ensure quality in every precaster's plant operations, personnel and field operations. PCI is pleased to announce that our PCI Plant Certification program is now accredited by the International Accreditation Service (IAS). For all of the details on how this strengthens our already highly regarded certification please see the article on page 50.

I hope you enjoy the new look and feel of *Ascent*, and find the content within the following pages educational, informative and inspirational!

INSIGHT

Hollow-core Aids Masonicare Retirement Facility

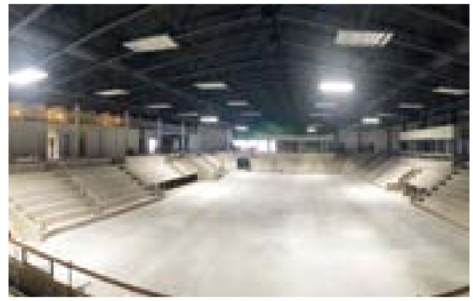
MYSTIC, CONNECTICUT

Masonicare is constructing a 179-unit retirement community in Mystic, Conn., to include independent and assisted-living rental apartments. When planning made it apparent the original schedule for construction could not be met, the contractor value-engineered the project's flooring system so hollow-core slabs could be used, in lieu of another system.

The $35.4-million facility includes apartments of various styles and sizes along with a dining room, social and wellness programs, and a pool. Built on an 18-acre plot next to the Denison Pequotsepos Nature Center, it features a structural system composed of cast-in-place concrete beams and light-gauge metal framing, according to Brendan Clancy, project manager at Strescon Limited in Saint John, N.B., Canada.

Strescon provided 150,000 square feet of precast concrete hollow-core slab and 30 inverted tee beams for the two-story building. Schedule restraints led general contractor C.E. Floyd in Bedford, Mass., to ask to change from cast-in-place beams filigree slabs. Strescon then teamed with American Steel and Precast Erectors to provide fully supply-and-install scope of work for the project.

Fabrication began in January 2016, with erection finished in April, ahead of schedule. The project will open this fall. Bessolo Design Group served as architect of record for the project, which is being co-developed by BROM Builders Inc. and Masonicare.



Precast Concrete Components Help Build Colgate Arena

HAMILTON, NEW YORK

Colgate University's new ice-hockey arena, located on the site of Van Doren Field, is using precast concrete stadium components for its interior walls and seating. The 2,171-seat arena, part of the 97,000-square-foot athletic facility, is schedule to open in October.

The athletic building includes state-of-the-art locker rooms, training room facilities, equipment room facilities, and offices for Colgate's ice hockey, lacrosse, and soccer teams in addition to the ice hockey rink.

LeChase Construction Services, of Syracuse, N.Y., signed Oldcastle Precast-Selkirk to design, engineer, manufacture, and ship precast concrete L-shaped single stadium risers, cantilevered support vomitory wall panels, wall panels, and stairs. They were used to create seating areas, team and pedestrian walkways, and ice rink perimeter walls.

Precast stairs with integral landings were designed to lead from the concourse level directly to ground level, and L-shaped risers connect to the precast walls for added structural support. Additional precast wall panels surround the ice rink, providing the perimeter wall.

The building envelope wasbuilt first, so all precast components were erected inside the envelope. Numerous preconstruction logistics were developed with the client to safely erect the precast components due to the limited clearance space.

The use of precast concrete components for the ice arena provided a consistent, durable solution that allowed for quick assembly of the infrastructure, provided more construction site workspace for support crew and equipment, and provided a durable surface that can withstand the constant battering.

SASAKI Architects of Watertown, N.Y., is the architect of record, while BuroHappold of New York, N.Y., is the engineer of record.

Tu Named to Head PCI's Florida Regional Association

TAMPA, FLORIDA

Diep Tu has been named the new executive director of the Florida Prestressed Concrete Association (FPCA), a regional arm of the Precast/Prestressed Concrete Institute (PCI).

A registered, licensed professional engineer in Florida, Tu previously was the director of engineering for the Florida Concrete & Products Association (FC&PA) for more than 16 years. Before that, Tu served as the rigid-pavement research engineer for the Florida Department of Transportation's Materials Research Office.

Tu will develop marketing strategies for the building and transportation markets while also promoting precast/prestressed concrete construction to architects, engineers, general contractors, owners, students and professors, city and county agencies, departments of transportation and tollway entities.

Submit your headline news for consideration in a future issue of Ascent to Brenda Banks at bbanks@pci.org.

Mixed-Use Rehab Features Insulated Precast Panels

PHILADELPHIA, PENNSYLVANIA

High-performance insulated architectural precast concrete panels were chosen to reclad an aging eight-story building at 34 South 11th St. in Philadephia, Pa. Formerly a warehouse, the building is being converted into a mixed-use facility with retail and commercial spaces by Clemens Construction Co. of Philadelphia.

The project, representing the first phase in the $500-million East Market redevelopment, needed to set an appropriate aesthetic tone while remaining within budget. To achieve this, the building's façade was removed to expose the concrete structure and was then reclad with the precast concrete panels, which feature a lightly sandblasted, deep charcoal exterior finish.

Designers at BLT Architects and Morris Adjmi Architects selected the panels to take advantage of the building's 14-foot-high ceilings. The design concept features large windows framed with precast concrete to create a contemporary look with a dramatic visual effect. The 11-inch-thick panels, fabricated by Coreslab Structures, include 4-inch layer of polyisocyanurate insulation by Thermomass. The panels also feature 3-inch finned projections.

The weight of the panels (16,000 to 32,000 pounds) and the inconsistency in shape and size of the building's existing bays required customizing the panels on the bays to fit each situation. Approximately 90% of the panels were installed at night so the street could be cosed for crane access.

Multiple pieces were delivered on each flatbed to minimize congestion and maneuvering in the tight downtown area. The erection was completed in June.

Holliday Named PCI-IW Executive Director

CHICAGO, ILLINOIS

Amy Holliday has joined PCI of Illinois and Wisconsin as executive director. Previously, Holliday served for 16 years at Fabcon Precast in Savage, Minn., where she began her career as an estimator and moved into sales. While in sales, she worked with contractors, architects, and engineers in the Twin Cities and with retail clients across the nation. She has a degree from Dunwoody College of Technology in Minneapolis , Minn.

Clark Pacific Names Marketing Director

WEST SACRAMENTO, CALIFORNIA

Geene Alhady has joined Clark Pacific as executive director of sales and marketing as well as a member of the firm's business-development team. Previously, Alhady served as general manager of Trimble Buildings' Real Estate and Workplace Solutions Division and president of Meridian Systems, a plan-build-operate technology solutions company. Alhady holds a bachelor of science degree in construction management from California State University.

Eckenrode Heads PCI's New Gulf South Region

GULFPORT, MISSISSIPPI

PCI has restructured and renamed its Gulf South Region office, which serves Alabama, Louisiana, and Mississippi. The region is being headed by Executive Director Dan Eckenrode, who has more than 13 years of experience in the precast concrete industry. Most recently, he served as director of sales for Conewago Precast in Hanover, Pa., as one of the original members of the precast division team.

Eckenrode will focus on increasing market share for members, creating marketing strategies, and coordinating communication between members and the development, architectural, and construction communities. He also will create continuing-education opportunities for design professionals. Contact the office at pcigulfsouth1@att.net or visit www.pcigulfsouth.org.

Ironrock Lights Third Kiln

CANTON, OHIO

Ironrock, makers of Metrobrick Architectural Thin Brick and Royal Thin Brick, has lit a third tunnel kiln at their manufacturing facility. The added output will help meet growing demand for thin brick and quarry-tile products as well as provide capacity to introduce Royal Thin Brick, a tumbled thin-brick product line. It also will build inventory for faster turnaround of products for small to midsize projects.

Submit your headline news for consideration in a future issue of Ascent to Brenda Banks at bbanks@pci.org.

Three Finishes Used for Office Park

BURLINGTON, MASSACHUSETTS

The Summit Office Park, named for its prominent location on a hill in Burlington, Mass., needed a strong image to draw tenants to the five-story, 280,000-square-foot facility. To accomplish that, designers chose architectural precast concrete panels in three distinct finishes. The choice proved especially beneficial when 2-foot overhangs were added onto the building as the design was being finalized.

Precast concrete panels were chosen for the project due to the versatility of the design, the economy of the materials, and the speed of erection, says Keith C. Calvin, project manager at Gutierrez Construction, the general contractor. The building features a V-shaped layout, with the two legs forming an interior angle where they meet at the main building's front entrance. Cube 3 Studio LLC in Lawrence, Mass., is the architect on the project, which is planned to open in the third quarter of 2017.

The three precast finishes help to delineate the separate wings and reduce their scale. One wing was finished with a light, almost white concrete mix, while the other features a dark, charcoal mix. A medium-tan color was chosen for accents on both portions. The colors help break up the long, linear design of the building, says Calvin.

The biggest challenge came in creating the 2-foot overhangs that were added as the design was being finished. The steel had to handle additional load, and more connections had to be added to secure the panels. Strescon Limited in Saint John, N.B., Canada, with a New England sales office in Burlington, Mass., fabricated the precast concrete components.

In all, 233 architectural panels and spandrels were erected in approximately 42 days, finishing in August 2016.

2015 PCI Foundation Report Available

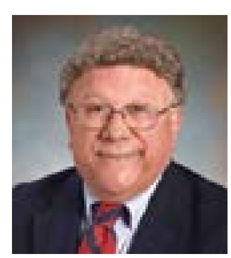
CHICAGO, ILLINOIS

The 2015 PCI Foundation Annual Report, the second annual update on the group's work with architectural schools nationwide, can now be downloaded from pcifoundation.org. Overall, the program to date has worked with 13 schools, 24 professors, more than 900 students, and a variety of PCI members and regions.

"We have evidence that the programs have produced graduates who apply their training in projects in their employers' design offices," says Tom D'Arcy, 2015 chairman. To receive a hard copy of the report, email info@pci-foundation.org.

Ebersole Joins High Concrete Group

DENVER, PENNSYLVANIA



J. Glenn Ebersole Jr. has been appointed market development manager for High Concrete Group LLC. He is responsible for increasing brand awareness and social-media visibility, as well as developing markets for the company's architectural precast and other precast products.

Previously serving as strategic vice president of business development/marketing for Hollenbach Construction, he is a registered professional engineer for Pennsylvania, New Jersey, Maryland, Delaware, and Vermont. He holds a Bachelor of Science degree in Civil Engineering and a Master of Engineering in Engineering Science from The Pennsylvania State University.

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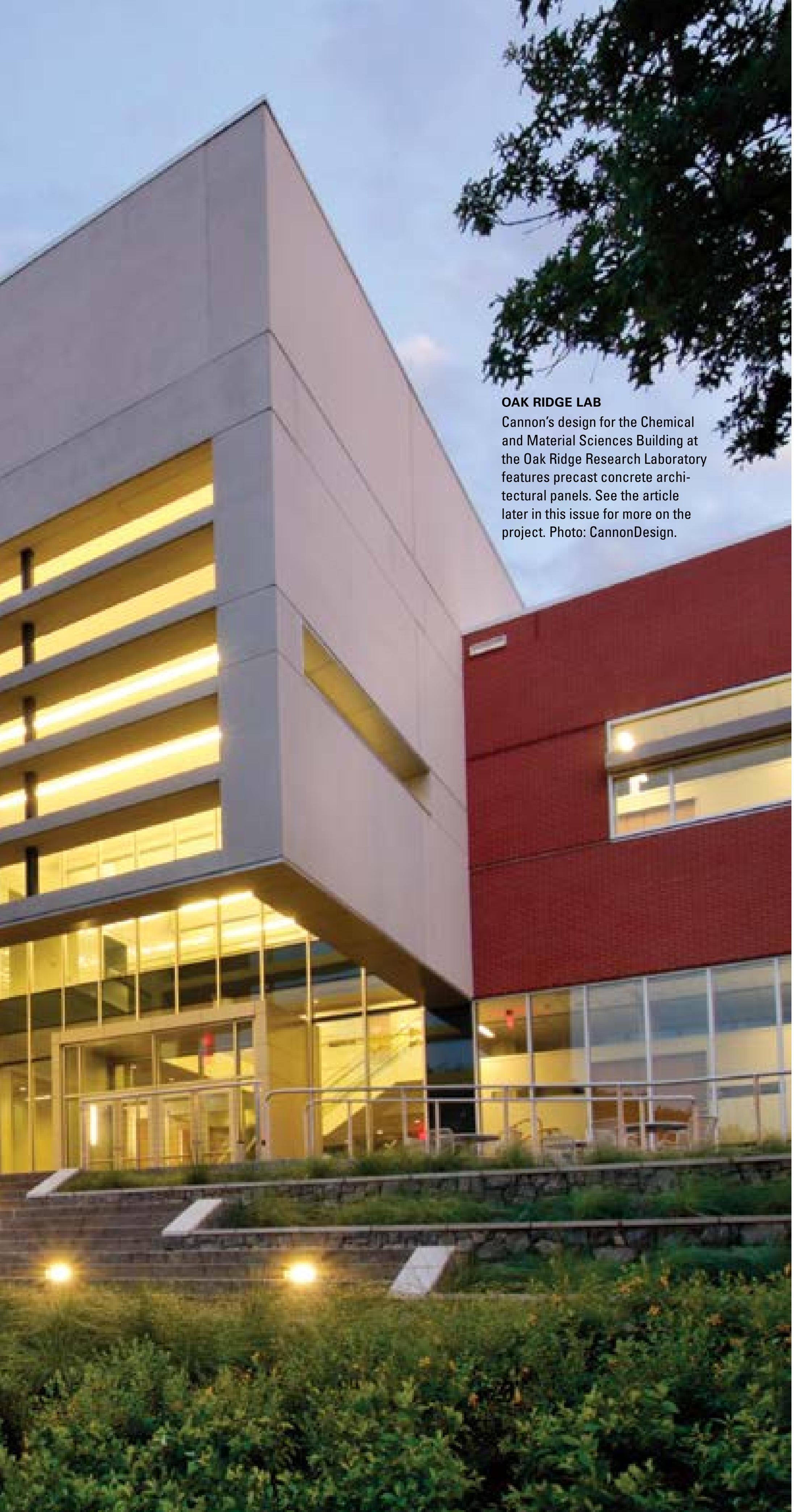
BALANCING INNOVATION, Collaboration

CannonDesign's Michael Zensen loves solving puzzles, especially the challenging building designs created through innovative leadership

— Craig A. Shutt



OAK RIDGE LAB
Cannon's design for the Chemical and Material Sciences Building at the Oak Ridge Research Laboratory features precast concrete architectural panels. See the article later in this issue for more on the project. Photo: CannonDesign.

Michael Zensen, CannonDesign

Michael Zensen has loved the challenges of designing and constructing buildings since his family built their own home in the mid-1970s. Today, as vice president of CannonDesign, he continues that fascination with creative designs and a desire to help others better understand the science of building through educational programs and volunteer groups.

'You have to love solving complex puzzles to thrive as an architect in a firm committed to design excellence.'

"You have to love solving complex puzzles to thrive as an architect in a firm committed to design excellence," he says. "Every aspect of the business relates to that." The goal is to understand the client, even beyond their words. "You have to listen to the client express their needs, but owners can't always define all the problems they are trying to solve through the project. It's important to ask pointed, incisive questions to clearly define the problem, so that the solution will really meet their needs."

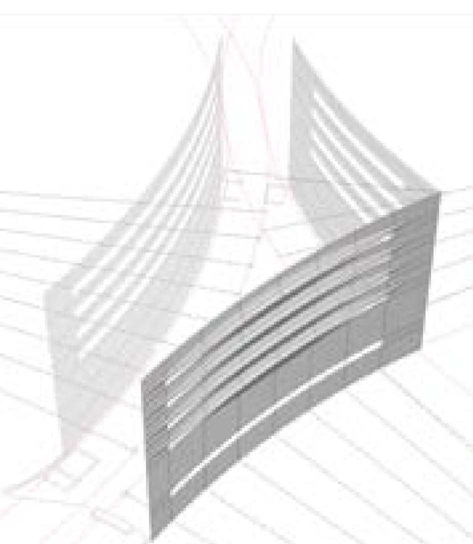
Zensen thrives on achieving that goal, especially when it involves unspoken or even unknown needs. "The most enjoyable part of the project is discovering the problem to be solved and then defining it in easily articulated terms that resonate with the client mission. Then you can truly partner with the client to identify potential solutions and start tackling the obstacles and challenges associated with each potential solution."

Every project has challenges, as Zensen has known since he saw his parents' home being built. "It was a very painful process for my parents," he laughs. "I wanted to figure out why it was so hard to create something that met people's needs and expectations, because it didn't seem like it should be that hard. I was drawn to architecture out of this notion of service for people, while at the same time recognizing that even with that simple basic house, the unclad anatomy of the building was so complex, so fascinating, and so much cooler than the completed project."

Zensen took those interests, along with a 13-year interest in art, to the University of Kansas, where he received a 5-year Bachelor of Architecture degree and was exposed to the "artful side of building and design."

BUILDING ENCLOSURE COUNCIL

To encourage better understanding of the more technical aspects of architecture, Zensen helped establish the Building Enclosure Council of St. Louis (BEC-STL) in 2006. He worked with George Crow of McCarthy Construction, Matt Ford of Universe Corp., George Everding of CannonDesign-Allegion, and Brian Finnegan of Centria to develop the local chapter for the council, established by the American Institute of Architects and the National Institute of Building Sciences. The program, which now has 26 councils nationwide, promotes discussion of training, education, technology transfer, and other factors impacting building enclosures.



PRECAST PROFILE
The diagram for the precast concrete panels at the Mount Sinai Medical Center in Florida shows the sweeping curve of the façade. Photo: CannonDesign.

Zensen's interest was sparked by a seminar on building envelopes by Building Science Corporation. "I realized that mistakes were being made, in both contract documents and on construction sites, that violated key principles of building science," he says. "As I educated myself, I also realized the younger generation wasn't being educated in these basic principles of façade dynamics. At the time, there were not a lot of professional journals focusing on the science of building as an integral part of the art of architecture or building."

His experience with leading the building-envelope design on several of CannonDesign's projects gave him the opportunity to explore precast as a cladding solution. "The beauty of precast concrete is that it can provide a skin and substructure in one product, and it can contribute to construction schedule acceleration because of this characteristic," he says.

"The precast concrete industry has really been revolutionized by the emergence of new technologies in design and fabrication. This has been aided by the rise of some precast fabricators seeking to differentiate on quality and design while maintaining competitive price points. These factors expand the ability to express the fluidity of the material. We are truly now beginning to see the potential of the material to be expressive, unique, and complex, while still meeting aggressive schedules and budgets."

This revolution is being brought about by integrating the latest design and manufacturing technologies, such as 3D modeling and printing, high-tech CNC routers, and other design and modeling aids. "With the entire industry—design, manufacturing, and construction—embracing Building Information Modeling, you can collaborate at a very detailed level with the expertise in each building trade.

DAYLIGHT CONNECTION
The design for Mount Sinai will to connect users to the views and the sun via low-maintenance precast concrete cladding. Photo: CannonDesign.

Collaborating with contractors and other professionals maximizes success. "True creativity and unique designs result from realizing the potential of systems, materials, and modern manufacturing technologies. Pushing ideas from the design side only gets you so far," he says. "Collaborating and partnering with an expert in a material or system who wants to work on something extraordinary and challenging allows us both to create something spectacular."

NEW DELIVERY METHODS

New delivery methods have encouraged more collaboration, and CannonDesign has taken advantage of those with a number of projects. Key projects include several for the Oak Ridge National Laboratory, where CannonDesign has worked with McCarthy Construction using an Integrated Project Delivery format.

"Research laboratories have unique needs that impact their buildings in specific ways," he says. "The most rewarding part of those projects is that each laboratory is deeply involved in a different science doing amazing things, and we learn a little about those by defining the building's needs."

Those needs often required creating versatile and adaptable buildings. "The world is changing very quickly, driving research constantly in new directions. Buildings need to adapt and respond to those changes. We have the opportunity to be brought into those specialized worlds for a while and get a glimpse of emerging science that will potentially change the world."

One major project for Oak Ridge, operated by the U.S. Department of Energy, was the Chemical and Material Sciences Building, a three-story, 160,000-square-foot research facility. The space features laboratories and offices and was clad with precast concrete architectural panels. The panels were erected in a vertical position, measuring 10 to 12 feet wide and 30 to 45 feet tall. Most of the panels were embedded with thin brick to match existing buildings on campus.

The project was completed on a CM/GC delivery method, with the precaster brought onto the project early on a design-assist basis. That allowed for added resourcefulness in creating the building envelope, especially the use of long, narrow precast concrete sunshades over ribbon windows. (For more on this project, see the related article.)

LAB PARTNER
Precast concrete panels clad the high-bay laboratory at MAXLab on the Oak Ridge campus, which helped the facility achieve LEED Gold certification. Photo: CannonDesign.

CannonDesign also helped develop a related project, the 18,000-square-foot Maximum Building Energy Efficiency Research Laboratory (MAXLab), which investigates ways to improve processes and materials for building envelopes. The facility features a high-bay lab with an overhead crane for envelope-system research, a low-bay lab for HVAC-system research, a data center, and offices. The high-bay section was clad with architectural precast concrete panels, which helped the project achieve LEED Gold certification. The project also was completed on a construction manager-at-risk basis.

EMPHASIS ON HEALTHCARE

CannonDesign offers a general practice that excels in many markets in addition to the Science and Technology segment. "One of our strongest segments is our international healthcare practice, which allows us to contribute to improving patient outcome through creative approaches to clinical spaces and operational work flows."

The firm has designed a variety of healthcare projects, which offer different challenges, but one core design goal ties them all together. "Incorporating views and natural light are important to healing environments, especially for oncology treatments, where a large percentage of patients receive infusion treatments and spend long periods sitting in one place," he says. "It is vital that we make the environment comfortable while meeting the hospital's functional needs as well as patients' personal needs for either connection to other patients in similar conditions or personal solitude during treatment."

Healthcare facilities tend to grow, adding building expansions to meet evolving community and healthcare delivery needs. "It is very challenging to add significant area to a building and not cut off the existing facility from views and light and prevent networks of endless, stagnant corridors."

That emphasis can be seen in the company's design for the Mount Sinai Medical Center of Florida, a seven-story hospital tower and emergency-care facility in Miami Beach, at the center of the campus facing Biscayne Bay. The architects designed a building with sweeping, curving faces featuring large windows on a narrow, trapezoidal footprint. Architectural precast concrete spandrel panels were used to clad the building.

"It's apparent in that building that we focused on connecting users to the views and the sun," he says. "Our aim was to provide wall-to-wall glass to maximize daylight." The precast concrete panels provide a durable, low-maintenance cladding that could cost-effectively supply the flowing curves on each façade. "It allowed us to take advantage of the three-dimensionally shaped façade, which breaks down the mass of the building by modulating and engaging with the strong Miami sun."

Another recent healthcare project was the University of Kansas Hospital, a bed tower being built in multiple phases. Its façade features architectural precast concrete panels with vertical reveals, creating a staggered pattern over the face. A low front portion features a buff finish, while a larger portion at the rear features the same design but on a larger scale with a white concrete mix. A long stretch of solid curtain wall sits atop the low front portion.

DELIVERY METHOD ISSUES

Especially on its high-tech and healthcare projects, CannonDesign collaborates with construction team members in a multitude of formats, including Construction Manager at Risk (CMR). "CMR has really dominated the market during the past 15 years, due to tremendously escalating costs and the desire to control cost and reduce the risk of a bid-day budget bust," he says. "We have had varying levels of success with it. It works best when major portions of the skin and mechanical systems can be competitively bid at early stages prior to completion of documents, and the design team is allowed to work in an integrated manner to develop the design with the trade contractor."

CannonDesign has also participated in a number of design-build projects. "I think the desire to integrate the design and construction team was a good goal, but owners need to realize that in design-build contracts, first costs tend to drive all decisions, even if those decisions impact quality and/or long-term costs for the owner. As the design professional, we are not always able to engage in the debate of long term versus short term if we are contracted to the contractor."

'Owners need to realize that in design-build contracts, first costs tend to drive all decisions.'

The firm also has been involved in a number of Public-Private Partnership (P3) projects. "As a large organization, we can bring a lot of skills and expertise to the table, so we can adapt to many types of contractual structures and still provide both exceptional design and exceptional service," says Zensen. "But it can be quite challenging to be as responsive as we would like to be for the client and end users when our contractual obligations are directed to another entity that has other pressures and goals beyond the exact outcome of the facility."

CannonDesign's P3 Projects are focused in Canada, where the scale of some, such as the CHUM (the Centre hospitalier de l'Université de Montréal) in Montreal, requires engagement of the firm's unique SFMO (Single Firm Multi Office) methodology, in which expertise and production are shared across multiple office locations.

"I expect we could see more of this format in the U.S.," he says. "The P3 model exists due to pressures for expansion of services that are in conflict with available capital and finance opportunities available to tax-supported institutions. I think while this condition does not currently exist in the commercial healthcare industry in the U.S., these same pressures certainly exist in the higher education, the VA healthcare system, and infrastructure projects in this country."

SUN ENGAGEMENT
Precast concrete produced a three-dimensionally shaped façade for the Mount Sinai Medical Center, which minimized the building's mass and helped it engage with the strong Miami sun. Photo: CannonDesign.

STAGGERED FACE
Precast panels cladding the University of Kansas Hospital feature vertical reveals that create a staggered pattern over the building's face. Photo: CannonDesign.

One element all the alternative-delivery methods share is a desire to accelerate the process. "Speed to market, reducing construction time, and accelerating realization of revenue are always critical to our clients financial proformas," says Zensen. "But buildings are one-off designs. Every site comes with a different climate and different constraints, and each building solves unique problems for the owner and for the built environment. Speed can be the enemy of providing a great solution."

To counter that trend, the firm is expanding its project-delivery options to include "designer-led designer-built" in which CannonDesign provides a turnkey project, providing the same advantages as CMR and design-build but maintaining contractual obligations and relationships with the client. "I'm excited about this concept," he says. "It will allow us to accelerate some construction activities while continuing to develop the design, because the risk is all absorbed by the turnkey design team."

The firm has used the format in Pittsburgh with success and is expanding its capabilities to other regions. "This is really the natural outgrowth of our construction management practice," says Zensen.

The firm encourages a "designer-led, designer-built" format it has used with success and hopes to expand.

COMMUNITY SERVICE CONTINUES

Although Zensen is no longer involved in an official capacity with the BEC-STL, the group continues to grow. "Starting the BEC was an exciting time," he says. "Trying to get a new volunteer organization off the ground and provide high-quality education programs at low cost was quite a challenge during the height of the financial collapse. I'm glad we created a financially sustainable group by partnering with design and construction firms and could provide strong building-science-centered educational programs. It has allowed the BEC-STL to continue to serve this important community educational service."

As he works to encourage creativity in the professional market, he's also working in a volunteer capacity on the personal side. Zensen is now running the not-for-profit, Art in the Park St. Louis, which hosts an Art Fair Event featuring 80 artists. The event takes place annually in September and is attended by about 8,000 people. Proceeds are used to commission unique art pieces for a local park.

Art in the Park presents some unique challenges but also some of the same as BEC did due to its reliance on volunteer labor, Zensen notes. "I stepped away from BEC to expand my public service outside direct connections to the profession and to allow new blood to invigorate that organization," he explains.

His new volunteer effort surrounds him with artistic people and allows him to contribute to his immediate local community. But, he does not intend to run this program indefinitely, either. "If I am running the program in 10 years, I've failed. Organizations of all types need new blood and new ideas. They need to be set up and organized to transition to new leadership, or they are destined to someday not exist."

CINETOPIA

ALTERNATIVE Delivery Formats GROWING IN POPULARITY

Precast concrete often aids owners considering alternative delivery methods to encourage dramatic aesthetics, maximized energy efficiency, and expedited occupancy with controlled costs

— Craig A. Shutt

Owners today are looking for the best balance of design quality, fast construction, energy efficiency, controlled costs, and other key needs. Often, they realize that alternative-delivery methods beyond the traditional design-bid-build approach offer better ways to accomplish their goals. They can require new approaches to design and construction relationships, but they typically pay off in dramatic ways.

Design-build methodology has been used in some form for many years, often leading to a reconsideration of collaboration methods. That has led to such approaches as Construction Manager/ General Contractor (CM/GC), Public-Private Partnerships (P3), Integrated Project Delivery, and combinations that use elements that best fit the participants and project.

This evolution happens as developers see benefits from having construction partners bring their expertise on any issues as early as possible. That has fostered conversations on multiple paths to accomplish goals with subcontractors, such as bringing them in on a design-assist basis to avoid duplications in design and requests for information. Precast concrete fabricators have become adept at joining projects early on a consultation, design-assist, or value-engineering basis, to help maximize efficiency of components throughout the design and construction process.

The best delivery method for each project will depend on a number of variables, but most can be used with virtually any type of project. The following examples show how alternative delivery methods benefited a range of building types and used precast concrete components to help achieve their goals.

DESIGN-BUILD LABS
A total-precast concrete structural system and architectural panels help meet the needs of the DOE's Energy System Integration Facility. Photo: JE Dunn Construction.

Photo: Bill Timmerman, SmithGroupJJR.

ENERGY SYSTEMS INTEGRATION FACILITY

LOCATION
Golden, Colo.

PROJECT TYPE
Experimental laboratory, data center, and offices

SIZE
180,000 square feet (80,000 square feet for precast concrete laboratory)

COST
$135 million

DESIGNER
SmithGroupJJR, Phoenix, Ariz.

OWNER
Department of Energy's National Renewable Energy Laboratory, Golden, Colo.

STRUCTURAL ENGINEER
Martin/Martin Inc., Lakewood, Colo.

CONTRACTOR
JE Dunn Construction, Denver, Colo.

PCI-CERTIFIED PRECASTER
Stresscon, Colorado Springs, Colo.

PRECAST COMPONENTS
991 pieces, including double tees; inverted T-beams; L-beams; rectangular beams; Thermomass walls with 3 inches of insulation, an exterior 3-inch architectural wythe and an interior structural wythe of 8 or 10 inches; columns; shear walls; spandrels; shaft lids; and site walls

THREE FUNCTIONS
The lab contains offices, a data center, and high-bay labs, which precast concrete helped make into flexible open spaces for research of all types. Photo: Bill Timmerman, SmithGroupJJR.

ENERGY SYSTEMS FACILITY

High-tech laboratories have special needs beyond those of more traditional buildings. In the case of the Department of Energy's (DOE's) Energy Systems Integration Facility in Golden, Colo., a design-build delivery method led to an innovative design in which the building's three core functions were divided into separate but connected structures. To meet the high-tech needs of the center's research laboratories, the team specified a total-precast concrete structural system and architectural panels.

The 182,500-square-foot facility is the first in the country to conduct integrated megawatt-scale research and development on the components and strategies needed to safely move clean-energy technologies onto the electrical grid at the speed and scale required to meet the nation's long-term goals. As such, DOE officials wanted to ensure they created a highly functional design that could be adapted to meet current and future research needs, while also providing a dramatic appearance. It also had to provide an ultra-green workplace, both to make a statement and to provide long-term efficiency.

The facility provides three functions: office space for employees, a data center, and the high-bay laboratories, which contain approximately 80,000 square feet. The laboratory spaces, ranging in size from 5,000 square feet to 10,000 square feet with 32-foot-tall ceilings, had to be versatile to adapt as new technologies were tested and also offer easy access for large equipment. They required large, unobstructed space as well as robust loading capabilities. The building also had to provide a 50-year service life, in addition to respecting stringent energy requirements.

The project was let on a design-build basis, as a key part of planning included the high-tech laboratory space which drove the schedule. It needed to be completed early to allow time for the specialized equipment to be installed. It also was the segment placed highest on the site, which had a 45-foot slope from one end to the other.

> 'The building was unique from the very beginning at its bid stage.'

DESIGN-BUILD COMPETITION

"The building was unique from the very beginning at its bid stage," says Brad Gildea, an associate at SmithGroupJJR, the architectural firm on the project, which worked with JE Dunn Construction. The project was let with a design-build delivery method, but it was awarded through on a competition among teams based on each group's qualifications, pricing, and proposal. The three participating teams were given a stipend to produce their proposal and present it. "It was pretty intense even before we got the project."

The design-build format was seen as a way to encourage innovation and fast-track the project, he explains. In creating their plans, the teams followed performance-based characteristics laid out in the Request for Proposal. Each team was given a 900-page set of parameters without a conceptual outline or bridging documents. It features programming needs, specifications, and performance needs. "We had to digest all of that, come up with a design, verify its constructability with our partners, and then present it," Gildea explains.

Although the firm had never worked directly with JE Dunn, a relationship had been established between SmithGroup's

Laboratory Group in Phoenix and JE Dunn's office in Denver. "We both knew the project was looking for participants, and we got together."

Their preliminary design was selected, and then the team value-engineered it to align with the final budget parameters. "We went through design/schematic development to 100% of the design-development stage to provide a Fixed Firm Price." Once they had the elements worked out, their construction plan had to be approved by DOE.

The team then solicited input from precasters to help work out a final plan for the structure. "In the initial phase, we considered a steel-frame building," Gildea says. "But it became apparent that a precast concrete structure would provide more efficiency."

'We wanted a precast partner early on to help tailor the design to our needs.'

PRECASTER PROPOSALS

The design-build team went through an "intense" schematic-planning phase after winning the project and presented the proposal to two precasters, who did rough drawings and analyzed their plan based on efficiency and cost. "We wanted a precast partner early on to help tailor the design to our needs and to ensure the plan was efficient for the interior design as well as for the exterior skin," Gildea says.

Mike Tilbury, vice president at JE Dunn Construction, agrees the format aided the project and led them to the precast concrete structure. "Design-build was definitely a key part of the success. We could work collectively as a team and analyze costs and performance requirements to determine that precast concrete provided the best approach to reach all of our requirements."

Stresscon won the project and joined the team. "Stresscon proved to be most flexible in meeting our needs and providing a good solution," Gildea says. The team used Building Information Modeling (BIM) to model the design and create the most efficient precast structure.

The precast concrete components provided multiple benefits, explains Mark Kranz, vice president and design director at SmithGroup. "The precast concrete columns and double tees provided the structural capabilities and open spaces on the interior, while structural load-bearing, insulated sandwich wall panels using a custom aggregate with an acid-etch finish on the exterior architectural layer provided a durable, energy-efficient, and aesthetically intriguing building envelope."

"Manufacturing the panels was challenging," says Michael Benedict, the project manager for Stresscon and now a consultant for the firm. "They had to be well insulated, load-bearing and 32 feet tall. They also had a lot of deep reveals that needed to be defined well." The panels feature 3 inches of insulation with a 3-inch exterior architectural wythe of concrete and either an 8- or 10-inch interior structural wythe, depending on its location and structural requirements. A few panels with a 3-inch interior wythe also were used for the building's base. In all, 919 components were produced.

The precast framing allowed for quick erection of the shell along with other benefits. The double tees provided long spans for the required open spaces as well as creating a four-hour fire wall between the lab and the adjoining data center. "The inherent fire protection offered by precast concrete eliminated the site activity, time and costs that would have been required to fireproof the walls to the level that was needed for the laboratories," says Tilbury.

HIGH-TECH PANELS
The precast concrete panels are well insulated, load-bearing and 32 feet tall, and feature deep reveals with strong definition. Photo: Bill Timmerman, SmithGroupJJR.

HIGH BAYS
The high-bay laboratories required large openings for roll-up doors, which were provided by the precast structure with no difficulty. Photo: Stresscon.

Photo: Bill Timmerman, SmithGroupJJR.

Block-outs for rollup doors were provided in the panels on one façade to provide easy access for trucks to deliver large payloads. "These could be provided in the panels without a problem," says Benedict. "We do it on a regular basis and these weren't out of the ordinary, except for the height of the panels."

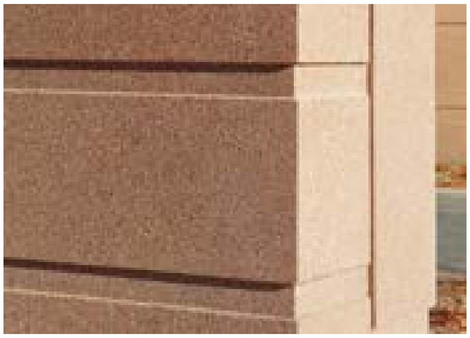
CRAWL SPACE CREATED

The sloping site presented challenges, but also provided an opportunity for the creation of a crawl space beneath the laboratory that becomes taller, varying between 4 and 16 feet, as it extends to the other sections further down the slope. Once building pads were established for the building segments, four separate concrete crews could work concurrently on foundations.

The crawl space was added after the design had been completed, as the building originally was planned to have a slab-on-grade base. "There was a tremendous amount of mechanical and electrical infrastructure, and the owners asked if we could add a crawl space to handle it," Gildea explains. "As we were using double tees for the rest of the structure, we were able to add them in this area to provide desired the access and meet necessary loading requirements."

"The Research Electrical Distribution Bus is a one-of-a-kind electrical distribution system that had never been designed or built before," Tilbury notes. "The precast concrete crawl-space design allowed us to have crews inside working to install what would have been underground conduit while allowing other crews to work simultaneously on the upper floors. That provided a huge savings in time. Without that approach, to get all of the underground systems into place and then try to build over it afterward, would have crushed our schedule."

The exterior panels feature a gray finish with a textural coating applied after the panels were erected. "We tried a value-engineered approach of applying paint rather than using integral color, but it didn't provide the same aesthetic," Gildea says. Three passes with the textured coating were performed to create base, light splatter, and dark splatter areas.



CUSTOM FINISH
The panels feature a custom-aggregate outer architectural layer, with an acid-etch finish to provide a durable, energy-efficient and aesthetically intriguing appearance. Photo: Bill Timmerman, SmithGroupJJR.

The office and data center, which feature metal panels, are separated from each other and the high-bay labs by "knuckles" in the envelope that keep them distinct. The two sections cantilever off of a precast concrete, structurally framed base that was clad with 9-inch-thick precast concrete panels with an appearance created with a custom aggregate and an acid-etched finish. Fifteen mockups were completed to ensure a precise match between the textured lab panels and the finished base panels.

"There are very complementary looks among all the sections," Tilbury says. The textures fit with the energy campus's overall aesthetic language, which includes metal panels, glass curtain wall, aluminum accents, and precast concrete panels.

TEES OFFER VERSATILITY

The double tees provided an additional benefit, as they had Unistrut assemblies cast into the lengths used for roofing components. This offers the opportunity for scientists to attach any riggings or harnesses they need to hang devices and not worry about loading requirements. "It gives them flexibility to perform any experiment necessary in the most efficient layout," says Gildea. The embedded Unistrut also offers a safety benefit, as future installations will not require overhead drilling.

The wall panels' R-20 insulation, coupled with the roof's R-40 insulation, helps the building achieve its "aggressive" energy goals, Gildea says. "Stresscon really rose to the top in suggesting ways that we could achieve the R-values we needed." This was aided by the non conductive connectors that hold the insulation in place, eliminating any thermal bridging. "The 16-inch-thick insulated wall panels provided the R-20 level we needed without any need to fur out the inside and add insulation. It also helped the electrical and mechanical contractors to have finished concrete walls on the inside to work with."

'The 16-inch-thick insulated wall provided the R-20 level we needed.'

The project was planned to meet LEED Gold certification, but ultimately it achieved LEED Platinum certification, the highest available, generating 56 of a possible 62 points. Precast concrete aided this in a variety of ways, including high energy efficiency, local manufacture of materials, using local materials, use of recycled and recyclable materials, minimization of construction waste, and more.

The precast erection moved smoothly and was completed in approximately 60 days. Construction started at the bottom of the hill and moved up, with the crane repositioned on the slope as needed. As the work was done on federal property, everyone on the site had to be vetted and identified, so the contractor created a fenced-off site to control access away from the rest of the campus.

"The precast concrete box went up fast, well before the cold weather set in, and we framed in the windows until they could be installed in the spring," Gildea says. Gas-fired heaters were installed while trades fitted out the laboratory spaces. "On sections where they were putting up the steel framing, they were working through cold weather while those working on the precast sections were inside, toasty and warm."

Because the high-bay lab building was on the high side of the slope and had such complex systems, the critical path for the project ran through it, Tilbury says. "Getting it up quickly was huge. It was absolutely critical to the schedule."

Today the facility is home to 200 scientists and engineers who are working to find efficient ways to solve energy concerns. They are doing it in a building that is versatile, contemporary, highly functional, and highly energy efficient, while being respectful of its surrounding environment.

"It was a creative approach that turned out very well," says Gildea. "The precast concrete structure came together efficiently and provided the aesthetic, functional, and structural needs we required."

ADDED VERSATILITY
Unistrut assemblies were cast into the roofing components to allow equipment to be hung without worry about loading restrictions. Photo: Bill Timmerman, SmithGroupJJR.

Photo: Coreslab.

THE UNIVERSITY OF TAMPA FACILITY

As The University of Tampa expanded, it needed new classroom and administrative space as well as parking for its staff and students. In 1997, The Beck Group constructed a 212,465-square-foot, five-level precast concrete parking structure for 583 cars. In 2000, the university awarded phase two of the garage, an addition of a five-level, 49,540-square-foot single bay with brick/sealed precast concrete exterior to the existing three-bay parking garage, adding 235 parking spaces. In 2013, university officials challenged the firm to create an addition to that structure, this time featuring eight levels, including additional parking spaces plus three floors of classroom and community space.

The University of Tampa's new Maureen A. Daly Innovation and Collaboration Center adds 511 classroom seats for students and 31 faculty offices on floors one and two, the John P. Lowth Entrepreneurship Center on the eighth floor, and 386 parking spaces on the intervening levels. To achieve these diverse needs in a tight space, while connecting the new and existing structures together both through an access bridge and through aesthetic design, the university used an Integrated Project Delivery team that featured Beck as both architect and construction manager.

> The university used an Integrated Project Delivery team to achieve its diverse needs on a tight space.

Others were brought onto the team as well, including structural engineer Master Consulting Engineers Inc. (MCE). They decided the best way to meet these needs was to create a total-precast concrete structural system that essentially isolated the first two floors of classrooms inside a building-within-a-building, and then build the parking levels above that in an encompassing structure. Coreslab Structures (TAMPA) Inc. fabricated the precast concrete components to achieve this goal.

The use of the Integrated Project Delivery team, in which the architectural and construction services are provided by the same firm, offered significant benefits to the project, says Armando Castellón, principal at MCE. "It helped generate important input in the early days before the design was finalized," he said. This proved especially beneficial when the top-floor community spaces were added after design had started. "We had to coordinate the work and modify the existing plans, and that was much easier to do with the Integrated Project Delivery format."

Construction could start almost as soon as the plans were finished, he explains, as the precaster was fabricating components while drawings were completed and the site was prepared. "We worked closely from day one with the precast manufacturer, so we had the drawings completed of a complicated structure where two fully independent buildings were occupying the same footprint. We were able to develop the separation between the two buildings of classrooms and parking to avoid any sound or vibration transfer between the buildings. It helps a lot due to the complications with all of the loading we had going on for the two buildings, as well as for the connections to the existing garage."

In essence, a precast concrete structural frame was created for the first two levels of classroom and office space; then a second frame, with different columns and shear walls, was built within it. "The University was extremely worried that noise and vibration from automobile traffic would disrupt classroom activities, so we had to isolate those levels completely from the upper floors," he says. "Precast concrete helped ensure they were entirely separate."

The first two floors feature hollow-core slabs for flooring, while those above use double tees. The top level's flooring features bridge tees covered with 6 inches of insulation with a concrete topping over it to create isolation. "The top floor of conference rooms offers a high-profile location with beautiful views of the campus," says Castellón.

TOP OF THE CLASS
The University of Tampa's Maureen A. Daly Innovation and Collaboration Center combines classrooms, faculty offices, and parking. Photo: Coreslab.

THE UNIVERSITY OF TAMPA MAUREEN A. DALY INNOVATION AND COLLABORATION BUILDING

LOCATION
Tampa, Fla.

PROJECT TYPE
Higher education, retail, and parking structure

SIZE
213,000 square feet

DESIGNER/CONTRACTOR
The Beck Group, Tampa, Fla.

STRUCTURAL ENGINEER
Master Consulting Engineers, Tampa, Fla.

OWNER
The University of Tampa, Tampa, Fla.

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

PRECAST COMPONENTS
1,128 individual pieces from 38 product types, including columns, beams, shear walls, double tees, bridge bulb tees, fascia panels, and architectural panels

The exterior columns were erected 2 inches apart in some locations, says Mark McKeny, sales manager at Coreslab Structures (TAMPA) Inc. "We had to be sure the vibrations couldn't transfer." Each level was erected simultaneously with the interior structure followed by the exterior one next to it.

CANTILEVERED PARKING

The existing building's foundation had not been planned for any expansion, McKeny notes, so it could not support additional load, requiring an innovative approach to connect the garages and provide the amount of parking required. By cantilevering the parking levels, new foundations could be placed 8 feet 8 inches away from the existing garage, eliminating the need to retrofit the existing foundations. The cantilever on the south elevation extended the structure 10 feet to allow for a more efficient parking layout along with creating a unique façade. Large tie-backs were used to secure the cantilevered levels' double tees.

> The two structures were connected via a bridge constructed of 18-inch-deep precast concrete bridge tees spanning the 60-foot space.

The two structures were connected via a bridge constructed of 18-inch-deep precast concrete bulb tees spanning the 60-foot space. The bridge spans from the second floor of the existing facility to the first double-tee level, on the third floor, of the new structure. The bulb tees were fabricated with lightweight concrete and 61-foot-wide horizontal load-bearing wall panels that supported six bridge tees per level.

"The bridge connection from the existing garage was necessitated by a lack of space in the new footprint to include sufficient ramping past the classroom level to reach the parking levels," explains McKeny. This bridge had to be high enough to

BRIDGING THE GAP
An access bridge created with precast concrete double tees spans the roadway connecting the existing building with the new. Photo: Coreslab.

provide sufficient clearance for the City of Tampa's 20-by 60-foot air-right requirement for the road below.

HIGH MARKS

The conference room on the top floor provides expansive views of the university's campus. Photo: Coreslab.

The façade on the cantilevered portion features a buff-colored frame around long, thin, columns finished with embedded thin brick. The columns actually consist of two panels, a top and a bottom piece, with part of the framing holding four brick-covered "fingers" of concrete. The concrete in these fingers was mixed with gray concrete to replicate the look of mortar, while an architectural mix design was used to achieve the buff frame.

Inlaid thin brick also was used on other sides of the building in more traditional panelized forms, with ribbon-window cutouts provided to replicate the look of a more conventional office or classroom. The featured brick is a special brick used throughout the University of Tampa campus, for which typical bricks were cut to be embedded. A special formliner supplied by Innovative Brick Systems was used to secure the brick in place due to the high level of tolerances needed to cast it.

The base of the bridge features arched precast concrete fascia pieces with the university's name embossed into the side.

A mezzanine created in the top floor also posed challenges, as it couldn't be supported from the floor because those components were already loaded to the maximum, Castellón says. So the mezzanine loads were supported off the roof-bridge tees.

The tight site and small footprint, located at the center of an active campus along a busy street, complicated delivery and erection of components, McKeny notes. "We could have only two or three trucks on the site at once, so we had to coordinate deliveries quickly and keep things moving. Adds Castellón, "The site was open, but it was not very large, so it required careful maneuvering."

CUSTOM TOUCHES

Thin brick corner pieces were used to provide returns that eliminated joints at the corners. Photo: Coreslab.

The project has proven a great success, with a dramatic look and each function working smoothly. A coffee shop on the first floor adds even more activity and color to the facility. "The building is very active and achieved the goal of being two buildings in one," Castellón says. "The two spaces are completely independent. Anyone in the classroom spaces can feel comfortable, because there is no vibration felt."

The use of the Integrated Project Delivery services helped ensure all of the challenges were met and aided the project's efficiency. "This approach takes design-build to the next level," says McKeny. "The challenges we faced really were aided by early consideration and coordination. It was a true integration of subcontractors with the owner, designers, and contractor sitting in the same room to work through the steps needed to resolve conflicts."

RALPH L. CARR JUDICIAL CENTER

LOCATION
Denver, Colo.

PROJECT TYPE
Courthouse and judicial offices

SIZE
695,707 square feet

COST
$258 million

DESIGNER
Fentress Architects, Denver, Colo.

OWNER
Trammell Crow Co., Denver, Colo.

STRUCTURAL ENGINEER
Martin/Martin, Lakewood, Colo.

CONTRACTOR
Mortenson Construction, Denver, Colo.

PCI-CERTIFIED PRECASTER
Gage Brothers Concrete Products, Sioux Falls, S.Dak.

PRECAST SPECIALTY ENGINEER
InfraStructure LLC, Omaha, Neb.

PRECAST COMPONENTS
1,191 architectural pieces (863 office building, 328 courthouse)

CARR JUDICIAL CENTER

A Construction Manager at Risk (CMR, also called CM/GC) format for delivery aided the design efficiency for the Ralph L. Carr Judicial Center in Denver, Colo., which features precast concrete architectural panels on its façade. The panels combine classic architectural touches with a contemporary feel to help blend three structures: a 12-story office tower that houses judicial and legal agencies, an adjacent four-story courthouse building with space for a variety of jurisdictions (including the state's Supreme Court), and a two-story linking building.

The 694,707-square-foot complex provides more efficient space for the state, consolidating seven judicial and legal agencies that had been leasing space in 10 locations. The new facility will serve as the center for legal proceedings in the state for some time, as the buildings were designed for a 100-year service life.

"We had a variety of goals we wanted to meet with this aesthetic design," says Julian Fentress, business development director for Fentress Architects, the architectural firm on the project. "We wanted to keep the buildings in the 'color family' of the state capitol design and keep it expressive of the courts overall. We wanted to balance a sense of openness and transparency and accessibility with a dignified quality that showed the strength of the judicial system."

Fentress was hired by the owner, along with the general contractor, Mortenson Construction, who was brought on 2 weeks later to help create the plan. "It was a Construction Manager at Risk delivery method, but it felt very much like a design-build project," says Fentress. "We were able to leverage the advantages of the contractor's expertise early in the process and bring that knowledge to bear as we brought in major subcontractors on a design-assist basis."

PRECASTER OFFERS DESIGN-ASSIST

The aesthetic needs led the team to look for a malleable, solid appearance, which led them to precast concrete. "Precast was a cost-efficient solution due to the repetitions of shapes within the panels," says Charles Cannon, project architect. "It allows us to create the articulation and fenestrations needed to succeed within the design goals." Gage Brothers was chosen to provide the architectural panels and consult on the design specifics.

"The precaster was selected to join the project team very early in the design process," says Fentress. "It was highly valuable to have the precaster involved so early, as they could bring a high level of experience that helped the design team avoid pitfalls and quickly reach project solutions as they worked to achieve the high design goals. The involvement of the precaster was instrumental in giving us the ability to quickly turn drawings and calculations around."

One of the specific details this early collaboration aided involved detailing the skin. "There are always multiple ways to attach the panels, and some will work more effectively than others in each design," explains Bob Louden, a principal at Fentress. "Bringing Gage on early allowed us to understand the best methods for attaching the precast to the steel and detailing the steel into the structure."

Since Gage joined the team early, they were able....., says Brett Sisco, construction executive for Mortenson. "They were able to work closely with the architect to ensure the design vision was met and that the ornamentation planned for the cladding was possible to achieve in the way it was drawn."

The team held regular meetings and teleconferenced as needed, walking through the details, says Joe Bunkers, vice president of preconstruction at Gage. "We looked carefully at every aspect, especially insulation and waterproofing," he says. "On every detail, we asked if this approach would extend the building's life."

LONG-TERM DURABILITY AND LOW MAINTENANCE COSTS

That was a critical consideration to meet the 100-year design life. "Precast was selected not only because it provided lower initial costs, but it also reduces the long-term maintenance costs for the owner," says Cannon. The large, panelized design reduced joints and ensured few points for moisture penetration that need to be inspected or updated every 15 years.

To enhance that, a two-layer waterproof joint-sealer system was devised, featuring a water-tight bead applied behind the grout layer. "It creates a system that is accessible and easy to replace in the future," Sisco says. "Precast's durability and low maintenance needs were very appealing to the state."

The courthouse structure features stone embedded in the precast panels, while the office building is clad with architectural panels with a finish that replicates the appearance of stone above the second level, with granite cladding embedded in panels on the first two levels. The only solid stone on the project was used for the stone pillars across the front of the courthouse.

Precast concrete also helped meet the "aggressive" schedule set for both design and construction phases, Sisco notes. "Precast was instrumental in getting the building enclosed quickly and watertight in an efficient way. We were really happy with how the precast concrete worked on the façade."

> 'The integration of steel with the precast concrete was accomplished using BIM to design the pieces and then following that design to fabricate the steel framing.'

The panelization was aided by the use of Building Information Modeling (BIM). "The integration of steel with precast concrete was accomplished using BIM to design the pieces and then following that design to fabricate the steel framing," says Louden. "The subcontractor created a model of the steel with haunches applied for the precaster, and the precaster could then take that model and align his connections in the right spots before casting. It was a dream come true to be able to integrate systems so thoroughly."

"We worked out everything in the BIM before fabrication began, so clashes in the field were minimal," says Sisco. "Gage was able to design to the shop-drawing level, so they knew exactly what was needed for the connections and panels." The BIM processes worked so smoothly that the project received a national award from the American Institute of Architects for BIM Technology in Integrated Design.

CUSTOM THICKNESS CREATED

The panels required 4-inch offsets in the face to allow for the desired articulation, but adding these made the panels too heavy for the tower crane. To resolve this, the precaster designed a custom panel that was 6 inches deep. This depth provided the desired look of the panel stepping in and out while maintaining the same depth to control the weight of the panel.

"We took special care on the coursing of the stone and the way it wrapped around corners," says Fentress. "We worked it out well in advance to ensure it would be done efficiently." Adds Louden, "Aesthetic efficiency was a key aim for our design. We wanted the stone to turn

CONSOLIDATED SPACE
The complex consolidates seven judicial and legal agencies that had been leasing space in 10 locations. Photo: © 2013 Jackie Shumaker.

the corner, and that took more work in detailing than we had anticipated, because that detailing can be difficult. By having the precaster on board early, we could work it out to the extent that it's difficult to tell that it is precast and not stone."

In some cases, the panels were delivered to a staging area on the way to the site where the spray foam insulation could be applied in advance, as it would have been too difficult to reach some portions once the panels were erected. The insulation, along with precast concrete's inherently efficient mass and other attributes, helped the project achieve LEED Gold certification.

The precast façade also aids with blast deterrence, Cannon says. "Although the building was not designed for actual blast events, the owner is relying on the visual durability and solid natural presence of the precast concrete as a deterrent to threats."

The erection moved smoothly, with 1,200 pieces erected in 4 months. As many as four crews worked simultaneously on the site. A nearby staging area was used to deliver the appropriate panels as needed. "Any project downtown will have challenges maneuvering material," says Louden. "The contractor worked closely with the city and traffic engineers to close lanes as needed for the shortest time possible."

The prefabricated nature of precast concrete helped minimize site congestion. "The more work you can prefabricate on downtown jobs, the better it is," Louden says. "It can be hard to get labor onto the site and have room to do their jobs. Precast lent itself well to alleviating site activity."

A separate mobile crane was used for heavier pieces that could not be set with the tower crane. "The heavier pieces were more challenging, but they were definitely worth it due to their overall speed of erection and efficiency." Adds Sisco, "There were some heavy picks in congested areas, but it was a much better way to get it done quickly at a lower cost than any other proposal."

The panels were erected floor to floor, but also were supported column to column to provide sufficient load transfers. The office building was erected first, followed by the courthouse.

The CMR format aided the project's efficiency, and Louden expects they will see more of it in the future. "Public entities are using more types of approaches to project delivery today," he says. "The best one depends on the owner's appetite for risk. But the federal government really embraces design-build and sees the benefits. Colorado is now using it, and other states are coming around."

Adds Sisco, "This project could not have been done so efficiently without bringing Gage in at an early stage to work out the details. It worked really well. It turned out beautifully."

STONE LOOK
Granite was embedded in to panels on the first two levels, with finishes replicating stone used on upper levels. Photo: © Steve Maylone.

AN INTEGRATED SOLUTION FOR

Insulated Precast

Photos courtesy of U.S. Department of Energy

About Thermomass

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

Innovative Products
From the smallest office to the largest stadiums and everything in between, Thermomass offers a complete selection of concrete insulation and advanced fiber-composite connectors.

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

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

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SPOTLIGHT

NREL Energy Systems Integration Facility

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

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

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

thermomass®

1200 INTREPID

LOCATION
Philadelphia, Pa.

PROJECT TYPE
Speculative office building

SIZE
94,000 square feet

COST
$18.8 million

DESIGNER
Bjarke Ingels Group, New York, N.Y.

OWNER
Liberty Property/Synterra L.P., Philadelphia, Pa.

STRUCTURAL ENGINEER
Environetics Design Inc., Philadelphia, Pa.

CONTRACTOR
Turner Construction, Philadelphia, Pa.

PCI-CERTIFIED PRECASTER
High Concrete Group LLC, Denver, Pa.

PRECAST COMPONENTS
421 architectural panels, typically 15 feet tall by 5 feet wide by 12 inches thick (for east façade panels) or 8 inches thick (for other three sides)


Photo: Rasmus Hjortshoj.

PRECAST CONCRETE CREATES 'SHOCK WAVE'

BIG's iconic precast façade of the Intrepid office building features cantilevered curves facilitated by the precaster who worked out details in advance as a design-assist partner

— Craig A. Shutt

As you approach the structure, the façade comes to life, rippling and curving as the colors dance around the building, responding to the sun and the clouds. The "shock wave" that appears to have hit the façade from the circular park in front generates a sense of wonder and awe at 1200 Intrepid at the Navy Yard in Philadelphia, Pa., a building with a unique response to its specific location.

"The building definitely addresses the site," says Kai-Uwe Bergmann, principal at Bjarke Ingels Group (BIG). "In many cases, architects design big, boxy buildings that could be placed anywhere and don't connect directly to the site. You would really be hard-pressed to place this building anywhere else other than where it is, due to how it connects. We like to think about a building beyond its borders and look at how it interacts with its neighbors and the open spaces around."

The 94,000-square-foot, four-story building is located at the Navy Yard's Corporate Center in Philadelphia, a master-planned development within the Navy Yard encompassing approximately 1.35 million square feet. The center offers state-of-the-art, sustainable facilities to various tenants and also creates build-to-suit office space. The properties are owned by joint venture Liberty Property/Synterra LP. During the past 11 years, the partners have developed 10 properties in the center, investing $233 million. The Navy Yard also has developed four buildings with an additional investment of $67 million.

'The "shock wave" of the public space spreads like rings in the water, invading the footprint of the building to create a generous urban canopy at the entrance.'

"The Navy Yard is undergoing a major transformation from its military background to an office park and neighborhood," Bergmann explains. "Our commission involved creating a speculative office building, for which no tenants were committed. Part of our job was to create a reason for tenants to want to be here." But that had to be accomplished on a budget under $200 per square foot. "Designing speculative office space with the constraint of a stringent budget was the key challenge," Bergmann says.

"Our design for 1200 Intrepid has been shaped by the combination of Robert Stern's urban master plan of rectangular city blocks and James Corner's iconic circular park," explains founder Bjarke Ingels. The master plan laid out a circular park in front of the building, with roads on either side leading to the entry. BIG suggested curving the roads around the park to emphasize its shape. "That then created the idea in my head of curving the building to fit the space on a grand level," explains Ingels.

PUBLIC 'SHOCK WAVE'

"The 'shock wave' of the public space spreads like rings in the water, invading the footprint of the building to create a generous urban canopy at the entrance," explains Ingels. "The resultant double-curved façade echoes the complex yet rational geometries of maritime architecture. Inside, the elevator lobby forms an actual periscope, allowing people to admire the mothballed ships at the adjacent docks."

The master plan called for a rectilinear design overall, so the building flattens out on the top floor. "The impetus for the curve of the façade came from the curve of the park and the roads in front of it," Bergmann says. "But we also wanted to be truthful to the master plan as well as to the site plan." The exact shape of the "shock wave" curve was inspired by the curved bow of the battleships docked a few blocks away.

INFLUENTIAL CURVES
The curve of the building's façade was influenced by curve of the ships docked in the Navy Yard. Photo: Rasmus Hjortshoj.

The park, Bergmann notes, offers "a beautiful amenity for the Navy Yard, and it takes the site from being an ordinary office park to being something special. It helps to create the feel of a neighborhood that you can hang out in. We wanted to have a building suited to that environment."

The goal was to connect the people with their environment. "The sidewalk starts to become a part of the building," he relates. "You can almost see the front of the façade as the result of a 'shock wave' that comes off the circular park and creates a double-curved impact on the façade at the entrance to the building."

PRECAST CONCRETE EXPERTISE

To achieve this concept, Bergmann turned to architectural precast concrete panels, a material BIG uses frequently, especially in its homeland, Denmark. "We are a Danish company, and in Denmark, precast concrete is the predominant building material," he says. "We use it for structural elements, decorations and fascia, and façade pieces of all kinds."

He estimates that 80% to 90% of Danish projects include precast concrete. Danish architects often arrive at that solution due to the long, cold winters. "Designers have realized in the past 60 or 70 years that precast concrete can be cast indoors, all year round, under very favorable conditions, which also gets more of the work off-site." Previously, firms relied on masonry for many projects. "But now precast concrete has been found to be a much better option."

DOCK VIEWS
The atrium of the building features an angled mirror that reflects views of the nearby Navy Yard. Photo: Rasmus Hjortshoj.

BIG arrived in the United States in 2010 and received the commission for this project in 2012. “We came very quickly to the idea that precast concrete would be a great way to achieve our goals.”, says Bergmann.

Precast concrete’s plasticity played a key role in that decision. “It has an industrial feel, but if you have a deft touch, it allows the design to flow smoothly,” he notes. “We see precast concrete as providing an opportunity for creativity.”

That creativity was encouraged by his early interest in various material capabilities and his questioning of how they could be pushed further. “I started my career actually working as a carpenter, stone mason, and glassblower, to learn and respect the trades that I as an architect would work with,” he says. “I saw a certain inventiveness in those materials, the same inventiveness I remembered from playing with LEGO blocks as a child. You have certain specific pieces, and you use the creativity of a child to create any kind of shape you want.”

Bergmann retained that inventiveness as he began using these materials in his architectural designs. “That is what is most exciting,” he says. “When you design with precast concrete, you have certain shapes you work with, but then the architect can unleash his creativity with those shapes. We can take that limited pallet of shapes and sizes and create almost any shape or feel that we want.”

BIG has done other designs with curving, geometric designs in precast concrete, he notes, including the 40th Precinct Police Station in the Bronx, N.Y. But Intrepid offers the most dramatically flowing shape, which required significant cantilevering and structural-load analysis. “We’ve done other designs using these cantilevered concepts that push and pull at the envelope,” he says. “It’s all about addressing the site in the best way and then accomplishing that with the material.”

‘When you design with precast concrete, you have certain shapes you work with, but then the architect can unleash his creativity with those shapes.’

REFLECTED SHOCK
The building was designed to address its site, with the curving roads in front of it representing a “shock wave” that impacts the façade. Photo: Rasmus Hjortshoj.

This cutaway shows how the office space adapts to the curving façade. Photo: Bjarke Ingels Group.

DESIGN ASSIST PROVIDED

To accomplish that, Turner Construction collaborated with the precaster, High Concrete Group, on a design-assist basis early in the design process. "We have had 15 years' experience working with precasters, and we know the dos and don'ts," he says. "High came onto the project with the general contractor, after we had completed the design concept and were working on construction documents. But even at the shop-drawing level, we were still refining the design, so they had input into how to create efficiencies by adapting the design to fit how they could accomplish things best."

The adaptations at the design stage factored in every detail possible, including how panels could be transported to the site and what design techniques could be used on the panels to protect their chamfered edges from damage during handling. "Those are important pieces to consider as early as possible to ensure they are accounted for."

TIGHT CORNERS
Only the front façade curves, creating challenges in matching its design to the three flat sides. Photo: High Concrete Group.

Was High shocked by the concept of the "shock wave?" "High's team reacted the way most people do when they are asked to use their brains and see potential for growth as a person and a professional," Bergmann says. "They saw it as a wonderful experience. It's true that not everyone would enjoy that idea so much, but High's team jumped on it as a chance to show off their skills and products."

High's team recognized the significant challenges and were intrigued by how they could be met. "We were brought onto the project after its aesthetic design was decided," says David Bosch, design team leader at High. "But structurally, it was all ours, with the provision that we weren't allowed to transmit gravity loads to the steel frame. That made for an interesting project to erect and to ensure against a progressive collapse."

Most of their attention focused on the curved east façade, adds Matt Krebs, High project manager. "Three elevations were cut and dried, but we realized the cantilevered and sloped elevation had a lot of issues involving joint spacing and alignment to ensure the panels would meet up smoothly and could work with each other across the façade. The key challenge was how to orient the panels so they could achieve the look but still ensure they would close themselves together tightly at each connection."

BIG came to High's team and said, "Here's what we want to do," Krebs relates. In return, High's engineers said, "Here's where we think there will be problems with that." "We had a lot of iterations back and forth with BIG to achieve their goals and maintain efficient constructability of the design."

BIM ADDED ADVANTAGES

Designing with Building Information Modeling (BIM) aided the process of working through the details. "It wasn't universally used then, but we have now transitioned and use it on every project," says Bergmann. "It's not a proprietary system, it's part of any CAD system, and it aids the process a great deal. We think most companies will have to transition to using it to be able to live up to the new designs that are being created."

'The key challenge was ensuring that the curving precast concrete panels could align properly.'

General contractor Turner Construction was a part of that program. "We were involved from the bidding process on, and we worked with the BIM designs," says Bill Swanson, project executive. "The key challenge was ensuring that the curving precast concrete panels could align properly, and the 3D model allowed us to see how to make that happen."

"High's company policy today states that every design will be created with BIM," says Krebs. They also are encouraging the outside engineers they work with to make the transition. "There are big advantages

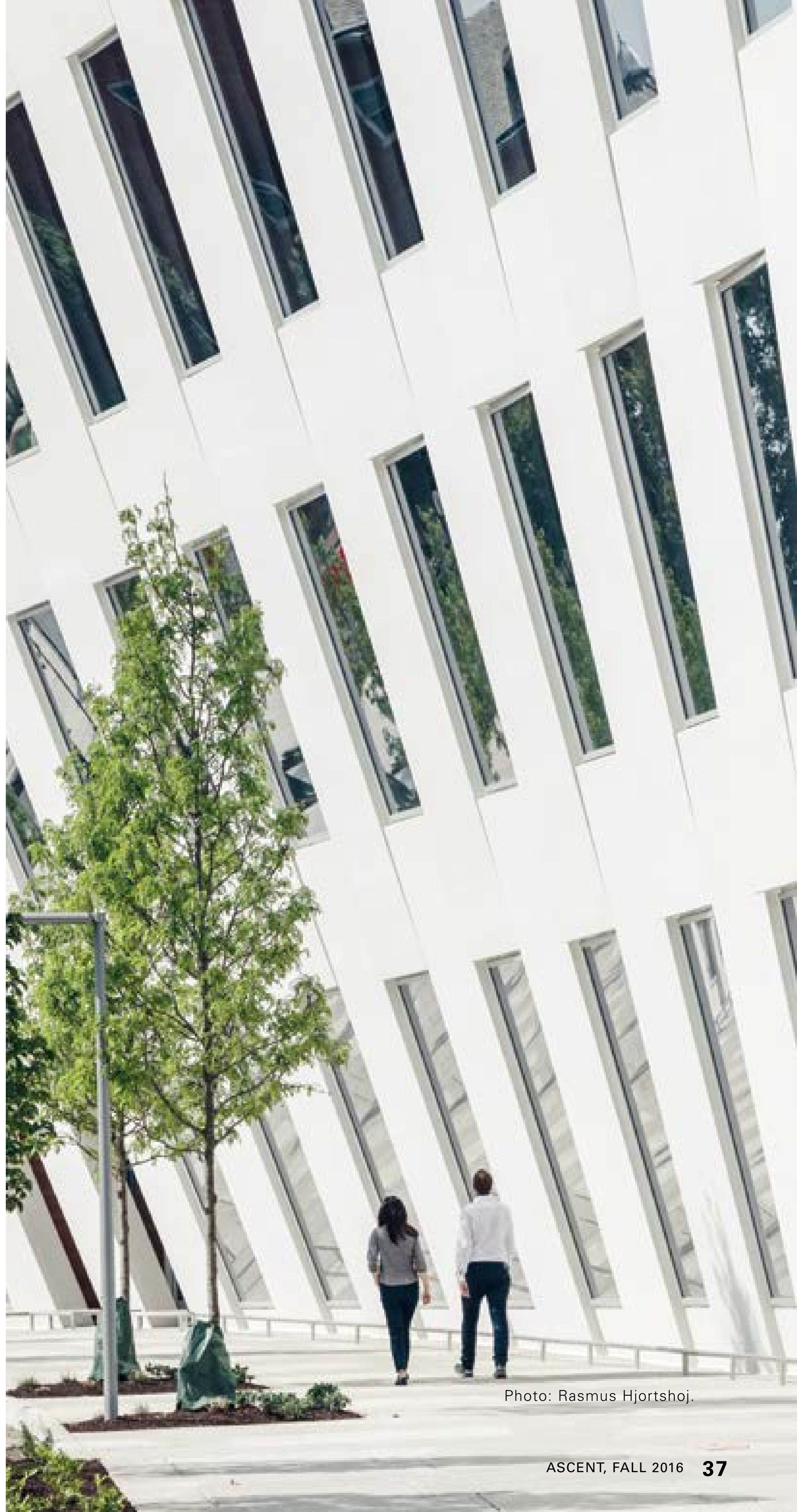


Photo: Rasmus Hjortshoj.

HOOK 'EM
Hook attachments at the top and bottom of the panels allowed them to be placed into the exact location for connection. Photo: High Concrete Group.

REACHING THE SUMMIT
Shorter, square panels were used to finish off the alternating pattern of panels at the roofline. Photo: High Concrete Group.

that come from using 3D modeling," he says. "It gives us advantages in visualizing and anticipating loads and connections. I really don't think we could have done this project with two-dimensional models."

There can be a steep learning curve to using it thoroughly, he notes. "But we learned it and now we use it on every project." It especially helped to work out the lateral connections that were critical to the design of the curves. "They were fairly typical, but they had to be slightly modified in each case to adjust to the curve."

'It really makes it feel as if the wall moves as you walk toward and along it.'

Casting the panels for the east façade proved especially challenging, as each had its own curve and slant with different chamfers on the edges. "The lack of repetition was an unlikely situation for a precaster, as repetition is our bread and butter," notes Krebs. However, the other three sides had enough economy in their shapes to make it effective. "Three sides of this building were a piece of cake," says Swanson. "They could be cast like a cookie cutter. But the east side required more attention."

The panels are typically rectangular in shape (before twists and curves), measuring 15 feet tall and 5 feet wide, with four panels forming the outline of each similarly rectangular window. The windows alternate up the façade, leaving the panels to zig-zag around them as they loom over visitors. "Each of the pieces is faceted and is very different," Bergmann explains. "It really makes it feel as if the wall moves as you walk toward and along it, while the glass reflects the sky's changes as the clouds and color change during the day. It makes it feel alive in that moment, which will be different from the next time."

LOADS FLOW TO GROUND

An additional challenge came from the requirement that, as the panels cantilevered and swerved around the windows, their loads had to bear to the ground rather than load onto the steel framing behind them. "The steel-strut system was designed to hold them in place but not to bear their load," Bergmann explains. "That was necessary to allow them to flow properly. It required extra thinking, but it also made it a lot of fun."

The panels were designed to appear to be 11 inches thick, but the backs were partially hollowed out, reducing their thickness to 4.5 inches at the face to minimize the weight. The panels' backsides feature thick metal bars, about 4 inches wide by 14 to 16 inches long and 1.5 inches thick, which tie each panel to the adjacent ones. The loads then transfer back and forth as they flow to the ground. "It's not that unusual of a concept, but the cantilever puts more stress on the panels than is typical," Swanson says. "It ensures all the stress stays in the panel."

"There was more load than we had anticipated initially, but it wasn't difficult to control," Krebs says. The panels feature overdesigned shear bars and thicker bearing plates than is typical. "They're really not that unusual."

Precast concrete sandwich insulated panels were considered, Bergmann notes, but their thickness and interior insulation would have limited the curvatures that could have been achieved. Instead, the panels were sprayed with insulating foam after erection. The panels have only a 4-inch structural framing that allows them to appear thinner at window penetrations when inside the building. All of the panels received a light sandblast finish.

SPOT WELDING
The precaster and erector spot-welded the connection plates onto the steel frame by referring to BIM drawings so they were in place before panels were erected. Photo: High Concrete Group.

CUSTOM TOUCH
Each panel on the curved façade required a personal, customized fit to ensure it fit perfectly into its assigned spot. Photo: High Concrete Group.

"The windows serve as gaps in the panels," Bergmann explains. The walls protrude slightly beyond the windows, he notes, creating a little shade with their thickness. "The precast wall serves as a rainscreen and shading device. We wanted to ensure we could provide large window openings so from inside the rooms didn't feel like Swiss cheese. But we also wanted a sweeping façade. When you are there, you're surprised by the size of the panels, but you're also surprised by the size of the windows."

SITE OFFERED EASY ACCESS

The site offered easy access with room for staging, Swanson says. "The Navy Yard worked with us well to close streets as quickly as possible for the time needed, and we used that time efficiently." Three sides of the building provided easy access for cranes, while the fourth side abutted a road.

The erection process moved smoothly, at least once all of the details of how to erect the panels on the east façade were worked out. The steel frame was erected first, and then the precaster and erector laid out their weld points, referring to drawings of the actual panels that would be erected in each position and using high-reachers to then spot-weld the plates prior to any erection.

"We spent 1½ months working with the erector to plan out the locations of the welding points," Krebs says. Adds Swanson, "The connection points for the entire building were laid out for real, rather than by referring to drawings and putting in weld points, which is not the typical approach. But they wanted to avoid any risks of mistakes in the drawings from transferring to the frame and requiring adjustments during the erection process."

Each panel on the east side required a personal, customized fit. Hook attachments were embedded in each panel at the top and bottom. Once the panel was hovering in its approximate placement location, a come-along was used from behind to pull

FINISHING TOUCHES
The close attention to detail throughout the project—which met budget and schedule—resulted in a building with a dramatic sense of movement. Photo: High Concrete Group.

the bottom into position so it could be welded in place, then the top was attached.

"The orientation for each panel changed, so there was no constant to work from," Bosch says. "The location of the panels was accomplished by assigning points at the corners of each panel in the model and transferring those digitally via a file to the building. This was the only way to locate them with accuracy." Adds Krebs, "There was a lot of theory-based work, but it worked out perfectly."

In fact the erection went faster than anticipated. "Those panels really flew up there," says Swanson. "It was all about getting the engineering and the 3D modeling complete and correct. Once it was done and approved, the actual erection just went." Bergmann was pleased to see that no field adjustments were needed as the panels went up.

LEED GOLD CERTIFICATION

The project was targeted to achieve LEED Gold certification, and the precast concrete panels helped reach that goal. They enhanced energy efficiency with their dense mass and provided a variety of manufacturing benefits. These included local manufacture using local materials, use of recycled and recyclable content, and reduction of construction waste.

As a final touch relating to the Navy Yard's pedigree, the roof of the building's lobby features a "periscope" that emphasizes the building's location near the river. "The coolest and most beautiful part of this center is that it is only a few blocks away from the ships at rest," Bergmann explains. To take advantage of this, an angled mirror that reflects the ships at dock to those who look up was screwed into the substrate on a supporting frame along the roof inside the lobby atrium.

Such amenities add to the dramatic sense of movement and wonder evoked by the façade as visitors approach. "The panelized façade is unique, but it still managed to hold to budget," Bergmann stresses. "It shows that you don't have to dumb things down to hit your budget. You can think intelligently about what you want to do and work closely with the team members to do the work efficiently."

Krebs agrees. "This was by far the most unusual façade we've ever produced. It became more and more impressive to us as we erected the panels and saw it taking shape and fit together perfectly. It was definitely exciting to watch it go up. It's still very impressive for us to see it, even after it's done, and we know exactly how it's loaded."

BIG will continue to create impressive designs using precast concrete, Bergmann says. It's currently completing several projects with the material. They include the Faroe Islands Education Center near Tórshavn, Faroe Islands, which combines a high school, technical school, and business school, as well as the "Hualien residences" in Taiwan, a 1,000-square-meter show home for a residential development that emphasizes the surrounding nature. Projects in the United States. also are on the drawing boards.

"Precast concrete is our go-to product," Bergmann says. "We are working on projects in eight states now, and we will be using precast concrete whenever possible."

‘big room’ collaboration

FACILITATES PRECAST HOSPITAL DESIGN

Eleven-member Integrated Project Delivery agreement provides in-depth communication that cut the schedule by 30% for new hospital

— Craig A. Shutt

Integrated Project Delivery (IPD) is gaining attention and popularity by encouraging in-depth team collaboration, which leads to fast delivery, ease of budgeting, and high-quality design and construction. This approach was used by an 11-member team that entered into an IPD Agreement with a stated goal of delivering the Sutter Medical Center in Castro Valley, Calif., on budget and 30% faster than comparable projects. A key element in achieving that goal was the façade’s use of preassembled precast concrete panels and glass-fiber-reinforced concrete (GFRC).

‘How we deliver design and construction in a normal contract is somewhat broken.’

"In my opinion, how we deliver design and construction in a normal contract is somewhat broken," says Ralph Eslick, senior project manager at DPR Construction, the general contractor on the Sutter Medical Center project. "It adds construction time, cost, risk, and makes it difficult to foster teamwork. Decisions get made that prove costly for others on the team. With an IPD, we all work together to minimize costs for everyone."

Working together arises through necessity. The firms signing the proposal agree they will be compensated for all labor, materials, and overhead at cost, and they will receive an additional percentage of the profits. "All profits are at risk for all of the partners if the project comes in over budget," Eslick explains. That encourages them all to find cost-effective approaches for everyone involved. "Companies can’t lose money, as their costs are guaranteed," he explains. "But they may work for several years on a project and not make a profit if it’s eaten up by changes and unforeseen adjustments. It creates a better way to disperse risk."

Andrew Flanigan, director of design for Devenney Group Ltd., the architectural firm on this project, notes that the collaboration speeds documentation. "IPD provides a better way of planning and produces a more logical process," he says. "You don’t have to complete everything before releasing each document. You can sequence the work much faster in smaller segments."

SUTTER MEDICAL IFOA

For the Sutter Medical Center, the 11 members signing the Integrated Form of Agreement (IFOA) committed to designing and constructing a 130-bed, $320-million hospital featuring a highly efficient

Photo: Clark Pacific.

IPD EFFICIENCY
The IPD delivery method cut the permitting process in about half, a key concern for medical centers. Photo: Clark Pacific.

model for clinical care centered around the patient. The IFOA required the group to work collaboratively, use Building Information Modeling (BIM) technology for designing, and implement Lean construction practices to eliminate waste.

Once the agreement had been worked out, costs were established. "We committed to the pricing before we had any design documents," says DPR's Eslick. "It was an abnormal way to go about it, but we could do it because the client guaranteed we would never be out of pocket."

The agreement was developed in part due to the strict review and permitting practices used in California, which often added years and expense to the construction of health facilities. "We have often created designs for proposals and then put them on the shelf for more than a year before we could progress," says Sam Argentine, senior project manager at Clark Pacific Inc., which fabricated the precast concrete and GFRC components.

The process was aided by a phased-review system created by the state's Office of Statewide Health Planning and Development to accelerate the permitting process. The process cut the review time in approximately half, to 12 months. "The medical center we did previous to this one took 7 years from start to finish," Argentine notes. This one took approximately 3 years. "It went considerably faster and was easier to get moving."

'BIG ROOM' MEETINGS

The collaboration process for the 11 partners—as well as for other subcontractors not directly in the agreement, such as Clark Pacific—centered on meetings in what was termed the "Big Room." The room served as the nerve center for planning and featured walls filled with schedules, sticky notes with each activity and deadline, smart boards, wall-to-wall white boards, and other collaborative planning resources.

MATERIAL VARIETY
A variety of materials, including preassembled precast concrete panels and GFRC, reduce the visual size of the facility. Photo: Clark Pacific.

The room was necessary due to the team's dispersed locations, providing few opportunities for everyone to collaborate in person at the same time. The core team met in the Big Room for 3 days every 2 weeks to review the design, assess the schedule, outline and identify every element of the workflow, and update the project budget. Not everyone was needed for all meetings, but it was difficult to always know exactly who would be needed, as various activities would begin to affect an unexpected area, the participants said.

"Colocation is a key part of IPD collaboration, but participation and scheduling of colocations has become the big battle today," says Eslick. "It's a key part of the process, but with the variety of telecommunication options today, there are more opportunities for participating via long distance."

'Participation and scheduling of colocations has become the big battle today.'

The Big Room participants blocked out each project activity from design through construction. That allowed them to envision how each element impacted the others and ensured each activity began at the appropriate time to reach the scheduled delivery. "We could then identify the individual activity needs for each floor plan before releasing documents," says Flanigan. "The process advanced incrementally in the design phase and then pushed forward on steroids in construction."

The precaster, Clark Pacific, was brought in on a design-assist basis to ensure input was received to avoid later issues. The IFOA was concluded before decisions were finalized on how the building would be clad, Eslick explains. Adds Flanigan, "Once Clark Pacific came on board, we had schematics of the exterior ready for us to review for their combination of GFRC and precast concrete. They aided us with workflow planning from design through construction."

Clark Pacific visited the Big Room regularly, Argentine reports. "We came in every few months to answer questions about framing and working out potential interferences between components." Adds Flanigan, "We held clash-detection sessions to avoid conflicts with embed locations and attachment issues." Says Eslick, "Clark Pacific was very helpful to the design, and a big team player even though they weren't one of the IFOA signatories."

BIG ROOM
The members of the IPD team met in the Big Room for 3 days every 2 weeks to review the design and assess the schedule. Photo: Devenney Group.

Lessons Learned

Having gone through the IPD process, the team listed a variety of lessons that came out of it in its report on the experience:

1. Plan and Replan. Adapting plans is critical as new information and feedback is received. Careful planning of tasks and the team's ability to identify the last responsible moment to release work for production allows the design to evolve with as little rework as possible. This approach results in a highly coordinated design that takes less time and resources.

2. 3D Model-Based Coordination is Critical. Collaborative 3D modeling during the review process is vital to identifying and resolving all of the hundreds of cross-discipline design issues as early in the process as possible, much before a 2D process could do it.

3. Target Costing Improves. As the team aligns its assumptions and gains confidence in the coordinated design, the budget will trend down toward the target cost without compromising any of the owners' goals.

4. All Design Changes Are Major. Changes that one partner considers minor can cause significant problems as they ripple through the process. The Sutter team had to break away from the traditional design-then-check workflow to create a more proactive approach in which potential changes were communicated to the cross-discipline team. That allowed options to be explored earlier and solutions with the least cross-discipline impact were chosen.

5. Share Incomplete Solutions. It is acceptable and actually better to share an incomplete solution rather than wait until the design is completed to address them. Sharing incomplete solutions generates more feedback from the team and encourages earlier thinking about issues, which saves having to return to rework a design after completion.

RANDOM PATTERNING
Projections were created by casting panels in different sections of an enormous formliner, placing them in different locations in various panels. Photo: Clark Pacific.

COLLABORATION TOOLS

The team developed a series of tools to aid their collaboration. A key one was the Value-Stream Map, which documented all workflow steps. As it was developed, team members discussed their understanding of the design and their part of it. That led to determining how each element connected to others.

Planning evolved as new tasks were added, existing tasks were made more specific, and some tasks were eliminated or combined into others. The workflow steps were color coded with sticky notes to classify tasks by source and activity. "We focused on specific task activities rather than the traditional approach of tracking by high-level milestones," says Flanigan. "The entire team was there for each planning session, so they could see how each change impacted their own responsibilities."

BIM played a key role and in fact was required by the agreement. A variety of software programs, including Revit, CAD Duct, CAD Pipe, AutoCAD Civil 3D, AutoCAD MEP, CAD Sprink, XSteel and Navisworks were used. The designs progressively expanded. They were split between interior and exterior models, then interior models were split by floor. Once this mapping was completed, the estimators and BIM engineers could estimate costs closely and share cost variations quickly.

To assist in coordinating the various trades, the steel subcontractor modeled all elements in the building-skin system that connected to the structural steel. A software toolkit was developed for use by the steel subcontractor and others to produce a standardized model that was accessible to everyone. The toolkit included standard reports, drawing templates, API interfaces for RFI creation and management, visualization tools, and other resources.

> More than 25% of the wall penetrations were moved or removed due to conflicts in rebar placement apparent in the modeling.

More than 25% of the wall penetrations required by the precast concrete design were moved or removed due to conflicts in rebar placement that became apparent in the modeling.

The panels were cast and delivered to the site for immediate erection as the schedule required, eliminating site congestion. Photo: Clark Pacific.

GFRC AIDS SEISMIC DESIGN

GFRC and Clark Pacific's assembled panels were chosen to clad the building due to restrictions imposed by the seismic zone and the desire for speedy construction, says Flanigan. "GFRC was lightweight enough to work in the seismic zone without issues, which was not true for other similar materials. It made a lot of sense to get a monolithic look, and the ability to prefabricate so many components of the system into one panel was a big help."

The Clark Composite Architectural Precast Panels (C-CAPP) offer a durable, lightweight, low-maintenance, hybrid cladding system. It consists of a 2-inch-thick concrete skin mechanically attached to a steel frame, with insulation added behind. The panels weigh approximately 30 pounds per square foot and can accommodate ½-inch deep reveals along with small bullnoses and returns. The system is designed, fabricated, installed, and warranted by Clark Pacific.

The C-CAPP system was used to clad the building's two towers and features a split-faced stone appearance created with a custom formliner. A 6- by 10-foot rubber liner was cast onto stone, from which a positive was made in clay, providing the base for the formliner used to cast the pieces. Each formliner was designed for a one-time use, Argentine notes. A white concrete mix allowed the towers to stand out against the blue-tinged glass and aluminum curtain wall alongside.

Four metal fins were attached via embeds into the tower, each progressively longer than the higher one, extending out as the panels angle outward. "We coordinated the sloping pieces with the curtain-wall subcontractor to ensure the interface would connect perfectly," says Argentine. Metal tubing was added behind the panels to allow attachment to the steel framing.

The panels were cast in a maximum size of 15 feel tall by 32 feet wide. "The panelized system helped speed construction," says Flanigan. "We could erect very large sections at once and enclose the building quickly."

The GFRC panels serve as a base for the facility, cladding the two three-story buildings that intersect with the tall towers clad with C-CAPP and the blue curtain wall and a second glass storefront-clad tower on the opposite end. The panels feature a brown integral color finish with rectangular shapes projecting out in random patterns.

The precast panels, which weigh 30 pounds per square foot, feature a concrete skin attached to a steel frame, with insulation added behind. Photo: Clark Pacific.

RANDOM FORMLINER USED

Although random in appearance, the panels were cast in one enormous 23- by 45-foot formliner with the rectangular projections spread randomly throughout the formliner. The architect then selected sections of the liner in

Core Strategies

The team identified a number of strategies that can help achieve project objectives easier:

1. Project as Laboratory. The team remained open to trying new technologies and software that would help it adopt the best options to meet the project's goals.

2. Understand the Process. Before starting the design, the team allocated adequate time to plan the design process. Value-Stream Mapping detailed the workflow steps at appropriate levels of intricacy to create meaningful cross-discipline discussions and reduce rework loops.

3. Manage by Commitments. Once flow of value is understood via Value-Stream Mapping, members made commitments to each other to complete the specified activities and remove constraints downstream.

4. Maximize Off-Site Fabrication. Working with trade partners to assemble components away from the site under controlled conditions in a plant increased efficiency and enhanced the construction schedule.

5. Leverage BIM. BIM was used to provide constant coordination, share information, and increase the reliability and certainty in the design so it could be used directly for fabrication and preassembly.

6. Cut Rework with Direct Digital Exchange. Information was reused rather than recreated whenever possible. This was especially helpful for model-based estimating, detailing, coordination, automated fabrication, and scheduling.

7. Access Real-Time Information. All team members could access the most recent project information at any time, regardless of where the information was created or stored.

Some of the panels include a sloped right-hand face to fit against the slope of the curtain wall's left-hand side. Photo: Clark Pacific.

which different panels would be cast. "We cast pieces in different parts of the form every day based on the architectural design," says Argentine.

"It was a lot of fun to create a new pattern every day," says Flanigan. "The rectangles pop in and out, and we could make them random across the face with no repetition by using different parts of the form and casting some panels upside down from others. It was enjoyable to develop that with Clark Pacific and see the results."

'Traditionally in our industry, too many projects end up going to arbitration and mediation, which costs everyone time and money.'

The project progressed efficiently and met its target dates and costs. "This project should encourage more owners to try an Integrated Project Delivery approach," says Flanigan. "It forces a team atmosphere in which everyone benefits through collaboration and concern for the entire process. Everyone has skin in the game for profit and risk."

Eslick agrees. "Traditionally in our industry, too many projects end up going to arbitration and mediation, which costs everyone time and money. On an IPD project, we all work to minimize costs for everyone." That doesn't work for everyone, he notes. "Each company has its own business model, and some may not be able to make IPD work for them and retain profitability."

Flanigan notes that Devenney has added some of the practices it learned in this project to virtually every project it now works on, regardless of delivery method. Those activities include 3D collaboration, coordination of BIM modeling, and pull planning.

Eslick expects IPD to grow in appeal. "It's going to become much more popular, but it will be a long process to convince everyone of the benefits that come from adapting to it," he says. "I compare it to wearing a hardhat on a project, which I started doing in 1976. It took until 1988 for it to be a common thing. Today, I wouldn't dream of not wearing one, and if I saw someone on a site without one, I would think they were doing something dangerous. This may be the same progression that IPD follows."

INTERNATIONAL ACCEPTANCE
PCI's IAS accreditation ensures its quality-certification process aligns with international best practices.

PCI PLANT CERTIFICATION PROGRAM GAINS

IAS Accreditation

International Accreditation Service now accredits PCI Plant Certification Program, increasing credibility and awareness for industry stakeholders, code officials, specifiers and international authorities

— Craig A. Shutt

After several years of preparatory work by both committee members and staff at the Precast/Prestressed Concrete Institute, the organization has achieved accreditation from the International Accreditation Service (IAS). It has accredited PCI's Plant Certification Program, which now is managed in accordance with IAS Accreditation Criteria (AC) 477 and ISO/IEC 17021 *Conformity Assessment – Requirements for bodies providing audits and certification of management systems.*

"IAS provides objective evidence that an organization operates at the highest level of ethical, legal, and technical standards," explains Dean A. Frank, PCI director of quality programs. The group is a subsidiary of the International Code Council (ICC), which develops the construction codes and standards used by most municipalities. The three driving tenets of the accreditation procedure are "Competency, Confidentiality, and Impartiality."

PLANT CERTIFICATION COVERED

The accreditation covers PCI's plant certification and does not extend to its Erector Certification or Personnel Certification programs currently, Frank notes. "Our focus has been on meeting the quality-management needs that satisfy the PCI's criteria for the manufacture of precast concrete products and revising our certification requirements to bring them in alignment with worldwide best practices."

Those efforts have included developing a comprehensive Quality Management System Manual and the requisite supporting operating-procedure documents, along with revising PCI Policies governing plant certification, and developing standardized competency and evaluation requirements for PCI staff, committee members, and plant auditors. In addition, a new committee on Safeguarding Impartiality was established to enhance confidentiality and impartiality requirements.

"Our goal in attaining IAS accreditation was to ensure all processes associated with PCI's quality-management system certification process fall in line with internationally accepted best practices and to ensure continuous improvement of the PCI Plant Certification program," Frank says. "Accreditation provides objective validation of PCI's commitment to providing top-quality certification programs that reassure specifiers and provide owners, designers, engineers, and contractors with the high-quality products that help them do their jobs and grow the industry."

Who is IAS?

IAS is a nonprofit, public-benefit corporation providing accreditation services since 1975. A subsidiary of International Code Council (ICC), it accredits a range of companies and organizations, including governmental entities, commercial businesses, and professional associations. It acts similarly to a registrar and has more than 900 accredited entities worldwide. IAS accreditation is based on recognized national and international standards that ensure domestic and global acceptance of its accreditations.

ALL GAIN BENEFITS

IAS's independent accreditation of PCI's plant certification procedures provides everyone on the construction team with more assurance that the products will perform as anticipated, with tighter tolerances, precise mix designs, and long-term quality.

"It provides a tool for specifiers who can write into their specifications that PCI-Certified products must be used, thus ensuring they receive exactly the products they need," Frank explains. "PCI-Certified Plants devote significant resources to maintaining their certification, and they want to be certain they receive the most benefits possible from that effort. PCI-Certified Plants are held to high standards, and it's only appropriate that PCI also is held to a high standard. This accreditation process verifies those standards, essentially providing "certification" of PCI's certification process."

PCI sought to achieve multiple goals with this accreditation. They include:

- Ensuring all processes associated with the quality-management process fall in line with internationally accepted best practices.
- Providing a tool to ensure continuous improvement of the PCI Plant Certification program.
- Maintaining and increasing credibility with design professionals, code officials, and authorities having jurisdiction.
- Providing objective evidence of PCI's commitment to providing top-quality certification programs.
- Assuring specifiers that PCI-Certified Plants can manufacture engineered-to-order and complex structural and nonstructural elements as designed.
- Showing that PCI's plants operate at the highest level of ethical, legal, and technical standards.
- Offering credentials to ensure PCI Plant Certification will be accepted in the marketplace and by governmental agencies that regulate service or product acceptance.
- Aligning more closely with ICC and enhancing the program's standing with various building departments and authorities having jurisdiction.
- Increasing credibility of the Plant Certification program on an international level.

The program addresses any perceived conflicts of interest in having PCI-retained personnel performing certification audits for the plants, Frank explains. It provides an outside, credible source to review performance and standards that is accepted worldwide.

Significant changes were made to the PCI Certification Process to align with the IAS requirements, Frank notes. These involve identifying all nonconforming practices and separating them into minor and major actions that must be addressed. Any nonconforming practice also requires a written response from the plant with planned corrective actions to document progress. "Plants must take immediate corrective action upon learning of a major nonconformance issue and submit objective evidence, such as photos, copies of records, etc., to PCI for verification that the nonconforming practices have been addressed. Many agree this is a big improvement to the program and will enhance the program's credibility."

CUSTOMER SATISFACTION FOCUS

A key element for owners, architects, engineers, contractors, construction managers, and others working with the precaster is the Customer Satisfaction Process. This system ensures complaints about quality or other aspects of the products can be officially filed with the Director of Quality Programs, who then coordinates with the plant to give additional incentive for the plant to resolve the issues.

To facilitate any questions, a Feedback page had been added to the PCI website. It contains forms that can be filled out and submitted to PCI quickly.

Designers and others on the construction team will benefit by reassurances of consistent quality across all participating plants and the capability to specify precise needs and receive them. In the past, various building departments have accepted PCI Plant Certification in lieu of Special Inspections required in the International Building Code's Chapter 17. "In those cases, PCI-Certified Plants were deemed to be Approved Fabricators in those jurisdictional areas," Frank explains.

IAS Accreditation offers more assurance to the construction team that quality standards are being met and offers more consistency among all PCI members. "IAS accreditation provides independent verification that the program's procedures appropriately address competency, confidentiality, and impartiality," says Frank. "It should go a long way in easing the minds of construction team."

TIGHT TOLERANCES
IAS Accreditation ensures the construction team that products will meet specifications with tight tolerances and precise mixes.

Photo: CannonDesign.

OAK RIDGE LAB

BENEFITS FROM CM/GC DELIVERY

U.S. Department of Energy's first use of CM/GC delivery method produces Oak Ridge National Laboratory building on a tight schedule and on budget, assisted by precast panels and sunshades

— Craig A. Shutt

Photo: CannonDesign.

With multiple project delivery methods being used today, owners are looking for the best balance of design quality, fast construction, energy efficiency, and other key needs. For its new Chemical and Materials Sciences Building at the Oak Ridge National Laboratory (ORNL) in Tennessee, the U.S. Department of Energy (DOE) selected McCarthy Building Companies Inc. to deliver the building in the Construction Manager at Risk format.

Using this delivery method, also known as Construction Manager/General Contractor (CM/GC) format, the owner uses a single procurement to secure preconstruction and construction services, according to the Federal Register, the daily journal of the federal government. This allows the owner to receive the contractor's input on constructability issues and provide early input on design issues, the environmental-review processes, and other factors that will impact costs, schedule, and quality.

> Utilizing the contractor's unique construction expertise in the design phase can offer innovations, best practices, reduced costs, and reduced schedule risks.'

At a point between 60% and 90% of design completion, the owner and CM/GC negotiate a Guaranteed Maximum Price for construction based on the defined scope and schedule. The CM/GC then serves as the general contractor, hiring subcontractors and directing the construction.

"The CM/GC method has proven to be an effective method of project delivery," the Register notes. "Utilizing the contractor's unique construction expertise in the design phase can offer innovations, best practices, reduced costs, and reduced schedule risks."

DOE'S FIRST CM/GC PROJECT

The selection of McCarthy to produce the project as the CM/GC marked the first time DOE has used this delivery method, according to Ryan Molen, McCarthy project director. The campus' buildings are managed by a partnership between the University of Tennessee and UT-Battelle, which serves as the management and operations contractor for the projects.

CHEMICAL AND MATERIALS SCIENCES BUILDING

LOCATION
Oak Ridge, Tenn.

PROJECT TYPE
Research laboratory

SIZE
160,000 square feet

COST
$73.5 million

DESIGNER/STRUCTURAL ENGINEER
CannonDesign, St. Louis, Mo.

CONSTRUCTION MANAGER
McCarthy Building Companies Inc., St. Louis, Mo.

OWNER
Oak Ridge National Laboratory, Oak Ridge, Tenn.

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

PRECAST COMPONENTS
236 architectural panels embedded with thin brick, plus sunshades varying from 11 inches to 1 foot thick projecting 3 feet from windows

Photo: CannonDesign.

"McCarthy was engaged with the owner, architect, and consultants from design through construction and until the facility became operational," Molen says. "This early and complete involvement lowered the owner's overall risk on the project."

McCarthy came onto the project when it was about 35% designed, says Daniel Joseph, senior project manager at McCarthy. "CM/GC is very beneficial for the client. We can provide constructability reviews, price certainty, estimating plans, and construction reviews, all with the goal of ensuring the project is completed on time and on budget. We also can provide a Guaranteed Maximum Price early in the project design that helps maintain the budget throughout the project."

The delivery method also aids McCarthy, which performs approximately 70% of its contracts in this manner today, he estimates. "It absolutely works to our benefit," he says. "It allows us to build a relationship with the entire design team early on, so when tough situations arise, the relationships are in place, and we've established trust and have a perspective on what everyone needs for them to be successful. It gives us a leg up, especially in regard to logistical issues that often become major points."

CM/GC projects can vary in their approach, he notes. "Some owners hire us before the architect, and some select the architect first and then select us. In some cases, the architect has input on our selection, and vice versa."

HIGH-PROFILE BUILDING

The three-story, 160,000-square-foot research facility was funded by the Science Laboratory Infrastructure program through the Office of Science and by funds from the American Recovery and Reinvestment Act. The building holds a prominent position on the Laboratory's 10,000-acre campus and needed a striking aesthetic design that also met strict budget and schedule controls. The original concept for the project was completed by Flad Architects, while finalization of concept design, the design and construction documents, and construction administration were provided by CannonDesign.

The facility features 56 labs, 164 offices, and 91 modular work stations. It replaces a prior space constructed in the 1950s that suffered from high energy and maintenance costs. In keeping with the campus architecture, the Chemical and Materials Sciences building's structural steel frame was clad with architectural precast concrete panels and glass curtain wall.

The precaster, Gate Precast Co., was brought onto the project early to help work through design issues. "As architects, we're generalists," says Michael Zensen, vice president of CannonDesign, the architectural firm on the project. "Our knowledge can go only so deep into a particular specialty area, and capabilities are different among different suppliers. If we want to push the envelope, we have to engage the specialists and craftsmen early on so we can explore and exploit the possibilities unique to each project." (For more on Cannon's work and Zensen's thoughts on alternative-delivery methods, see the related article.)

In this case, he notes, the team understood the best selection for the façade quickly. "We knew budget constraints were leading us to precast concrete as a solution" he says. "There was a desire to coordinate with the existing brick on campus, but we wanted to take advantage and express the unique characteristics that precast could offer. We knew it was important for the precaster to be on board while the design was being completed so we could maximize the design potential and still maintain the construction budget."

The precaster was selected from a competitive bid on the schematic design drawings, with contingency reserved for design development of the precast. "This approach gave us time to develop and test the unique features of the project, even through building mock-ups," Zensen says. "By the end of design development, the technical challenges of the unique features were solved and the precaster was 100% on board with the solution."

Zensen encourages clients to bring the precaster on board early. "It works really well, especially with a precaster like Gate that wants to be the one that others look to for inspiration," he says. "They want to be the guys who do things nobody else can does. When a subcontractor partner like Gate also has the aspiration to do extraordinary things, it is amazing what can be achieved even in a constrained budget."

'If we want to push the envelope, we have to engage the specialists and craftsmen early on so we can explore and exploit the possibilities unique to each project.'

SEVERAL TEXTURES
A number of colors and textures were used to provide aesthetic variety. Photo: Gate Precast.

FIRST BIM USE

McCarthy introduced both Oak Ridge National Laboratory and the U.S. Department of Energy to BIM on this project, using it as a tool for the first time on the campus. Photo: Gate Precast.

TWO-PART PROPOSALS

"The existing campus appearance drove our material choices," agrees Joseph. "But we weren't tied strictly to masonry. We were aware of precast concrete's capabilities." McCarthy solicited two-part proposals from three precasters. The fabricators were asked to explain the extent of design assistance available to assess reaction loads and locations, and a breakdown of panel square footage, finishes, and weights.

Gate agreed to a lump-sum amount to provide design assistance and reaction engineering. The square-footage cost they provided was used to estimate the cost for enclosing the building. "Once we agreed on the issues and the square footage, it provided the price certainty we wanted," says Joseph.

In fact, specifying precast opened the door to new ideas. "Once we decided on that approach, we realized there were more options for creating details than we would have had using masonry," Zensen explains. "We could create reveals, expressive lines, and even brise soleils."

'We realized there were more options for creating details than we would have had using masonry.'

The latter element proved especially exciting. "The brise soleils are important to the aesthetic expression of the building. They bring reflected light in and block out direct sunlight. Without the early collaboration, they probably would have been cut from the project, reducing the quality for the occupants of the lab."

Gate's early involvement also impacted the constructability review, Joseph says. "We worked with them early in the process, before design schemes were committed. It was a very collaborative process, especially on how best to redistribute load points. We were all working toward the same goal."

BIM AIDS DESIGN

A key aid in their collaboration was the use of Building Information Modeling (BIM) throughout the process. "We are ardent believers in BIM," says Joseph. "It allows us to build the building virtually before we have to build it in real life. It can solve a lot of challenges that arise." A key one came in plotting out kicker bracing that ties the precast panels to the structure in a space where HVAC ductwork had to be located. "Having the braces already indicated in the model allowed the HVAC contractors to visualize what they had to work with and fit their ducts around the bracing."

The precast panels are 10 to 12 feet high and 30 to 45 feet wide, cladding the building in a horizontal position. Most were embedded with thin brick selected by the design team. "We took brick from a variety of samples and created multiple 3- by 3-foot sample panels," Joseph says. The samples were delivered to the site, where they were laid directly against the façades of nearby buildings to decide on the best match. The samples were narrowed to three options, from which the client selected a winner.

The thin brick is recessed at some locations, creating architectural highlights. A total of 236 panels were cast, encompassing 41,642 square feet of cladding. The solid panels were sprayed with foam insulation after installation, and the interior walls were furred out and drywalled. The panels were prestressed to provide additional strength for their tall heights.

FAST ERECTION
Precast concrete production nearly outpaced erection of steel framing, requiring close control of scheduling. Photo: Gate Precast.

BRISE SOLEILS ADDED

The most creative aspect of the precast concrete installation was the creation of the free-spanning brise soleils, or sunshades, above the long stretches of ribbon windows. The projections are 1 foot thick at the location of steel supports and 11 inches thick at their thinnest points. "The design and engineering required to make this feat possible was an obstacle within itself," says Bill Henderson, vice president of operations at Gate.

Each mold had to be built independently, with block-outs that would accommodate the steel supports. The panel reinforcement was tied to tube supports prior to casting. Each shade fin was prestressed for increased strength and resistance to cracking. Adjustable bearings were used to accommodate deflection in the structure while maintaining the load of the sunshades.

The shading helped the building achieve LEED Gold Certification, exemplifying ORNL's emphasis on energy efficiency in both practice and purpose. "The R-values that the precast concrete panels and insulation provided helped meet the high standards needed to achieve Gold certification," says Joseph.

ERECTION GOES QUICKLY

Due in part to the advance planning and collaboration, the erection moved smoothly, despite being located 18 feet from an active campus road. A Manitowoc triple-9 crane was used to set the bulk

LEED GOLD
The shading helped the building achieve LEED Gold Certification. Photo: Gate Precast.

of the panels, which were placed at a staging area about 1 mile away on campus. Each night, six to eight truckloads of panels were ferried to the staging area, minimizing traffic during the day. Approximately 10% of the panels were set with a 750-ton hydraulic crane due to site restrictions that limited access. Those pieces were set on the weekend so the road could be shut down with minimal disruption.

"Erecting the precast was a great experience," says Joseph. "We didn't understand just how fast it could be set in these conditions. We started framing the steel with the goal of setting four to six panels per day, and they peaked at 10 to 12 per day. We had to closely monitor both the framing and precast schedules to ensure that we weren't getting ahead of ourselves and delivering panels without any place to erect them."

'The R-values that the precast concrete panels and insulation provided helped meet the high standards needed to achieve Gold certification.'

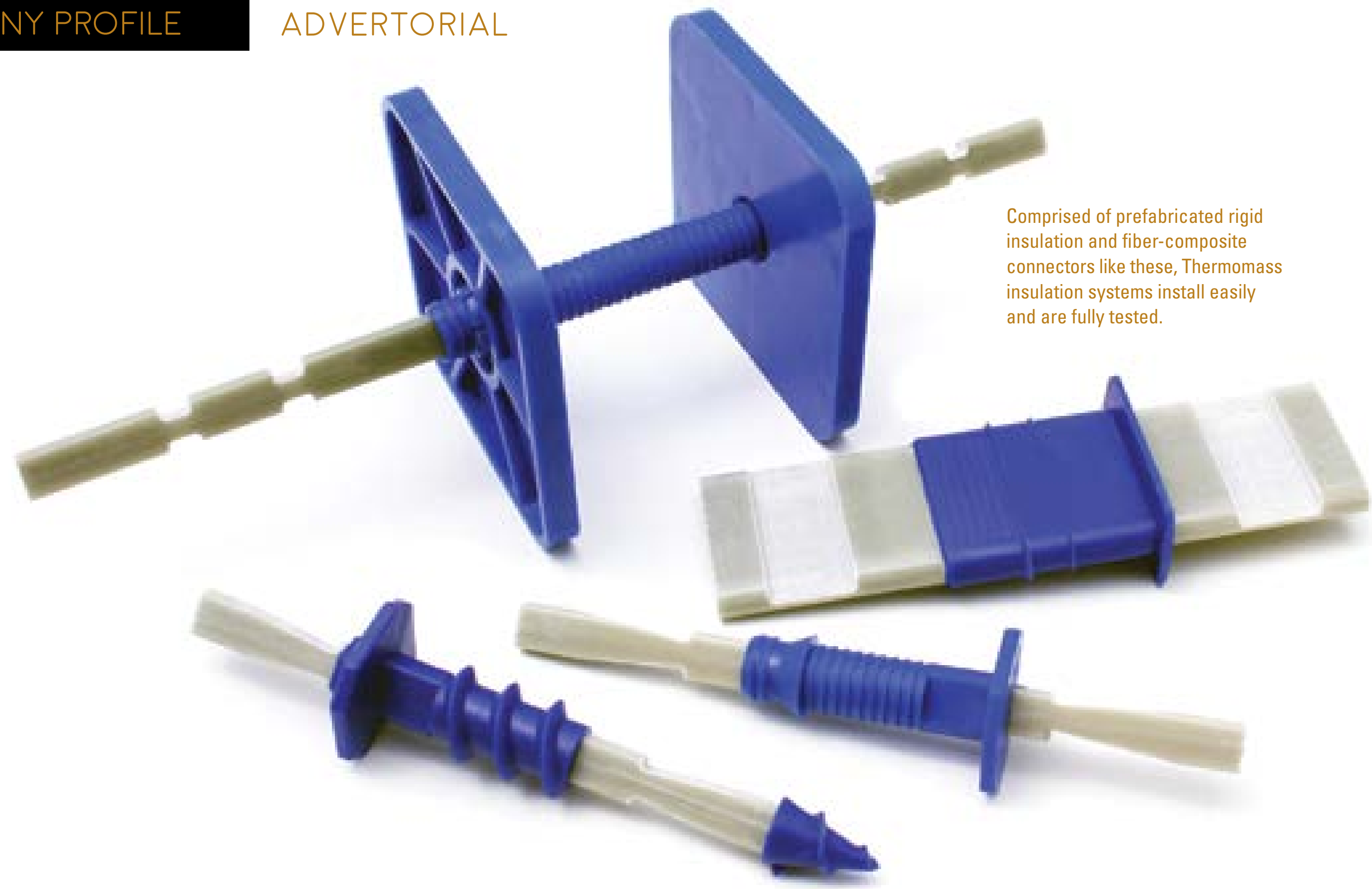
That speed rippled through the project, he adds. "Getting the building enclosed early was a big part of staying on schedule." In fact, the schedule called for a 24-month timetable, but the project was ready for occupancy in only 22 months.

The project proved so successful that ORNL commissioned McCarthy to construct the nearby Maximum Building Energy Efficiency Research Laboratory, or MAXLab. The $16-million, 17,970-square-foot project features a similar façade treatment for its high-bay laboratory spaces, which house test apparatus for large-scale wall assemblies. That project was also completed under a CM/GC contract.

"CM/GC can work on any project, if the client is willing," says Joseph. "We've used it on laboratories, industrial buildings, food manufacturing, production plants, and all types of projects."

The close collaboration encouraged by the format not only aids cost and schedule, but it can produce new, creative ideas. "Having a partner like Gate's team, who know their business as well as they do, allows us to have a conversation back and forth to leverage both of our expertise," Joseph says. "In those cases, sometimes the good-idea fairy comes out and ensures we find the right solution."

SUCCESS RIPPLES
The CM/GC format proved so successful that other projects at ORNL now are being constructed using the delivery method. Photo: Gate Precast.



Comprised of prefabricated rigid insulation and fiber-composite connectors like these, Thermomass insulation systems install easily and are fully tested.

THERMOMASS DELIVERS
More than Just Great Products

Founded in 1980, Thermomass has long been a pioneer in the high-performance sandwich panel market and has helped clients around the world design and build durable, versatile, and energy-efficient concrete walls. We manufacture a complete line of precast insulation products and fiber-composite, nonconductive connectors, but we know that great projects are built from more than just quality materials.

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

INNOVATIVE PRODUCTS

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

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

Thermomass also pioneered the process of CNC fabrication of rigid insulation to exacting specifications to best meet the ideal of edge-to-edge panel insulation. Combined with Thermomass connectors, this system is the smart choice for almost any precast concrete panel application—from single family homes to NFL football stadiums and everything in between.

DEDICATED SERVICE

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

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

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

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

NREL's Energy Systems Integration Facility features Stresscon precast panels insulated with Thermomass System NC to meet both the safety specifications and the energy efficiency demands for the laboratory environment. Photo: U.S. Department of Energy.

CONCRETE RESULTS

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

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

Perhaps the most telling measure is this: Thermomass systems have been selected for thousands of projects all over the world over the past four decades, many of which have garnered industry acclaim. In particular, Thermomass products and assistance have played vital roles in a number of recent high-profile, zero-energy projects for notable clients like the National Renewable Energy Laboratory and NASA.

A COMPREHENSIVE APPROACH

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

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

DESIGN PROFESSIONALS JOIN

Design-Build Movement

—G. William Quatman, Esq., FAIA, DBIA
General Counsel & Sr. VP, Burns & McDonnell Engineering;
National Board Chair, DBIA

Photo: Jason Dailey.

The concept of integrating design and build functions to create highly collaborative projects has been around since the pyramids in ancient Egypt. Over time, this became known as the master builder concept, or "capomaestro" during the Italian Renaissance. But a desire to separate the art of architecture from the craft of the construction trades in the mid-1800s and into the early 1900s slowly separated the very professionals who should be working closely together. Silos were created and collaboration suffered until owners began to demand a better way of delivering projects. Today, the architect/engineer (A/E) community is not only on board the design-build train, but many of their members are even leading it. I am the third design professional in a row to serve as chairman of the Design-Build Institute of America (DBIA) Board of Directors, and next year another architect will become its chair. That is because the design community has come to realize that when contractors join the design process, one group's goals become the entire team's goals, producing projects that showcase design excellence and innovative solutions to unique challenges.

THE STATE OF DESIGN-BUILD

When DBIA was established in 1993, only three U.S. states had legislative authority to use design-build for public projects. Slowly but surely, DBIA National and our 14 affiliated regions have worked with public owners to achieve some level of design-build authority in all 50 states. Two federal laws passed in 1994 and 1996 opened the door to "best value" selection of design-build teams by federal agencies, using a two-step process. And as of this year, after legislation passed in my home state of Missouri, half of the states have full design-build authority for all types of public design and construction projects.

Design-build is being used across all sectors as well. In fact, 40% of all buildings are now completed using design-build (a 10% point increase from a decade ago), and more than half of building projects over $10 million are delivered using design-build. A 2014 McGraw Hill Construction survey showed that architects, contractors and owners expect the use of design-build to grow more than any other delivery method.

Additionally, DBIA is in the middle of surveying state Departments of Transportation, and has so far found a whopping 600% increase in completed transportation design-build projects since 2002, and transportation owners who have used design-build like it. In fact, 87% of respondents said they would use design-build again, and of the 13% who said they wouldn't, their primary reason was a lack of statutory authority.

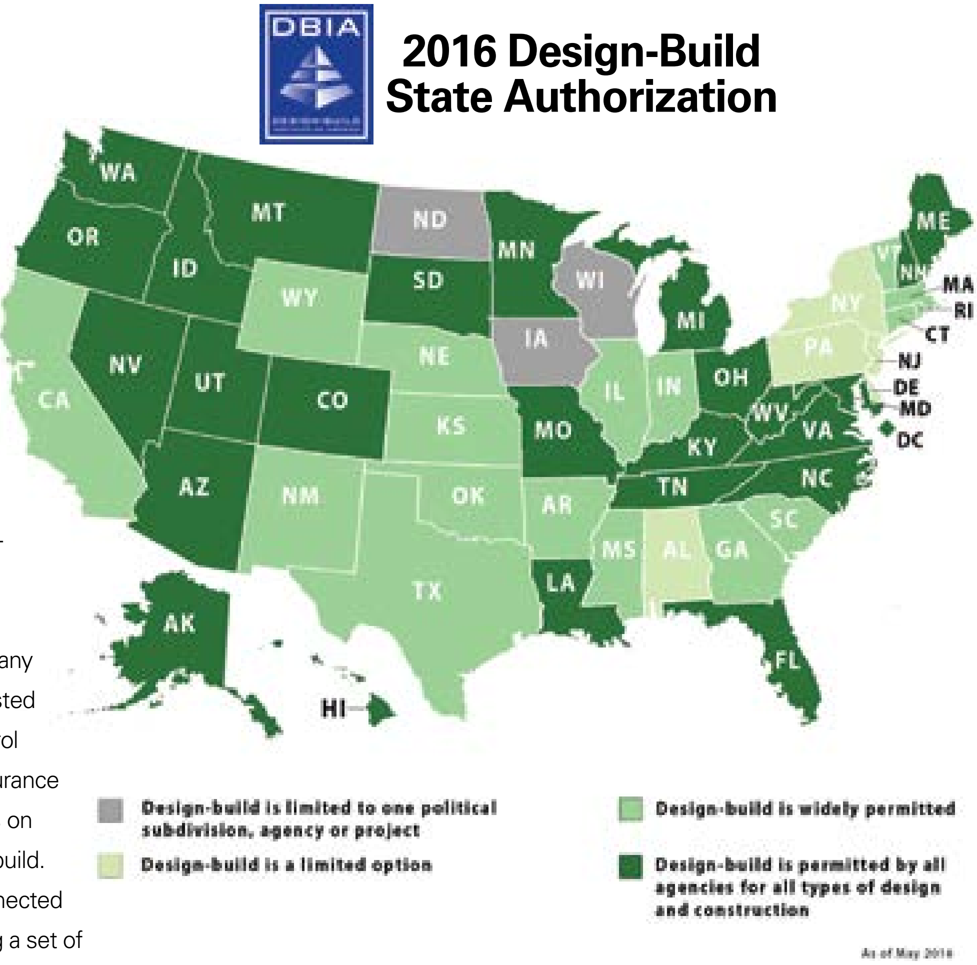
DESIGNERS IN DESIGN-BUILD

The idea that architects are opposed to design-build is no longer true. From 1909 to 1976 the American Institute of Architects (AIA) had an ethical rule that barred their members from "engaging in building contracting." That rule was repealed in 1978 and the AIA began publishing design-build contracts in 1985. In 2005, the AIA Board adopted a policy statement that encouraged architects to take the lead role in design-build. What a difference 100 years makes! Now, more than ever, architects are recognizing the benefits of working alongside the contractor and owner from the beginning to the end, as a collaborative team. The aforementioned McGraw Hill Construction survey showed that both architects and contractors say design-build is the best delivery method for improving process efficiency and producing the fewest change orders.

In 2007, I chaired the AIA's Design-Build Knowledge Community, which led a series of successful seminars coast-to-coast and internationally, including programs in San Juan, Puerto Rico, and London England. The programs were packed at each venue with architects who reacted positively to the institute's suggestion that architects can take on the lead role in design-build, with many members and seminar attendees reporting that their firms had made this move with great financial success. The AIA's endorsement of this method gave encouragement to its membership to "be a leader." Not just architects, but engineers have embraced design-build, and today we see many of the top design-build contractors being engineering firms that have brought construction in-house.

Early on, insurers and lawyers cautioned design professionals about the risks of design-build. But many have come to realize that through teaming with trusted partners, collaboration in all phases, and more control over the entire process, claims can be avoided. Insurance statistics have found fewer claims against A/E firms on design-build projects than on traditional design-bid-build. And, designers are having more fun by staying connected with their projects in all phases rather than throwing a set of plans over the wall to an unknown contractor who is tasked to interpret the design and build it properly. Just attend one DBIA regional or national conference and watch the interaction among designers and construction professionals.

It is a new era in this industry, and exciting to be a part of.



RESEARCH DEMONSTRATES BENEFITS

Architects surveyed by McGraw Hill said that design-build was the best delivery method to reduce project schedule, which is supported by multiple studies going back to the pivotal Construction Industry Institute/Pennsylvania State University (CII/Penn) study demonstrating design-build is 33% faster than design-bid-build on average. A 2016 follow-up CII/Penn study also showed that more than a quarter of design-build projects have less than 0% cost growth, while only 12% of design-bid-build projects can brag about the same.

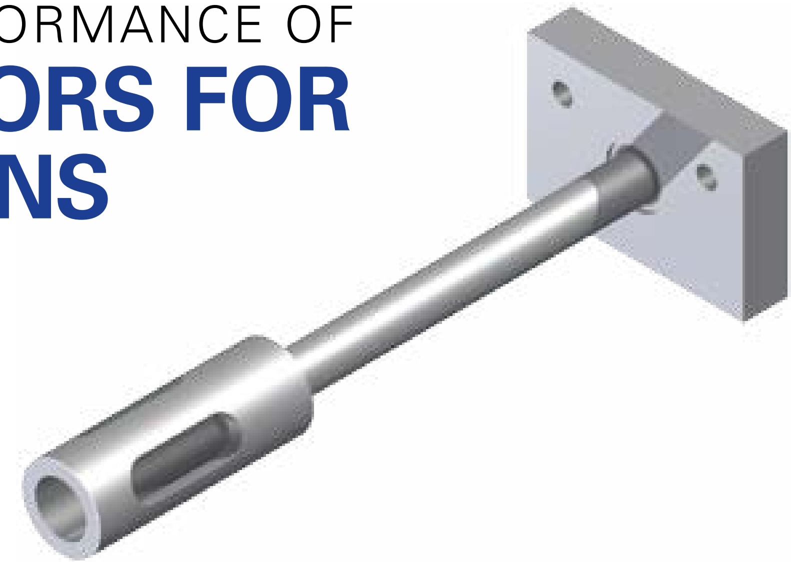
DBIA LEADING THE WAY

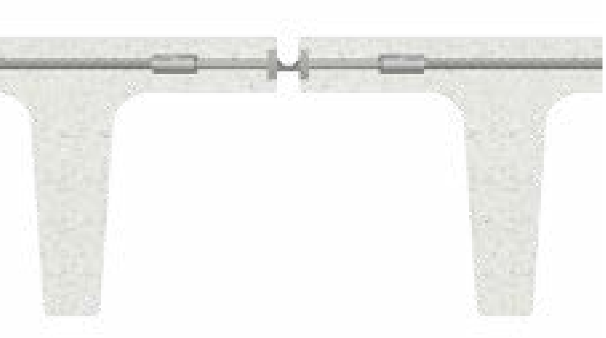
DBIA members span the entire spectrum of design and construction professions, of course, including architects, engineers, specialty contractors, subcontractors, public and private facility owners, attorneys, industry consultants, business development professionals, students and faculty. As use of design-build grows, our members are finding the connections they've made to the entire design and construction industry at DBIA to be incredibly valuable in forming joint ventures and identifying willing partners for a design-build team. This diverse membership means our resources are rarely tailored to just one sector. Our best practices, primers, contract documents, webinars and courses are often geared to the entire project team to encourage the collaboration that is essential to innovative problem-solving.

DBIA was founded not only to expand authority for the use of design-build in all 50 states, but also to define and teach best practices in the delivery method. Our top award given to leaders in design-build is named for an architect, Filippo Brunelleschi of Florence, Italy, making a complete circle back to the days of the master builder, or capomaestro. As more professionals take our courses and become certified every year, some owners are explicitly looking for DBIA™ or Assoc. DBIA™ certified team members. After 23 years as an association, DBIA feels confident that Design-Build Done Right™ has shaved years off of countless projects, held down construction costs, reduced project claims and litigation, and helped produce the highest-quality projects. We hope you will join us in this movement, whether you are a design professional, contractor, owner or other member of a construction team.

REVOLUTIONIZING THE PERFORMANCE OF CHORD CONNECTORS FOR SEISMIC CONDITIONS

MeadowBurke®



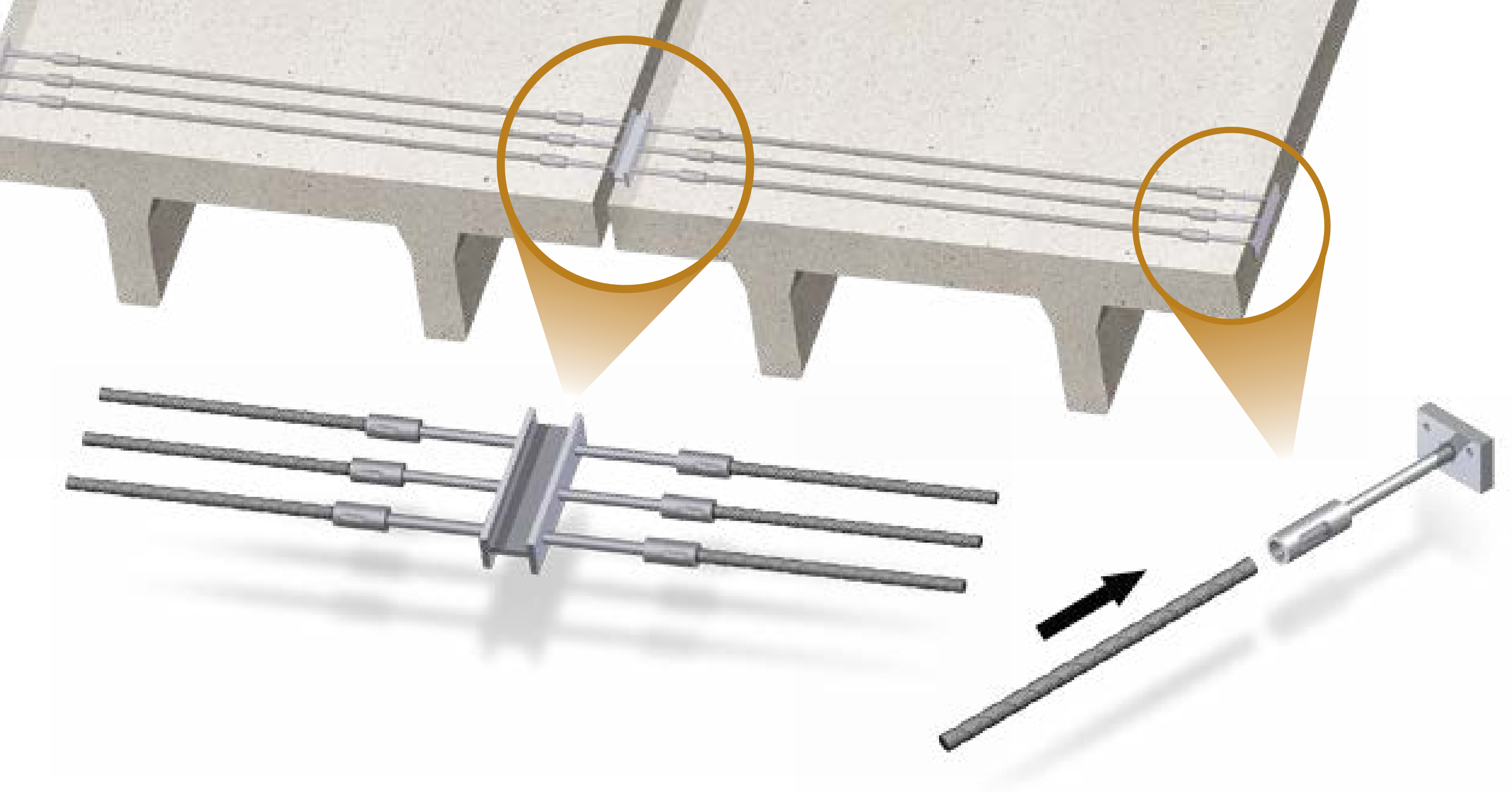


Building safe precast structures in earthquake zones is challenging for engineers and precast/prestressed producers alike. Structural performance depends on the ductility of connectors joining each precast element. This is especially critical at the double-tee connections. Until now, the lack of ductility in precast structures would cause extreme vulnerability to weld breaks during seismic activity resulting in significant compromise and even catastrophic failure of the structure. Recent chord connector advancements by the engineers at Lehigh University and Meadow Burke have yielded a code-compliant, seismic-resistant system chord connection. The system provides reliable force transfer and ductility to the diaphragm while under considerable seismic demands and is known as the Seismic Chord Connector.

The Seismic Chord Connector by Meadow Burke is a seismic chord connection that provides reliable force transfer and ductility to the floor system under large demands. Designed to be used in pretopped precast concrete diaphragm systems, the Seismic Chord Connector works exceptionally well in double-tee flooring structures where the ductility dramatically improves the reliability of the connection under earthquake and high wind demands.

Requiring just two plug welds for the rebar attachment, the Seismic Chord Connector can be placed in the form using existing rebar chairs where the face of the connector is centered in the flange depth, or if using shims, centered in the flange depth using the plastic form connection plates. The pretopped double tees are then placed in position, and the diaphragm connections are welded.

The simple design of the Seismic Chord Connector allows easy replacement of current cumbersome methods. The connection provides over 0.6" of reliable deformation

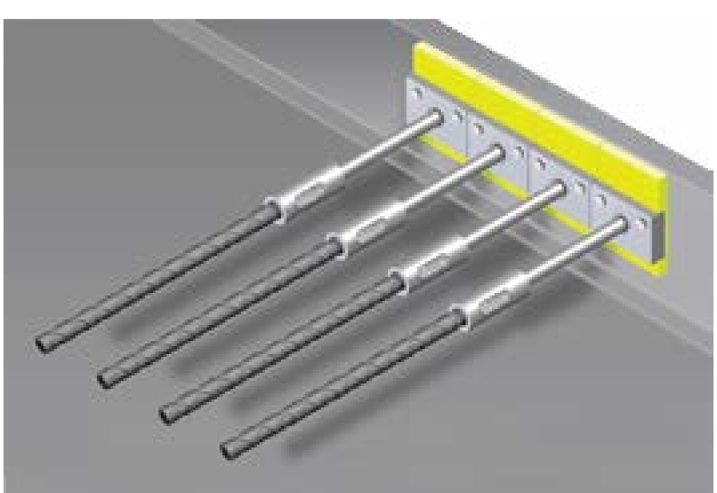


capacity and eliminates the need for field cast concrete pour strips, thereby improving the quality and service life of the building. It also provides a useful detail for any precast system where reliable welded tension connections are needed.

Designed with finite element software and validated through experimental testing, the Seismic Chord Connector is a code-compliant system that meets the ASCE 7-16 requirements for High Deformation Elements. The ASCE 7-16 is a building code for the design, live loads and environmental loads of buildings such as those which arise from the effects of wind, snow, and earthquakes. The loading criterion is designed to assure safety, serviceability, and integrity.

The ASCE, American Society of Civil Engineering, anticipates the publication of the ASCE 7-16 standard in early 2017. The official release for the Seismic Chord Connector by Meadow Burke is expected to be announced shortly after.

For more information visit www.meadowburke.com.



ADVANTAGES OF THE SEISMIC CHORD CONNECTOR

- Code-compliant, fully tested
- HDE Connection in accordance with ASCE 7-16
- High deformation capacity of 0.78" at 23.6 kips
- Connection elongation helps to eliminate brittle failure
- Easy installation
- Inventory item, eliminating prefabrication
- Provides a reliable dry chord connection for total precast design

Teamwork Focus

IN MINNESOTA STATE MANKATO PRECAST PROGRAM

— **Marty McIntyre**
PCI Foundation

A highlight of the Precast Studio program at Minnesota State at Mankato was the tour of the Vikings Stadium as it was under construction. Students are able to learn about structure and scale by seeing erection of precast members. Photo courtesy Mohamed F. Diab.

As design/build methods have gained a foothold in the construction industry, schools of architecture, engineering, and construction management have looked to foster partnerships between disciplines and schools. These interdepartmental programs allow professors to look at new ways to teach their assigned subjects. They also provide students with an opportunity to learn in a cooperative environment that mimics some of the work-world relationships they will need to develop after graduation.

For the precast concrete industry, the idea of design-build is a natural. Because precast concrete is an engineered product designed specifically for each structure, there have always been elements of partnership in precast concrete projects. One program receiving a grant from the PCI Foundation and capitalizing on that partnership is the Precast Program at Minnesota State University, Mankato, a collaboration between the Construction Management and Civil Engineering programs that has just finished the second year of a 4-year grant from the PCI Foundation.

While each program has its own classes and focus, they come together for multiple tours and guest speakers, as well as for a Building Information and Modeling (BIM) course housed in the Construction Management department. Both programs work with staff from Wells Concrete in Wells, Minn., to ensure that students have an opportunity to learn from projects currently underway by studying precast design, learning about how BIM is used for the project, seeing the fabrication process, learning from staff working on the project, and seeing the project erected.

CLASSROOM WORK AND REAL-WORLD EXPERIENCE

What does this mean for the future of design-build projects? Students leaving the Minnesota State Mankato program feel ready to step into positions with a variety of employers, including the precast industry, contractors, owners, and engineering firms. And they come prepared to work together. "One of the other aspects in our precast concrete design class is that we are interested in giving them a 'real-world' experience," says engineering Professor Farhad Reza. "The Wells Concrete engineers shared an interesting precast project with the students. This fall, the students were given a wall and column layout and then had to learn to design all the structural aspects to it."

The students had to design several types of precast components, including double tees, hollow-core floors, inverted T beams, and prestressed columns. In addition to presenting information as a guest lecture on the project, the Wells Concrete engineer made himself available to students throughout the semester.

On the construction management side of the program, the precast concrete work is taught through a Risk Management course. Students in the program research how building products are affected in several risk areas. For example, some students looked at how cold weather affects building construction and how a customer building a project might consider the building material and method as part of its building plan.

For the risk-management class, the students are able to ride along virtually with Wells on an actual project to see how a typical project unfolds. "We take a project through estimating, sales, design, BIM, and 3D drawings. After that, we have them out to see production, quality management, inspection, the field process, and all while talking risk management. It's been very helpful for students to see the project all the way through," says Gregg Jacobson, Wells vice president and general manager.

Having the focus on risk mitigation is a good idea from the precast concrete perspective. "Housing the precast in the risk mitigation program at the Construction Management school has worked out very well," says Dan Jutunen, president and CEO of Wells Concrete. "Most of the Construction Management students will be hired by contractors, and every contractor we work with is looking carefully at risk mitigation.

JOBSITE TOURS

As part of the precast program, learning is not limited to the classes students take. All of the students from both programs are invited on tours. "We may have only 12 or 15 students in a class, but when we took the Viking Stadium site tour, we ended up bringing a bus for 55 students and faculty," says Jacobson.

Students from both groups and other classes take part in plant and jobsite tours throughout the program. The students get a lot out of the precast plant and jobsite tours because they are prepared for them prior to ever stepping foot outside the classroom. "For plant visits, we start by talking about planning. We don't just go in and look at the operation," says Mohamed Diab, associate professor of Construction Management. "We are always interested in how everyone works with the owners. The students need to know about how decisions are made.

BIG BEAM COMPETITION

Another way that the professors enhance the experience for the engineering students is through the Precast/Prestressed Concrete Institute (PCI) "Big Beam" competition. One or two teams of engineering students work in conjunction with the Wells Concrete plant and must design, fabricate, and break a precast beam to specifications that are changed each year. This is where many of the students get to see the work that they have previously done put into action: fabricating the product and seeing how what they designed holds up under stress.

The students' response to the Big Beam competition is very positive. They noted learning about design beyond the equations on the screen and starting to understand what it means to the final product, as well as learning how to work as a team. "The biggest thing that I learned from Big Beam is that one must always consider practical restrictions, beyond those that are accounted for in design calculations, when determining the dimensions of a prestressed, precast member. It helps to ensure an efficient and feasible product from paper to product," says student Alex Fiebiger.

Students from Minnesota State at Mankato have an opportunity to visit Wells Concrete and see how prestressing plays a roll in the fabrication of precast/prestressed products. Photo courtesy Mohamed F. Diab.

PROGRAM SUCCESS

The program has been a success with the students. Many of the students who finished have been hired by engineering firms, the Minnesota Department of Transportation, and contractors. Several have had internships at Wells Concrete, and Wells has even hired two students from the program.

The first student Wells hired was Chase Radue, who is now a field engineer. "The civil engineering program at Minnesota State Mankato may not be big, but it provides big-time opportunities thanks to the support from companies like Wells Concrete and organizations such as PCI Foundation," says Radue.

Minnesota State University Mankato Precast Program

	Civil Engineering (CIVE)	Construction Management (CM)
Fall Courses and Activities	**Prestressed Concrete Design Course:** Students independently designed structural components for the Microsource Plant in Shakopee, Minn., based on layout information from drawings provided by Wells Concrete.	
	Field Trips: Several field and plant trips involving both CIVE and CM students and faculty were organized by Wells Concrete.	
	Student Scholarships: PCI Foundation Scholarships of $2,500 each were awarded.	
Spring Courses and Activities	**Big Beam Competition:** The program includes participation of a team in the PCI Big Beam competition.	**Risk Management:** This class provides an overview of risk management.
	Building Information and Modeling: Students in this class learned how to create and use BIM in the construction industry.	
	PCI Convention & National Bridge Conference, March 1-5, 2016.	

PCI Continuing Education

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

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

Distance Learning Opportunities

> WEBINARS

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

UPCOMING WEBINARS

October 25 and October 27, 2016, "Efficient Design Assist—Precast Concrete Case Studies"
Webinar attendees will learn how precasters are getting more involved in projects and why owners, designers, and construction managers are turning to them for innovative solutions. We will feature case studies of iconic structures and discuss the precasters role in making the project successful.

> PCI ELEARNING CENTER

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

In-Person Learning Opportunities

> SEMINARS AND WORKSHOPS

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

Seminars

HIGH-PERFORMANCE STRUCTURE, BUILDING ENCLOSURE AND AESTHETICS IN PRECAST

October 19, 2016, McKimmon Conference Center (NCSU), Raleigh, N.C.

October 20, 2016, Hilton University Place, Charlotte, N.C.

October 27, 2016, Hilton Columbia Center, Columbia, S.C.

October 28, 2016, The Buckhead Club, Atlanta, Ga.

Quality Control Schools

Level I/II

November 1-4, 2016: Phoenix, Ariz.
December 05-10, 2016: Nashville, Tenn.

CONTINUING EDUCATION AIA

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

> LUNCH-AND-LEARNS

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

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

When it comes to quality, why take chances?

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

Whatever your needs, working with a 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.

GROUPS

> GROUP A – ARCHITECTURAL PRODUCTS

CATEGORY AT – ARCHITECTURAL TRIM UNITS

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

CATEGORY A1 – ARCHITECTURAL CLADDING AND LOAD-BEARING UNITS

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

> GROUP B – BRIDGES

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

CATEGORY B1 – PRECAST CONCRETE BRIDGE PRODUCTS

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

CATEGORY B2 – PRESTRESSED MISCELLANEOUS BRIDGE PRODUCTS

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

CATEGORY B3 – PRESTRESSED STRAIGHT-STRAND BRIDGE MEMBERS

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

CATEGORY B4 – PRESTRESSED DEFLECTED-STRAND BRIDGE MEMBERS

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

GROUP BA – BRIDGE PRODUCTS WITH AN ARCHITECTURAL FINISH

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

> GROUP C – COMMERCIAL (STRUCTURAL)

CATEGORY C1 – PRECAST CONCRETE PRODUCTS

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

CATEGORY C2 – PRESTRESSED HOLLOW-CORE AND REPETITIVE PRODUCTS

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

CATEGORY C3 – PRESTRESSED STRAIGHT-STRAND STRUCTURAL MEMBERS

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

CATEGORY C4 – PRESTRESSED DEFLECTED-STRAND STRUCTURAL MEMBERS

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

GROUP CA – COMMERCIAL PRODUCTS WITH AN ARCHITECTURAL FINISH

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

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

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

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

> ALABAMA

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

> ARIZONA

Coreslab Structures, (ARIZ) Inc. A1, B4, C4, C4A
Phoenix, (602) 237-3875
Green Fuel Technologies LLC dba Royden Precast B4
Phoenix, (602) 484-0028
Stinger Bridge & Iron B4
Coolidge, (520) 723-5383
Tpac, An EnCon Company A1, B4, C4, C4A
Phoenix, (602) 262-1360

> ARKANSAS

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

> CALIFORNIA

Bethlehem Construction, Inc. C3, C3A
Wasco, (661) 391-9704
Clark Pacific A1, C3, C3A, G
Fontana, (909) 823-1433
Clark Pacific C4A
Irwindale, (626) 962-8751
Clark Pacific A1, C3, C3A
West Sacramento, (916) 371-0305
Clark Pacific A1, B3, C4, C4A, G
Woodland, (530) 207-4100
Con-Fab California Corporation B4, C4
Lathrop, (209) 249-4700
Con-Fab California Corporation B4, C4
Shafter, (661) 630-7162
Coreslab Structures, (L.A.) Inc. A1, B4, C4, C4A
Perris, (951) 943-9119
KIE-CON, Inc. B4, C3
Antioch, (925) 754-9494
Mid-State Precast, L.P. A1, C3, C3A
Corcoran, (559) 992-8180
Oldcastle Precast, Inc. B4, B4A, C2, C2A
Perris, (951) 657-6093
Oldcastle Precast Inc. C2
Stockton, (209) 466-4215
Precast Concrete Technology dba CTU Precast A1, C3, C3A
Olivehurst, (530) 749-6501
StructureCast A1, B3, C3, C3A
Bakersfield, (661) 833-4490
Universal Precast Concrete, Inc. A1, B1, C1
Redding, (530) 243-6477
Walters & Wolf Precast A1, G
Fremont, (510) 226-9800
Willis Construction Co., Inc. A1, C1
Hollister, (831) 623-2900
Willis Construction Co., Inc. A1, C1, G
San Juan Bautista, (831) 623-2900

> COLORADO

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

> CONNECTICUT

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

> DELAWARE

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

> FLORIDA

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

> GEORGIA

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

> HAWAII

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

> IDAHO

Forterra Structural Precast A1, B4, C4
Caldwell, (208) 454-8116
Teton Prestress Concrete, LLC. B4, C3
Idaho Falls, (208) 522-6606

> ILLINOIS

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

> INDIANA

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

> IOWA

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

> KANSAS

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

> KENTUCKY

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

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

> LOUISIANA

Atlantic Metrocast, Inc. C2
New Orleans, (504) 941-3152
Boykin Brothers, Inc./ Louisiana Concrete A1, B4, C3, C3A
Baton Rouge, (225) 753-8722
F-S Prestress, LLC B4, C3
Princeton, (318) 949-2444
Fibrebond Corporation A1, C1, C1A
Minden, (318) 377-1030

> MAINE

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

> MARYLAND

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

> MASSACHUSETTS

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

> MICHIGAN

International Precast Solutions, LLC A1, B3, C3, C3A
River Rouge, (313) 843-0073
Kerkstra Precast Inc. A1, B3, C3, C3A
Grandville, (616) 224-6176
M.E.G.A. Precast, Inc. A1, C3, C3A
Shelby Township (586) 294-6430
Nucon–Stress-Con Industries, Inc. A1, B4, C3, C3A
Kalamazoo, (269) 381-1550
Peninsula Prestress Company B4, C1
Grand Rapids, (517) 206-4775
Stress-Con Industries, Inc. B3A, C3
Saginaw, (989) 755-4348

> MINNESOTA

Crest Precast, Inc. B3, B3A, C3, C3A
La Crescent, (800) 658-9045
Forterra Building Products B4, C2
Elk River, (763) 441-2124
Fabcon Precast, LLC A1, B1, C3, C3A
Savage, (952) 890-4444
Molin Concrete Products Co. C3, C3A
Lino Lakes, (651) 786-7722
Molin Concrete Products A1, C1, C1A
Ramsey, (651) 786-7722
Wells Concrete A1, C3, C3A
Albany, (320) 845-2299
Wells Concrete A1, C4, C4A
Wells, (800) 658-7049

> MISSISSIPPI

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

> MISSOURI

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

> MONTANA

BC Concrete, Inc. dba Missoula Concrete Construction, A1, B3, C3, C3A
Missoula, (406) 549-9682
Forterra Pipe & Precast B4, C3
Billings, (406) 656-1601
Forterra Building Products B4
Montana City, (406) 442-6503

> NEBRASKA

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

> NEVADA

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

> NEW HAMPSHIRE

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

> NEW JERSEY

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

> NEW MEXICO

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

> NEW YORK

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

> NORTH CAROLINA

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

> NORTH DAKOTA

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

> OHIO

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

> OKLAHOMA

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

> OREGON

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

> PENNSYLVANIA

Architectural Precast Innovations, Inc. A1, C3, C3A
Middleburg, (570) 837-1774
Brayman Precast, LLC B1, C1
Saxonburg, (724) 352-5600
Concrete Safety Systems, LLC A1, B3, B3A, C3, C3A
Bethel, (717) 933-4107
Conewago Precast Building Systems A1, C3,C3A
Hanover, (717) 632-7722
Dutchland, Inc. C3
Gap, (717) 442-8282
Fabcon Precast, LLC A1, B1, B1A, C3, C3A
Mahanoy City, (952) 890-4444
High Concrete Group LLC A1, B3, C3, C3A
Denver, (717) 336-9300

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J & R Slaw, Inc. A1, B4, C3, C3A
Lehighton, (610) 852-2020
Nitterhouse Concrete Products, Inc. A1, C4, C4A
Chambersburg, (717) 267-4505
Northeast Prestressed Products, LLC B4, C3
Cressona, (570) 385-2352
PENNSTRESS A1, B4, C4
Roaring Spring, (814) 224-2121
Say-Core, Inc. C2
Portage, (814) 736-8018
Sidley Precast C3
Youngwood, (724) 755-0205
Universal Concrete Products Corporation A1, C3, C3A
Stowe, (610) 323-0700

> RHODE ISLAND

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

> SOUTH CAROLINA

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

> SOUTH DAKOTA

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

> TENNESSEE

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

> TEXAS

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

> UTAH

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

> VERMONT

J. P. Carrara & Sons, Inc. A1, B4, B4A, C3, C3A
Middlebury, (802) 388-6363
S.D. Ireland Concrete Construction Corp. A1, B1, C1
Williston, (802) 863-6222
William E. Dailey Precast, LLC A1, B4, B4A, C4, C4A
Shaftsbury, (802) 442-4418

> VIRGINIA

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

> WASHINGTON

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

> WEST VIRGINIA

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

> WISCONSIN

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

> WYOMING

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

> MEXICO

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

> CANADA

BRITISH COLUMBIA

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

NEW BRUNSWICK

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

NOVA SCOTIA

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

ONTARIO

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

QUEBEC

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

> UAE

Arabian Profile Company Limited G
Sharjah, 971(6) 5432624

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When it comes to quality, why take chances?

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

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

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

Guide Specification

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

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

Erector Classifications

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

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

GROUPS

> CATEGORY S1– SIMPLE STRUCTURAL SYSTEMS

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

> CATEGORY S2– COMPLEX STRUCTURAL SYSTEMS

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

> CATEGORY A– ARCHITECTURAL SYSTEMS

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

> ARIZONA

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

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

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

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

> CALIFORNIA

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

> COLORADO

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

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

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

> CONNECTICUT

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

> FLORIDA

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

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

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

James Toffoli Construction Company, Inc. S2
Fort Myers, (239) 479-5100

Pre-Con Construction, Inc. A, S2
Lakeland, (813) 626-2545

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

Solar Erectors U.S. Inc. A, S2
Medley, (305) 825-2514

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

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

> GEORGIA

Bass Precast Erecting, Inc. S1
Cleveland, (706) 809-2718

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

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

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

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

> IDAHO

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

> ILLINOIS

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

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

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

> IOWA

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

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

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

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

> KANSAS

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

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

> MARYLAND

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

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

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

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

> MASSACHUSETTS

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

> MICHIGAN

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

Devon Contracting, Inc. S2
Detroit, (313) 221-1550

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

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

> MINNESOTA

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

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

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

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

> MISSISSIPPI

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

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> MISSOURI

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

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

> NEBRASKA

Structural Enterprises Inc. S2
Lincoln, (402) 423-3469

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

> NEW HAMPSHIRE

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

Newstress, Inc. S2
Epsom, (603) 736-9000

> NEW JERSEY

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

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

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

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

> NEW YORK

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

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

The L.C. Whitford Co., Inc. S2
Wellsville, (585) 593-2741

> NORTH DAKOTA

Magnum Contracting, Inc. S2
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