

CIVIL ENGINEERING NEWS

STRUCTURES

Museum Supported by 'Floating Box' Bracing System

The members of the design team for the new home of the National Museum of American Jewish History, in Philadelphia, are working together closely to create a structure that seamlessly integrates form and function. The architects wanted to create a participatory experience through which the building itself would speak to the dual concepts of cultural longevity and cultural permeability in the face of change, as well as to the fact that all cultural experiences exist within a broader historical context. The physical form of this idea is a four-story-high terra-cotta-clad "floating box" that will house the museum's main exhibition spaces while an attached crystal-line space wraps around one side of the building and extends from the second floor to a full story above the roof, framing views of Philadelphia's Independence National Historical Park.

The structure, which will house permanent and visiting exhibitions as well as education and administrative spaces, was conceived in two pieces, according to Matthew D. Melrose, P.E., an associate in the office of New York City-based Leslie E. Robertson Associates (LERA) and a project manager for the museum's design. Melrose says that the northwest portion of the structure is meant to rise as a box and to be supported on tapered concrete megacolumns.

The building will be constructed of reinforced concrete up to and including the ground floor. Daniel A. Sesil, P.E., S.E., M.ASCE, the LERA partner in charge of the museum project, says, "We find that it's a very practical approach for designing museums [since] the ground floor tends to have variations in elevations related to function." Structural steel was used for the remainder of the building.

To fulfill the architects' desire for a museum that would appear as a floating

terra-cotta box linked to, but independent of, a smaller transparent space, the engineers have designed a panelized lateral bracing system that integrates the box's terra-cotta cladding. "We wanted to have a system that was easily erectable, thin in profile, and closely followed the nature of the floating box [concept]," says Sesil. The lateral bracing system also creates a boundary plane through which visitors pass as they enter and exit the glass-enclosed exhibit areas.

Sitting atop eight tapered concrete megacolumns and four transfer girders, the 120 ft (36.6 m) long, 72 ft (22 m) wide terra-cotta-clad box begins at the second floor and extends upward approximately 70 ft (21 m). Two 4 ft (1.2 m) deep plate girders encircle the top and

bottom of the lateral system, imparting additional stiffness.

The modules that make up the perimeter lateral bracing system are each prefabricated tubular panels that measure 10 ft 6 in. (3 m) wide and are composed of two 4 in. (102 mm) deep by 6 in. (152 mm) tall diagonal components taking the form of an inverted chevron, two 4 in. (102 mm) deep by 12 in. (305 mm) tall horizontal components that extend the width of the panel, and two 10 in. (254 mm) wide steel vertical components. An 18 in. (457 mm) vertical gap between the panels provides space for structural and architectural elements.

The glass curtain wall is located on the western side of the building and wraps around two corners to



A four-story-high terra-cotta-clad "floating box" that is linked to, but independent of, a smaller transparent space will be the new home of Philadelphia's National Museum of American Jewish History. Scheduled for completion in the fall of 2010, the museum will house permanent and visiting exhibitions, as well as educational and administrative spaces.

create a space accessible at each floor that measures 82 ft (25 m) long and 12 ft (3.6 m) wide. The mullions are anchored to back-to-back aluminum channels approximately 10 in. (254 mm) wide and are placed on an 8 ft (2.4 m) grid. The structure's concrete floor slabs and additional wind struts impart stability to the glass wall. A 14 ft (4 m) tall structural steel trellis located on the roof extends the glass space a full story above the main roof line, supporting two stories of the curtain wall to create a double-height open-air terrace for the fifth floor. A further three and a half stories of the curtain wall hang off the fifth-floor concrete slab.

The lower floors of the glass space are enclosed areas that provide additional exhibit space for the museum. As Robert D. Young, an associate partner in New York City-based Polshek Partnership Architects and the associate partner for design on the project, explains, "People [will be] addressing the [Independence National Historical Park] and then going back into the exhibits. [It is] a reminder to people that this experience that they're seeing is part of a bigger American experience."

According to Young, who is leading the design along with design partner James S. Polshek, the glass features a hand-drawn ceramic frit that provides a sense of movement in the facade of the building when viewed from afar and a sense of texture, as in a piece of linen, when viewed up close. "It's really not a tall building, but it's going to have quite a lot of presence," says Young. "You don't have to stomp your feet around. Sometimes you can just stand there looking good."

Within the terra-cotta portion of the museum, a 30 ft (9 m) wide, 72 ft (22 m) long, and 90 ft (27 m) high atrium extends from the basement level to the underside of the fifth floor and is encircled by exhibit spaces on various floors. Glass flooring at the fifth floor that is 16 ft (5 m) long and 4 ft (1.2 m)

wide and within bridges and stairs that cross the atrium will enable natural light to extend into the atrium space.

The stairs are supported with structural steel stringers that cross the atrium and act like tall, narrow torsional boxes, according to Sesil, while the treads and glass flooring are formed from multilayered glass components that are designed to take the standard 100 psf (4,788 Pa) loading.

Special care was taken to isolate an auditorium located in the basement from vibration and noise caused by the Southeastern Pennsylvania Transportation Authority (SEPTA) station next to the site. A floating structural floor slab is enclosed by fully grouted masonry walls for acoustic isolation.

All water runoff from the site will be collected in a 16,500 gal (62.4 m³) cistern located in the basement of a two-story, L-shaped administrative structure that wraps around the back of the museum. From there the water will be released at a prescribed rate to the combined sewer. According to Joshua F. Frankel, an associate with Polshek Partnership Architects and a project manager for the museum work, the cistern is 8 ft (2.4 m) in diameter and 45 ft long and weighs more than 100,000 lb (45,360 kg). It sits upon a series of grade beams that distribute the load into the museum's spread footings, which are approximately 1.5 to 3 ft (0.5 to 1 m) deep and generally between 3 ft and 7.5 ft (0.9 and 2 m) on a side.

The 100,000 sq ft (9,290 m²) museum is located on a 110 by 200 ft (33.5 by 61 m) site on the corner of Fifth and Market streets and overlooks the Liberty Bell Center. The new location will replace the museum's current facilities, which are a block away.

The construction of the project is expected to cost approximately \$65 million and the entire project is budgeted at \$150 million. The designers anticipate that the building will be complete by the fall of 2010.

—Catherine A. Cardno, Ph.D.



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