AMERICAN AIRLINES TERMINAL

Steel at Work Throughout JFK's Largest Terminal

OPPOSITE The sweeping roof exposes the truss system.

After demolishing an older terminal building and constructing a new 2.2-million-square-foot complex in several phases, the operators of the new American Airlines Terminal will have created John F. Kennedy International Airport's largest terminal. Highlighting the $1.3 million design is a dramatic roof structure of exposed steel trusses that undulate overhead as they climb to a height of 90 feet. Its use for the exposed trusses, and for many of the building's other architectural elements, including elevator doors, curtain wall support, and canopies that shelter sidewalks, roadways, and crosswalks, showcases steel as one of the most versatile construction materials.

The terminal was constructed in several phases, involving the selective demolition, major renovations, and construction of new structures and jetways, in order to avoid disrupting American's current operations at JFK. The first phase of the project was construction of what is called Concourse C. The second phase consisted of a tunnel connecting Concourse C to the existing building and construction of approximately one-third of the new main building. This phase was completed after January 2005. The third phase consisted of demolishing the existing Terminal 9 and then constructing the west side of the new terminal and Concourses A and B West. The fourth phase of construction consisted of demolishing the existing Terminal 8 and then expanding the new terminal on the east side, followed by completion of Concourses A and B.

According to John Coto, a senior project engineer with VRH/Torcon, a joint venture, the project's Jamaica, NY-based construction manger and general contractor, the project has been fast-tracked because it required over 3,000 shop drawings. An average of 200 shop drawings were processed each week for over a year.

Ahmad S. Ardebili, an associate at Severud Associates Consulting Engineers, the project's New York-based structural engineer, noted that construction on the new Terminal 8 actually began one year before architectural, mechanical, electrical, and plumbing designs were completed. "We began with the main structure and coordinated efforts in the field with other team members," he noted. "We met every Tuesday and we kept three full-time engineers on-site to observe the construction."

The building, which has a timber pile foundation with an on-grade concrete slab, uses a moment-frame system to meet wind and seismic requirements. This superstructure (not including the architecturally exposed structural steel (AESS) roof and wall framing) consists of ASTM A572 steel with three-inch metal deck topped with 3 1/2-inch lightweight concrete.

The project has three main architecturally exposed structural steel elements. The first is the Main Terminal Building roof composed of long-span, tri-chord steel trusses that are up to 11 feet deep and whose double top chords are spaced 14 feet apart. These trusses are spaced 60 feet on center to create the architecturally exposed roof.

According to Andrew D. Mueller-Lust, an associate principal at Severud, the architect wanted a uni-directional appearance. "This required complex curving of the truss chords with alternating convex and concave curves," he explained. "The curves have radiuses of 645 feet, 605 feet, and 425 feet. All trusses were fabricated from ASTM A500 Grade B structural steel pipe."

To further complicate the geometry, the steel trusses taper in depth from 11 feet at the front of the terminal to seven feet in the rear. There are three long spans to provide the required column-free areas. These spans are 150 feet long, 75 feet long, and 60 feet long.

"A unique thing about the design is that the column grid is offset from the truss grid by 30 feet," Mueller-Lust said. "Usually these are aligned, but to create the desired architectural effect each steel column supports four diagonal struts, each with an 18-inch diameter, to provide a load path for the gravity and lateral loads. The lateral force resisting system transfers the lateral load to the top of the vertical columns to transfer the roof load downward."

The vertical portion of each column was designed as a steel cantilever to transfer the lateral load to the main floor framing. From there, the loads were transferred to the foundation. In addition, there were some large thrust forces caused by the arching of the curved steel. To resist the thrust, the bases of the steel columns at the main level were tied together. In some locations, this was done by increasing the girder sizes to account for the axial thrust force.

The second architecturally exposed structural steel element consists of the concourse trusses. Each concourse truss is a three-chord steel truss with a single span across each concourse. The span for Concourse B is 90 feet, the span for Concourse C is 60 feet, and the span for Concourse A is 45 Feet.

Three-part columns, featuring a vertical element and two diagonal braces, support each concourse truss. Together with the roof trusses these form a portal frame for the lateral loads.

Terminal 8's third AESS element is the wall supports. The walls of the Main Terminal Building include a main vertical element spaced at 30 feet on center that consists of a tube-shaped steel member 20-inches deep and 8-inches wide. At the north and south walls, some wall supports rise as high as 60 feet. On the east and west sides of the terminal, the walls are as high as 70 feet. At the 70-foot-high walls, the rectangular tubes have been combined with 36-inch deep steel wide flange sections to provide the required stiffness.

Between each vertical element are horizontal tube-shaped members (10-inches deep by 4-inches wide) spaced at about 10 feet on center. This combination of verticals and horizontals creates a support grid for curtain wall panels.

Canopies over the pedestrian walkways also incorporate steel. One walkway canopy adjacent to the building is 600-feet long and 38-feet wide. Another, located along the roadway opposite the building, is 800-feet long and 22-feet wide. There are also two steel crosswalk canopies that connect the other two canopies. Each of these is 107-feet long and 30-feet wide.

All of the canopies are steel-framed with the roadside canopy featuring a single-column cantilever. The canopy at the building is cantilevered from the entry vestibule at the arrivals level and from the ground 46 feet below. The crosswalk canopies consist of five-foot-deep steel box trusses.

The American Airlines project has presented a number of design, fabrication, construction, and logistical challenges, complicated by the fact that the project team had to ensure there would be absolutely no disruption to airport operations and traffic. "Steel," said Severud's Ardebili, "has made construction feasible, especially the architecturally exposed elements and the long span roof trusses for which no other material could have been used." ■

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OPPOSITE The terminal's multiple concourses were constructed in phases.

TOP, MIDDLE Exposed steel truss work provides structural transparency and bright airiness.

BOTTOM The Admiral's Club is decked out in contemporary steel and glass.

AMERICAN AIRLINES TERMINAL

Owner **American Airlines Corporate Real Estate** *Fort Worth, TX*
Developer **Port Authority of NY&NJ** *New York, NY*
Architect **DMJM+Harris** *New York, NY*
Engineer **Severud Associates Consulting Engineers, PC** *New York, NY*
General Contractor **VRH/Torcon, a joint venture** *Jamaica, NY*
Structural Steel Fabricator
(Concourse C) **ADF Steel Corp.** *New York, NY*
Terre Bonne *Quebec*
(Main Building, Concourses A&B) **Interstate Iron Works** *Whitehouse, NJ*
Structural Steel Erector
(Concourse C) **DCM Erectors Inc.** *New York, NY*
(Main Building, Concourses A&B) **Metro Steel Construction** *Whitehouse, NJ*
Miscellaneous Fabricator and Erector **FMB, INC.** *Harrison, NJ*
Metal Deck Erector **Solera/DCM Erectors Inc.** *New York, NY*