BRONX MUSEUM OF THE ARTS EXPANSION

Steel Structure Frames an Eye-catching Facade

When planning its north wing expansion on a modest midblock site, the Bronx Museum of the Arts identified three principal goals. It knew that whatever it erected would have to stand out from its relatively drab surroundings in order to attract passersby but still embody the image of a notable cultural institution. It would have to provide wide-open, column-free galleries, spacious enough for mounting all kinds of exhibitions and installations, without giving up the structural flexibility to accommodate future phases of the expansion program. And as with any cultural institution, the building would have to be of robust construction, capable of standing for 100 years or more, without the structure causelessly consuming much needed floor area. According to Bernardo Fort-Brescia, principal of the Miami-based architecture firm Arquitectonica, which designed the expansion, a steel structural system was integral in meeting all of these needs. Steel could handle the long spans of the interior, is flexible enough for future alterations, and is an enduring material. It also allowed the architects to easily frame an accordion-like curtain wall with fragmented facades that face multiple directions, clearly demarcating the new museum wing from any approach.

The expansion's high ceilings—the first and second floors measure 22 and 20 feet in height—created the first structural challenge. "We needed a stiff structure, as there is a lot of height between floors," explains Arquitectonica project architect Paul Sheehan. Reinforced concrete is often chosen to fulfill this role, but the museum's other needs surpassed concrete's limited ability to provide flexibility. In response, the engineers at Thornton Tomasetti designed a composite structure with steel playing the leading role. Along the building's north-south axis, the longer direction of the building, a rigid moment frame supports lateral forces, while on the north and south sides, or the east-west axis, poured-in-place shear walls manage the loads. The foundation of the building sits directly on the bedrock below, which is relatively shallow throughout the area and can support up to 20 tons per square foot.

The architects designed the moment frame to form a central bay on each of the museum's four floors, including the basement, giving the structure both strength and flexibility. The engineers designated Grade 50 beams and columns throughout the building. "Between Grades 36 and 50, there is a substantial weight difference," comments structural engineer Narinder Chhabra of Thornton Tomasetti. The choice allowed the designers to specify slimmer shapes and thereby cut the building's overall steel weight by approximately 20 percent. Most of the beams and columns in the moment frame are W14x61s. The exception comes on the second floor, where larger W30x99 beams were used to support an outdoor terrace space in the rear portion of the third floor, which has to handle snow drifts. "The moment connections are designed for the full capacity of the member, thus achieving a rigid joint between beams and columns," notes Chhabra. Each floor supported by the moment frame is a 3-inch metal deck with 2.5 inches of concrete.

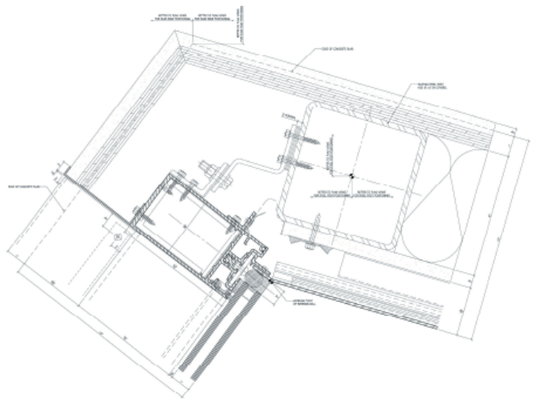
A separate structural system supports the irregular shapes of the expansion's curtain wall facade. From the beginning of design, the architects knew that the curtain wall would be a crucial feature of the

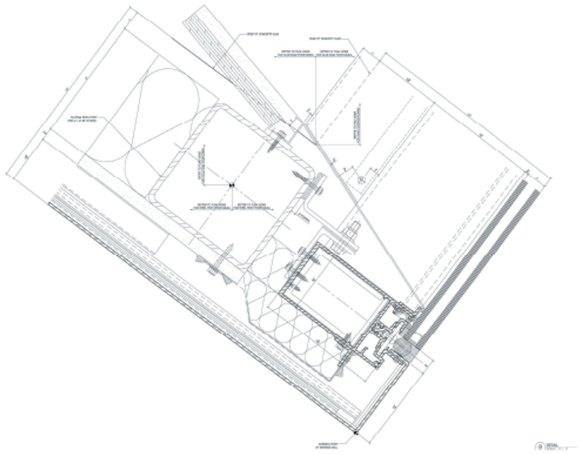
PREVIOUS The museum's steel-framed curtain wall features fragmented angles, visible from any approach to the mid-block location.

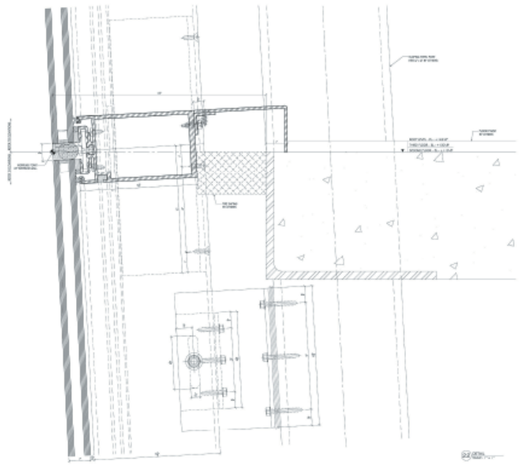
THIS PAGE AND OPPOSITE A structural steel moment frame supports the interior spaces, while the curtain wall is supported by a separate system of hollow structural sections.

PREVIOUS: © NORMAN MCGRATH; THIS PAGE: © ARQUITECTONICA

© ARQUITECTONICA







“With concrete we would not have been able to coordinate the frame with the exterior after the parts had been fabricated.”

building. “Our objective was to determine a new face for the museum, because it needed to stand out,” says Fort-Brescia. “We soon came up with the idea of a folding, accordion-like facade, which maximizes visibility—no one has to turn their neck to see it.” Painted aluminum panels and glass sheets form the folds of the facade and are held up by steel framing that, according to Chhabra, was the best system for coordinating with the geometry of the curtain wall, which tilts in both plan and elevation. “With concrete we would not have been able to coordinate the frame with the exterior after the parts had been fabricated,” Chhabra says.

The curtain wall’s panels lean against A500, 46 ksi, 6x6 hollow structural sections (HSS) that are attached to the 5 1/2-inch-thick floor plates. Outriggers, which resemble bent plates, form the connection between building and facade. Welded to the floor slabs, the outriggers clip to the HSS members, which incline vertically and horizontally to create the

ABOVE These drawings show the connections between the slab edge, HSS framing, and curtain wall panels.

OPPOSITE The facade’s fragmented angles distinguish the museum from its surroundings.

ABOVE AND OPPOSITE The stiffened steel moment frame provides 22 and 20-foot floor to ceiling heights on the first and second stories.

wall's shifting shapes. Portions of the floor slabs extend past the first spandrel beam, the frontal frame of the building, to give shape to the irregular extrusions of the curtain wall. Three- to four-foot cantilevers made of W14x22 steel beams bolted to the frame of the museum support those portions of the floor. Despite the numerous connections to the main structure of the building, the facade is only laterally braced to each floor. As Sheehan points out, "That whole wall dead loads straight to the ground."

From the outset of the design process the client asked the architects for a building that could be easily expanded, from an additional size of 20,000 square feet to an eventual 60,000 square feet. According to Sheehan, this only impacted the south shear wall, into which the designers had to incorporate an opening that could support a continuous connection to an adjacent building. "Another advantage to a steel structure," says Chhabra, "is that it gives us the flexibility to go back and create a new shaft or mechanical openings in the slab—we can create a new frame and cut the deck." When the remainder of the addition is complete, the accordion-like facade of the North Wing will continue to stretch out to the corner of the block and anchor a new residential tower above.

"We think it is important that a museum stands out from its surroundings," reiterates Fort-Brescia. In order to balance a desire to create a remarkable building with the specific programmatic requirements, all on a budget of $19 million, it was important to devise a structure that would not only support an open and vertically-spacious building, but simultaneously and seamlessly stand as a bulwark against time while being flexible enough to accommodate the future growth of the institution. The use of a steel structure allowed for these disparate and complex needs, enabling both structural stability and flexibility, and ultimately producing an enormously successful project that will certainly put the Bronx Museum of the Arts on New York's map of must-see cultural sites. ■

BRONX MUSEUM OF THE ARTS EXPANSION

Owner **The Bronx Museum of the Arts** *Bronx, NY*
Developers **New York Department of Cultural Affairs** *New York, NY*; **Department of Design and Construction** *Long Island City, NY*
Architect **Arquitectonica** *New York, NY*
Structural Engineer **Thornton Tomasetti Group, Inc.** *New York, NY*
Construction Management **New York City Department of Design and Construction** *Long Island City, NY*
General Contractor **M.A. Angeliades** *Long Island City, NY*; **PMS Construction Management** *New Rochelle, NY*
Structural Steel Erectors **E-Z Erecting Corp.** *Astoria, NY*
Miscellaneous Steel Erector **E-Z Erecting Corp.** *Astoria, NY*
Architectural Metal Fabricator **Omnitec Building Systems, Inc.** *St. Laurent, Quebec, Canada*
Architectural Metal Erector **Jordan Panel Systems Corp.** *Northport, NY*
Ornamental Metal Erector **E-Z Erecting Corp.** *Astoria, NY*
Curtain Wall Fabricator **Omnitec Building Systems, Inc.** *St. Laurent, Quebec, Canada*
Curtain Wall Erector **Jordan Panel Systems Corp.** *Northport, NY*