PRECAST
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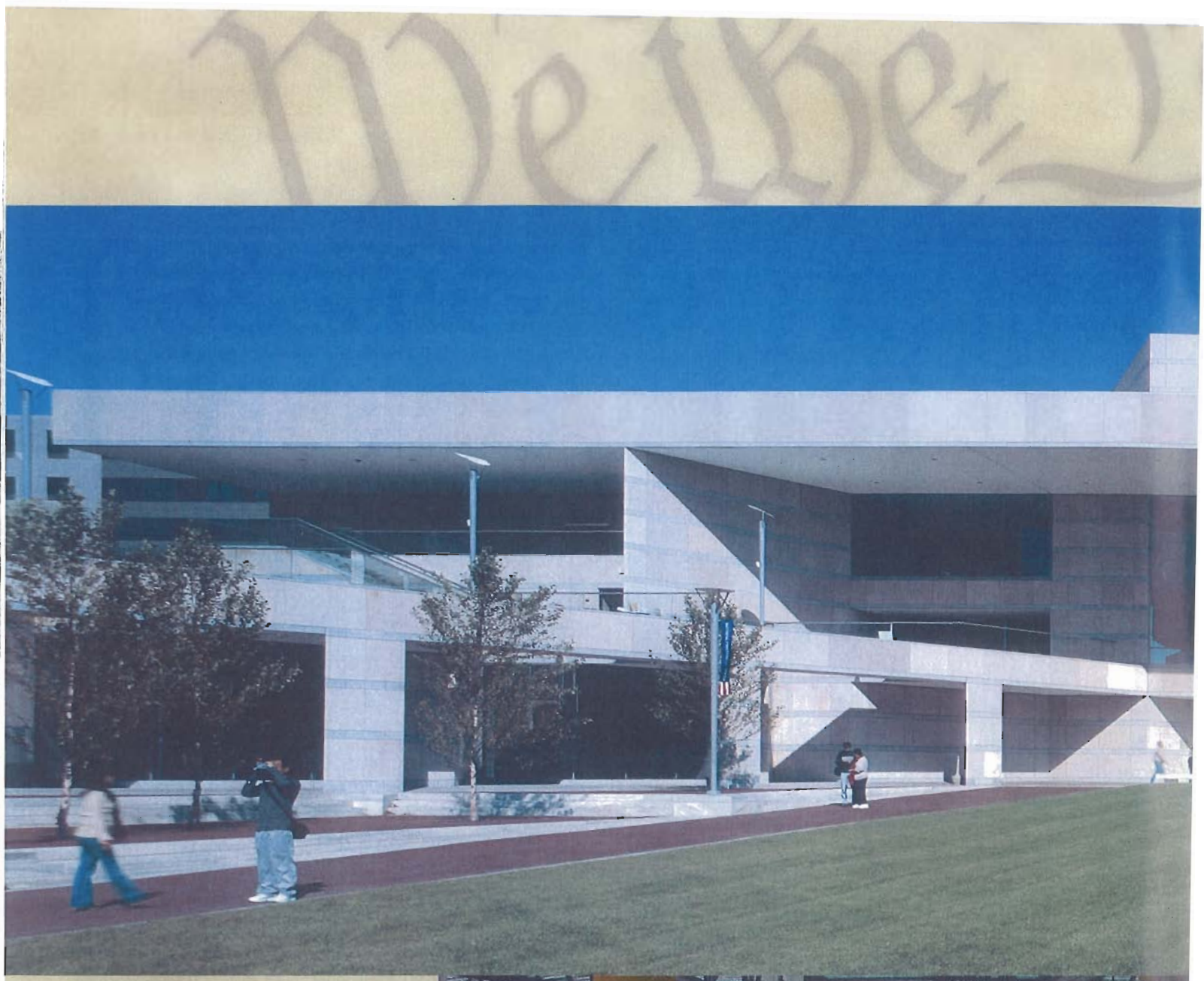
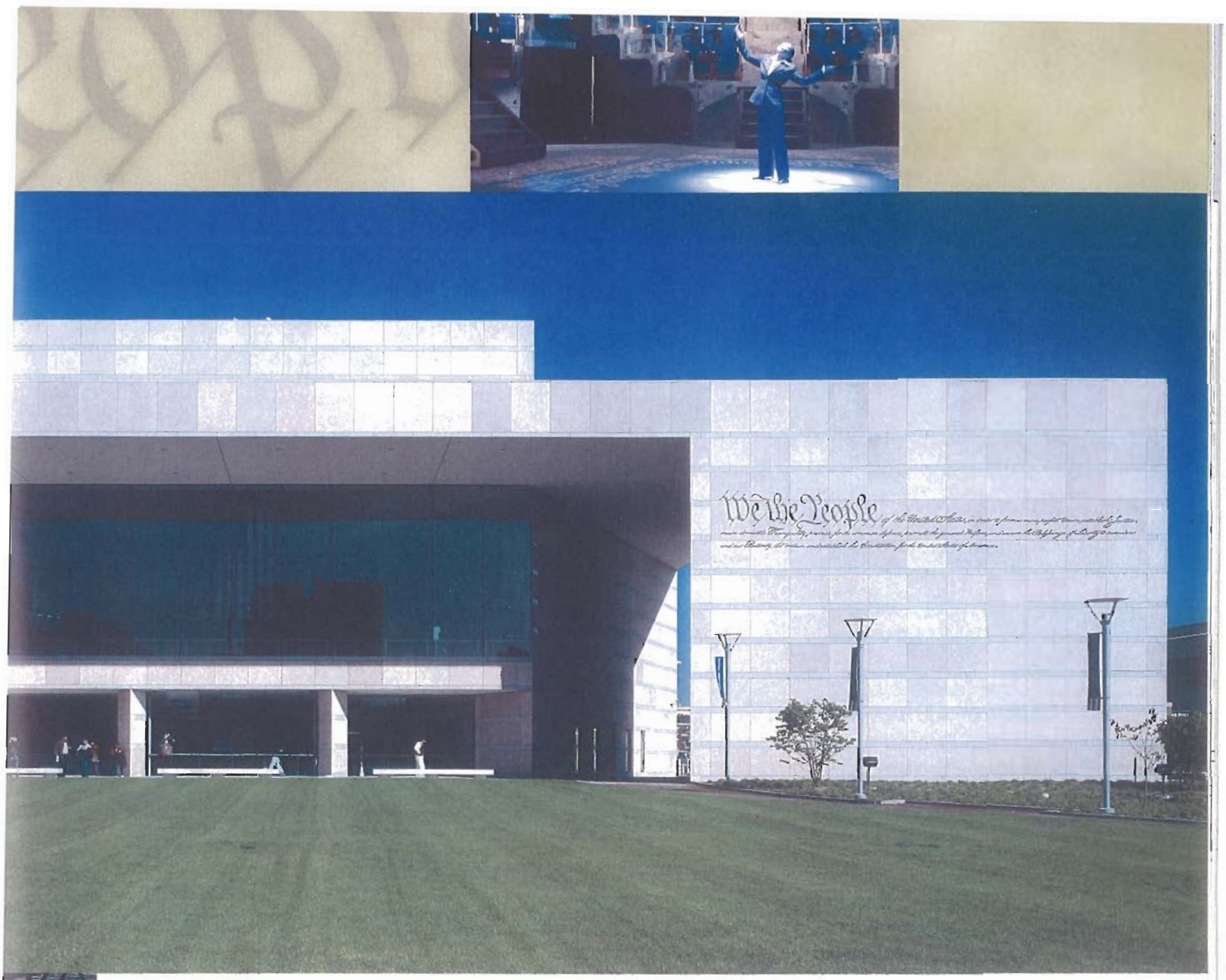
# Precast Takes Center Stage



## Precast concrete becomes a part of history with the construction of the National Constitution Center's 350-seat, star-shaped theater.

BY BRIDGET McCREA

Photos courtesy National Constitution Center




Courtesy Bethlehem Precast Inc.

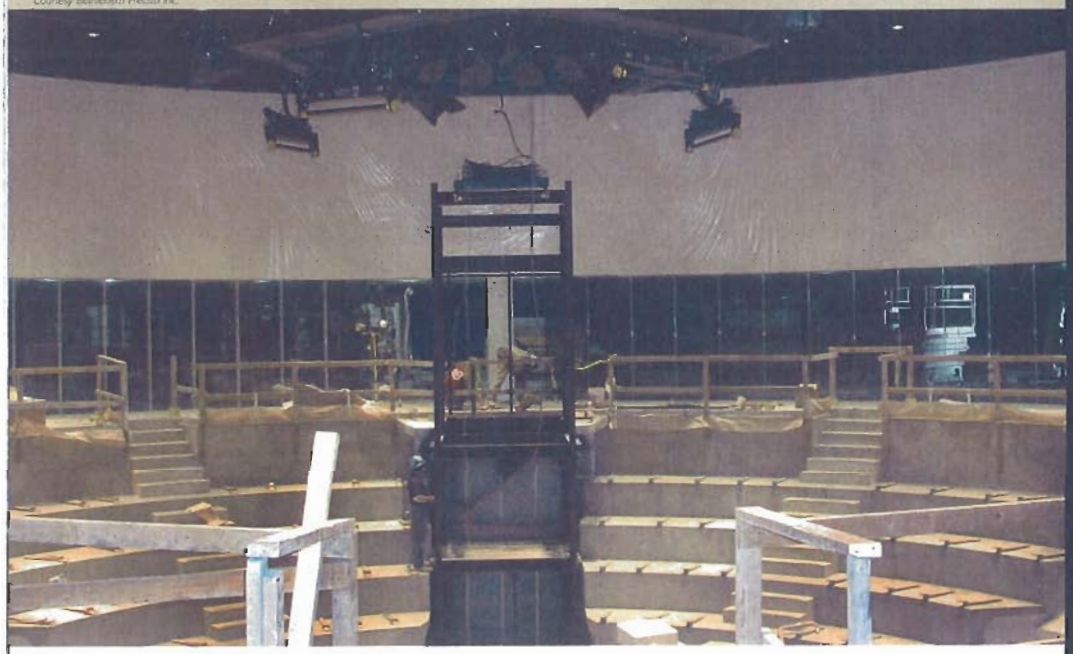
# PRECAST TAKES CENTER STAGE

EVERY YEAR ROUGHLY 1 million visitors are expected to stream into the Kimmel Theater in Philadelphia to "experience" a multimedia presentation on the National Constitution Center's (NCC) orientation. At some point during their visit, each one of them will plop down into a seat in the theater-in-the-round that features a 360-degree screen around the perimeter, five smaller screens and a live actor who presents "The Founding Story."

The lights dim and the show begins. An actor in contemporary dress walks into the middle of the theater and asks: "What makes us Americans?" As the story progresses, the media elements change. Filmed elements are first projected on the floor, next on the 360-degree screen, then on a scrim that fills the center of the space, and at key points on the audience itself. The show ends, as it began, with a question: "What will we do with freedom?"

The National Constitution Center's new theater features a seating area that presented some unique design challenges that were resolved using precast concrete.

Courtesy Bethlehem Precast Inc.



Visitors then shuffle out to the next NCC experience, blissfully unaware of just how much work went into creating the 350-seat, star-shaped theater where they just watched the enlightening multimedia production. Using structural design and construction drawings provided by Cowan Associates Inc. of Quakertown, Pa., the precast concrete seating sections for the circular theater were constructed and erected by Bethlehem Precast Inc. of Bethlehem, Pa.

Cast in custom-made steel forms, the curved L-shaped precast concrete sections for the theater provide the support structure for five sections of five levels of seating. According to Charles R. Tomko, Cowan's director of structural engineering, the L shape created the riser and tread sections for the step theater, and the base sections were recessed for retractable aluminum stairs. Each section was welded to steel bearings on sloping steel girders at the tread and riser via embedded weld plates.

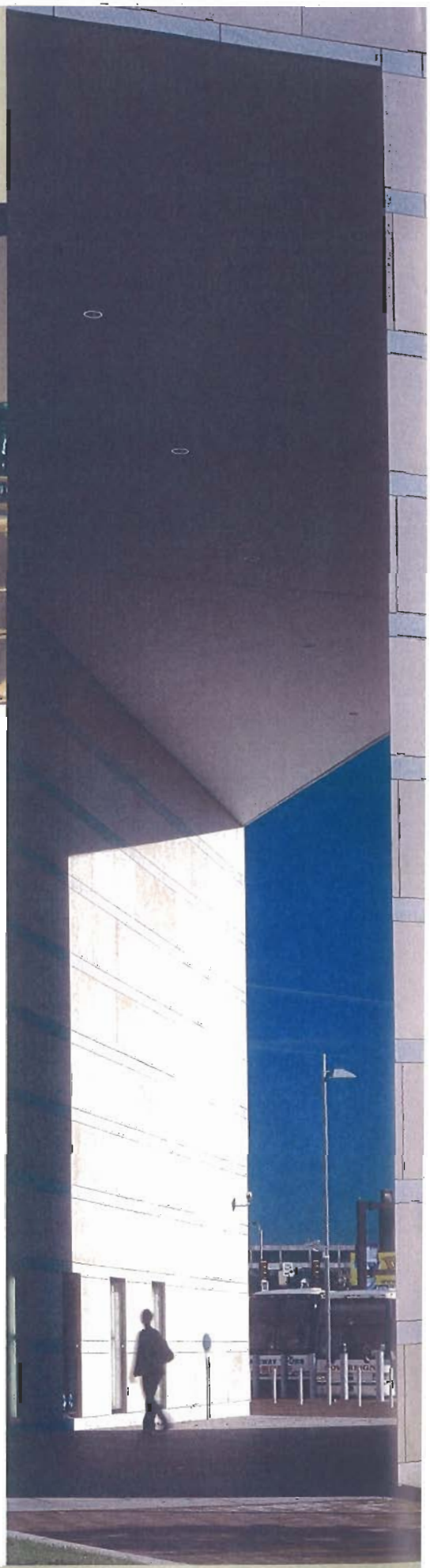
"Because the steel girders radiate outward from the middle, the precast sections had to span increasing widths as they progressed up the theater and outward in increasing radii," Tomko explains. "The precast is exposed and acts as a walking surface and support for the theater seats."

## RICH HISTORY

The National Constitution Center (NCC), an independent, nonpartisan, nonprofit organization dedicated to increasing awareness about the Constitution and its relevance to Americans' daily lives, was created by the Constitution Heritage Act in 1988. On Sept. 17, 2000, 213 years to the day the U.S. Constitution was signed, the NCC broke ground with President Bill Clinton presiding over the official ceremonies. On July 4, 2003, the two-story NCC opened its doors.

Located on the third block of Independence Mall, the NCC joins two of the nation's greatest symbols of freedom: Independence Hall and the Liberty Bell. The NCC tells the story of the U.S. Constitution through more than 100 interactive and multimedia exhibits, photographs, sculptures, texts, films and artifacts.

The NCC is the first museum in the country designated as a member of the National Archives Experience Alliance Initiative.



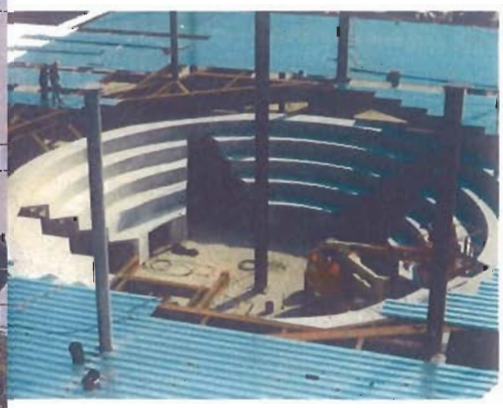
## PRECAST PLEASE

Getting the idea for the NCC off the drawing board and into reality required a whopping 85,000 square feet of Indiana limestone, 2.6 million pounds of steel and a half-million cubic feet of concrete. Designed by New York architectural firms Pei Cobb Freed & Partners and Ralph Appelbaum Associates, the NCC's total square footage of public space is 160,000 square feet, including galleries.

The precast portion of the NCC consisted of 30 elements comprising 56 yards of 5,000-psi concrete. Tomko insisted on a high-quality finish and tight tolerances for the public forum, and Bethlehem Precast delivered.

Thomas Engelman, president at Bethlehem Precast, says his firm was invited to bid on the precast portion of the NCC by Philadelphia-based Turner Construction, the project's general contractor. Engelman says the idea of creating curved elements for the amphitheater was unusual for his company, which decided to take on the challenge and get involved with the historic project. Originally, the amphitheater was specified for cast-in-place concrete, but time constraints and the need for a more aesthetic, quality look prompted project owners and engineers to opt for precast instead.

Chris Auer, project manager for Turner Construction, says his firm was brought in to conduct value engineering and cost cut-



Embedded plates at the tread and riser were welded to steel bearings on sloping steel girders.

ting for the overall project, which was originally put out for bid in the fall of 2000. Because all three bids were over the owner's budget, Turner Construction spent a year bringing the project back in line with the owner's projections. "An agreement was reached in April 2001," says Auer. "Our firm gave a guaranteed price to the owner at that point, and we proceeded with the work."

Auer says one way his firm was able to cut costs in the Kimmel Theater was by switching from cast-in-place to precast concrete – a move that saved the NCC $87,000 while also shaving several weeks off the construction time. He says the choice of precast also allowed the components to be designed by the precast concrete manufacturer, rather than working from performance specifications.

One of the most interesting aspects of the project was the precast pieces themselves. Not the typical straight sections of concrete, these 30 elements were cast in a true radius to form a circular seating area on which manufactured seating could be arranged.

Engelman says the curved aspect of the precast structures presented a design challenge, mainly because each had a different circumference and radius. "We had to match the five different levels and all curves within a half-inch tolerance," says Engelman, whose firm has traditionally worked in the residential sector but recently branched out into more commercial and industrial applications. "It definitely made for a tricky job."

Engelman adds that the precast portion of the theater not only met but also exceeded the project owner's expectations. It was a feather in the cap of the precaster, who had never worked with the NCC, nor had it ever undertaken such an unusual project. "When they came here to our plant to inspect the pieces in the middle of the project," says Engelman, "they told us that they were much nicer than they had anticipated."

## GETTING THE JOB DONE

Early on, Auer says several project participants were reluctant to take on the task of installing a precast structure because of its size and weight. To overcome the objections, he says the contractors modified original plans and used a tower crane outside the building to drop the heavy pieces into the structure. "In one seating area we installed more joints than were shown on the original plans, because the structure would have been too heavy and long," says Auer.

Engelman says the project itself took more time than usual to plan out, which involved such fundamentals as deciding whether to use wooden or steel forms. "We make a lot of our forms out of wood, but in this case it just didn't pay to do so because the pieces were so big," says Engelman, who subcontracted Spillman Co. to create the forms for the curved face, side and back surfaces out of steel. Bethlehem Precast then manufactured the wooden cores, which aren't visible and therefore did not require the same strict tolerances as the other portions of the theater.

Because the precast concrete would be an exposed element within the amphitheater, the NCC wanted a smooth, quality finish. Unlike cast-in-place concrete, Engelman says precast fit the bill perfectly. "I don't think they could have ended up with a good, quality finish from poured-in-place, at least not without a lot of patching and extra finishing," he says. "We used a steel-form finish, which turned out very smooth and of very high quality."

Engelman and Auer both agree that using precast concrete created time efficiencies for the project. "We gave them a quick way to get their amphitheater started," says Engelman. "We started in November, the steel forms arrived in December and by the end of January all of the pieces were made and ready to install."

The expedient work continued at the job site, where Bethlehem Precast hired an erector to install the pieces and weld them into place within two days. The same task would have taken a construction crew using cast-in-place concrete two days to complete just one of the five levels, says Engelman. "The crane was able to set the steel while the pieces were being aligned and set manually," he explains. "We were in and out in two days, and saved the NCC a few weeks by getting it up and installed quickly instead of spending days craning, bucketing and moving (wet) concrete."

## IMPRESSIVE RESULTS

Auer vividly remembers the day the NCC executives clambered into what would soon become the Kimmel Theater to touch, feel and see the structure's pre-

cast concrete seating section. "It was one of the first finished products in the building," Auer says, "so everyone was walking around and sitting on the precast, envisioning what the theater was going to be like."

Emily Bittenbender, the NCC's vice president of design and construction, also remembers that day and the milestone that it represented on what would wind up being a three-year-long project. Bittenbender, who has since left the NCC to open her own firm, says she worked closely with project management group Hill International to coordinate everything from the architects and exhibit designers to the sculptors and fabricators, bringing the NCC to life.

The decision to use precast came after the original bids came in over budget, Bittenbender says. "Using precast not only saved us $87,000," she says, "but it also made for a pretty straightforward, easy installation. It was a great solution for our budget problem and time constraints."

Overall, Bittenbender says the NCC was "extremely pleased" with the end result and the fact that the precast presented no design or installation challenges that couldn't be resolved quickly. "Switching from cast-in-place to precast was really no sweat at all," she says. "It has provided a great foundation for what is the center core of the entire building and one of its most important rooms and functions."

*To find a manufacturer of this product in your area or for more information, visit NPCA's Web site at www.precast.org or call toll free (800) 366-7731.*

## PROJECT PROFILE

**Project:** *A 350-seat, star-shaped amphitheater within The National Constitution Center.*

**Owner:** *The National Constitution Center, Philadelphia*

**Architect/Engineer:** *Pei Cobb Freed & Partners, New York; Ralph Appelbaum Associates, New York; Cowan & Associates Inc., Quakertown, Pa.*

**Contractor/Installer:** *Turner Construction Inc., Philadelphia*

**Precast Manufacturer:** *Bethlehem Precast Inc., Bethlehem, Pa.*