Precast Provides for Versatility and Innovation in Parking Structures

Owner demands for revenue, sustainable design and other features drive unique designs using total-precast concrete parking systems

— Craig A. Shutt

The tight economy encourages developers to create more efficient buildings, and parking structures are not immune to those demands. A desire to generate more income and a growing interest in using sustainable-design guidelines are adding challenges for designers. Fortunately, total-precast concrete parking structures can help meet those needs while handling site, speed, aesthetic and budget requirements.

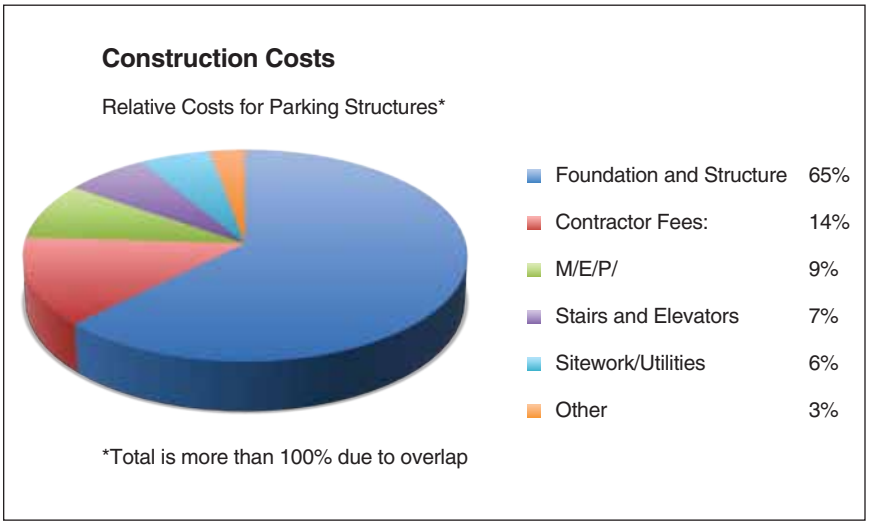
Evaluation of structural materials is a key factor in both the initial and long-term costs for parking projects. The foundation and structure account for 65% of all construction costs for a parking structure, according to a 2009 presentation by Carl Walker Parking in Kalamazoo. This is significantly higher than for other types of structures, in which a large portion of the budget goes to interior partitioning, finishes and other functional and aesthetic requirements (see the diagram).

Multi-use projects are growing in demand, as owners want to raise revenue from their facilities as well as draw more users to them. These needs create a variety of parking impacts. (For more on these trends, see the Parking Trends feature on page 30.)

Meanwhile, the growing green-building movement and use of the Leadership in Energy & Environmental Design (LEED) standards are making owners consider how they can include these elements in their projects.

"We're seeing a lot more interest in using LEED standards with parking structures," says Jim Duller, an architect with Clark Nexson Inc. in Charlotte, N.C., who has designed several such projects. "As the green movement grows, it's becoming more popular, especially in any of our government work, where it's already mandated. We expect more cities and other building owners to follow their lead."

While balancing these concerns, owners also are mandating that parking structures blend with surroundings, becoming an addition to the neighborhood rather than a necessary evil. Precast concrete's capabilities to match many types of stone and other materials can aid with this, providing the versatility to meet any aesthetic challenge.



Foundation and structure accounts for the dominant portion of a parking structure's construction cost, much more than for other types of buildings.

UNCW Blends In

An example can be seen in the 1,000-car, 305,000-square-foot parking structure designed by Clark Nexson on the campus of the University of North Carolina at Wilmington. The four-story parking structure, the first on the university's campus, serves the new 13-acre Seahawk Crossing Privatized Student Housing Complex. Both as the first such campus facility and to complement the new center, the project had to blend with its surroundings rather than announce its presence.

Fact Sheet

Project: *University of North Carolina at Wilmington East Parking Deck*

Location: *Wilmington, N.C.*

Project Type: *Parking structure*

Size: *305,000 square feet*

Cost: *$12.8 million*

Designer: *Clark Nexsen, Charlotte, N.C.*

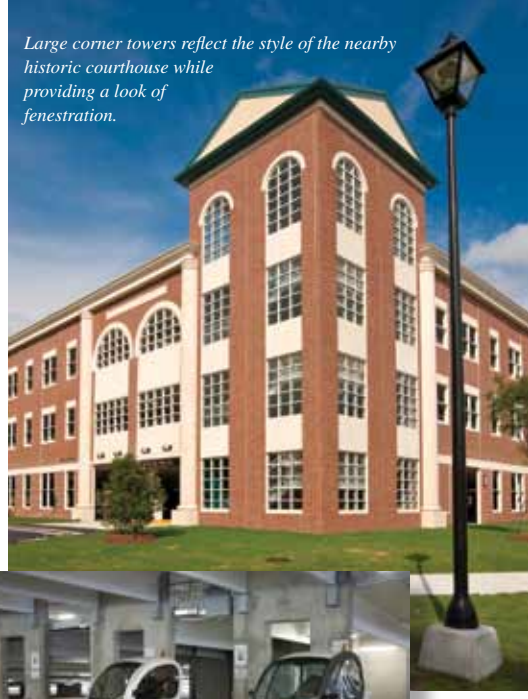
Owner: *University of North Carolina, Wilmington, N.C.*

Contractor: *Donley's, Raleigh, N.C.*

PCI-Certified Precaster: *Metromont Corp., Greenville, S.C.*

Precast Specialty Engineer: *Reigstad & Associates Inc., St. Paul, Minn.*

Precast Components: *651 components, comprising shear walls, columns, double tees, factory-topped inverted tee beams, wall panels, flat slabs, spandrels, stairs, U-shaped molds and cornice molds.*



Large corner towers reflect the style of the nearby historic courthouse while providing a look of fenestration.

The open plan of the precast concrete design allowed electrical service to be run easily, providing power for electrical vehicles, generating a LEED point for the structure.

The three-story parking structure at the University of North Carolina at Wilmington, the first on campus, features a total-precast concrete structure with an exterior façade designed to resemble traditional Neo-Georgian architecture.

The appearance of windows along the façade led city officials to question whether the building met requirements for an open-air parking structure. (It does.)

'We're seeing a lot more interest in using LEED standards with parking structures.'

To achieve this, Clark Nexson's design features a Neo-Georgian style with classical trim and detailing. A total-precast concrete structural system was used, consisting of shear walls, columns, double tees, inverted tee beams, wall panels, flat slabs, spandrels, stairs, U-shaped molds and cornice molds. The design helped the complex achieve LEED Silver certification.

"The university is in a coastal city that's flat, and officials didn't want the parking structure to stand out and detract from other buildings," Duller explains. "The design had to incorporate brick and columns like all buildings on campus."

The total precast concrete system features perimeter panels incorporating embedded thin brick to match the adjacent student housing. A limestone-colored mix was chosen for the base concrete, to contrast the brick-clad portions and the trim and cornice details. Metromont Corp. in Greenville, S.C., provided the precast components and helped with the brick selections.

"We worked closely with the precaster to find a brick style and color that would match others on campus," Duller explains. The designers visited the precaster's plant to review options and selected four mixed palettes. They used those to create sample boards that they took back to campus to compare with existing brick buildings.

To achieve the ideal match, the designers mixed several tones of brick to create the exact color desired even though no one shade matched perfectly. "The base concrete color was slightly lighter than the mortar used between the bricks on the other buildings," he explains. "So we used a slightly darker brick to achieve the contrast and mixed those in with other slightly different colors. The overall impression was the same and provided the match we needed."

Windows and arches were highlighted by exposing the base concrete

The alley through the center of the site at the Herald Court parking structure was turned into a feature by creating retail spaces along both first-floor sides and transforming the alley into a pedestrian walkway.

One of the biggest challenges was creating the embedded thin-brick precast concrete columns. The top side, which could not be cast in the form, features hand-laid brick pressed into the concrete to form mortar joints.

The alley was finished with cobblestones, period lighting and other touches to complement the precast concrete façade. The parking levels above connect via access ramps on each floor, seen at back.

The total-precast concrete design features a variety of finishes, including embedded thin-brick that was used on all four sides of ground-floor columns.

Fact Sheet

Project: *Herald Court Centre*

Location: *Punta Gorda, Fla.*

Project Type: *Parking structure*

Size: *161,887 square feet (including 17,000 retail)*

Cost: *$5.26 million*

Designer: *Fawley Bryant, Sarasota, Fla.*

Owner: *City of Punta Gorda, Florida*

Contractor: *Owen Ames Kimball, Punta Gorda, Fla.*

PCI-Certified Precaster: *Coreslab Structures (TAMPA), Tampa Fla.*

Precast Components: *851 pieces, including double tees, columns, beams, litewalls, shear walls, spandrels, moment frames, stairs, flat slabs, wall panels and balconies.*

'The ability of the precast concrete to span large distances lends itself well to automobile traffic.'

and adding reveals around the openings. Smooth-finished concrete was also used to create the cornice and engaged columns that project from the brick plane, adding depth and breaking up the scale of the façade.

The locations of the precast concrete joints were carefully considered and placed to integrate into the design, Duller notes. Major vertical joints were placed behind the large false colonnades, which matched similar columns on other buildings.

Using precast concrete also helped keep interior space open. "The flexibility of the precast concrete allowed the design to incorporate the aesthetic aspects while still retaining the large, clear floor spaces and open-air ventilation necessary," he says. "The ability of the precast concrete to span large distances lends itself well to automobile traffic. The open floor space created by the long precast concrete spans allowed needed clearances and turning radii."

Precast Helped Complete The Project One Month Ahead of Schedule and Under Budget.

Speed of construction was another important factor in choosing a precast concrete design. "As an integral part of the larger student-housing project, the parking structure provides the majority of required parking for the development," he explains. "Construction needed to be completed before

the adjacent wood-frame housing buildings. So we were racing against stick-built construction to match their schedule."

To ensure the deadline was met, the architect selected the precaster during the design-development phase and worked closely with its engineers to design an efficient precast concrete package to meet the tight schedule. In the end, the project was completed one month ahead of schedule and under budget.

Ironically, the team had to do extra calculations because they had done their job so well. As they had disguised the structure's openings behind false mullions and frames, city officials contested whether the design constituted an open-air parking structure. If it were deemed a closed structure, significant time and expense would have been needed to add mechanical and electrical measures.

The designers provided the city with additional calculations to show the design met the percentage requirements necessary to qualify as an open-air structure. "It's really a compliment to the project that they contested its open-air function," he points out.

First LEED Certification

The project was the first building on campus to receive LEED certification. "The natural environment is a leading focus of several major academic programs at the university, and promoting sustainability is a core value," Duller explains. "The parking deck played a key role in achieving a Silver rating. Several LEED points were attained as a direct result of the advantages that precast concrete construction provided."

Precast concrete can aid with a number of LEED points, including through its recyclable attributes and nearby manufacture, as well as for construction-waste management, rainwater diversion, and energy-efficient construction, which all were used in this project. (For more on those aspects, see the Sustainability article on page 16). In this case, the precast concrete design helped with some unique design aspects as well.

Designers allocated one structural bay to bicycle storage to achieve SS 4.2: Alternative Transportation: Bicycle Storage. The design's openness also provided easy access for electrical-conduit runs that allowed efficient installation of 30 alternative-fuel vehicle-refueling stations. That qualified the structure for the point under SS 4.3: Alternative Transportation: Low-Emitting & Fuel Efficient Vehicles.

"Since the parking deck opened, it has become a welcome addition to the campus," he says. "The deck provides much-needed additional parking capacity, created the first LEED Certified project for the university, and has blended fluidly with its surroundings." Since the parking structure was completed, two other decks have been built in the city, following the lead of this first successful design.

Herald Court Square

The four-story, 162,000-square-foot Herald Court Square parking structure in Punta Gorda, Fla., also had high aesthetic standards to meet. The designers used the total-precast concrete design to help convert site obstructions from problems into features. That resulted in the creation of a well-regarded pedestrian way that features retail space along the ground level.

'We had to determine how to make the most efficient use of the footprint.'

The location had an alley running through its middle, explains Richard Fawley president and principal architect on the project at Fawley/Bryant Inc. in Sarasota, Fla. "When we began talks with city officials about specific goals, we realized that they hadn't really thought through how the site obstacles would impact the plan," he says. "We had to determine how to make the most efficient use of the footprint."

The designers took their cue from an alley to the north, which had been turned into a gentrified pedestrian way with coffee shops and other upscale boutiques. "We took that spirit and continued it so the downtown area would have a long pedestrian way that opened to points south." That meant adding retail space to the facility to serve as additional revenue-generating sources. The designers convinced city officials of the benefits, emphasizing that it maximized efficiency of the site. But it also created new challenges.

"It wasn't one big square, so the biggest challenge was working with the precast concrete design to ensure the floor levels connected across the alley to provide vehicular access," he explains. The structure consists essentially of two rectangles that connect via ramps on each floor at one end, providing access to the alley at both ends and drawing light down into the parking levels.

A key challenge was creating a layout using few shear walls, as the city wanted no distractions from the upscale appearance and no obstacles that could restrict flexibility for first-floor retail uses. The precast concrete spandrels connected with wall columns to create a frame system that resists lateral loads, eliminating the need for shear walls.

"The precast concrete structural system was selected because it represented the best choice given cost, site constraints, timing, and aesthetics sought," Fawley says. "Time is money, and the precast concrete system considerably reduced the number of days needed for construction." The precast components arrived onsite as needed and could be erected immediately, he notes. "This eliminated the extra time typically required for storing, hoisting, placing, and tying reinforcing steel that is associated with cast-in-place concrete frames."

Façade Complements Neighborhood

The structure's façade was designed to be sensitive to its neighbors, which include the historic county courthouse and a variety of restaurants. Dominant, Spanish-style towers were positioned at each corner, with thin brick embedded in precast concrete spandrels and column covers to provide accents for the two tones of concrete used over the bulk of the façade. Coreslab Structures (TAMPA) Inc. in Tampa, Fla., provided the precast concrete components.

Canvas awnings, Bahama shutters, anodized storefronts, mesh-screen windows, powder-coated railings, and other touches provide a relaxed, casual atmosphere. The alley was accessorized with brick pavers, light poles, benches, and landscaping. The first-floor was designed for a variety of retail operations as well as public

LEED Scorecard

The UNCW parking facility achieved a total of 33 points to be LEED Certified. Those points were earned in this manner (*=points aided by precast concrete):

Category	Points
1. Sustainable Sites: Site Selection	1
4.1 Sustainable Sites: Alternative Transportation: Public Transportation Access	1
4.2 Sustainable Sites: Alternative Transportation Bicycle Storage & Changing Rooms	1*
4.3 Sustainable Sites: Alternative Transportation: Low-Emitting & Fuel-Efficient Vehicles	1*
5.1 Sustainable Sites: Site Development: Protect or Restore Habitat	1
5.2 Sustainable Sites: Site Development: Maximize Open Space	1
6.1 Sustainable Sites: Stormwater Management: Quantity Control	1*
6.2 Sustainable Sites: Stormwater Management: Quality Control	1
7.1 Sustainable Sites: Heat Island Effect: Non-Roof	1
3.1-3.2 Water Efficiency: Water Use Reduction	2
1. Energy & Atmosphere: Optimizing Energy Performance	2*
3. Energy & Atmosphere: Enhanced Commissioning	1
6. Energy & Atmosphere: Green Power	1
2. Materials & Resources: Construction Waste Management	2*
4. Materials & Resources: Recycled Content	1*
5. Materials & Resources: Regional Materials	2*
4.1 Indoor Environmental Quality: Low-Emitting Materials: Adhesives & Sealants	1
4.2 Indoor Environmental Quality: Low-Emitting Materials: Paints & Coatings	1
4.3 Indoor Environmental Quality: Low-Emitting Materials: Carpet Systems	1
5. Indoor Environmental Quality: Indoor Chemical & Pollutant Source Control	1
6.1 Indoor Environmental Quality: Controllability of Systems: Lighting	1
6.2 Indoor Environmental Quality: Controllability of Systems: Thermal Comfort	1
7.1 Indoor Environmental Quality: Thermal Comfort: Design	1
7.2 Indoor Environmental Quality: Thermal Comfort: Verification	1
8.1 Indoor Environmental Quality: Daylighting & Views: Daylight 75% of Space	1
8.2 Indoor Environmental Quality: Daylighting & Views: Daylight 90% of Space	1
1.1 Innovation & Design Process: Innovation in Design	1
1.2 Innovation & Design Process: Innovation in Design	1
2 Innovation & Design Process: LEED Accredited Professional	1

restrooms.

One of the biggest challenges came in producing the four-sided embedded-brick columns for the first floor, Fawley says. Such columns typically are 2 feet by 2 feet, whereas these were 4'8" wide, with no corner brick. "Alignment and uniformity were very important for the four-sided columns," he says.

After several experiments, the columns were poured 1/2-inch low and had bricks hand-laid on top similar to laying tile. "This definitely put a lot of trust in the plant employees," he says. "They had to have a good eye for detail but also lay large areas of brick in a timely manner." Finishing crews layered a grout mixture on the top-in-form side and created the mortar joints. "The finished product looks very impressive."

Using a fast-track system, the designers worked from the architects 3D Revit model rather than finished documents. "With not much repetition, the detailing created a large number of piece details," he says. Out of 851 pieces, 580 unique designs were needed.

The project was designed to have a zero setback, which limited site access. "Precast concrete provided the added benefit of not requiring a staging area for forms, reinforcing steel, scaffolding, plank, miscellaneous materials, and erection machinery. By casting the brick into the columns at the plant, we saved considerable time and improved the quality control," Fawley says. Materials were delivered in off-peak hours to minimize disrup-

tion to the neighborhood.

The result has been a welcome addition to the area that now is used for street parties on a regular basis. The project won the 2010 Florida Main Street Award for Best Public Improvement Project.

Parking Hits Home Run

Another major civic-improvement project involved providing parking facilities for the new Yankee Stadium in the Bronx. Rather than creating one massive parking structure, the program involved five smaller projects, including one with a rooftop park that enhances the public spaces. "From the initial RFP, the design/build team developed the project into what is now a neighborhood feature for locals and game-day visitors to enjoy," says Michael Nelson, senior associate and project architect with Clarke Caton Hintz architects in Trenton, N.J.

The new Yankee Stadium under construction at the time was displacing parks and recreation facilities from the neighborhood. The plan called for replacing seven acres of those facilities atop one of the parking garages. "The phasing of the project provided unique challenges, as it was necessary to have temporary parks and recreation in place atop one structure before gaining control of another," Nelson explains. This was further complicated by the need to maintain space for media staging requirements for game broadcasts during the season.

The project created three parking structures containing 3,140 spaces: Ruppert Plaza Garage, with 1,580 spaces plus the rooftop Macombs Dam Park; 164th Street Garage, with 630 spaces; and 161st Street Garage, with 930 spaces. Two existing structures, with 2,400 spaces, were also substantially modified.

Securing the foundations posed the first challenge, as the site is ringed by subway tunnels, historic bridges and a vibration-sensitive electrical substation. Piles had to be driven carefully, with mini-piles used in several locations and pile-supported cantilever retaining walls up to 25 feet high supporting the building's foundation wall for the Ruppert and 161st Street structures.

All three facilities feature total-precast concrete structural systems. In all, 22.7 miles of precast concrete double tees (1.127 million square feet) and 13,424 linear feet (2.5 miles) of precast concrete beams were used. Unistress Corp. in Pittsfield, Mass., provided the precast concrete components.

Fact Sheet

Project: *New York Yankees Parking Redevelopment Program*

Location: *Bronx, N.Y.*

Project Type: *Parking complex*

Size: *1.54 million square feet (in three structures)*

Cost: *$280 million*

Designer/Landscape Architect: *Clarke Caton Hintz, Trenton, N.J.*

Structural Engineer: *Fay, Spofford & Thorndike, New York, N.Y.*

MEP & FP Engineer: *Kelter & Gilligo Consulting Engineers, Princeton Jct, N.J.*

Civil Engineer: *Yu & Associates Inc., Elmwood Park, N.J.*

Green Roof Consultant: *Jeffrey L. Bruce & Co., N. Kansas City, Mo.*

Owner: *Capital Projects, City of New York*

Contractor: *Prismatic Development Corp./Hunter Roberts Construction Group, joint venture*

PCI-Certified Precaster: *Unistress Corp., Pittsfield, Mass.*

Precast Specialty Engineer: *Hoch Associates, Fort Wayne, Ind.*

Precast Components: *22.7 miles of double tees, 13,424 linear feet of beams, 213,000 square feet of precast walls and spandrels, 3,500 pieces of thin brick.*

The 1,580-car Ruppert Plaza Garage features a rooftop public park that helps replace some of the park displaced by the new parking structures. Double tees with extra-wide flanges were used to support up to 4 feet of soil for plantings.

The 161st Street garage features precast concrete spandrels embedded with multi-hued green thin brick to complement the green-tinted curtain wall.

The New York Yankee redevelopment program involved three new total-precast concrete parking structures, shown in the bottom half of this layout of the ballpark area.

The new total-precast concrete 164th Street garage is situated on a narrow site adjacent to the ballpark and serves as the stadium's fourth façade.

The 161st Street parking structure connects to the historic Macombs Dam Viaduct bridge, (at right), an elevated roadway 16 feet higher than the building's elevation. The garage features a continuous floor plate and an offset to provide access to the bridge's ramp.

Value-Engineering Saves Time, Cost

The two-level Ruppert Plaza Garage initially was designed as a steel-framed structure, but the design-build team value-engineered it to precast concrete. "We determined that a superior, cost-effective building could be achieved with precast concrete," Nelson says. "The use of precast concrete improved the level of service and provides superior durability. It also enabled the garages and park to be constructed quickly and economically."

The double tees and beams provided the necessary load support to construct the new plaza on the rooftop. It features a variety of park amenities, including a combined soccer and football field, basketball and handball courts, a running track, bleacher seating for 600 and shade structures. Landscaping was provided throughout, including large Paper Bark Maples and Golden Raintrees that were incorporated into grass viewing mounds. These plantings were anchored in up to four feet of soil and strategically placed on beams or columns of the structure below. "It was a very complex multi-layered system of waterproofing, drainage, concrete, and soil that also included electrical, irrigation and AV requirements," Nelson says.

The double tees on this level were designed to be narrower, with thicker flanges, and incorporated a 2-inch field-poured concrete topping slab so they could support the increased soil loads. The structure also had to support emergency vehicles, which use the park as a staging area during track and field events.

The park's perimeter is lined with precast concrete landscape planters, buffering the park from the active street beyond. The rooftop landscaping is designed to merge seamlessly with nearby parks and recreation facilities being constructed in the footprint of old Yankee Stadium.

The Ruppert Plaza project's façade consists of broad precast concrete spandrel beams with a veneer of specially glazed green thin brick. "It created an economical solution for blending the boundary of the garage with the planned adjacent park," he explains.

Narrow Site Maximized

The five-story 164th Street Garage, adjacent to the new stadium, is designed for use by the club and its VIPs, including season-ticket holders. The narrow, rectangular structure runs along the left field wall of the stadium, serving as its fourth façade and screening the loading and service areas behind the ballpark.

The design was deliberately given a modern feel with white precast concrete components and a stainless-steel mesh skin. The precast's color was matched to the adjacent stadium's coloring. "The dialogue between the stainless-steel mesh shrouding the mass of the precast concrete is a deliberate modernist interpretation, which contrasts with the more traditional brick façade of the other two garages," Nelson says.

A 12-inch-thick precast concrete wall was provided along the façade facing the stadium to provide blast resistance in case of security threats.

The façade of the four-story 161st Street Garage features spandrels with multi-hued green thin brick, complementing the green-tinted curtain wall glass shrouding the vertical stair and elevator cores. The clean lines and careful proportions were designed to continue the aesthetic of the Ruppert Plaza Garage nearby.

Despite the complexity and size of the project, the work moved steadily and was completed on schedule, Nelson says. "This is a credit to the entire design/build team along with the precaster. The erection of the precast concrete went very quickly." A staging area was created within the confines of the project, allowing materials to be ready as needed for erection. Trucks delivered materials at night to avoid adding to congestion or disrupting traffic in the area.

The projects logistics, which included connecting to the adjacent historic Macombs Dam Viaduct Bridge, required close coordination. Those efforts paid off with a dramatic combination of facilities. The overall project received Real Estate & Construction Review's Building of America Award. In presenting the award, it said, "The Yankee Stadium Redevelopment Project-Parking Structures was one of the most imaginative, unique, innovative and dynamic projects in the New York/Philadelphia area."

These projects show some of the ways in which precast concrete systems can help parking structures meet a wide range of needs, be they economical, construction speed, sustainable design, revenue generation, or addition of green spaces. As owners' needs grow and sites become more restrained, designers will look to precast concrete designs to help them meet more challenges. ■

For more information on these or other projects, visit www.pci.org/ascent