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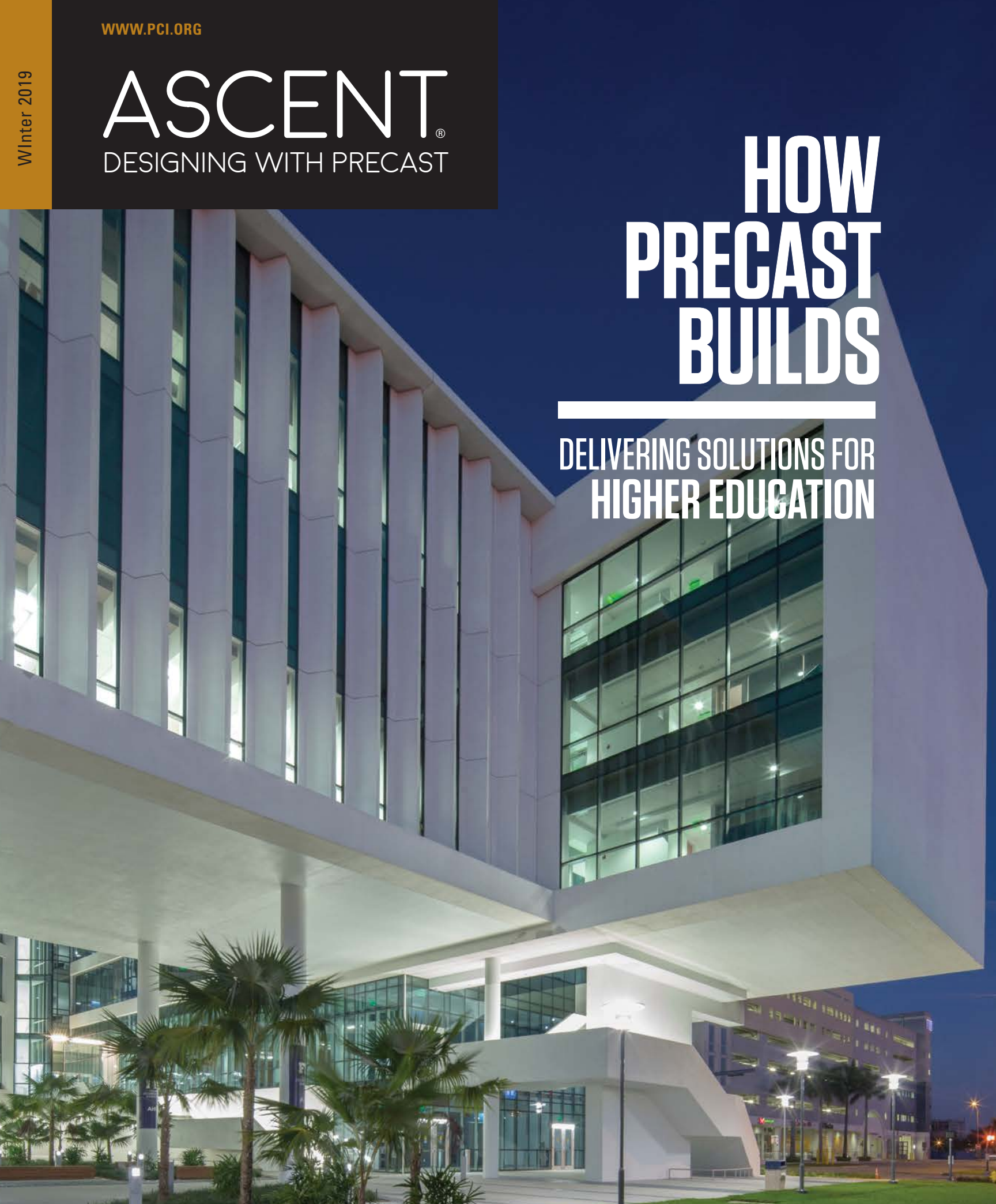


HIGHER-EDUCATION TRENDS

UNIVERSITIES STRIVE TO BE 'NIMBLE'

PRECAST CONCRETE ARCHITECTURAL AND STRUCTURAL COMPONENTS HELP DESIGNERS MEET THE DEMANDS OF EVOLVING TEACHING METHODS

BY CRAIG SHUTT

Facility needs at universities and colleges are evolving. Teaching techniques change, funding sources shift, and technology impacts every facet of academic life. Those factors add to other ongoing needs, such as tight construction schedules, strong aesthetic plans, and concerns about preparing for the future. Designers often find that precast concrete architectural panels and structural framing systems can help meet this array of challenges.

"Universities definitely are thinking today in terms of creating more nimble and adaptable buildings," says Mark Jolicoeur, principal at Perkins+Will Inc. in Chicago, Ill. "We often talk in terms of making designs for these buildings more 'nimble,' as so many trends impact what goes on in the buildings, and they will be here a long time."

Foremost among these trends is a change in teaching techniques. "Group learning has become one of the biggest trends to impact our design of spaces," says Fabian Kremkus, design principal at CO Architects in Los Angeles, Calif. "Classes are being taught in modules that vary from large to small groups. The lessons are problem-based, with a professor who floats from group to group to give advice and critique progress and then has a closing lesson on the experience."

The goal, he notes, is to better replicate the work environment. "The tiered lecture hall is going away," he says. "We're creating more flexible, flat-floor spaces with strong technological support, including monitors all around the room and spaces for students with laptops." This also affects finishes, adds Jolicoeur, with more walls covered with materials that can be written on to work through problems and then erased.

"Each client varies, but there is definitely more learning with visual materials and collaboration," Jolicoeur says. Interiors also include more transparency, allowing those walking through the halls to see activities. "It creates more excitement if others see what's going on in an environment that's more active than lecture halls."

Administrators at Longwood University in Farmville, Va., are speeding construction on two large student-housing buildings on campus by reusing the existing steel frame and enclosing them with insulated precast concrete walls, as seen in this rendering of the finished design. ***Rendering:*** *Little.*

Tighter Schedules

Although those layout needs change, other challenges stay the same—especially tight schedules. "Schedules are always a driver, especially on residence halls," says Richard Naab, project manager at Little, a national architecture and design firm. "Universities have sold those beds ahead of time, and they need to be there."

The deadlines remain constant, no matter what delays prevent design and construction from starting, notes Thomas Carson-Reddig, a partner at Little. "It's a crazy market today," he says. "Some programs are too tight with their schedules. We always want more time, of course, but we have to find ways to make it work in the time we're given. We have to be smart about how we design and what materials we use to ensure everything is completed on time."

Kremkus agrees. "Everybody wants to be faster today; time is always an issue on these projects." CO Architects addresses the demands by creating early bid packages for such elements as foundations, which go out while other drawings are completed. "We create as many early packages as possible to get things moving. As a result, there is more prefabrication going on to speed up the process," he says. "The faster the envelope can go up, the better. Precast concrete helps with that a great deal."

Top: The new student housing at Longwood University, shown in a rendering, will feature a traditional look that was achieved with precast concrete wall panels that tie back to the existing steel frame. | Bottom: Prior to removing the exterior to replace it with architectural precast concrete panels, the student-housing buildings at Longwood University in Farmville, Va., featured 1960s-era looks that were not especially welcoming to the adjacent town. ***Rendering and photo:*** *Little*

Several finishes, including inset thin brick, have been used on the insulated architectural precast concrete wall panels used on the new residential buildings at Longwood University. A variety of architectural ornamental pieces also are being cast.
Photo: *Gate Precast.*

Rehabilitation Helps Schedules

This need for speed has led more schools to evaluate rehabilitating buildings to return them to service faster, notes Little's Carson-Reddig. "When you can retain a portion of the building, such as its steel frame, you can provide a significant upgrade and a faster enclosure. That allows interior trades to begin work faster, speeding the schedule tremendously."

Little took that approach on a project now underway at Longwood University in Farmville, Va., Two 1960s-era residence halls are being rebuilt from their existing steel frame, with insulated precast concrete walls cladding the structures. They replace concrete masonry units with a brick cavity wall with no insulation. The insulated panels, which are stacked on the foundation and tie back to the steel frame, will help the buildings become the first on the campus to achieve LEED v4 environmental sustainability guidelines.

Carson-Reddig explains that this approach was taken for the project, which is being done as a construction-manager-at-risk with Franck & Lohsen in Washington, D.C., as design architect, due to the tight schedule and aesthetic needs. "The design architect wanted a traditional look for the building, and precast concrete provided a lot of versatility in achieving the look we wanted." Little worked closely with precaster Gate Precast in Oxford, N.C., to create the architectural panels.

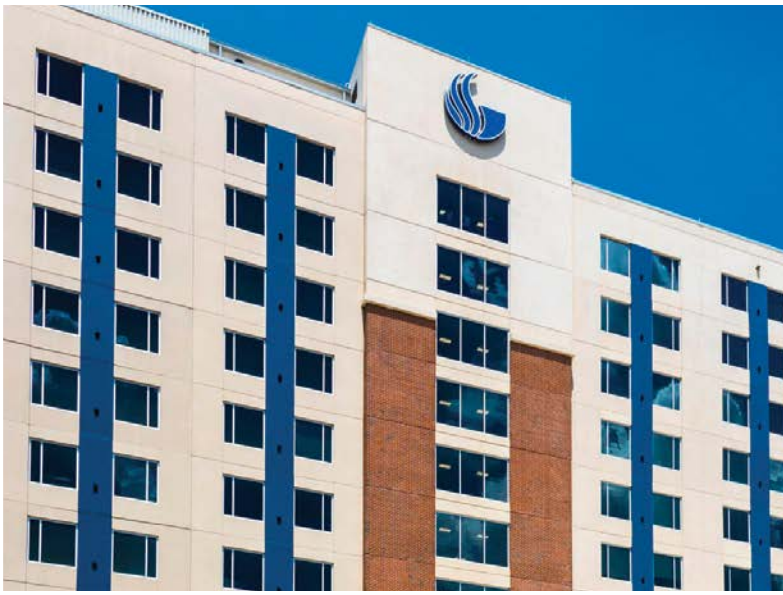
"These are the two largest buildings in town, and they serve as a gateway from the town to the campus," Carson-Reddig says. "Taking the building down to its structural frame gave us the opportunity to create a new image that provided a transition to welcome the town to the campus." The buildings feature two-story columned entries reminiscent of turn-of-the-20th-century hotels, presenting a dramatic face to the town.

The jack arches in the brick inlay panels created a key challenge for the precast concrete producers, adds Mo Wright, marketing director at Gate. "They would have been difficult to do in the field," he notes. "But being able to prefabricate them allowed us to cut them ahead of time and deliver them to be set in the mold."

Using thinner precast concrete panels helps with rehabilitation projects, as they can be supported more easily on existing frames. They provide a variety of benefits, especially to speed construction through prefabrication, which can include installing glazing and other materials before installation.

CO Architects also is working on a new five-story science building at California State University at Sacramento that uses a thin-panel precast concrete system from Clark Pacific in West Sacramento. "Thinner panels, if they're efficient, are good, especially as they reduce the amount of concrete while retaining the benefits," says Kremkus. "There's a definite trend to making shells lighter and thinner without a lot of additives while still achieving the look you want."

The new Science Building at California State University at Sacramento includes a variety of programmatic needs, including laboratories for biology and chemistry along with classrooms, offices, a planetarium, and an observatory. All needs were met by using a total–precast concrete structural framing system that supports thin-wall precast concrete panels. ***Photo:*** *CO Architects.*



Left: The Piedmont Central Housing & Dining Hall at Georgia State University, a 1150-bed student-housing building, is the state's first public-private partnership project. It features a total–precast concrete structural system, including architectural wall panels.

Right: Three finishes were used on the exterior façade of the new student housing at Georgia State University: a medium sandblasted buff color replicating limestone, cast-in red thin brick, and vertical runs with a smooth finish that were painted in the school's signature blue color with a high-performance stain after installation. ***Photos:*** *Metromont Corp.*

Funding Sources Change

Another key trend impacting design and delivery methods is the need to use alternative funding sources as traditional ones dry up or focus on buildings with specific functions. "Many governmental bodies say they will only fund projects with academic uses, not housing units or parking," says Naab. "Those projects have to find other ways to get built."

Longwood's student-housing revisions were funded by the university's foundation, which has strong support among alumni, he notes. "Each university has its own circumstances and resources, and many, especially residential halls, are looking to public-private partnerships [P3] for funding."

> *"Higher-education clients are institutional by nature, and they make decisions for the long term"*

In those situations, administrators work with a developer to create housing on-campus or nearby, and the developer funds construction, manages the building, and collects revenue while reserving the units for students. One example is the Piedmont Central Housing & Dining Hall at Georgia State University, a 1150-bed student-housing building that is the state's first P3 project.

The 252,000-ft^2, 11-story residence hall was built and is operated by Corvias Campus Living for the university. It houses first-year students, with a design intended to help them meet and socialize. Eight programmatic concepts were developed, including such activities as exercise rooms and meeting spaces, with each floor offering a different program suggested by varying color coding.

To help achieve both short- and long-term goals, designers used a total–precast concrete structural system, including architectural wall panels on the building. Metromont in Hiram, Ga., fabricated the precast concrete components.

Choate Construction was brought onto the project early, creating a construction-manager type of collaboration with architectural firm Cooper Carry in Atlanta, Ga. The team decided on the precast concrete structural fame early in the process, owing to the tight schedule and subcontractor availability.

The exterior panels were cast in both 10- and 11-in. thicknesses, with 3 in. of beadboard insulation sandwiched between two wythes of concrete. That gave the panels an *R*-value that exceeded the energy-code requirements while saving time for finishing. Both the exterior and interior sides were finished.

The floor system features the precast concrete producers Metrodeck system, which consists of inverted-tee beams with beadboard insulation ribs covered with a poured topping. The combination creates a sturdy floor component with voids that reduce weight while expanding its length, similar to hollow-core without being an extruded product.

Three finishes were used on the exterior façade: a medium sandblasted buff color that replicates limestone, cast-in red thin brick, and vertical runs with a smooth finish that were painted in the school's signature blue color with a high-performance stain after installation.

The new University Center at Case Western Reserve University blends a variety of exterior materials, including precast concrete, glass, and lightweight aluminum panels. Material selections emphasized functionality, aesthetics, and efficiency, and served to delineate various functions in the building. ***Photo:*** *Perkins+Will.*

Long-Term Outlook

A key component for many projects is the client's emphasis on the long-term outlook. "Higher-education clients are institutional by nature, and they make decisions for the long term," says Jolicoeur. "They don't have a developer's mentality of flipping the building in a few years. Universities are expecting these buildings to be on their campuses for 50 to 75 years, and they are looking at both first cost and long-term costs as important factors."

As a result, there has been a movement toward rain-screen designs that provide a protective exterior barrier as a cladding system. "It has to offer long-term value with durability, low maintenance, and especially performance," he says. "Any vulnerable point is getting more attention. Administrators realize that if they save money on their initial finishes and on the skin and roof, it can lead to trouble."

That has created a movement away from materials such as traditional brick façades that offer a lot of joints. It also has focused attention on vulnerable points, such as where the walls and roofs connect. A wide variety of materials can meet these needs, he notes, including glass, metal panels, and precast concrete.

Perkins+Will recently completed a project at Case Western Reserve University (CWRU) that blends a variety of exterior materials, including precast concrete. The new Tinkham Veale University Center, constructed at the heart of the campus on a difficult, restrained site, was added above a parking structure, requiring no additional structural load. The building was designed as a connecting bridge between the original Case Institute of Technology and Western Reserve University, which joined in 1967 to create CWRU.

"The materials selected emphasize functionality, aesthetics, and efficiency," Jolicoeur explains. Double-wall glass makes the building more open and inviting, lightweight aluminum plate cladding serves as a rain screen and represents machine-like refinement, and architectural precast concrete panels provide an aesthetic that differentiates program areas, such as the standalone restaurant open to the community.

P+W recently completed a health science building at the University of Cincinnati with a cladding of architectural precast concrete panels with ribbon glass running through them with zinc at the base. Combining administration office space, faculty

offices, classrooms, and interdisciplinary space, the 110,000-ft^2 building was designed to be "agile," serving today's needs yet also focused on future needs of practitioners, faculty members, students, and staff.

"The interdisciplinary approach encourages inquiry and exploration," the firm says. The building is divided into two four-story wings connected in a V shape at a central atrium that serve as a hub for social and collaborative interaction. The building also helps meet a public mission of outreach, with a secondary entrance provided along the façade in close proximity to the elevator core within the adjacent parking structure. The building opened in the fall of 2018.

"Architecture for higher-education projects is evolving toward making buildings contextually fit their academic use while also fitting with the campus aesthetics in some way," Jolicoeur says. "Some buildings are iconic and signature statements, but most have to complement their surroundings."

Sustainability Designs Grow

This long-term view provides one reason why administrators are encouraging more sustainable designs. Perkins+Will's CWRU project, for instance, was designed to achieve LEED gold certification.

"Sustainability is highly desired," says Jolicoeur. "Certainly, the ability to do the same amount while paying for less energy is a top priority. We have to evaluate and emphasize the return on investment with each material selection. Some approaches make more sense than others, but that varies with the project, the site, and the client. There are a wide range of options."

Some projects, he notes, make use of geothermal energy sources, but it's on a case-by-case basis. Tying into an existing system also makes sense if the capacity and location are available.

One such project was recently completed at Clemson University in Clemson, S.C., where administrators increased enrollment to 25,000 students (from 18,000), which required adding student housing. That led to the development of the Douthit Hills Student Dormitories, a $212-million residential village completed in 2018.

The complex comprises seven residential buildings in two groupings along with a student hub. The development was planned

Douthit Hills Student Dormitories, a $212-million residential village at Clemson University, comprises seven residential buildings in two groupings along with a student hub. All eight buildings, which feature a total–precast concrete framing system and architectural panels, will be LEED-silver certified. ***Photo:*** *Metromont Corp.*

as "a bold statement that tells students and visitors they've arrived at one of the nation's top schools," the university says. It is reportedly the largest undertaking in both size and cost in Clemson's history.

The east side of the project contains three residential buildings housing first-year students. The 780-bed complex includes space for staff and residential advisors and is adjacent to parking and green space that offers a buffer between town and campus.

The west side consists of four residential buildings housing 700 upperclassmen, with about 400 of the beds replacing existing housing units. The studio and two- and four-bedroom apartments feature oversized windows, courtyards, and landscaped walkways.

The central hub, with a contemporary glass front and tall columns, separates the two housing developments. It contains a dining facility, campus bookstore, fitness center, coffee shop, and other social amenities.

All eight buildings will be LEED-silver certified and contain sustainable features such as directional, nonintrusive LED parking area lighting that can be remotely programmed to shut off when not in use. Achieving this goal was helped by the use of all–precast concrete structural systems, consisting of insulated wall panels, columns, beams, slabs, and MetroDeck flooring systems. The components are being provided by Metromont Corp.

General contractor Holder Construction had seen the work done by the precast concrete producer on a student-housing project at the Savannah College of Art & Design and realized that the total–precast concrete system would help win the bid by providing competitive pricing and a fast schedule for completion.

Metromont worked closely with the two architectural firms on the project, The Boudreaux Group (east side) and Clark Nexsen (west side) to rework the layout to achieve an open feel. Horizontally stacked wall panels allowed the precast concrete producer to incorporate more punchouts for windows and doorways without compromising the structural load-bearing ability.

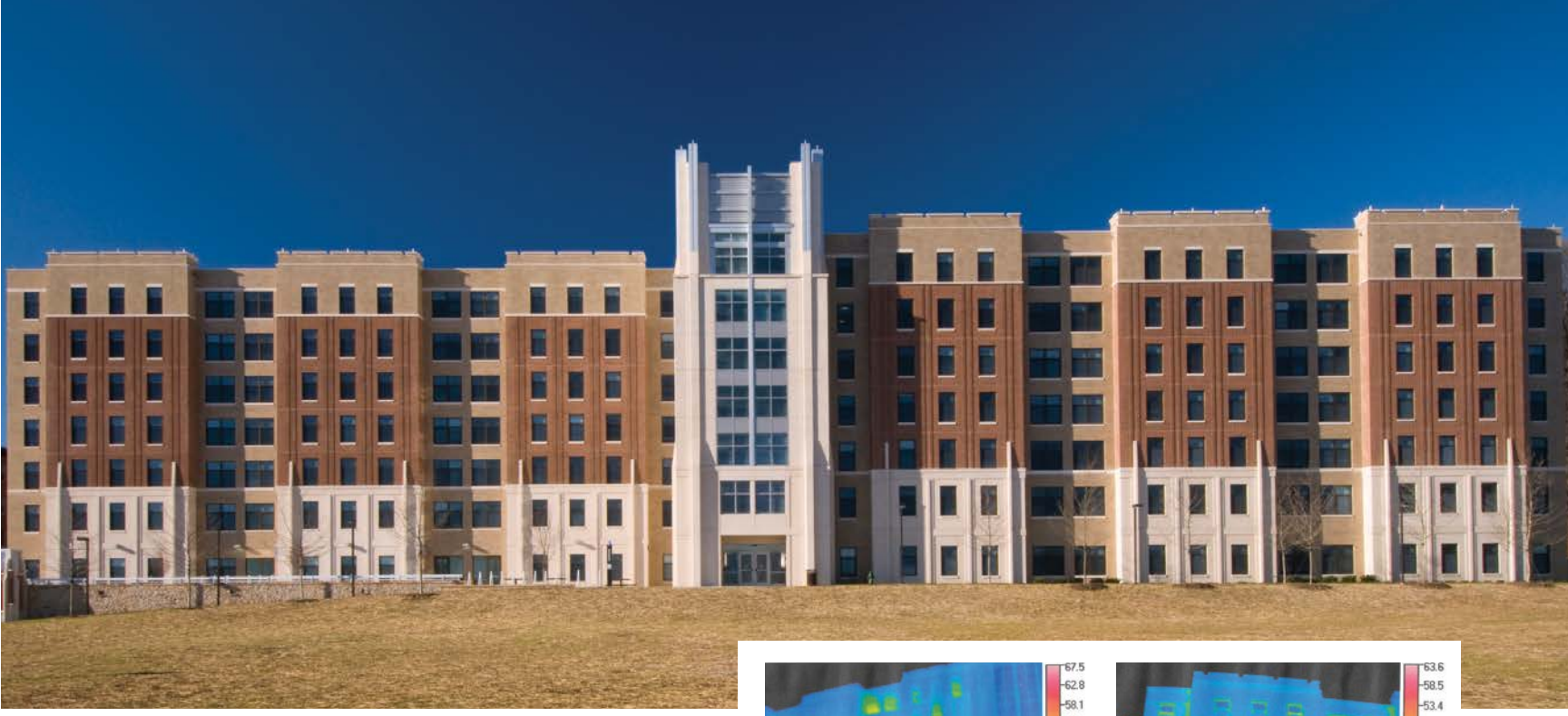
New Products Aid Sustainability

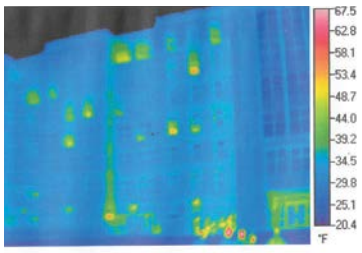
A variety of new products are helping achieve higher sustainability goals. Solar panels, for instance, are gaining attention, as costs come down and their appearances change. "Their cost is reaching the point where they're more practical," says Jolicoeur. "When they reach the point where grants aren't required to help fund them, they'll really take off."

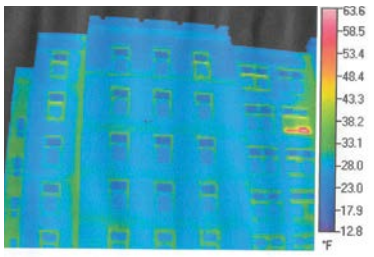
Adds Kremkus, "The big players are creating panels that look more like part of the built environment. That offers more opportunities to incorporate them unobtrusively. We're seeing more of a trend toward incorporating energy generation into all types of building envelopes."

The ability of insulated precast concrete sandwich wall panels to eliminate thermal breaks while providing both interior and exterior facings has drawn attention to both their energy-saving benefits and their speed of erection. Little specified such panels for Opus Hall, a residential building for Catholic University of America in Washington, D.C., and they were fabricated by Gate Precast.

The panels featured a 4.5-in. interior structural wythe of concrete, 2 in. of continuous insulation, and a 2.5-in. exterior wythe inset with thin brick. The noncomposite sandwich wall design eliminated thermal bowing, while the Thermomass fiber-composite connectors eliminated thermal bridging. The walls created no cavity where moisture could collect and provided a fire endurance rating of more than four hours, a sound transmission class rating of 54, and an exposed interior concrete wall that maximized its thermal mass effect.







Top: *Architects at Little specified insulated precast concrete sandwich wall panels to clad Opus Hall, a residential building for Catholic University of America in Washington, D.C. The 9-in.-thick panels feature 2 in. of continuous insulation.* ***Photo:*** *John Cole.*

Bottom: *When Opus Hall, a residential building at Catholic University of America, was completed, architectural firm Little performed thermal-imaging studies to find areas of heat loss. The use of insulated precast concrete panels helped ensure there were none.* ***Images:*** *Thermomass.*

When the project was completed, thermal imaging was done for each façade of the eight-story building. It showed a continuous, solid mass of blue (that is, cold) with no hot spots, indicating virtually no loss of heat energy through the precast concrete walls. "We often do thermal imaging today to prove the building's energy performance," says Naab. "The benefit of creating no thermal breaks is significant."

Cutting-edge technology also is required, although that standard constantly changes, creating more challenges. "Technology has become a key building service," says Jolicoeur. "We need to plan for it as a service and how it can be logically stacked."

Wireless connectivity is critical, but buildings still require space for servers and equipment. "Wi-Fi is only good for so much," notes Kremkus. "Heavy research needs servers and hard wiring." Cooling is a big concern, as is data and electrical wiring accessibility. "When we use concrete, we need to plan these services well in advance to ensure there are no cuts required in the field," says Carson-Reddig. "It takes more time, but it's not difficult if you're working together."

Total–Precast Designs Grow

In some cases, designers find total–precast concrete structures provide the best combination of benefits in speed, economy, aesthetic versatility, durability, and others. That was the case for CO Architects' Science building for Sacramento State. The building, which houses laboratories for biology and chemistry along with classrooms, offices, a planetarium, and an observatory, features a total–precast concrete structural framing system that supports the thin-wall precast concrete panels. Sundt Construction Inc. in Sacramento is the general contractor on the project.

Perkins+Will often uses a total–precast concrete system for spaces that require large, open floors. That most often arises for them with high school designs. "We use precast concrete systems for gymnasiums, as we can provide column-free spaces and create sophisticated articulation on the exterior that adds depths and shadows," Jolicoeur says. "Integrating insulation into the walls while creating a panel with both the interior and exterior surfaces creates an efficient design. These buildings don't have to look like a Costco any more, despite their utilitarian nature."

Total–precast concrete designs often win the day with parking structures, which are becoming more important to universities but more difficult to fit onto tight campuses. "Land is very rare these days for large buildings like parking structures, but campuses need them to serve students," says Kremkus. "Most institutions want to consolidate efficiently to make the best use of parking."

A strong example of what can be achieved was created at Sacramento State in a new six-story, 1750-car on-campus facility that was designed to blend and complement the dense trees of the nearby arboretum. Designed by Dreyfuss + Blackford in Sacramento, the structure features precast concrete columns, beams, double tees, spandrels, and other components fabricated by Clark Pacific, which also served as general contractor.

SCUP AIDS DIALOGUE

Many designers (including a number quoted here) belong to the Society for College & University Planning (SCUP). The Ann Arbor, Mich.-based group has more than 5000 members who engage and share knowledge through a variety of conferences, trend reports, online resources, and social-media platforms.

The members consist of all types of planning officers, including chancellors, research directors, architects, engineers, contractors, and environmental planners. About 60% of members work for public and private institutions of higher learning, while 38% are consultants and architects. The rest are nonprofits and government agencies.

"SCUP members share a common interest in the teaching, learning, and sharing of information about college and university planning in all its forms," the organization says. **To learn more about the association, visit WWW.SCUP.ORG.**

"Because of the increased erection speed possible with the precast solution, the overall project schedule was more aggressive and intended to be completed over a single school semester," says Thomas Ketron, director of marketing at Clark Pacific. Its design achieved Parksmart Gold certification from the Green Building Certification Institute for the U S. Green Building Council, making it the highest performing, most sustainable parking structure on campus.

Creating Gateway Statements

Aesthetics are a key ingredient for every design, no matter its location. More attention is being paid to buildings on the edges of campus, where they are more likely to interact with nearby neighborhoods.

"'Gateway' buildings at the edges of campus are receiving more attention, as they make a statement as people arrive at the university," says Jolicoeur. Those buildings often have more leeway in fitting into an existing architectural style established many decades earlier. Little gained that leeway in designing the appearance for the Longwood University student residences.

"Their position at the gateway to the university was very important, especially as they were so tall and prominent," says Naab. The ability to create a similar but distinct appearance was critical. "In the past, schools have wanted to match their existing look exactly, and that can be challenging. Today, they're more open to adapting that style to create a more contemporary look. And precast concrete panels make it easier to find a solution, because there are more brick colors available and the joints can be made to look more realistic."

The designers often do large-scale mock-ups of brick panels to review with clients prior to making a final choice. "Being able to choose among different brick, 'mortar' [background concrete], and trim colors creates a lot of options if universities are open to experimenting."

CO Architects often works with clients wanting a new style, Kremkus says. "They don't call us if they want a conservative or traditional look. We aren't a good fit. Our clients typically are looking for a sense of place and a design that caters to functionality, but the building also must make a forward-thinking statement about how its material are used."

Material costs are a growing concern, as pricing often changes from specification to purchase. "Rising material costs are impacting us more all the time," says Kremkus. "Those costs impact everyone and require us to try to save money other places later on." Carson-Reddig agrees, noting that some material costs are rising as much as 1% per month at times. "It makes it difficult to try to construct the project from the design that was created. There needs to be a buffer built in to allow for that, and we have to be smart about our estimates."

Delivery Systems Expanded

These challenges are leading universities to look more closely at alternative delivery systems, especially design-build. "The biggest trend underway is the use of design-build for more projects," says Kremkus. "Owners want to mitigate risk and transfer it to the build team. They want more assurances on price to avoid overages. We have to meet those parameters and prove we will deliver the project as outlined by its program requirements and budgets."

Administrators typically provide specific programmatic needs developed with a planning team that consists of architects, engineers, planning consultants, and users. This input culminates in an "almost room-by-room" program, he says, which is then fleshed out by the designers. "This approach is new in the past four to five years."

A new six-story, 1750-car on-campus parking facility at the University of California at Sacramento was designed with precast concrete columns, beams, double tees, spandrels, and other components to help meet an aggressive schedule.

The new parking structure, which features a total–precast structural framing system, achieved Parksmart Gold certification from the Green Building Certification Institute for the U. S. Green Building Council, making it the highest performing, most sustainable parking structure on campus. ***Photos:*** *Clark Pacific.*

Design-build works somewhat differently from a P3 project, he adds, in that it lets the designer work with the contractor one step from the university. In a P3, the developer hires the team and works directly with administrators. "The collaborative design-build process works very well in either case," Kremkus says. "The dialogue is a big part of these methods, and we welcome that."

Naab agrees. "Design-build allows an early dialogue to ensure all the implications of a design for its constructability are understood and handled. It helps to have the contractor at the table."

Adapting to the Future

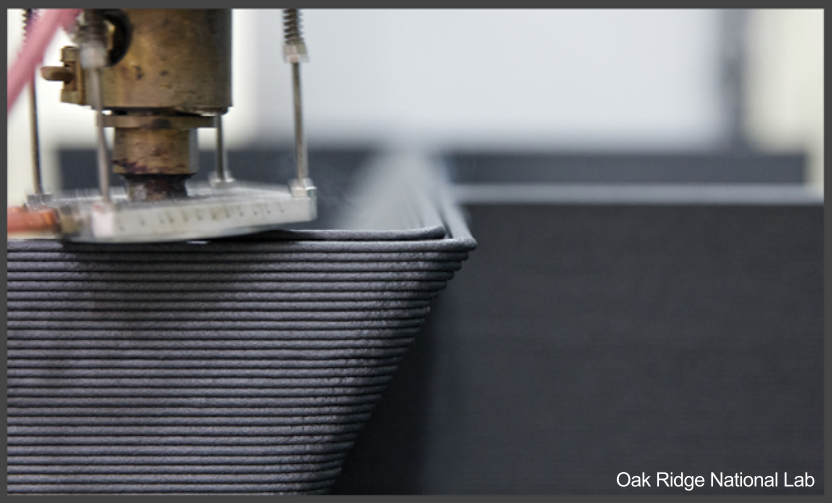
Designing in industries that are evolving how they perform and that involve so many technical and diverse functions—sometimes within the same building—means designers must pay closer attention to new ideas in technology and many other fields. They must anticipate where higher-education designs are going and be there to greet them as they arrive.

"Universities are looking for more adaptability and flexibility in their learning spaces," says Carson-Reddig. "Administrators expect their buildings to last for decades, but how the spaces are used changes very rapidly today. We have to rethink how we design and build to address those changes. There are interesting dialogues underway about the evolution that is taking place."

Jolicoeur agrees. "The only thing we know for sure is that we don't know what the future will bring. Yet we need to prepare ourselves for it. That means we have to be designing for adaptability."

Fortunately, materials such as precast concrete offer the adaptability, flexibility, durability, and aesthetic versatility to help address those challenges. "We definitely need to be creating more nimble and adaptable buildings than we have in the past," Jolicoeur says. "But the work we have done and that others have done have shown that the ante is being upped for what can be done with precast concrete." ●

Forms produced utilizing 3D printing for concrete exterior systems offers solutions for a complex facade.



Oak Ridge National Lab

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

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

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

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