Brick Facing EXPANDS Precast Parking Options

— Wayne A. Endicott

University of Denver College of Law Parking Structure
Denver
University of Denver School of Architecture

Creating the proper image for a large parking structure can be a significant challenge. The large mass of such projects can overwhelm other buildings in the neighborhood, drawing attention to a facility that is driven first and foremost by its functional needs. Designers today are often turning to precast concrete to help meet this challenge, thanks to its plasticity of design and ability to use visual tricks to distract from the structure's size.

In many cases, those design techniques include the creation of a brick façade for the structure, helping it project a high-quality image or fit with surrounding masonry buildings. The reasons vary for using precast options, such as inset brick, form liners or even laying up brick against precast panels. They include economics, speed of construction, elimination of expensive trades, better control of activities on the site, better control of aesthetics and alignment of the brickwork, higher quality workmanship overall and closer tolerances for factory-cast products.

Fifth & Lafayette Parking Structure
Royal Oak, Mich.
Rich & Associates Inc., Southfield, Mich.

More designers are taking advantage of the range of ways that brick facings can be applied to precast concrete parking structures to create a distinctive image

"We are designing more parking structures using precast concrete panels faced with brick in different ways," says Matt Jobin, project manager for Rich & Associates Inc. of Southfield, Mich. "Our use of brick has been increasing significantly in the past 10 years. We've designed numerous structures with field-applied brick, but increasingly we're looking at brick-faced precast concrete architectural panels as a way of getting the job done."

The reasons the firm uses this approach can be seen at a recent all-precast concrete project completed in Royal Oak, Mich. Officials wanted to create a new public parking facility, but the chosen site caused neighbors to mobilize. Their primary concern was that the large structure wouldn't fit into the neighborhood's fabric. The city heeded their call for sensitivity, asking the architects to explore ways to ensure the building blended with its residential surroundings.

Jobin and his design team suggested a façade consisting of precast concrete components inset with brick to mimic the look of nearby townhouses. The designers worked with National Precast Inc. in Roseville, Mich., to produce the architectural panels for the project. The exterior façade combines 173 different shapes of brick clad litewalls (typically 11 feet, 4 inches by 36 feet) strategically stepped in and out of the exterior plane. Precast cornices and keystones help define the façade, giving it the look of a row of townhouses.

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Parking Garage II
Tampa, Fla.
Burke, Hogue & Mills Associates Inc., Lake Mary, Fla.

A new parking structure in Royal Oak, Mich., features inset brick on architectural precast concrete panels along with punch outs mimicking windows to create the illusion of a series of townhouses.

A cornice above the entry to the Royal Oak facility adds to the residential feel of the building.

Fact Sheet

Project: *Fifth & Lafayette Parking Structure*

Location: *Royal Oak, Mich.*

Designer/engineer: *Rich & Associates Inc., Southfield, Mich.*

Contractor: *Skanska, Southfield, Mich.*

Owner: *City of Royal Oak*

Precaster: *National Precast Inc., Roseville, Mich.*

Size: *Four stories, 488 spaces, 184,455 square feet*

Components: *648 pieces of precast concrete, including architectural exterior litewall, brick exterior litewalls, brick exterior parapet, architectural keystones, stair panels, architectural exterior spandrels, exterior columns, interior columns, interior litewalls, exterior beams, inverted tee beams, stairs with landings, flat stair slabs and double tees.*

Project construction cost: *$7.2 million*

Brick Ordered First

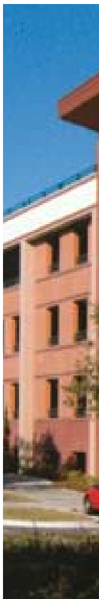
The brick for the panels was ordered before the precast form liners that hold the brick in place, Jobin notes. "We've found this to be the best way to make sure that we get the quality we want," he explains. "We asked the precaster to take a random sampling of 100 bricks after receiving the material and use that as a guide in creating the dimensions of the form liner. This ensures we'll get the best possible result with the tightest tolerances."

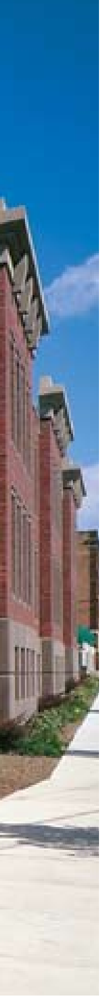
There are certain limitations on the brick when casting it into panels, he adds. "The method of manufacturing these panels typically dictates that a hard-faced brick be used. In addition, you need to limit the absorption of the brick to ensure good bonding to the concrete. It also is critical to specify ASTM C216, Type FBX, to ensure that the dimensional accuracy is suitable for this system. You can't, for example, use a sand-faced brick." He also recommends using a modular brick. "That way, you limit the differential between bricks."

Several factors made architectural spandrels with inset brick the best choice for this project, he says. "The most notable advantages included construction speed, durability, openness and year-round construction." The initial cost was less than other systems, and the maintenance advantages, which will keep operating costs lower over the life of the building, gave it additional cachet with city officials.

The four-story structure's footprint is approximately 210 feet long by 214 feet wide. Constructed of precast concrete columns, interior shear walls, interior litewalls, pretopped 12-foot double tees and exterior architectural precast litewalls, the project took just 13 months to complete. The precasting schedule included 17 weeks for production, submission and approval of shop drawings. Once these were complete, only 14 weeks were needed to fabricate the components, with another eight weeks spent erecting the pieces.

The ability of the exterior litewalls to resist lateral movement allowed engineers to eliminate shear walls, providing an open, expansive interior. The litewalls also allowed the designer to hide the fact that the exterior bay of the deck is ramped or sloped.



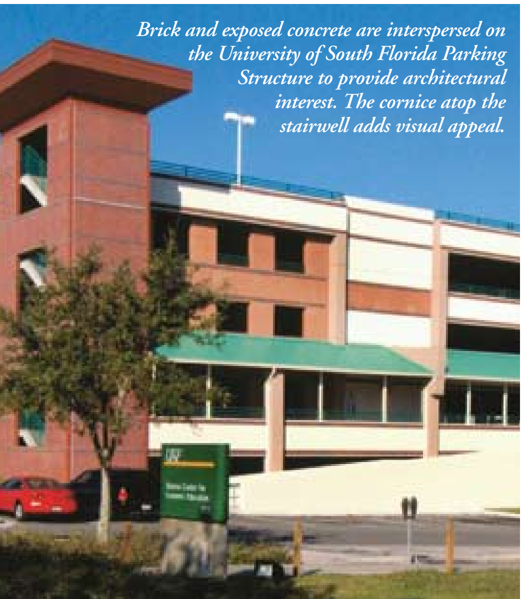


University Parking

Another designer who sees benefits in using inset brick panels is Bob Hogue, principal in the architectural firm of Burke, Hogue & Mills Associates Inc. in Lake Mary, Fla. One of the firm's recent projects focused on the design of a student, employee and visitor parking facility at the University of South Florida in Tampa. The key challenge here also was to create a parking structure that would blend with the existing campus.

"The new facility fits the vernacular of the campus," he explains. The design firm had prior experience with using brick-faced structural precast concrete panels. "We have used the integral-cast brick on five parking structures at another university campus," with most of them featuring cast-in brick façades. "We have tried using site-laid brick on projects, but we've found that casting the brick into the panels solves a lot of issues. For instance, if you're going to lay the brick on site, you have to have structural-steel angles anchored to the panels or brick ledges cast into the precast concrete. You also have to scaffold the building for the bricklayers to work. The risk of differential movement between the precast concrete and the face brick is much greater."

There are some issues that need to be addressed with cast-in brick, Hogue says. "You have to be sure that your brick manufacturer keeps the proper tolerances. Since the brick is laid into a form liner, the brick has to be the right size, or it will float out of the mix when it is poured. You have to know your brick maker's capabilities."



Brick and exposed concrete are interspersed on the University of South Florida Parking Structure to provide architectural interest. The cornice atop the stairwell adds visual appeal.

The design of the university's facility was dictated by several specific site constraints. Chief among these was the structure's proximity to the existing two-story Administration Building and the six-story Student Services Building. The university asked that the building not be taller than the administration building and that it provide approximately 1,500 parking spaces. The proposed site also contained an elevation grade difference of about 9 feet, so the designers had to fit the design to that elevation change.

The finished structure, with precast concrete components produced by Dura-Stress Inc. in Leesburg, Fla., accentuates the exterior vertical columns and features vertical precast wall panels with punched openings and horizontal precast spandrels. The integral thin brick and applied coatings create variations in the color and texture on the façades.

Painted steel-pipe railings cast into the exterior panels at the plant provide accent colors. During the casting process, the section of pipe rail to remain exposed was slipped over a steel reinforcing bar before the casting process was completed. This allowed a larger opening while using the rails to serve as additional lateral support.

The design concept evolved into a partial subterranean structure on the west and south sides, with the ground level extending from the grade at the east and north elevations. This gave the impression of a four-story building at the south and west elevations, while the north and east elevations show the true five-story façade. This design allowed ground-level parking to be accessed at the lowest point, while a second access point occurs at the second level at grade on the south portion of the building.

The interior structure consists of precast columns and inverted-tee beams, with precast litewalls at the vehicular ramp areas. An exterior elevated walkway was incorporated along the east and north façades, establishing a strong horizontal component. Precast concrete buttress columns accent the walkway system.

Stair towers located at the three most prominent corners anchor

'Casting the brick into the panels solves a lot of issues.'

The University of South Florida Parking Structure was built with brick-faced precast concrete, maintaining the campus' architectural style.

Fact Sheet

Project: *Parking Garage II*

Location: *Tampa, Fla.*

Designer: *Burke, Hogue & Mills Associates Inc., Lake Mary, Fla.*

Engineer: *Walker Parking Consultants Inc., Tampa*

Contractor: *Hardin Construction Co. LLC, Tampa*

Owner: *University of South Florida, Tampa*

Precaster/precast specialty engineer: *Dura-Stress Inc., Leesburg, Fla.*

Size: *Five parking levels, 470,000 square feet*

Components: *968 precast concrete pieces, including exterior columns, interior columns, litewalls, shear wall panels, spandrel panels, double tees, wall panels, precast stairs, flat slabs, inverted tee beams, buttresses and columns.*

Project construction cost: *$14.06 million*

The use of standard site-laid face brick for the University of Denver College of Law Parking Structure was dictated by architectural standards established by the university's school of architecture.

Brick was interspersed with copper-wrapped precast spandrels to provide architectural interest at the University of Denver College of Law Parking Structure.

Fact Sheet

Project: *University of Denver College of Law Parking Structure*

Location: *Denver*

Designer: *University of Denver School of Architecture*

Engineer: *Carl Walker Inc., Denver*

Contractor: *Saunders Construction Co., Englewood, Colo.*

Owner: *University of Denver*

Precaster: *Rocky Mountain Prestress, Denver*

Size: *Five parking levels (one underground, one on grade, three supported) 205,826 square feet of parking area, 66 parking stalls*

Components: *638 precast concrete pieces, including double tees, inverted tee beams, 11-inch structural walls, 8-inch structural walls, 12-inch shear walls, 8-inch stressed spandrels, 12-inch paced litewalls, stair landings and 7-inch risers*

Project construction cost: *$6.8 million*

the structure. The elevator tower incorporates large glazed panels, with glass-back elevator cabs providing patron safety. Exaggerated overhangs on the towers use a reverse-slope soffit, which ends at a prominent coping.

The project was completed in just seven months, in time for the opening of the fall semester. The precast concrete system created an additional advantage by providing parking for construction workers during the last three months of construction.

Field-Applied Brick

A third parking structure designed with a precast and a brick exterior provides parking at the University of Denver College of Law. In this application, the design features site-set full brick applied to the precast, according to project manager Rob McConnell, vice president at the engineering firm of Carl Walker Inc. in Denver. "The structure's design and the use of full-face brick set on site were dictated by the university's designers, who wanted colors and materials that provided continuity of the campus environment," he says. "The site-set full face brick combines with shot-sawn limestone to create the façade. Copper-wrapped spandrels provide accents."

Although site-set brick requires more time and takes coordination and closer attention to quality-control standards than cast-in brick, the project moved ahead smoothly. An all-precast concrete structural system was used, and allowances for the site-applied brick were made in the fabrication of the structural units. This especially meant creating brick ledges in the precast units to ensure a tight attachment of the bricks.

Built on a land-locked site, the facility offered restricted accessibility. The use of precast concrete sped completion. The total time from design to occupancy was only 10 months, McConnell notes. That was aided by selecting Rocky Mountain Prestress in Denver prior to starting design stages. Using the precaster's standard details, existing casting forms and production/erection processes saved several weeks on the engineering schedule.

The all-precast design features field-topped double tees supported by standard beams, columns and shear walls that resist seismic and lateral wind loads, plus precast spandrels, stairs and landings. Typical bays are 30 by 60 feet, and the clear-span design provides open access to drive aisles and parking surfaces.

Long-term durability was a key need for officials, so designers specified precast concrete with low water/cement ratios and entrained air. Corrosion-inhibiting admixtures, good cover over rebar and corrosion-resistant imbeds were also used. Since the structure is subjected to water penetration and potential damage from chloride intrusion, a penetrating sealer was applied to all traffic and parking areas.

The 10-month process for design and erection included phases that overlapped to shorten the schedule. Design took 12 weeks and erection 16 weeks. Production started 9 weeks after the beginning of design and erection began just 16 weeks after start of manufacturing. Field-applied masonry on the exterior and completing a tunnel from the garage to the Law building delayed the opening for two months after erection was completed.

These projects show that, while brick-faced precast concrete parking facilities can meet owners' needs for aesthetically pleasing appearances, there is no one way that the masonry appearance must be achieved. Designers who work closely with their local precaster can find a method and brick look that will produce a cost-efficient, quickly constructed and visually appealing design. ■

NOTE: For details on the PCI Standard for Thin and Half Brick, see complete story on website.

For more information on this or other projects visit *www.pci.org/ascent*.

PCI Standard for Thin Brick

The objective of this standard is to outline material standards and specification criteria for brick manufacturers to meet when supplying materials to precast concrete manufacturers. The intent is to establish acceptable dimensional tolerances and consistent testing standards for brick embedded in precast concrete systems. The brick manufacturers must confirm through the provision of independent test results that their brick products comply with the PCI Standard. The PCI Standard should appear in all specifications as the new approved industry standard. Brick manufacturers have agreed to promote the compliance of their brick with the new PCI Standard.

The following parameters have been established based on the successful use of embedded brick in precast concrete projects. The parameters set forth for use in these proposed standards are attainable brick properties that have been derived with input from brick manufacturers, precasters, engineers, and architects as well as consideration of existing test results.

A. Thin Brick Units: PCI Standard, not less than 1/2 inch (13mm) nor more than 1 inch (25mm) thick with an overall tolerance of plus 0 inches, minus 1/16 inch (+0mm, -1.6mm) for any unit dimension 8 inches (203mm) or less and an overall tolerance of plus 0 inches, minus 3/32 inches (+0mm, -2.4mm) for any unit dimension greater than 8 inches (203mm) measured according to ASTM C67.

1. Face Size: Modular, 2-1/4 inches (57mm) high by 7-5/8 inches (194mm) long.
2. Face Size: Norman, 2-1/4 inches (57mm) high by 11-5/8 inches (295mm) long.
3. Face Size: Closure Modular, 3-5/8 inches (92mm) high by 7-5/8 inches (194mm) long.
4. Face Size: Utility, 3-5/8 inches (92mm) high by 11-5/8 inches (295mm) long.
5. Face Size, Color and Texture: **[Match Architect's approved samples] [Match existing adjacent brickwork]. a.<Insert information on existing brick if known.>**
6. Face Size: Metric modular, 57mm high by 190mm long.
7. Face Size: Metric Norman, 57mm high by 290mm long.
8. Face Size: Metric Closure, 90mm high by 190mm long.
9. Face Size: Metric Utility, 90mm high by 290mm long.
10. Special Shapes: Include corners, edge corners, and end edge corners.
11. Cold Water Absorption at 24 hours: Maximum 6 percent when tested per ASTM C 67.
12. Efflorescence: Provide brick that has been tested according to ASTM C 67 and rated "not effloresced."
13. Out of Square: Plus or minus 1/16 inch (+/-1.6mm) measured according to ASTM C67.
14. Warpage: Consistent plane of plus 0 inches, minus 1/16 inch (+0, -1.6mm).
15. Variation of Shape from Specified Angle: Plus or minus 1 degree.
16. Tensile Bond Strength: Not less than 150 psi (1.0MPa) when tested per modified ASTM E488. Epoxy steel plate with welded rod on a single brick face for each test.
17. Freeze-Thaw Resistance: No detectable deterioration (spalling, cracking, or chafing) when tested in accordance with ASTM C666 Method B modified to withstand 300 cycles.
18. Modulus of Rupture: Not less than 250 psi (1.7 MPa) when tested in accordance with ASTM C67.
19. Chemical Resistance: Provide brick that has been tested according to ASTM C650 and rated "not affected."
20. Surface Coloring: Brick with surface coloring shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in applied finish when viewed from 10 feet (3m).
21. Back Surface Texture: **[Scored], [Combed], [Wire roughened], [Ribbed], [Keybacked], [Dovetailed]**

Test sample size and configuration shall conform to the following parameters in order to validate compliance by brick manufacturer with PCI Standard for use in embedded brick precast concrete systems:

1- Minimum number of tests specimens: Comply with appropriate specifications except for freeze-thaw and tensile bond strength tests on assembled systems.

2- Minimum number of test specimens for freeze-thaw and tensile bond strength test: Two (2) assembled systems measuring 12 x 32 inches (300 x 810mm) long with the brick embedded into the concrete substrate (assembled system), and then saw cut into two equal specimens, Sample A and Sample B, each 12 x 16 inches (300 x 405mm). The precast concrete substrate shall have a minimum thickness of 2-½ inches (63mm) plus the embedded brick thickness. The precast concrete shall have a minimum compressive strength of 5000 psi (34.5 MPa) and 4 to 6% entrained air. The embedded brick coursing pattern for testing purposes shall be modular size brick on half running bond pattern with a formed raked joint geometry of 3/8 inches (9mm) wide and a depth no greater then 1/4 inch (6mm) from the exterior face of brick. Five brick on each Sample A shall be tested for tensile bond strength, Item #16. Five brick on each Sample B shall be tested for freeze thaw resistance, Item #17 and then tensile bond strength, Item #16.

This close-up of the precast panels shows the brick face and window openings for the Royal Oak parking structure.

Fact Sheet

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Contractor: *Skanska, Southfield, Mich.*

Owner: *City of Royal Oak*

Precaster: *National Precast Inc., Roseville, Mich.*

Size: *Four stories, 488 spaces, 184,455 square feet*

Components: *648 pieces of precast concrete, including architectural exterior litewall, brick exterior litewalls, brick exterior parapet, architectural keystones, stair panels, architectural exterior spandrels, exterior columns, interior columns, interior litewalls, exterior beams, inverted tee beams, stairs with landings, flat stair slabs and double tees.*

Project construction cost: *$7.2 million*

Benefits include economics, speed of construction and better quality control.

A cornice above the entry to the Royal Oak facility adds to the residential feel of the building.

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Project: *Parking Garage II*

Location: *Tampa, Fla.*

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Project construction cost: *$6.8 million*

Brick was interspersed with copper-wrapped precast spandrels to provide architectural interest at the University of Denver College of Law parking structure.

Involving the precaster early allowed the design to exploit existing details, forms and processes.