Precast's Versatility Aids Parking

As parking needs expand, designers are looking to high-performance precast concrete to optimize aesthetics, speed, service life, and sustainability

— Craig A. Shutt

More demands are being made on parking structures today, as developers try to attract more people to more congested locations—and generate more revenue from the facilities. Attractive designs, whether blending with historic neighbors or creating a dramatic statement, are becoming the rule. Owners also are looking to add function by adding retail or building mixed-use properties atop the parking structures. They also are fitting them into tighter spaces with more activity around them. To solve these challenges and more, designers often turn to precast concrete solutions.

The following examples show some of the ways designers are using precast concrete's aesthetic versatility, sustainability, durability, resiliency, speed of construction, site efficiency, and other attributes to meet the growing challenges they face in designing parking structures.

The Z

A 10-story, mixed-use property in Detroit, Mich., tasked with revitalizing the city's historic Broadway district, The Z features retail, restaurant, and office space along with a 1,282 parking structure. To support these activities, designers planned a precast concrete parking facility with the goal of "creating a 'parking experience' atypical of the usual parking options in a major city," explains Joel Smith, principal at Neumann/Smith Architecture.

They accomplished this by designing a precast concrete façade with trapezoid-shaped spandrels that create large, dimensional windows along its length and horizontal openings that band the structure. Additional lights and accents create picture-frame designs that are reinforced on the interior with a series of murals that enliven each floor of the building.

The intention was to create the coolest parking deck ever," he says. "Parking decks are typically more functional in nature and less focused on aesthetics. Our goal was to ensure the parking deck didn't look like a parking deck." That focused in part on hiding the ramps so the building didn't reveal that it hid 10 floors of sloping surfaces. The team designed bold geometric cut-outs for the façade panels that replicated the look of windows. Each "window" spans two floors and was lined with LED lights to provide a bright, eye-catching outline that invokes the image of picture frames.

The structure features a total-precast concrete structural solution, including double tees, columns, inverted tee beams, ledger beams, spandrel panels, stair and elevator walls, shear walls, bollards, solid planks, and other components. A variety of finishes were used, including hard steel-troweling on interior shear walls, white sandblasted architectural spandrels, stained columns, and spandrels with a medium sandblast. Kerkstra Precast Inc. fabricated the precast concrete components.

"Precast concrete helped create the modern and clean, smooth and fluid look," he says. The façade was created with a bright white mix, which blends with neighboring buildings finished in white terra cotta. The bright color also served as a canvas for 27 world-renowned street muralists, who created artwork inside the building. The goal was to create a "museum" within the precast concrete walls, with the murals representing what they meant to each artist. "The experience is like driving through an art museum, discovering a little piece of the city on each floor."

The "picture-frame" effect on the building's exterior was created with trapezoidal infill pieces, which were clipped in place to the vertical columns. The design team originally explored the use of applied metal-skin panels, clipped to the structure, but this approach proved too complicated and expensive. "This way, the façade could be fabricated entirely and precisely by a single source," he says.

The spandrels and columns were erected to support the double tees, while the trapezoidal infill pieces clipped onto the spandrels, minimizing movement of the crawler-crane. Sliding connections allowed the panels to be precisely aligned to a high tolerance. "That was essential on such a crisp design," he says.

Casting Efficiencies

The same floor slope was used on both street elevations of the deck to minimize the number of unique pieces that had to be cast. In some cases, forms were reused for pieces that were inverted for use on opposite sides of the building, reducing formwork and saving time. A full-sized, foam mock-up of a typical bay was created to validate the design and installation; to benchmark the installation process; and to validate the jointing, piece lift points, and load bearing conditions.

The building spans an alley with

The Z, a 10-story, mixed-use property in Detroit includes a 1,282-car precast concrete parking structure designed with "picture-frame" style windows made with trapezoid-shaped spandrels and horizontal openings that band the structure. Additional lights and accents highlight the exterior, while murals enliven the interior. Photos: Neumann/Smith Architecture.

PROJECT SPOTLIGHT

The Z

Location: *Detroit, Mich.*

Project Type: *Parking structure*

Size: *535,000 square feet*

Designer: *Neumann/Smith Architecture, Southfield, Mich.*

Owner: *Bedrock Real Estate Services, Detroit, Mich.*

Structural Engineer: *Rich & Associates Inc., Southfield, Mich.*

Contractor: *Colasanti/Sachse JV, Detroit, Mich.*

PCI-Certified Precaster: *Kerkstra Precast Inc., Grandville, Mich.*

Precast Specialty Engineer: *IES Associates Consulting Engineers, Windsor, Ontario, Canada*

Precast Components: *Total-precast concrete structural system, including double tees, columns, inverted tee beams, ledger beams, spandrel panels, stair and elevator walls, shear walls, bollards, solid planks, and other pieces.*

crossovers located at level three, allowing users access to two major arteries into the city. It also uses its glass-enclosed corner stair towers as key landmarks for the building, working as "lanterns" on the block, he says. "They work as place-markers and main wayfinding elements that provide constant light and a sense of security." Each landing has bright-white LEDs and walls painted with a designated color. The exterior corners of the building are lined with vertical RGB LED lights with 16 million possible color combinations, changed to celebrate holidays and special events.

The erection moved smoothly, despite the building being fit in among a variety of existing structures. "Special attention was paid to the proportions of the building so it filled in the gaps between buildings but maintained an appropriate scale for the block," he says.

The team originally thought rigid insulation would have to be added within the panels to reduce the weight for lifting as well as to minimize the foundation load. But they calculated that by panelizing the picture-frame elements and optimizing panel sizes, they could maintain the limits for lifting and retain the panels' aesthetics while reducing costs. "We saved money because there was no need for another trade to finish the exterior of the building or for another mobilization," he explains.

Meeting schedule and budget was critical, he notes. "This parking deck is the owner's first ground-up project and the largest new-construction project in the city in a number of years, so the publicity that surrounded it put pressure on the team to get it right." The precast concrete was produced, shipped, and erected rapidly and within budget, to the extent that the owner saved enough money that amenities were added, including the murals and painting the interior.

The result is a dazzling structure that stood out to the judges in the 2014 PCI Design Awards competition. They gave it the award for Best Parking Structure. "The creation of this iconic design was made possible by the flexibility of precast concrete, utilized in this unconventional application," he says.

City Center

The six-level, 524-car precast concrete parking structure at the City Center Development in Columbia, S.C., transformed a low-density surface parking lot in an urban, historic area into a high-density infill project. "The building completed the street corner in accordance with the downtown context and evokes an architectural expression that responds to nearby office and retail buildings," explains Jason Likas, project manager for LS3P Associates Ltd., the architectural firm on the project. It includes retail space on the first floor along the street to promote activity and generate interest.

The building's façade features a variety of masonry materials, including cast-stone blocks but especially thin brick, cast into architectural precast concrete panels to blend with the neighborhood. "As brick is the dominant material on the surrounding historic structures, the design incorporates a predominant amount of brick combined with other materials," he says.

"Great attention was given to the brick detailing and structure to create the timeless aesthetic. The precast concrete approach allowed for more flexibility in the design of the façade, as the construction process is more controlled in the plant, providing more flexibility in the level of detail and arrangement of precast concrete pieces to meet the aesthetic goal."

The structure features a total-precast concrete framing system, including double tees, beams, columns, spandrels, fascia, Metrowalls, flat slabs, shear walls, and architectural panels.

"Our goal was to integrate a wide range and mix of materials, including different types of stone and masonry as well as aluminum, steel, and glass," he says. "Having the flexibility to implement a large range of materials, specifically glass, allowed for a 'see and be seen' environment at the stair towers especially, increasing passive security."

The openness of the parking structure was enhanced by the precast concrete design, he notes. "With the immediate adjacency of the existing building to the west and the desire to mimic the façade of the garage to that of the surrounding office buildings, obtaining the appropriate level of openness was a challenge."

Long vertical exterior façade panels with blockouts allowed the design to mimic the appearance of office windows while providing more control of the percentage of openness. Finishes were also kept to a horizontal pattern around the perimeter to mask the sloping floors behind the façade. "The longer beam spans provided greater flexibility and allowed for more openness to the overall structure."

Openness was enhanced further by pushing the building's shear walls to the exterior, maximizing internal sight lines for users at critical locations. "Internal openness was achieved without adversely affecting or limiting the design of the exterior aesthetic thanks to the flexibility in design that precast concrete provided."

Bay Window Created

One design element that combined aesthetics and openness was the large "bay window" added at one corner of the façade. The buff-colored spandrels cantilever off the frame and provide a three-sided window unit with lintel. "Cantilevering the structure beyond the face of the building creates depth and provides a focal point at the intersection," he explains. "The detailing of the unit was unique and an atypical element. Creating it while maintaining the appropriate vehicular and pedestrian restraints was challenging."

The building also features the first enclosed stairwells in the city for a public parking structure. The design plays this up by accenting the stair/elevator towers with glass curtain wall and spandrel panels that allow natural light to flood into the area. "It promotes a sense of visibility and security." Wayfinding was enhanced with colorful, curved, hanging ceiling features on each level. Sunshades also were placed on the south side along the tenant spaces and stair tower.

Designing and erecting the structure on the site also offered a challenge.

To achieve the full footprint that city officials desired, they purchased an adjacent property and demolished it. "The building had to optimize the number of spaces available and generate interest for customers and passers-by," he explains. Field-topped double tees were used to minimize joint widths at the tee-to-tee interfaces to reduce noise and vibration for the retail spaces on the first floor.

The site constraints required short ramps, as vertical vehicular circulation space was limited, he adds. Typically, a minimum of 165 feet is needed to obtain an 11-foot floor-to-floor height with accessible parking on the ramps, but the structure offered only 145 feet. To achieve the proper slope, the double tees in the end bays at each end of the ramp were dapped at different depths to create an additional 8 inches of vertical height over the inverted tees.

This technique resulted in an additional 16 inches in total vertical height gain per 360-degree revolution on the ramps, effectively lengthening the structure by about 20 feet. That extra space ensures all of the ramps can provide the maximum amount of parkable space, increasing efficiency. It also allowed exterior bays to remain relatively flat along the north and south sides of the deck (with slopes in those bays for drainage only), providing a more horizontal appearance. Enhancing the appearance further, the ramps were cast with a higher quality finish on the underside to provide more light reflectivity to brighten the ramp area.

The site was surrounded by streets and adjacent buildings, minimizing the available area for laydown space. The precast concrete elements were cast at the plant, delivered to the site, picked from the trucks and set immediately into place. "The contractor did not require space to store reinforcing steel, tied reinforcing cages, formwork, etc." Erecting precast concrete components also minimized the potential for damaging the adjacent historic structures due to vibrations associated with typical construction activities, he notes.

Local requirements limited the location and orientation of the

Cast stone block and thin brick were cast into the architectural precast concrete panels cladding the six-level, 524-car precast concrete parking structure at the City Center Development in Columbia, S.C. It helped transform a low-density surface parking lot in an urban, historic area into a high-density infill project. Photos: LS3P.

PROJECT SPOTLIGHT

City Center Development Parking Garage

Location: *Columbia, S.C.*

Project Type: *Parking structure*

Size: *184,397 square feet*

Cost: *$11.3 million*

Designer: *LS3P Associates Ltd., Columbia, S.C.*

Owner: *City of Columbia, Columbia, S.C.*

Structural Engineer: *Kimley-Horn and Associates, Raleigh, N.C.*

Contractor: *Contract Construction Inc., Ballentine, S.C.*

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

Precast Specialty Engineer: *Starnes Chambers & Associates, Rock Hill, S.C.*

Precast Components: *A total-precast concrete structural system, including double tees, beams, columns, spandrels, fascia, Metrowalls, flat slabs, shear walls, and architectural panels.*

The new three-level, 249,484-square foot, precast concrete parking structure at the Regional Transportation District (RTD) station for Jefferson County was designed to maintain the aesthetic design of the nearby judicial center, using colors, acid-etching, and exposed aggregates. Reveals were placed to mimic the gridded pattern found on the existing campus. Photos: IBI Group.

PROJECT SPOTLIGHT

RTD Jefferson County Parking Structure

Location: *Golden, Colo.*

Project Type: *Parking structure*

Size: *249,484 square feet*

Cost: *$12.5 million*

Designer: *IBI Group, Denver, Colo.*

Owner: *Regional Transportation District, Denver, Colo.*

Structural Engineer: *Martin and Martin, Lakewood, Colo.*

Contractor: *Hyder Construction Inc., Denver, Colo.*

PCI-Certified Precaster: *Stresscon Corp., Colorado Springs, Colo.*

Precast Components: *A total-precast concrete structural system, including double tees, inverted tee beams, columns, and pedestrian bridge tees, K-frames, hammer-head shear walls, litewalls, architectural wall panels and spandrels.*

foundations, requiring all of them to be eccentric to the columns and walls. That allowed no foundation projection beyond the face of the structure. "Typically, that would result in large eccentric loads to the foundations, significantly increasing the size of the footings around the perimeter," he explains. Using precast concrete components more easily allowed the designers to create a "pinned" connection at the base of the columns, eliminating the load transferred to the foundations in a lateral-loading event. That configuration reduced the load required through the foundation and reduced the impact of the eccentric columns.

The precast concrete design also sped up construction, ensuring a timely opening for the project. "Utilizing precast concrete allowed for a faster overall project schedule, which minimized the duration of the disruption downtown. It also eliminated the need for concrete mixers and pump trucks to block lanes during the busy daytime hours or overnight." That also minimized late-night noise at the site, which can invoke complaints from nearby tenants.

"Precast concrete was an integral of the design," he says. "It not only enhanced the overall appearance of the building, but it provided the essential structural elements to support the structure.

Jefferson County RTD

The new Regional Transportation District (RTD) parking structure for Jefferson County is located on the campus of the Jefferson County Judicial Center in Golden, Colo. The facility serves the western terminus station of the RTD-Fastracks-West Corridor light-rail line and parallels the 6th Avenue freeway that links Golden to downtown Denver at the new Union Station hub.

Officials knew they needed a striking design for the parking structure that did not detract from the scenery at the foothills of the Rocky Mountains. They also needed it constructed quickly to ensure it was ready when the adjacent train station was completed, as the station was situated on some of the original surface parking lot used by Jefferson County staff.

"Keeping with the theme of the judicial center, the architectural precast concrete used on the façade maintains the colors, acid-etched finish, and exposed-aggregate textures of the existing campus architecture," explains Peter Zurawel, regional director for IBI Group, the architect of record on the project. Reveals were placed to mimic the gridded pattern found on the existing campus buildings as well. "The warm tones available with precast concrete made it an easy choice to match the nearby sandstone outcroppings in the area," he adds.

The new three-level, 249,484 square-foot structure accommodates 822 cars. The precast concrete framing system features double tees, inverted tee beams, columns, and pedestrian bridge tees, with K-frames and hammer-head shear walls for lateral stability. Precast concrete litewalls along the ramps provided both gravity and lateral loadings along with openness for patron visibility and air circulation. The structure's perimeter is clad with architectural precast concrete wall panels and spandrels. Stresscon Corp. fabricated the precast concrete components for the project.

Precast Concrete Tunnel

At the sound end of the structure, the precast concrete framing was designed to create a tunnel for the light-rail train to pass through before reaching the boarding platform, adding some drama to the design. Adjacent to the south side of the facility, a precast concrete pedestrian bridge provides safe passage over the rail lines, maintaining an uninterrupted path for pedestrians. At both locations, precast concrete tee depth was minimized to ensure required clearances were maintained for the trains below.

Precast concrete's inherent nonconductivity eliminated the need for shielding from the high-voltage catenary wires powering the trains. Using precast concrete also simplified the required fire separations between train tunnel and the rest of the parking structure.

To further blend the structure with its surroundings, the spandrels feature a metal green screen attached to them that allows native landscaping to climb the façade, reflecting the experience of the surrounding foothill environment.

The design met all of the owners' functional, aesthetic, schedule, and budgeting goals, Zurawel says. "The owner likes the durability and low maintenance associated with the precast concrete structure."

The building was sited to tuck into the landscape at the front of the Justice Center, minimizing the impact of the primary view to the center itself and the surrounding hills. Precast concrete panels were used to construct the below-grade, retaining-wall system, expediting their construction so site work could begin. The precast concrete components took about four months to erect.

The structural versatility of the precast concrete panels allowed for corner glazing around elevators and stair towers, which met the owner's requirement for maximum visibility into the vertical-circulation elements, emphasizing user safety. It also created a signature touch that ensures the building doesn't disappear from user's sight as they approach, Zurawel notes. "In the evening, the brightly lit corner towers act as beacons, notifying the public of the location at the entry to the campus."

University of Houston

The University of Houston needed to expand its parking facilities near its athletic fields and to accommodate an expanded program that drew more students, most of whom commute. But it also wanted to add excitement and create a signature look to the facility, which would be located at a gateway to the campus. To meet all of these goals, designers created a total-precast concrete structure with decorative, school-themed flourishes and a retail walk along the side of the building facing the stadium.

The facility was built on a surface parking lot on the edge of campus, adjacent to the stadium and near where a new light-rail station was being built. As a result, speed was of the essence, says Marie Hoke, principal in charge at WHR Architects. "Any time you have to take parking off-line, it becomes a matter

PROJECT SPOTLIGHT

University of Houston "Cougar Walk" Parking Structure

Location: *Houston, Tex.*

Project Type: *Parking structure*

Size: *700,000 square feet*

Designer: *WHR Architects Inc., Houston, Tex.*

Owner: *University of Houston, Houston, Tex.*

Structural Engineer: *Walker Parking Consultants, Houston, Tex.*

Contractor: *Vaughn Construction Co., Houston, Tex.*

PCI-Certified Precaster: *East Texas Precast, Hempstead, Tex.*

Precast Components: *A total-precast concrete structural system, including double tees, columns, beams, shear walls, litewalls, stairs, and architectural load-bearing panels.*

The new University of Houston parking structure adjacent to the school's athletic stadium features a "Cougar Walk" (which is the name of their sports teams) of shops along the side facing the stadium and a pedestrian ramp that cantilevers from the precast concrete structure to provide quick access for users. Mesh screening with the schools' logo creates a signature look for the building at a gateway to the campus. Photos: WHR Architects.

of speed to replace it before things get problematic. We specified the precast concrete structure due to the very tight schedule and also because it was the most economical approach."

The 2,200-car structure, covering about 700,000 square feet on four levels, offers a long rectangular footprint that provided a long façade on which to front retail, creating a "Cougar Walk" (which is the name of their sports teams) of shops aimed at attracting game-day shoppers and showcasing athletic merchandise. But that side and the parallel side presented 750-foot-long faces that needed to be visually reduced in size.

"We used a variety of textures and aesthetic treatments to break down the scale of the very long sides," Hoke explains. "We didn't want to mix colors within a panel, as we knew that would add cost, but we could vary the textures within a panel. So we used several textures and reveals to create a change in lighting and shadows throughout the day."

The base panel look was created with a limestone aggregate with a buff color and medium to heavy sandblast, creating two mix designs. Thin lines of reveals, which create ribs of a rougher texture, were created with chamfers in the forms. "One of the great things about precast is its versatility to use multiple ways to achieve the same goal," notes Chris Romani, sales and marketing manager for East Texas Precast, which fabricated the precast concrete components. "This design could be achieved by a formliner or chamfers, but for this specific project it was determined that chamfers was the more efficient method.

Openings in the façade also were varied, with tall punchouts used on the first level and square openings provided on two upper levels (with additional parking on the roof). "The panels were erected vertically, which made varying the openings in size easier to work with," says Jeff Chittenden, senior project architect at WHR. The panels were load-bearing, which limited the shapes of the openings, as they couldn't interfere with the columnar load capacity. Reveals were added at key points to attract the eye and break up the masses further.

"Adding punchouts into the panels isn't as difficult as might expect if you have an exact plan and efficient panel sizes," explains Romani. "The key was to meet the small tolerances that were required, especially for vertical panels."

The façades were further enhanced with tall, post-applied vertical aluminum box fins that serve as banners to add dimension and draw attention to entry points. These were specified in Cougar red to make them stand out and announce the university's presence. The fins and awnings along the Cougar Walk were attached to the precast with tubing that was welded onto embeds in the precast panels, explains Mike Stites, operations manager for East Texas Precast Erectors, which erected the precast concrete.

Stairway Provides Landmark

The main stair tower was pulled outside of the building's footprint to ensure it didn't eliminate any parking spaces. This positioning was taken advantage of by covering its side with a perforated-metal screen with the university's logo attached to it.

On the side facing the stadium, an exterior pedestrian ramp funnels users to the stadium and back again, creating faster traffic flow. The ramp cantilevers off the structure outside of the parking footprint. "We were tasked with creating a 20-minute dump time, which is the time it takes to empty all cars from the structure. When this was coupled with the tight dollars per space and other requirements, created a number of challenges."

The structural system consists of precast concrete components, including double tees, columns, beams, shear walls, litewalls, stairs, and architectural load-bearing panels.

A waterproofing membrane was provided above the retail spaces to protect them from inclement weather, and a drainage system was added as well. "There is a lot of redundancy in the system throughout, especially for the waterproofing," says Chittenden. Three-foot-wide metal troughs were located beneath joints in the double tees that channel any water leaking through to drains. "It adds extra protection to the design."

One challenge developed after design had commenced, when office space had to be added to the first floor. "We agreed to add it and then learned that the space needed to be 5,000 square feet," says Hoke. "We didn't have that much space available that would still allow us to meet the parking needs." Space was carved out beneath the express ramps, and it then had to be insulated to control noise in the area.

Erection moved smoothly, in part due to the open space in the area. Even so, the busy campus required close cooperation to minimize transportation issues and site congestion. "Logistically, there were no issues with setting the crane wherever we needed," Stites says. Two cranes were used to speed erection, with one road providing access coordinated with construction at the nearby light-rail station.

"It was a pedestrian-rich environment, so we wanted to be in and out as quickly as possible," adds Stites. The vertical panels were designed with no wall-to-wall connections on the long sides of the structure, he notes. "It was an independent system with tees, columns, and beams, which saved all kinds of time and increased our speed." The entire project was erected in three months.

The result is a highly functional building that serves students during the week and game-day fans on weekends, with added excitement from the embellishments and retail spaces. "We had an opportunity to integrate a row of retail shops into the stadium side, which created a mixed development and added excitement," Hoke says. It also helps generate revenue and identify the parking as a university building at the entrance to the campus.

These projects show the diverse ways that precast concrete's versatility, speed, efficiency, and resiliency can aid parking projects of all types. Whether they are in tight urban locations or more open spaces that will serve as signature gateways, parking structures gain a variety of benefits by using a precast concrete structural system and architectural panels to achieve functional, budgetary, aesthetic, performance, and scheduling goals.

Winning Design

Saint Leo University adds significant parking space by moving existing lacrosse field to new facility's rooftop supported by Florida bridge tees

— Craig A. Shutt

Administrators at Saint Leo University in Saint Leo, Fla., faced a challenge typical to many colleges. While academic programs were expanding and the student population growing, the school's land area could not be increased to supply more parking facilities. To meet these needs, the design team appropriated a lacrosse field, extended the space by cutting into an adjacent hillside, and created a 150,000-square foot precast concrete parking structure on the site. They then restored the lacrosse field by placing it on the parking structure's roof.

The $12.7-million project abuts wetlands that served as a prime driver for the design of the structure. Building against the hill and down a slope to the wetlands proved challenging, especially with several levels dug below grade to avoid raising the structure and pushing the proposed rooftop lacrosse field too high into the air. But the results proved to be worth the effort.

"We wanted the parking structure to blend seamlessly into the campus grade," explains Edward Lunz, principal at Lunz Prebor Fowler Architects. Indeed, except for the stair towers and stadium profile, only the top of the athletic field is visible from the entry. Landscaping on three sides and on the pedestrian paths create a park-like view to the wetlands beyond.

Florida Bridge Tees Used

The structural precast system (sometimes referred to as total-precast) features 8-foot wide by 37-inch-deep Florida bridge tees, as well as traditional prestressed double tees, exterior and interior columns, beams, vertical lite walls, shear walls, several types of spandrels, stairs with landings, slabs, and wall panels.

In addition to the parking facility, 1,000-seat seating sections, concessions, and ticket-taking facilities were built with precast concrete components as standalone structures adjacent to the parking, aligned with the rooftop field. "Building these facilities as separate structures allowed both projects to be constructed at once, and designing all with precast concrete allowed for faster construction," Lunz explains.

The use of precast concrete for the structure resulted from the decision to add the FIFA-rated/NCAA-regulation lacrosse field to the roof. Saint Leo is now one of only three universities in the country with a rooftop field. "The main challenge was budgetary considerations," Lunz notes. "The innovative idea of locating the field on top of the garage required a judicious approach to the budgetary constraints." Shifting funds to allow for the field's creation required "a streamlined and efficient structure," he says.

"Additionally, the timing was tight and an accelerated schedule was requested." The schedule demands were driven by a need to complete the lacrosse field in time for the following year's season. "Precast concrete was the only logical solution that combined the desired cost effectiveness with the structural accommodations for parking, life-cycle cost, and long-term durability."

The Florida bridge tee was specified due to the heavier loads required for the rooftop level. The loads were further increased due to the university's desire to use the field for graduation ceremonies. "Those tees typically are used for bridge projects, but the 60-foot narrow tee design provided the load capacity that would be needed," explains Mark McKeny, sales manager for Coreslab Structures (Tampa) Inc., the precaster. "We had to account for the soil and turf dead load of 300 psf plus 150 psf live load for the assembly area."

The tees were cast with self-consolidating concrete, which typically provides 7,500 psi strength at 28 days. "The sections were deeper and heavier than would be typical to ensure we could support the rooftop loads," says Mark Cerminara, vice president and general manager at Salmons PC, the precast concrete specialty engineer.

Retaining Wall Placed

The precast concrete components were cast while the site was prepared. The site required considerable work, as a two-story slice of the hill had to be excavated. A 25-foot, cast-in-place retaining wall was built along one long side of the building to hold back the grade. The concession and seating sections were built against this wall. The soil was hauled away with off-road dump trucks and placed in a bowl-shaped site on campus to move it out of the way until it could be removed. "There was a tremendous amount of dirt that had to be moved from the site," Lunz says.

The retaining wall connects to the façade of the parking structure, requiring corbels to be placed precisely. "It's not really an unusual design, but it had to be coordinated closely," says Cerminara. "It created challenges in tolerances, and it required stronger connections to accommodate the heavier roof loads."

At the same time soil was being excavated to provide two below-grade levels to reduce the building's overall height. This placed the entry at mid-level, with one parking level below the entry and the lacrosse field above. A kiosk sign with a parking-space counter at the main entry guides patrons to open parking and indicates when the facility is full. Two-way, 60-foot clear bays, and four bays with one, two-way ramp down to the lower level ease congestion.

"We dug down because we wanted to make the project as environmentally friendly as possible and enhance the landscape," says Lunz.

Photo: Lunz Prebor Fowler Architects.

PROJECT SPOTLIGHT

Saint Leo University Parking Structure

Location: *Saint Leo, Fla.*

Project Type: *Parking structure*

Size: *150,000 square feet (275,000 square feet including adjacent supplemental facilities)*

Cost: *$12.7 million*

Designer: *Lunz Prebor Fowler Architects, Lakeland, Fla.*

Owner: *Saint Leo University*

Structural Engineer: *Master Consulting Engineers, Tampa, Fla.*

Contractor: *Creative Contractors Inc., Clearwater, Fla.*

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

Precast Specialty Engineer: *Salmons PC, Phoenix, Ariz.*

Precast Components: Florida bridge tees, prestressed double tees, exterior and interior columns, beams, vertical lite walls, shear walls, several types of spandrels, stairs with landings, slabs, and wall panels.

The new precast concrete parking structure at Saint Leo University in Saint Leo, Fla., was built adjacent to a wetlands and features a lacrosse field on its roof. Precast concrete concession stands and seating were built next to the parking as standalone structures. They feature the campus' signature Mission style.

Photo: Aerial Innovations.

Photo: Lunz Prebor Fowler Architects.

"It's a beautiful site, and we didn't want to block views to the wetlands and wooded areas if we didn't have to. We also wanted to ensure the lacrosse field remained accessible to pedestrians."

Vehicular wayfinding was provided with reflective stop bars and floor arrows, as well as reflective signage attached to the bottom of double tees. Pedestrians access the top-level field and main campus from stair towers at each end of the structure on all levels and at the main entry.

Three Fields on Roof

The rooftop fields required significant work once the bridge tees were erected. In all, three fields were built on the roof, including two practice fields placed perpendicular to the main field and striped for student use. The main field features artificial turf, although it was designed to allow a change to natural turf if desired, Lunz notes. "They wanted it to be able to support loads for graduations, when thousands of people might walk over it or sit on the field, so allowing a change to natural turf in the future wasn't difficult to factor in."

Creating drainage for a sports field on the roof added challenges, says Salmons' Cerminara.

"We had to consider camber on the tees and allow for the loads during any point in time. The field will not always have the heavy live load, so we had to allow for excess camber so natural drainage will be provided. We had to balance all of the loading needs at different times and calculate the optimum slope."

The field slopes from east to west with a trench drain at the end to collect water and direct it to a detention pond at ground level, where it is treated and released into the wetlands. To protect lower levels from a buildup of water, a burlap waterproof membrane was added over the tees, as well as a layer of rock. The rock had to be trucked in and moved by escalators onto the roof from the sides. "It was a pretty complex process," notes Coreslab's McKeny.

Mission Style Featured

The structure and adjacent facilities feature a Mission-style design, a predominant theme throughout the campus. This motif was designed into the structure—notably at the stair towers—and was also used on the standalone structures. Some of the curved shapes were cast into the precast concrete using formliners, while others were added after erection with stucco. The precast walls were painted gray after erection to match the color of the other buildings on campus.

"The Mission style is a hallmark of the campus, owing to the original abbey on the site," Lunz explains. "Using precast concrete gave us a much more durable surface to work with in creating some added touches." No special forms were needed to create the design, he adds.

'The Mission style is a hallmark of the campus, owing to the original abbey on the site.'

High lighting fixtures, towering 40 feet above the field, were needed to provide illumination for night-time activities. These fixtures were placed on heavy-duty, 32-inch-square precast concrete columns that serve as the bases. "They're much larger than would typically be provided for a parking structure," McKeny says. They also required 4-foot-long anchor bolts to be cast into the columns to secure the fixtures.

Fabricating the precast concrete components off-site minimized site congestion, a key requirement with so much campus activity nearby. The school gymnasium and baseball stadium were adjacent to the parking structure, along with existing surface parking areas. The construction also had to contend with a great deal of pedestrian traffic in the area. "It was a lot of activity, so we had to carefully plan our activities and minimize disturbances, especially as we were building next to the wetlands," Lunz says.

The precast components were cast and staged at a nearby site off-campus, McKeny notes. One traffic lane was provided to bring trucks in and out, the components were picked from the trucks and erected immediately. "Our goal was to avoid any traffic congestion or to interfere with activity on the campus in any way."

LEED Standards Met

The building was designed to meet LEED standards but was not submitted for certification. "We've designed other LEED buildings for the university, including one that achieved Gold," Lunz explains. "But for budgetary reasons, the university wanted the structure to comply with LEED but didn't want to spend the money on the application fee."

With the concession and seating areas placed along the side containing the retaining wall, the design offered three open sides for the interior parking levels, creating light, bright openings for daylight, Lunz says. In addition to 730 car spaces, there are 24 motorcycle and bicycle slots. Twenty golf-cart charging stations are located in the lower level. This amenity allows university personnel to park their cars and pick up a cart to get around campus, reducing vehicular traffic. Another 6,000 square feet of storage space was provided under the ramps to house the building's sprinkler system and university property.

The result is a multifunctional building that adds to the existing facilities while providing considerably more function without disturbing the natural beauty of the area. It also offers options for future changes when needed. In addition to the possibility for switching to a natural-turf field, designers also allowed the potential for removing the field and creating another level of parking if that option is needed in the future.

The designers achieved the university's goal of fitting the structure into the landscape a little too well. They discovered that the building blended so well with its surroundings that first-time users had difficulty finding it. Signage was added to direct visitors to the entry. "The university was very pleased with the building," says Lunz. "It meets all of their functional and aesthetic goals, so having hidden it so well that signage was needed was a minor point."

The structure also provided an improvement on the existing field. The new fields are elevated 3 to 10 feet above the adjacent roadway. The variance results from the topography sloping toward the wetlands, which had caused problems for the previous lacrosse field. That difficulty was ironed out by the rooftop position, which could adjust to the topography and create a literal level playing field for all.