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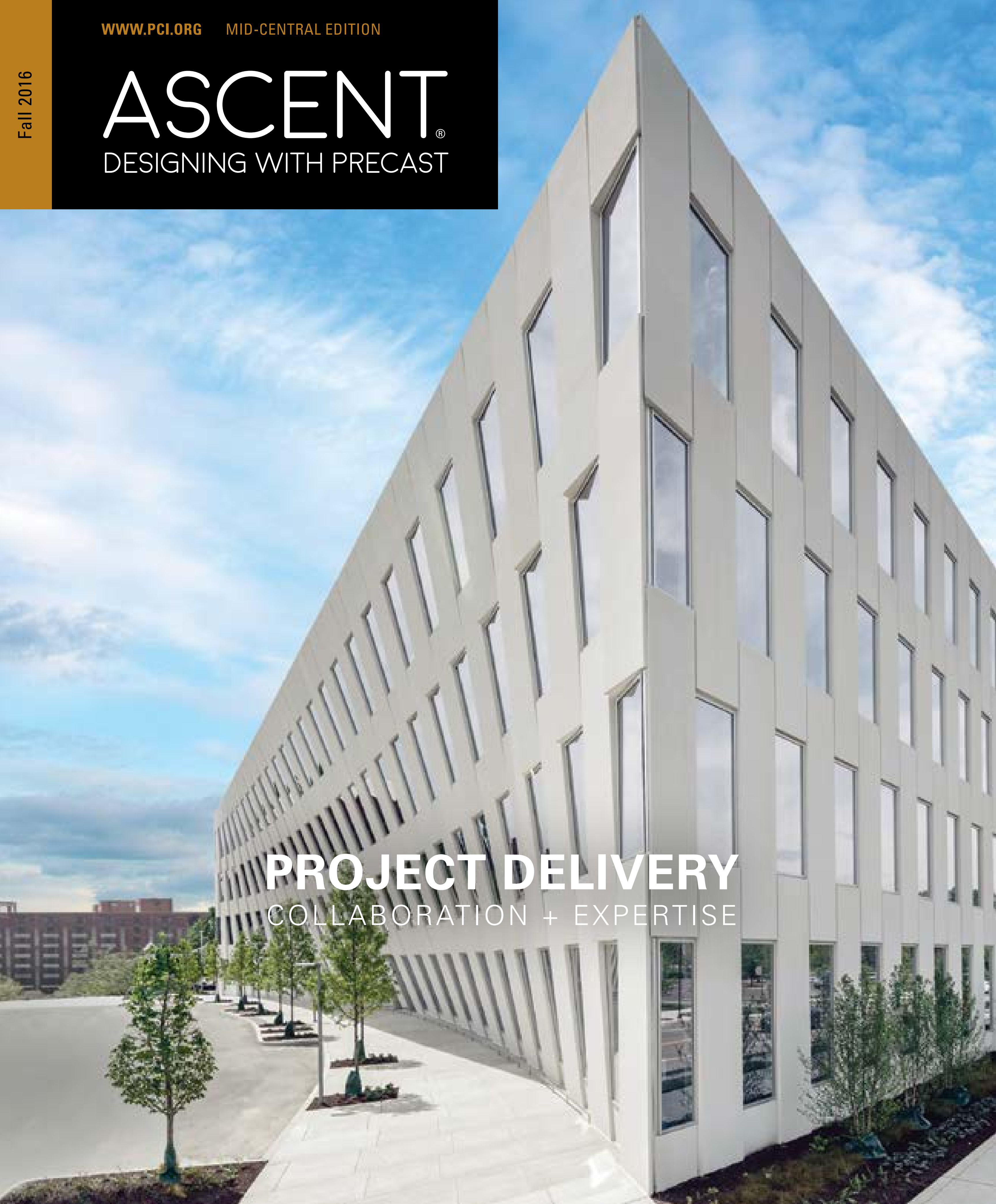


PROJECT DELIVERY

COLLABORATION + EXPERTISE

'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

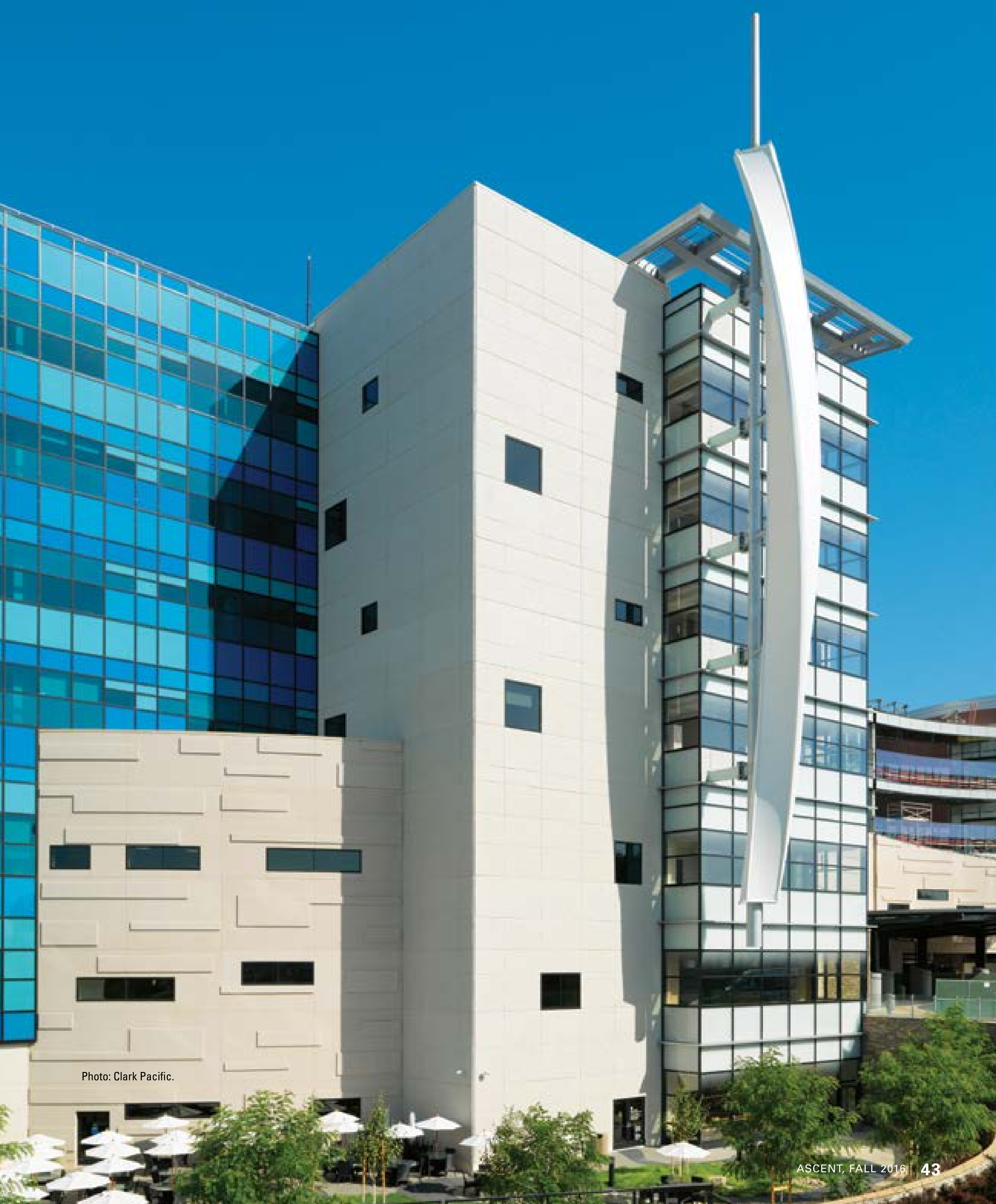


Photo: Clark Pacific.

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.

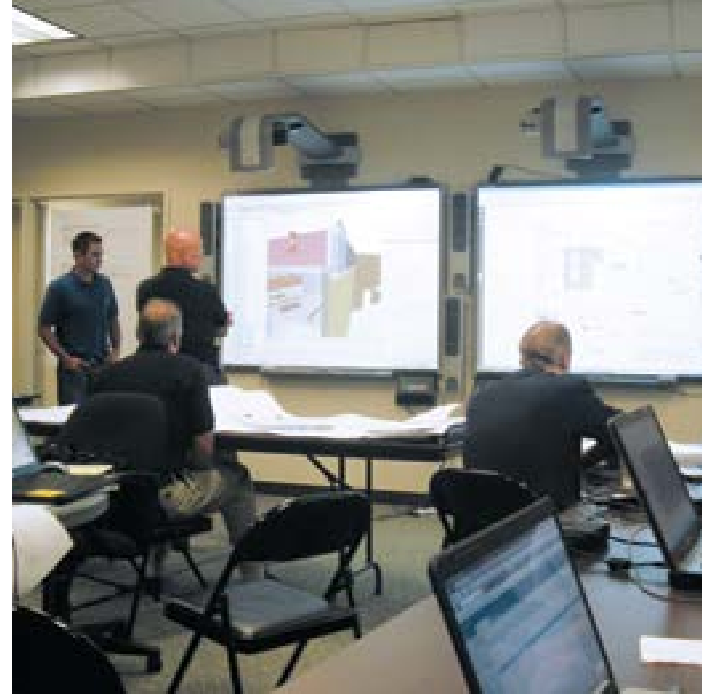
"Colocation is a key part of IPD collaboration, but participation and scheduling of colocations has become the big battle today," says Eslick. "It's a key part of the process, but with the variety of telecommunication options today, there are more opportunities for participating via long distance."

'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.

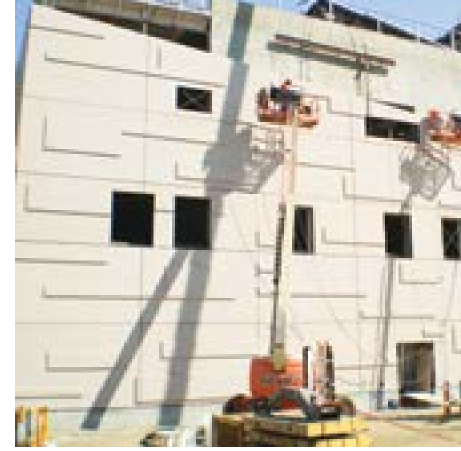
Planning evolved as new tasks were added, existing tasks were made more specific, and some tasks were eliminated or combined into others. The workflow steps were color coded with sticky notes to classify tasks by source and activity. "We focused on specific task activities rather than the traditional 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."

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."

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

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."

The Face of Lean Construction
Lightweight
Pre-insulated
Pre-glazed
Prefabricated
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