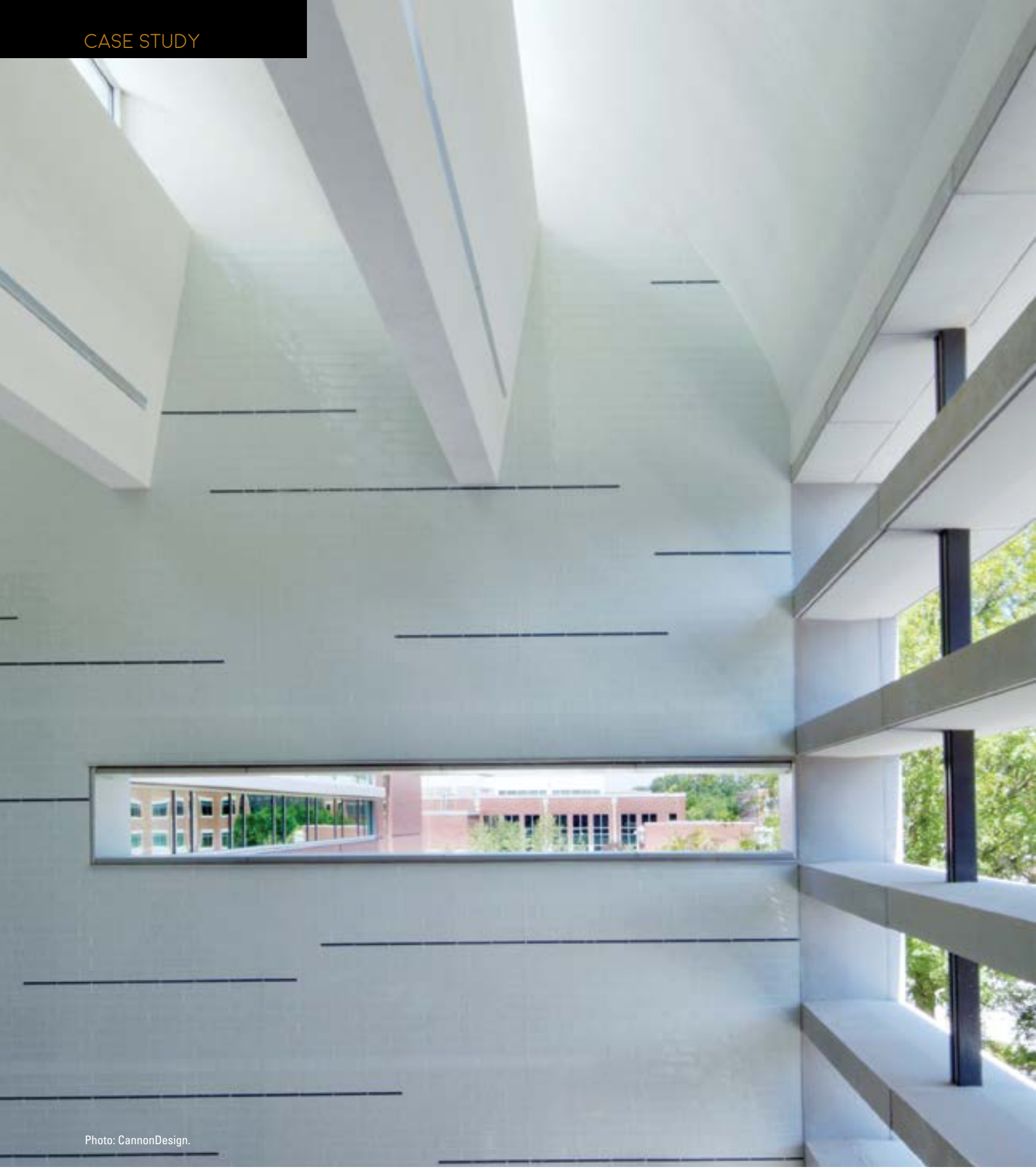

Photo: CannonDesign.

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.

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

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.

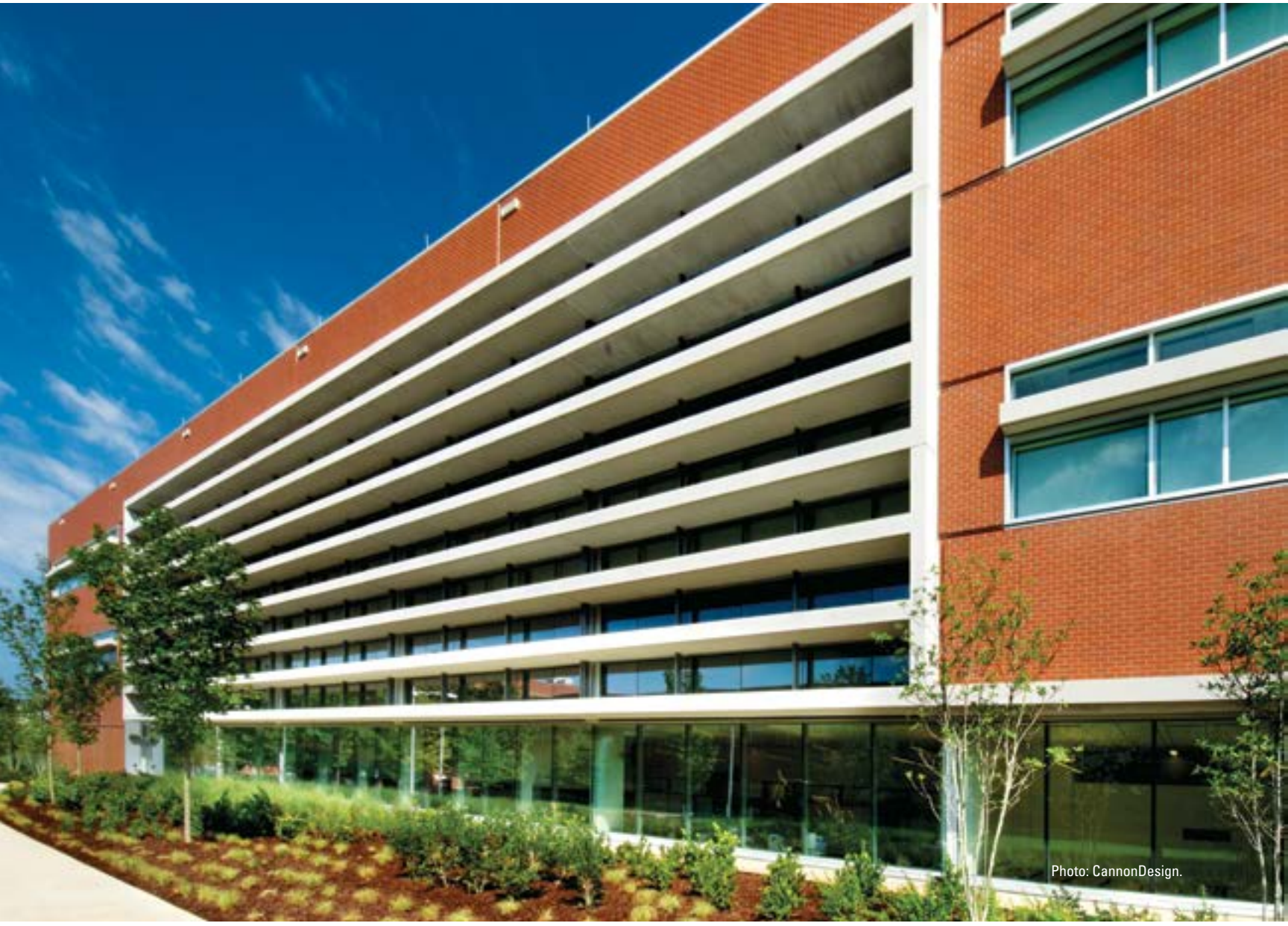
Photo: CannonDesign.

"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.)

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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."

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.

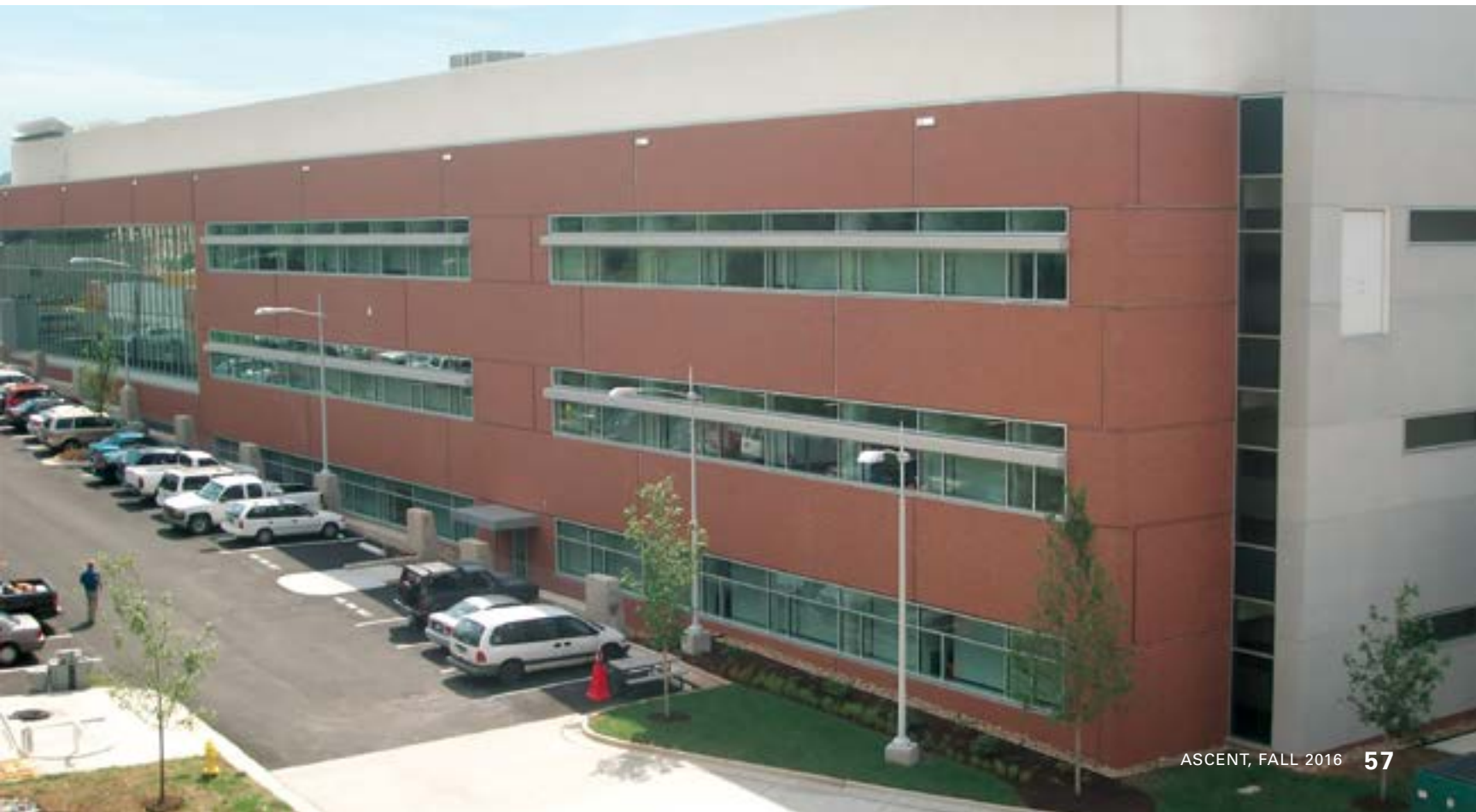
Each mold had to be built independently, with block-outs that would accommodate the steel supports. The panel reinforcement was tied to tube supports prior to casting. Each shade fin was prestressed for increased strength and resistance to cracking. Adjustable bearings were used to accommodate deflection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

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

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.