Easy Access

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Extensive use of structural steel enhances the open feel of the P4 Parking Garage at New Jersey's Newark Liberty International Airport.

Prominently located at the front door to Newark Liberty International Airport, the P4 Garage provides an efficient operation for parking 3,300 cars on six levels including grade, while also establishing a convenient intermodal transfer from the garage to the P4 AirTrain station.

The garage is a steel superstructure with an architectural metal screen-wall system enclosing the large exterior façade. A metal and glass curtain-wall system encloses a six-story elevator core tower. It is a signature element at the entrance to the airport and sets a new standard of design quality for public parking garages. It was recognized for its design with a 2003 New York State AIA Merit Award.

The structure required a design approach in keeping with the airport's comprehensive redevelopment program, which includes airline terminal expansion, an airport-access light-rail system and significant roadway and curbside improvements. The projects are necessary to accommodate increasing growth in air traffic, and to facilitate mass transit and surface-transportation access to the airport. The extension of the AirTrain airport access system to a Rail Link Terminal along the Northeast Corridor rail transit developed a link to the region's existing mass transit infrastructure. Further, Continental Airline's Global Gateway Program expanded its operation as part of the airport's new Central Terminal Area (CTA) master plan, developed to reorganize vehicular access roadway and curbside networks.

The redevelopment significantly reduced available short and long-term CTA parking by incorporating existing surface-parking into the other programs. The P4 Garage was one of two parking structures built to restore and increase the amount of parking spaces lost by these projects.

Above: The garage features a steel superstructure with an architectural metal screen-wall system enclosing the exterior façade.

Below: The painted structural steel frame provides large spans and vertical clearances necessary to facilitate easy navigation.

DESIGN CONCEPT

Those who use the P4 Garage can access all three terminals and other airport services. The garage accommodates both self-park and valet customers. Valet customers can drive to a frontage located at the P4 AirTrain station, leave their car with the valet operator, and board AirTrain to travel to terminals A, B or C.

Long-term parking customers enter the garage through an entry plaza, and after parking, can proceed to one of four glass-enclosed elevators located directly across from the AirTrain station lobby. The garage's efficient plan configuration, approximately 345′ by 525′, minimizes walking distances to the elevator core. The four glass-enclosed elevator cabs are accessed through a lobby space at each garage level. The use of glass promotes orientation for passengers, with full visibility of the AirTrain station and the terminal buildings from the garage. It also enhances passenger security and safety. The glass core, when lit at night, is a landmark for passengers when they arrive. Once at grade, a metal and glass crosswalk canopy provides weather protection as customers enter and exit the garage.

The garage's extruded aluminum screen wall system is in keeping with the aluminum and glass curtain-wall systems in the airline terminals and other AirTrain stations. The screen wall's triangular extrusion also is carried into the curtain wall that encloses the elevator core. Metal and glass are used for the entry/exit plaza canopies and frontage canopies.

On the garage's two short sides, the façade is carved away at the vehicular entry and exit plazas, providing architectural cues to these functions, as well as giving visual relief. A double-threaded helical ramp with precast concrete parapets becomes a sculptural element on a third façade, while the glass elevator core frames the fourth and most public side that relates to the AirTrain station.

Painted steel, stainless steel and painted metal panels also are used for accessory elements such as railings, bumpers, emergency stairs, walkway canopies and enclosures for fire extinguishers. Stainless steel for guard rails and other building components were selected to reduce long-term maintenance costs.

SIX-STORY STRUCTURE

The structural system is a composite of exposed, high-strength structural steel frames and precast double-tees with high-strength, cast-in-place concrete. This system was chosen over a conventional concrete-framing system because structural steel provides greater availability in sizes and depths for long spans and for meeting the headroom clearance requirements. The exposed painted structural steel also is easier to maintain in the future.

The garage's steel structure consists of paired columns and girders at each of the north-south building column lines. It supports the parking-deck floor loads and provides lateral stability to the structure during and after construction. The paired columns are tied together by steel plates (battens) at approximately 6′ on center, and are shop-fabricated at full height of the structure. The paired columns are erected with girders for the support of the precast double-tees, spanning in the east-west direction. The ladder frame of the paired columns in the transverse direction and the conventional rigid frame action in the longitudinal direction provides lateral stability.

The bay size is a 58′-long bay, allowing for two, back-to-back parking-stall lengths and a drive aisle between them. The bay width is 35′ in the other direction, allowing for three side-by-side precast concrete double-tees, each 11′-8″ wide. The framing system consists of a pair of steel columns connected by battens at each floor and halfway between floors. Along the width of the typical bay, a pair of parallel steel girders spans 35′ between the columns.

In the latter direction, the frame action to resist lateral seismic and wind forces is achieved by framing the girders into the column flanges (strong axis) with semi-rigid connections. Necked-down flange-connection plates (paddle plates) are provided top and bottom, since reversals from seismic forces are possible. In the other direction, precast double-tees 58′ in length span between the steel girders. The webs of the tees are notched at the ends to sit on top of the top flange of the steel girder. In this direction (length of tee), the lateral-force resistance is provided by the pair of double steel columns (weak axis) connected with battens, providing Vierendeel-type frame action as a vertical cantilever frame. This system benefits from the ductile behavior of steel frames in both directions to resist seismic forces and displacements. It also permits expansion joints (seismic separation joints) to be located farther apart than with a precast-concrete framing system.

No fire protective coating is required, since the garage is classified as an "open parking structure" in accordance with the New Jersey Uniform Construction Code (NJUCC) BOCA.

An interesting aspect of the garage is its location over an existing 90′-wide peripheral drainage ditch waterway that runs at an angle underneath the garage. After an environmental hydrologic assessment, widely spaced concrete caissons were chosen to provide the foundation support for each of the paired columns. The grade-level precast floor construction spanning over the ditch embankments is supported on concrete-filled, steel-pipe pile foundations.

DOUBLE HELIX

The circular, double-threaded helical ramp includes a separate up-ramp and an exit traffic ramp with identical footprints. The helix ramp creates more useable parking area than slanted-ramp construction or dual one-way helices. The continuous-curved rising slab and curb was constructed with high-strength cast-in-place concrete on an exposed steel frame structure.

The helical ramp consists of W18 and W21 radial steel beams supporting the cast-in-place curved concrete slab. The radial steel beams are supported by inner and outer chord of W24 straight steel girders and W14 columns. The inner and outer chords of the girders are at radii of 34′-8″ and 59′-6″, respectively, and are sloped to follow the ramp up-and-down of the spiral slab profile. Lateral stability of the ramp structure is provided by moment connections on the outer chord frames. The connections were designed, detailed and fabricated to allow the sloped and skewed orientation of the steel beams and girders. The spiral-slab formwork was simplified, resulting in quick construction speed.

The garage opened in December 2002 at a total cost of approximately $85 million, including a restricted-service road bridge over the peripheral ditch. The structure features approximately 7500 tons of structural steel. ★

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CLIENT

The Port Authority of New York and New Jersey Aviation Department Newark Liberty International & Teterboro Airports

DESIGN ARCHITECT & ARCHITECT OF RECORD

The Port Authority of New York and New Jersey, Engineering/Architectural Design Division, New York City

ENGINEERING & CONSTRUCTION MANAGEMENT

The Port Authority of New York and New Jersey, Engineering/Architectural Design Division, New York City

ENGINEERING SOFTWARE

STAAD III

STRUCTURAL ENGINEERS

(miscellaneous structures)
Weidlinger Associates, New York City

GENERAL CONTRACTOR

NAB Construction Corp., College Point, NY

All photos are courtesy of the Port Authority of New York and New Jersey.

The double-helix ramp was constructed with high-strength cast-in-place concrete on an exposed steel frame structure.