Economy **Parking**

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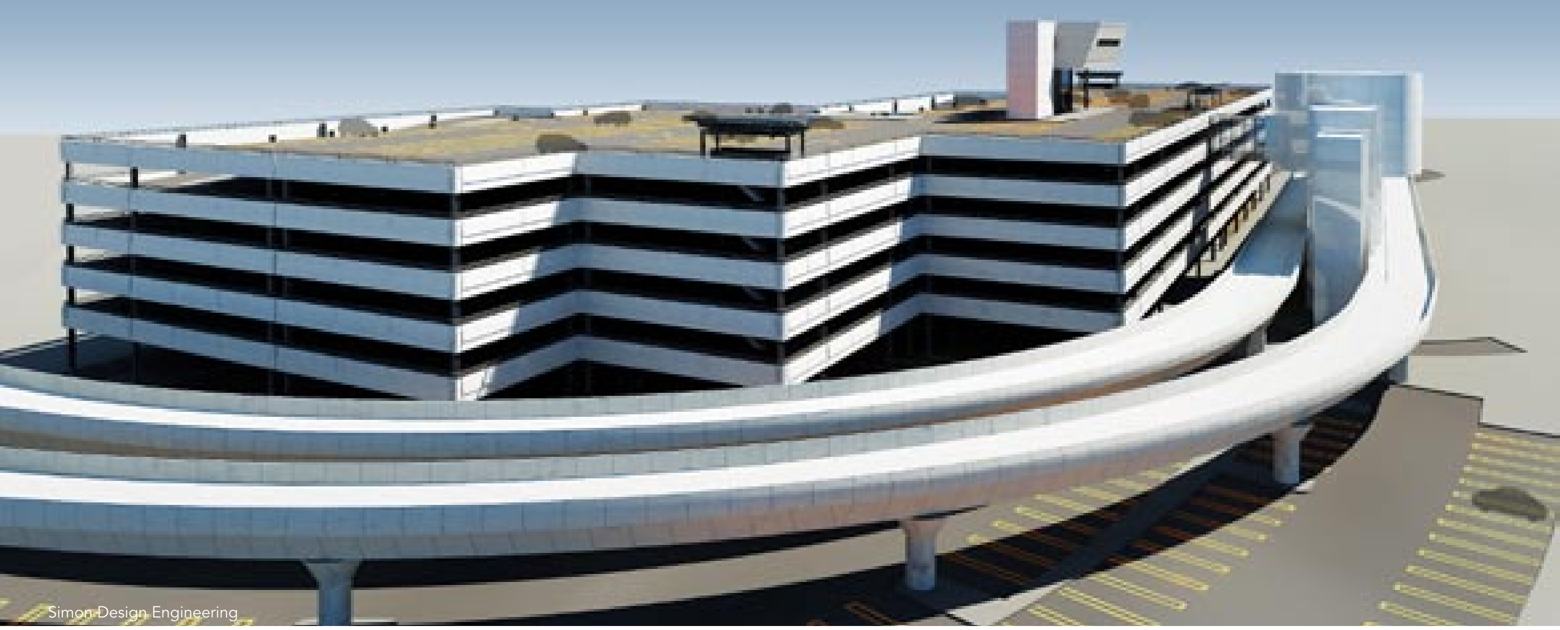
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Bridging underground utilities and reducing future maintenance needs are just two of the benefits steel provided.

FOR YEARS, there were discussions of replacing Eero Saarinen's aging Trans World Airlines Terminal at New York's John F. Kennedy International Airport. In 2007, those discussions became a reality when JetBlue Airways chose JFK as its hub. To support JetBlue's new Terminal 5, (T5), expansion proximate parking for 1,500 vehicles was required. The so-called Yellow Garage had to be built in a limited timeframe that corresponded with the opening of T5. The Port Authority of New York and New Jersey (PANYNJ), in conjunction with JetBlue Airways, compiled preliminary bridging documents and issued a Request for Proposals that was made available to a select group of general contractors.

The bridging documents established preferred points of egress and desired car counts, and the general footprint parameters based on a six-story, precast structure. Pedestrian egress included elevator cores, enclosed stairwells, and connections to the existing AirTrain monorail system. A key criterion indicated in the documents was that the new parking structure needed to reflect and compliment the aesthetic nature of the surrounding area, including the new T5 expansion and monorail system. Although the existing site utilities were indicated in the bridging documents, it also was noted that the number, location, and types of utilities had not been fully verified. This apparently innocuous note would later prove to impact the project in a significant way.

The Wellesley, Mass.-based structural engineering firm Simon Design Engineering, LLC, and The Berlin Steel Construction Company, Inc., Kensington, Conn., were approached as a team by Peter Scalamandre & Sons, Inc., a local New York contractor with significant Port Authority experience. Although the preliminary bridging documents were based on a fully precast concrete solution, they allowed for alternative structural systems. Scalamandre, the general contractor and lead on the design-build team, believed that a steel solution would greatly benefit the Port Authority and JetBlue based on comparing the available solutions. Simon Design revised the precast structural system, footprint, and

◄ As part of constructing the new Terminal 5 at New York's John F. Kennedy International Airport, the Port Authority of New York and New Jersey added a steel-framed new six-story parking structure for 1,500 cars.

▲ The design-build team's decision to use steel framing with long-span precast spandrels resulted in an open parking structure and reduced both the initial cost and maintenance requirements.

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column grid with the assistance of Berlin Steel and Scalamandre in response to the RFP and bridging documents.

The design-build team's structural steel beam and column solution with a precast concrete decking system was ultimately the preferred design solution, making the Yellow Garage the first PANYNJ design-build garage project using this approach. The final design incorporated precast spandrels, steel railings, and steel mesh, reflecting the surrounding structures while meeting the building code requirements as an open parking structure, which had several benefits. As an open parking structure the use of structural steel, devoid of supplemental fireproofing, allowed for open stairwells as a means of egress. It also permitted the use of exposed fire suppression standpipes and eliminated the need for sprinklers (no sprinklering). In addition, the Port Authority realized the benefits of steel construction, including the initial economical costs and the minimal maintenance requirements, among others.

The final design approach used 15-ft-wide precast concrete double tee floor slabs, manufactured off site, that were delivered by barge to the construction site. The double tees were furnished by Bayshore Concrete Products Corp. of Virginia, which also recently had provided the AirTrain monorail system's segmental, precast concrete elements to the Port Authority at JFK. The ability to use 15-ft double tees and other long-span pre-

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manufactured structural elements, which are traditionally considered too large to be transported on roadways, provided the Port Authority and JetBlue with a host of inherent benefits. Using steel framing and wider floor units allowed for longer spans, large parking bays and stalls, fewer columns and visual obstructions (ideal for patron safety and utility conflicts). It also considerably reduced the number of deep foundations and foundation elements, overall construction time, and the amount of joint sealants and waterproofing elements required.

The team's original steel coating concept called for the use of hot-dipped galvanized steel, which is economical and has demonstrated longevity and significant durability with little to no maintenance required in the first 50 years of a structure's life. However, the Port Authority's own design standards for steel required a three-coat paint system to provide a less industrial finish and appearance. As a result, all steel beams and columns were blast cleaned to an SP6 standard, and a stringent quality assurance program was implemented to ensure the surface preparation and coating applications were done in the factory with the requisite quality.

▼ Using steel framing and the ability to deliver the precast double tees by barge enabled the use of 15-ft-wide panels and other long-span structural elements, resulting in larger parking bays as well as fewer columns and visual obstructions.

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Toward Parking Automation

With the advancements in materials handling and robotics made in recent years, providing each client with a customized, optimal solution to meet individual parking needs is no longer restricted to traditional solutions. Solutions to parking have advanced significantly over the decades, and that advancement is gaining momentum.

Automated parking, often referred to as robotic parking, is here and carries with it a myriad of benefits. For example, with the absence of floors, an automated facility may be implemented under zoning code rules to avoid Floor Area Ratio (FAR) controls, which limit the size of buildings, even for above-grade facilities.

Structural steel is the logical choice for automated parking structures. Structural members are small and compact, which increases the speed of construction, supports the elimination of concrete floors, and potentially eliminates the need for fire ratings. Automated parking is also environmentally friendly. The facilities provide small building and construction site footprints, fewer structural and foundation elements, negligible carbon footprints, low head heights that greatly reduce overall building heights, and the ability to use a variety of "green" façade options such as solar panels. All those benefits *and* every patron could have a wait time of just 60 seconds to retrieve his or her car. To learn more about automated parking, visit **www.sde-us.com/docs/autoparking.htm**.

photos by Simon Design Engineering

Foundational Issues

Speed of delivery was paramount. A full geotechnical exploration and test pit program was set in motion immediately upon contract initiation to support the fast-track construction of foundations, prior to design of the steel superstructure. The Port Authority originally had planned to relocate the existing on-site utilities prior to commencing construction of the new steel and precast six-level parking structure; however, due to schedule constraints, the relocation of the utilities was released to the design-build team.

Once construction began, it became apparent that the existing utilities could not be relocated in a timely manner and that the project delivery schedule would be compromised. Even with considerable preconstruction design coordination and efforts, many conflicts with existing underground utilities still needed mitigation. Ultimately, more than 50% of the original foundation plan design had to be modified or redesigned during construction.

In real time, Simon Design worked with both the design and construction teams to enable the pile-driving and overall construction operations to keep moving as the foundation structural redesign was being done. By using BIM technology in conjunction with the steel and precast manufacturers, Simon Design was able to quickly and accurately lay out and design the project's foundations and superstructure in response to the daily discoveries of additional existing utilities, with a resolution turnaround of 24 hours or less. The BIM model also aided in the integration of the steel and precast systems, which greatly reduced the number of architectural component conflicts.

Existing electrical utility conflicts were bridged with shallow, heavy steel box beams, weighing up to a ton per ft, allowing the utilities to remain in place and functioning throughout construction. Structural steel's inherent ability to provide a high degree of torsional resistance made steel box beams the ideal solution for utility bridging, and allowed the box beams to be used as integral elements in the structure's steel moment frames, with large forces transferred to the foundations. After the steel box beams were in place, they were color coded for future reference and safety, and ultimately concrete encased and backfilled. Pile caps were also used to bridge the primary utility feeders that lead directly to JFK and were redesigned as the utility feeder locations were uncovered during construction.

Access Relocation

Another noteworthy modification during construction was the decision by the owner and architect to relocate the primary pedestrian core from the outside perimeter of the structure, to the center of the interior. To accommodate this change numerous columns were retrofitted with cover plates or swapped out, more than half of the foundations were redesigned, and transfer girders were added—all without consequence to the project's fabrication and construction schedule.

Although there were several hurdles throughout the Yellow Garage project, the revisions of the structural system saved 20% of the overall project cost and reduced the construction schedule by a year. The garage was completed in time for the opening of the T5 terminal. MSC

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