

# CONRAC Projects Increase Nationwide

More airports are consolidating rental-car facilities to add efficiencies, and high-performance precast concrete helps meet the additional functional challenges they create

— Craig A. Shutt

**W**hen officials at Nashville International Airport decided to create a Consolidated Rental Car (CONRAC) facility, they knew they faced significant challenges. Each company had its own procedures and signage needs, and they all wanted the building located close to the terminal to facilitate customer use. Airport officials also wanted to make efficient use of the space while creating a sustainable design and an aesthetically pleasing appearance. All of these goals were met with the structure, which features a precast concrete structural framing system (also referred to as total-precast system) and architectural spandrels.

“We bid the project with alternative designs for precast concrete and cast-in-place concrete,” explains Traci Holton, manager of design for the airport. “Precast concrete came out more cost effective, for several reasons. But a lot of factors went into choosing it beyond the economics, including scheduling and the site situation.” The three-level facility houses space for 2,400 rental cars along with related services.

The chosen site was directly opposite the main terminal, in what had been some of the long-term parking space adjacent to the short-term parking, just 360 feet away. That required a fast schedule to bring it online quickly and close coordination to allow access for delivery of precast concrete components. “It was right in the middle of the action. The schedule was fast, and it was important to stay on schedule.”

## Precast Concrete Benefits

Economics and speed of construction are two key reasons why precast concrete is often chosen for these projects. Its durability and ability to continue construction through the



*The CONRAC facility at Nashville International Airport features a total precast concrete structural system, which met designers' goals for efficiency, aesthetics, economics, and sustainable design, among others. The three-level facility houses space for 2,400 rental cars along with related services. Photo: Demattei Wong Architecture.*

winter offer additional benefits and led designers at TransSystems to specify precast concrete for the facility they are designing for Chicago's O'Hare International Airport. “We chose it for the economics but also for how much easier it would be to get the project built if we could erect components through the cold winter,” says Norman Lin, senior architect. “That will save us considerable time.”

TransSystems designers earlier had specified precast concrete for the Mineta San Jose International Airport CONRAC, the first in the country to integrate a quick-turn-around (QTA) operation and California's largest precast concrete parking structure at 1.8 million square feet. The precast concrete design provided a number of benefits, including the ability to adapt to an oddly shaped site, provide durability for refueling and washing services, and meet the high seismic requirements.

**‘The operation and design are evolving and becoming much more complex today.’**

Although CONRAC facilities may resemble parking structures from a distance, they are far more complex—and they are growing in popularity. “It's a fairly new building type, going back only to the 1980s,” explains Wesley Wong, principal at Demattei Wong Architecture, which designed the Nashville facility in conjunction with local architect Moody Nolan. “But the operation and design are evolving and becoming much more complex today. These structures represent a consolidation of a number of functions and have a variety of components which need to be integrated.”

They comprise such operations as a customer service area, with rental



*The precast concrete system at the Nashville CON-RAC facility provided a variety of dramatic elements, including a curved helix-ramp enclosure to which sculptural pieces were attached (below). Photos: Demattei Wong Architecture*

counters and offices for each company; rental car pick up return areas; a maintenance area, consisting of fueling, car washing, and detailing services requiring specialty equipment; and storage areas for vehicles. More CONRAC facilities are expanding service areas to upper floors, creating additional challenges for accommodating fuel and water at these locations.

## 'These are absolutely the wave of the future.'

"These are absolutely the wave of the future," says Wong. "Even the smaller-sized airports are building them. The processes of how they function and operate are evolving, but it makes the airport and rental-car operations more sustainable, efficient, and profitable." That's important, he notes, because rental-car revenues are typically one of the top money makers, along with airline and parking fees for airports, making them a key customer. "The rental-car industry is a major airport player because of the revenue generated."

The buildings' complexities make them far more complicated to design than a parking structure, designers agree. "People think of them as parking structures, but CONRACs are really a unique type of building with a high-level of customer service," says Lin. Wong agrees. "Parking cars is only one aspect of their operation.



The building that houses their operations is important, because it gives the rental-car companies an opportunity to showcase their product while also allowing them to efficiently prepare cars for their customers. There is much more activity 24 hours a day than in most other building types."

Parking structures have more predictable activities and traffic flows, notes Nashville's Holton. "In a CONRAC, there are people working and customers coming in 24/7/365. They're working at booths and using equipment, and they need barriers to separate companies and security requirements to protect the cars," she says. "They have to be able to move cars around smoothly and direct customers with their own unique sig-

nage. Each company has their own way of operating." CONRAC facilities also often include a multimodal aspect, requiring bus traffic and drop-off for passengers transitioning from the terminal, or returning.

### High Activity Levels

That activity level requires brighter spaces than most parking structures demand. "The floor-to-ceiling heights are taller than for parking structures, with elevated footcandles to make them more like offices," she explains. Adds Wong, "The electrical load is high due to the various functions and there is a need for high lighting levels, up to four times what you'd find in a typical parking structure."



*Dramatic photography was used as an aesthetic treatment for the San Jose International Airport CONCRAC structure, which features a total precast concrete structure. The technique was still being discussed when the structure was constructed, so designers had embeds placed into the precast concrete that the final decorative pieces could use for installation. Photos: Clark Pacific.*



Most parking structures provide 10- to 12-foot floor-to-floor heights, while CONRACs usually provide floor heights greater than 15 feet. That height provides space for equipment, increased daylight, and better ventilation to help meet emissions needs without having to provide mechanical ventilation. In San Jose, rental-car levels have heights of 12'2", while QTA floor levels were placed 24'4" apart (leaving out one intermediate level). Precast concrete is fairly easy to adjust the floor-to-floor heights, and use higher floor heights, whereas other systems, such as cast-in-place, typically require additional shoring and support.

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In addition to taller spaces, designers also need to create open floor plans so each company can plan their spaces as they want and adapt them over time. "Even though they all rent and process vehicles, each company has its own procedures, so we have to provide a design with enough flexibility to meet each company's specific needs," says Wong. Variations also occur based on the location's climate and the type of business, such as if it's predominantly for business or vacations.

To maximize flexibility, Wong prefers to design with 60- by 60-foot bays. "A 60- by 40-foot grid can work, but the larger bay size offers more flexibility," says Wong. The CONRAC facility at Logan International Airport in Boston, Mass., used precast concrete components to achieve the 60- by 60-foot bays, with structural H-frames supporting loads along the perimeter and interior moment frames used between columns and tees. "We liked the flexibility that the precast concrete framing system could provide to give each company complete freedom in designing its layout," says Camille

Bechara, project manager and lead designer on the project with Parsons Brinckerhoff. "Each has exclusive rights to lay out its space because there are no columns to impede them."

### QTA Services

QTA Services require special attention, especially refueling areas and car washing. In most cases, these are located on the ground floor so concerns over elevating flammable materials and supporting heavy weights are mitigated.

"QTA areas can't be placed just anywhere, they must be organized and planned closely," says Lin. They and other areas require mapping out specific necessities and working with the precaster to ensure all openings and penetrations for any service lines are cut in advance and align properly. "Everything has to be systematized. It can become a nightmare if they aren't planned in advance."

In San Jose, a four-level QTA was created in a stand-alone structure adjacent to the parking structure. This allowed refueling stations and car washes to be created at intermediate levels with tall ceilings, so each QTA could service two rental-car parking levels, designers explained. Wash and rinse services were provided in multiple 2,000-gallon tanks on each level, including a reverse-osmosis system for spot-free rinsing. To protect against moisture penetration with such high water use, the floors feature added water resistance in the form of a 3 ½-inch topping on the double tees, followed by a hot-asphaltic waterproofing layer, and another 4-inch topping.

Refueling areas require even more attention due to the higher concerns for fire control. "We work very closely with fire marshals on all of our projects to show how we'll meet prescriptive code requirements with performance-based analysis," says Wong. That coordination allowed the firm to receive 100% approval for a CONRAC facility under design in Miami, Fla., that will feature approximately 150 refueling stations on three levels.

"Multilevel refueling is a new concept, and Miami was the first for us," he says. "It's the latest innovation for CONRACs, and car companies like it—it expands the refueling service especially with buildings that have smaller footprints." That's often the

case, as rental-car companies want the CONRAC located close to the terminal to avoid transporting customers, but those are in-demand locations for parking, too. "Designers are always looking to add extra floors when the footprint is small, so expanding services to these levels provides added efficiency."

Nashville's refueling and washing services are located on the first floor, and officials worked closely with fire officials to meet all requirements. "We have the only CONRAC facility in the state, so the fire marshals were unfamiliar with the design and the needs," Holton explains. "We worked closely with them to make sure every requirement was met."

In San Jose, a number of objections to the original plan were raised. A key concern was protecting the pumps on each level from accidental vehicle damage that could spill gasoline and cause an explosion. This was met by adding shear valves to the pumps to stop the flow if equipment was hit. Additional concrete bollards were added around the fuel pumps delineated with striping. Eight-inch curbs separate inbound and outbound car lanes to eliminate chances for drifting into the wrong lanes.

### Aesthetics Are Key

Because these large buildings are usually located close to terminals, they become a key landmark for airports, requiring attention to aesthetics. "Aesthetics are important to CONRACs because they are highly visible," says Wong. "They are usually one of the first and last buildings that visitors see, so they leave a lasting impression, even if they aren't using them directly."

Designers work with the client and local groups to define the image that is to be presented. Typically, these include nods to regional imagery and other customized touches. "They offer a unique opportunity to provide a distinctive look that reflects the region and offer a signature appearance for the airport," says Wong.

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## Precast Concrete Benefits

High-performance precast concrete can provide a variety of benefits to a CONRAC project. Among its advantages are:

**Design Flexibility.** Double tees provide long-span capabilities, with the potential to create 60- by 60-foot bays with special engineering. They can eliminate columns to ensure each rental car company can design its space as it needs.

**Durability.** The inherent high strength and low permeability of precast concrete allows for easy maintenance and protection against water penetration or chemical washing agents.

**Fire protection.** The inherent inorganic composition of precast concrete prevents it from catching fire, and it can slow the spread of flame from any accident that occurs.

**Accelerated Construction.** Casting components off-site while site-preparation and foundation work is underway ensures the building can be erected quickly, saving time and allowing interior trades faster access. Also, precast concrete components can be erected through harsh winter weather, expanding the construction season and keeping projects on schedule.

**Minimized congestion.** By casting components off-site, fewer trades are required in high-activity areas near working runways and terminals.

**Aesthetic versatility.** Precast concrete's plasticity allows it to blend with existing buildings or create a singular statement in its design. Veneer can be embedded or form liners used to create texture, reveals, and other treatments.

**High quality control.** By casting under controlled conditions off-site, precast concrete components achieve high levels of quality assurance and create tight tolerances.

**Sustainable design.** Precast concrete contributes to multiple LEED points through its use of local materials and manufacture, recycled components, reduced construction waste, and other features.



Precast concrete components created 60- by 60-foot bays for the CONRAC facility at Logan International Airport in Boston, Mass. Structural H-frames supported loads along the perimeter, with interior moment frames used between columns and tees. Terra cotta veneer was applied to the exterior, its first use in North America on structural components. Photo: Fennick McCredie Architecture.

The Logan CONRAC facility used terra cotta embedded precast concrete panels, which were also part of the structural system. This was the first use in the country of load bearing panels with embedded terra cotta. The original plan called for inset brick to complement historic residential buildings facing the structure on two sides. But owners wanted a more contemporary look to blend with other modern airport buildings on the other sides.

The terra cotta provided warmth and texture while creating a panelized system that was easy to erect. The larger sizes of the masonry pieces provided the contemporary feel the owners sought. The panels feature  $\frac{3}{4}$ -inch terra-cotta veneer sheets measuring 2 by 3 feet embedded into the panels, which are large as 51-feet tall, 12-feet wide and 10.5-inches thick. The terra cotta was set into formliners and the concrete was cast over them, with added haunches on the reverse side of the panels to support the structure's double tees. Using embedded terra cotta saved about \$1 million, Bechara estimates.

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In San Jose, city officials considered a variety of options for façade treatments up to the last minute, so precast concrete spandrels were installed that serve as car-impact shields

as well as a base skin. Metal mesh and metal panels were later applied to these spandrels on three sides, while a unique large public-artwork mural was applied to the final side, featuring a photographic depiction of local citizens' hands waving greetings and farewells.

In Nashville, a kinetic sculpture was commissioned following a review of submitted options by the Airport Authority's Arts at the Airport Board. The winning design, "Wind Reeds" by Ned Kahn Studios in San Francisco, Calif., consists of more than 500 hinged-aluminum projections that sway with the wind's direction. The pieces are continuously moving and create new shadow lines and reflections throughout the day. They were installed on the helical ramp structure, which was clad with 40-foot-tall precast concrete panels cast with embeds so the sculptural elements could be added. "The ramp can be seen from different directions as passengers approach the terminal, so it's a very visible location," says Holton.

### Sustainable Design Concepts

The Nashville CONRAC also features a green screen wall covered in vegetation, one of a variety of environmental elements that were added. "Incorporating sustainable-design concepts is a key initiative of the airport authority," says Holton. The project was not designed to be LEED-certified, she notes, but sustainable elements were incorporated where possible.

A key element of that was inherent in the CONRAC concept, she notes. Previously, car-rental companies had to drive two miles to refuel and wash cars. Now, with the services located in the building, the companies reduce their driving needs each year by more than 800,000 miles, saving gasoline and minimizing emissions. The building also includes water-reclamation systems, energy-efficient lighting, and a lighting-management system that adjusts lighting levels based on available natural light.

The Logan CONRAC achieved LEED Gold certification, the first major CONRAC in the nation to achieve this level of certification, using many of these same concepts. At the San Jose facility, cost savings accrued during construction led to the installation of a 1.12-mw modular system of 4,680 monocrystalline solar panels on 3.4 acres of the roof. The panels will produce an annual output of 1.7 million kWh, which will offset about 20% of the facility's electrical needs.

The precast concrete designs helped achieved sustainable-design goals through its use of local materials and local manufacturing, use of recycled materials and being recyclable after its service life, minimizing construction waste, and other features. (For more precast concrete benefits, see the sidebar.)

### Working with Tight Project Sites

Environmental concerns and customer service are key reasons that



Photo: Fernick McCredie Architecture.



Photo: Fernick McCredie Architecture.



Photo: Blakeslee Prestress.

*The terra cotta panels used on the Logan CONRAC project provided warmth and texture in a panelized system that was easy to erect. The sheets were 3/4-inches thick and measured 2 by 3 feet. Using embedded terra cotta saved about \$1 million, according to the architects. The project achieved LEED Gold certification.*

CONRAC facilities are being placed as close to terminals as possible. "Airports want to look at more remote locations to avoid disruptions and avoid losing short-term parking, but rental-car companies want them close to make them more convenient," says Wong. "Rental car companies don't want to have to coordinate busing people to the location or using people movers. That's too costly, so they're putting pressure on to build them closer."

Trucking in precast concrete components for quick erection can speed up the schedule while eliminating site congestion. "We brought in our precast concrete along normal ac-

cess and had no difficulties," Holton reports.

At the San Jose International Airport, the CONRAC facility was placed near the terminal on a very tight site, says Lin. "It was very condensed, so we had to work out access to the site and how we would bring in the precast concrete. We had to closely coordinate deliveries and how to place the cranes." A key challenge came from one of the control towers being adjacent to the site, requiring precise control of the three or four cranes working at once.

"Precast concrete can be easier to work with, but it also has to be coordinated with other activities around the site," he says. Some pieces were split up and reduced in size to make them more maneuverable around the tower.

In Nashville, 40-foot-tall panels used at the helix ramp, and in some other locations, were erected with cranes set up at night with four-hour road closures. "We had to shut down traffic to certain levels of the terminal for those few hours to get them set, but it went very quickly," Holton says.

In San Jose, construction roadways were built to allow the components to be delivered to the needed locations. "Using precast allowed much of the structural work to take place off-site, which greatly aided maneuvering on the congested site." Because of tight site constraints in some locations, parking bays were left out to facilitate crane and truck access. Construction sequencing allowed the double tees in those locations to be backfilled to complete the bay once the rest of the

structure was erected.

As more CONRAC facilities are constructed, designers become more adept at creating efficiencies and using materials to their advantage. "We try to create a better design with each one we do, and more and more are being built all the time," says Wong. "Airports are land-poor and need space for parking and terminal expansions, so finding ways to provide all of the functions in more efficient ways is critical."

Nashville's Holton agrees. "The rental-car companies have told us since the first day the CONRAC opened that they need more space, and that need continues to grow," she says. "The space they have is very efficient, but they always want more so they can expand their business."

Those additions will come, Wong says. "We keep getting smarter with our systems and how we can make the projects more efficient. We can't take one design and use it anywhere else, as each has unique needs and challenges. But we can learn from each and incorporate the best ideas."

Precast concrete components often will be a consideration, as specifiers look at the benefits it offers and the challenges new projects must meet. "I did not have any experience with precast concrete prior to this project, and I learned a lot about using it," says Holton. "There are a lot of challenges with a CONRAC project, and a lot of coordination is needed working around an active airport. But from a construction professional's perspective, it's also a lot of fun." **A**