METALS IN CONSTRUCTION

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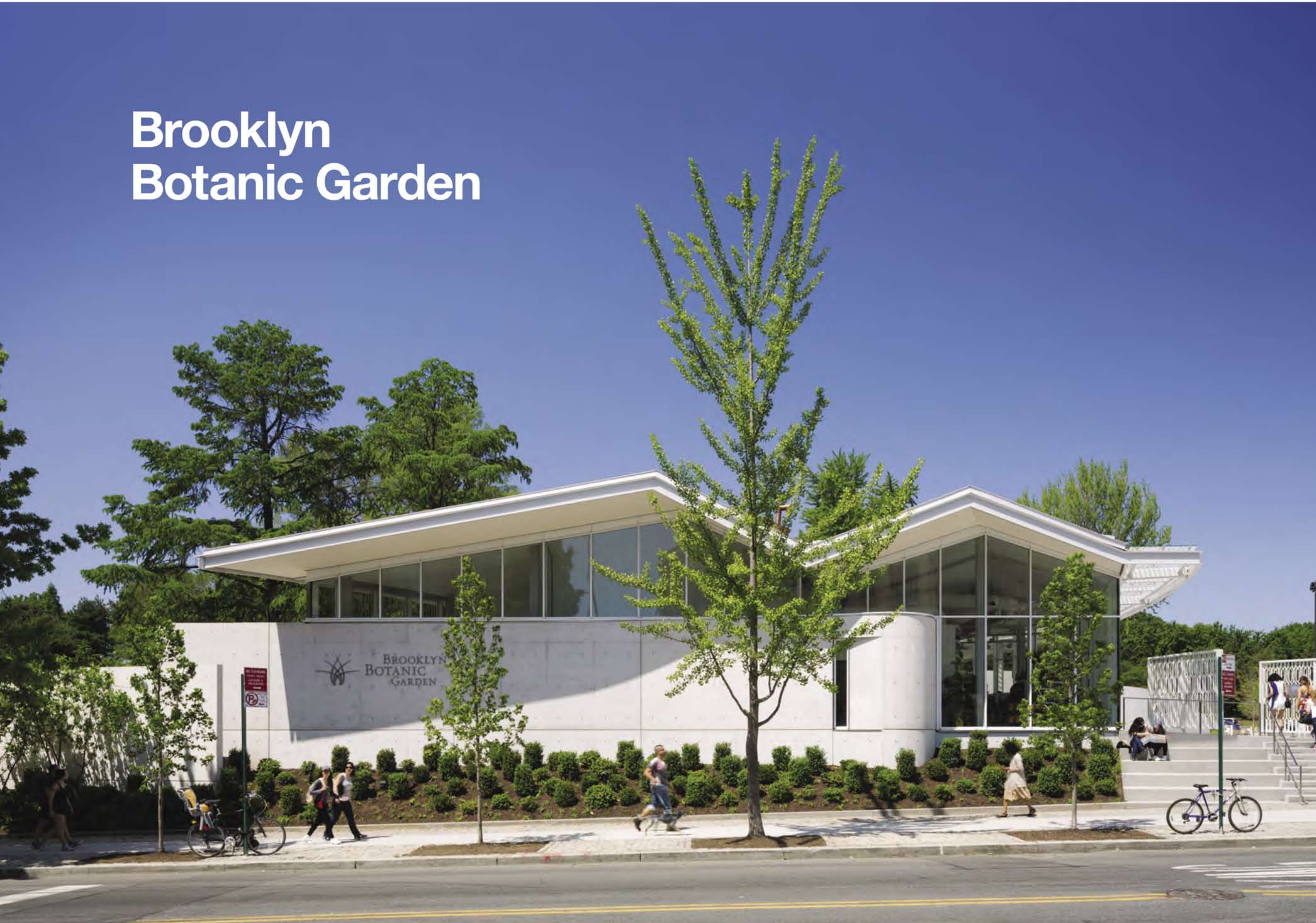
Brooklyn Botanic Garden



A new building celebrates the site's 100-year history with a chameleon-like steel structure that unites the garden with its urban environment.

PART ART MUSEUM, part reference library, the Brooklyn Botanical Garden (BBG) today holds over 10,000 taxa of plants and receives nearly 1 million visitors from around the world each year. Although officially founded in 1910, it was only on its centennial celebration that the garden broke ground on a visitor's center for use in welcoming them. Designed by New York-based Weiss-Manfredi Architecture/Landscape/Urbanism and completed in the spring of 2012, the center provides a new gateway to the garden's collections with a serpentine pavilion of glass and steel that has both the structural performance to meet the site's technical demands and the form to honor the garden's historical topography—all while providing much-needed visitor resources.

"We strategized early on to create a structured landscape with the intent that this would blur the architecture and design into an inhabitable topography," says Armando Petruccelli, the project architect for Weiss/Manfredi. Located at Washington Avenue, the 22,000-square-foot building is nestled within the berm separating the BBG from the parking lot of the Brooklyn Museum. The pavilion provides access to the garden's special collections, including the Japanese Garden and the Cherry Esplanade. "Like the gardens themselves, the building is experienced cinematically and is never seen in its entirety," explain the architects in their project brief. Visitors can enter through the main Washington Avenue entrance, or via a route that leads from the top of the berm through the visitor center on a stepped ramp to the main level of the Japanese Garden.

The building's curving shape follows the BBG's existing pedestrian pathways, creating an organic connection with the landscape. But the irregular form also required a high level of coordination between trades and quality control facilitated by the use of BIM throughout construction. Tight working conditions—

This spread The building uses earth mass and spectrally selective fritted glass to achieve a high-performance building envelope, minimizing heat gain and maximizing natural illumination.

the center is 320 feet long and its width ranges from approximately 60 feet at the retail pavilion's street side to a narrow point on the structure's westernmost garden side within the 600-by-150-foot site—meant every aspect was orchestrated to ensure the project moved forward smoothly.

"We made it apparent to the steel fabricator during bidding that there was a digital model, so they understood we'd already gone through a process of building a model and figuring out how structural frames will go together," says Petruccelli.

The architects modeled the steel design in 3-D, sharing their models with structural engineer Weidlinger Associates and with the project's steel fabricators. The ability to check drawings in three dimensions was crucial for all members of the project team because steel is bent in both the horizontal and vertical plane. "We thought it was a highly effective process when defining the geometries of the steel bending process," says Petruccelli.

One of the most challenging steel details is the project's roof design, which is highlighted by a serpentine C12x25 AESS channel that alternately serves as roof edge, steel trellis, and an ornamental stair stringer—a challenging detail for installers.

Working with a steel structure allowed for an efficient workflow beginning in the fabrication shop, where ironworkers could weld complex pieces in a controlled environment before delivering them to the site. "At first we thought about an all-concrete structure, but then realized with Weidlinger that a steel superstructure was more economical in conforming to the building's complex geometry," says Petruccelli. "We had so much going on geometrically that steel was the best way to process the form. Steel also allowed us to design a more column-free space, as well as being thinner in profile." As is standard in the industry, all of the project's structural steel shapes are produced using close to 95 percent recycled material, contributing 55 percent overall recycled content to the visitor center's LEED Gold-targeted calculations.

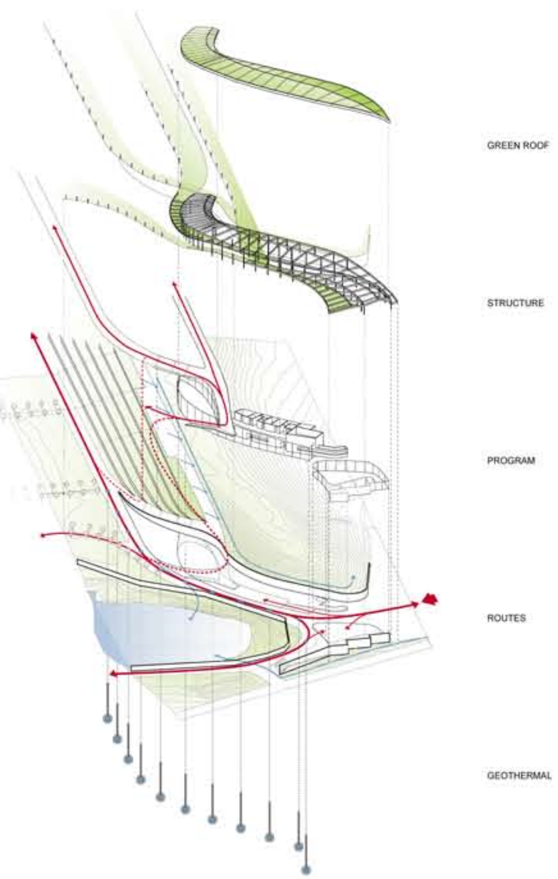
Though the structure accomplishes an elegant efficiency, it is meant to take a backseat to the garden. "One of the things that was key for the design was that visitors never lose sight of the gardens when occupying the space," says Petruccelli. "This was instrumental in why we have the glass curtain wall; we wanted to capture the feeling that you're in a garden and not in a building. The curtain wall achieves this, but also acts sustainably by harvesting natural daylight."

The curtain wall mediates between its interiors and the surrounding garden with low-e, low-iron insulating glass units that minimize heat gain. Each unit features a custom ceramic frit pattern designed to deter local birds from colliding with the glass. All glazing is heat strengthened or fully tempered as required by the design or by building code. Glass units are conventionally glazed into thermally broken extruded aluminum framing with a T-shaped profile. The system is anchored to the concrete floor slab and to structural steel roof framing above the finished ceiling; it also includes tieback bracing to architecturally exposed structural steel. Exposed stainless steel-finish anchor brackets are fastened to mullions with stainless steel countersunk bolts.

At the steel outrigger penetration that supports the glass canopy, a ⅛-inch-thick formed aluminum cover panel with formed returns is conventionally glazed into the aluminum framing. The system also incorporates mineral fiber insulation and a formed galvanized steel panel, creating an air seal barrier.

The project's steel-framed superstructure uses 29 Hollow Steel Section (HSS) rigid frames with full-penetration welded moment connections. These architecturally exposed structural steel (AESS) rigid frames have varying roof beam depths ranging between HSS10x6, 12x6, 14x6, and HSS18x6, depending on the span, loading, and cantilevers. The exposed HSS column sizes are HSS10x6, organized in a curvilinear 12-foot-on-center grid in an east-to-west configuration, allowing the architecture to adapt to the site's existing topography. The spans of the rigid frame bent roof rafters range from 12 to 36 feet, each one with different slopes that establish

Weiss/Manfredi; facing page top and right: Albert Večerka/Esto; facing page bottom: Weiss/Manfredi; Opening spread: Albert Večerka/Esto



the curved "topographic" roof structure, which has a total of 29 unique column grids.

Between the AESS HSS rigid frames, a system of structural wide-flange beams supports the warping 1 ½-foot-thick roof deck. The wide-flange roof beams use concealed W10x12 and W6x25 members. A series of beam penetrations are incorporated into the rigid frame and wide-flange beam structure for routing electrical, lighting, and sprinkler systems.

Providing shade to the center's walkways and interiors, a steel trellis system of fully welded HSS8x4 longitudinal members with HSS5x2 cross members and HSS6x4 longitudinal members and HSS4x2 cross members was shop fabricated and installed between HSS10x6 steel outriggers that penetrate through the glazed curtain wall to support a glass canopy. Composed of 46 custom ceramic fritted low-iron laminated glass units in a curved pattern, the canopy allows for natural light to filter through the entry's covered breezeway while minimizing heat gain. These laminated glass units are supported by custom stainless steel patch fittings that sit on the exposed steel trellis.

The BBG's visitor center underwent perhaps one of its greatest tests when Superstorm Sandy tore through New York with high winds and massive flooding. The center emerged unscathed, though some of the Botanic Garden's collections will have to be replaced. The center's living roof is an indication of the garden's resilience though, giving home to rabbits and even ducks as principal Michael Weiss revealed in a recent lecture about his firm's work creating landscaped environments that can withstand flooding. The building is a model for a new type of architecture that can blur the boundary between built urban structures and built landscapes, a theme that was reinforced during construction on the center's tight city site. "Because of property lines and the street, and the Japanese Garden and Cherry Esplanade to the west, we only had access from one side," says Petruccelli, describing how construction progressed from within the BBG toward Washington Avenue. "But the building process adhered to the concept of the project, which was to bring the garden to the street."

This spread: Albert Večerka/Esto

BROOKLYN BOTANIC GARDEN

Location: **1000 Washington Avenue, Brooklyn, New York**
Owner: **Brooklyn Botanic Garden**, *Brooklyn, NY*
Architect: **Weiss/Manfredi Architecture/Landscape/Urbanism**, *New York, NY*
Structural Engineer: **Weidlinger Associates**, *New York, NY*
Mechanical Engineer: **Jaros, Baum & Bolles Consulting Engineers**, *New York, NY*
Construction Manager: **LiRo**, *Brooklyn, NY*
General Contractor: **E.W. Howell Co.**, *New York, NY*
Curtain Wall Consultant: **R.A. Heintges & Associates**, *New York, NY*
Miscellaneous Iron Fabricator and Erector: **United Iron Inc.**, *Mount Vernon, NY*
Architectural Metal Fabricator and Erector: **Trainor Glass Inc.**, *Michigan City, IN*
Ornamental Metal Fabricator and Erector: **United Iron Inc.**, *Mount Vernon, NY*
Curtain Wall Erector: **Trainor Glass Inc.**, *Michigan City, IN*

This spread A geothermal heat-exchange system is used to heat and cool the interior spaces. Additional sustainable strategies include a green roof, storm water management, and rainwater collection that irrigates a series of landscaped terraces.