METALS IN CONSTRUCTION

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WINTER 13

JOHN JAY COLLEGE OF CRIMINAL JUSTICE / BROOKLYN BOTANIC GARDEN / BARCLAYS CENTER STRUCTURE / BARCLAYS CENTER FACADE / JACOB K. JAVITS CENTER / UNITED NATIONS SECRETARIAT / JETBLUE HEADQUARTERS / BLDG 92

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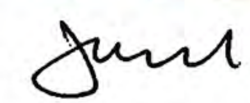
Above Building 92, a renovated Brooklyn Navy Yard structure, now welcomes visitors with a facade that speaks to the area's history. **Cover** The Barclays Center. See pages 16-27 for feature articles.

T.G. Olcott; facing page: Adam Friedberg; cover: Bruce Damonte

EDITOR'S NOTE
Appearance and performance

THE FACADE IS vital to a building's appearance and performance. But what are the options when both begin to deteriorate? This was the dilemma faced by the owners of two projects featured this issue: the recladding of the Jacob K. Javits Convention Center, and renovating the exterior of the United Nations Secretariat. Although two of New York's most iconic architectural images, like many buildings of the 1950s and 1960s their enclosure systems had fallen prey to years of wind, rain, and snow. Stopgap measures to prevent infiltration of the elements became time-consuming and were largely ineffective. The only reasonable response in order to maintain weather-tight integrity was to replace existing curtain walls with entirely new systems, systems that would not only enhance the buildings' ability to withstand the effects of weather but reduce energy consumption in the process. Unsurprisingly, improvements such as this are not inexpensive: The existing curtain wall must be demolished and removed and a new system installed, in phases, all with a minimum of tenant disruption. For buildings such as Javits and the UN, project teams face the added challenge of remaining respectful of the original design. But in the case of each project, as is the case in most recladdings, the benefits outweigh the costs. Along with netting what often amounts to several hundred thousand dollars in annual energy savings, realizing relatively quick payback periods, these projects eliminate hundreds of tons of greenhouse gases each year. Moreover, while reducing overall impact on the environment, owners are upgrading the value of their properties. Asked what they consider of greatest significance in this era of environmental awareness, you might find them giving yet another response—that in undertaking such projects they are improving the quality of life for not only those living and working in their buildings, but for the rest of us as well.



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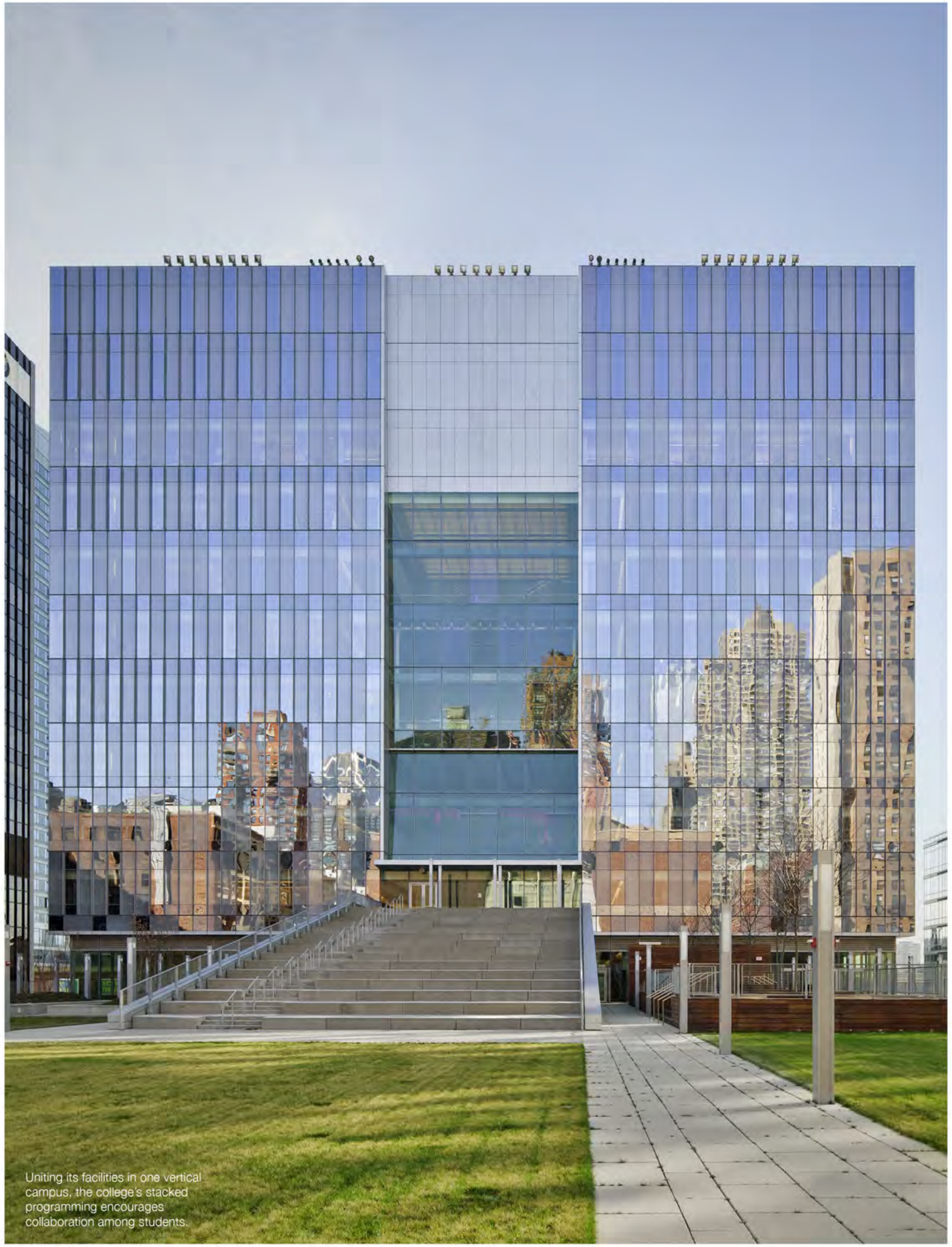


Uniting its facilities in one vertical campus, the college's stacked programming encourages collaboration among students.

Eduard Hueber

John Jay College of Criminal Justice

Structural steel enables a 15-story tower to overhang a train tunnel.

CANTILEVERING THE CORNER of a 15-story high-rise over an Amtrak train tunnel, which offers no possibility of bringing a direct load path to bedrock, isn't a job for just any structural material. In this sort of condition, engineers know that structural steel is the only material with the strength-to-weight ratio capable of handling the dynamic forces at play.

The team of architects and engineers who designed the recent expansion of the John Jay College of Criminal Justice faced this very challenge when devising a structural system for a new tower sited on 11th Avenue between 58th and 59th streets. The tower design, envisioned by architecture firm SOM as a vertical campus—essentially a stacked academic program that seeks to offer the same opportunities of random encounter and collaboration common to more traditional campuses—itself added more challenges. The design called for double-height spaces and 50-foot clear spans through the center of the building. In the words of Jason Stone, associate at structural engineering firm Leslie E. Robertson Associates (LERA), "Steel was the obvious choice because it's lighter than reinforced concrete and keeps the loads down. It was also the only option for the project's long span areas."

The tower and a 500-foot-long podium that connects the addition to John Jay's existing facilities on 10th Avenue make up a 620,000-square-foot expansion at the college. SOM took advantage of this long, low podium space, as well as the nearly two-story grade change between 10th and 11th avenues, to solve one of the problems of urban campus design. "One of the greatest challenges in city colleges is how to take move a multitude of students who have to go from class to class in ten minutes over vast floors," says Mustafa Abadan, the SOM partner in charge of the project. In the podium, the architects arranged classroom functions around a cascading circulation corridor that descends from the top of the podium down three flights to the first floor of the college's foundation building, the former De Witt Clinton High School, constructed in 1906. "The corridor creates sectional cutouts across three floor plates," continues Abadan. "It looks like Broadway cutting through the Manhattan grid and creating public squares." A green roof tops the podium, creating an idyllic oasis for students in the midst of a concrete jungle.

SOM divided the tower into three academic quads—one for the sciences, one for humanities, and one for economics and rational thinking—each with its own double-height space. These double-height spaces run unobstructed through the center of the building from 11th Avenue to the podium. The

This page Steel box girders and precast concrete panels support the first five floors over an Amtrak tunnel.

This page Structural steel provided the opportunity to create long-span spaces for student lounges, a 250-seat auditorium, and a black-box theater.

nature of the enclosure helps to open up the spaces even more. "The building has a predominantly glass exterior with frit patterns and lets lots of natural light into what are traditionally closed-up classrooms," says Abadan. "It also helps address the notion of the transparency of justice. The college is teaching people to be enforcers of justice and wants to instill in them that whatever they do in the field has to be transparent to society."

The site's chief limitation—the Amtrak tunnel—called for an innovative structural design, and LERA responded with a scheme that takes full advantage of structural steel's lightness, ductility, and strength. The building's anticipated dead loads promised to be too great to cantilever the entire building over the tunnel. Instead, the engineers devised a plan in which the first five floors cantilever out from the foundation on two jumbo box girders, while the upper ten floors hang from a truss system that connects to the braced-frame core. "This arrangement had a couple of effects," says Stone. "It reduces the load over the Amtrak tunnel—five floors of load instead of fifteen. It also created a dramatic architectural feature. The fifth floor has no perimeter columns. Below you have normal columns that go down to grade, and above you have hangers that come down from the roof, but at the fifth floor there's nothing at the perimeter at all. This worked out for the school as that floor is home to a large cafeteria."

One of the box girders that supports the first five floors above the Amtrak tunnel weighs almost a ton per foot of length, with a total weight of close to 50 tons. Its top and bottom flanges are 4 inches thick by 5 feet wide. Its web plates are 1 ½ inches thick and the total depth of box is 3 feet, 2 inches.

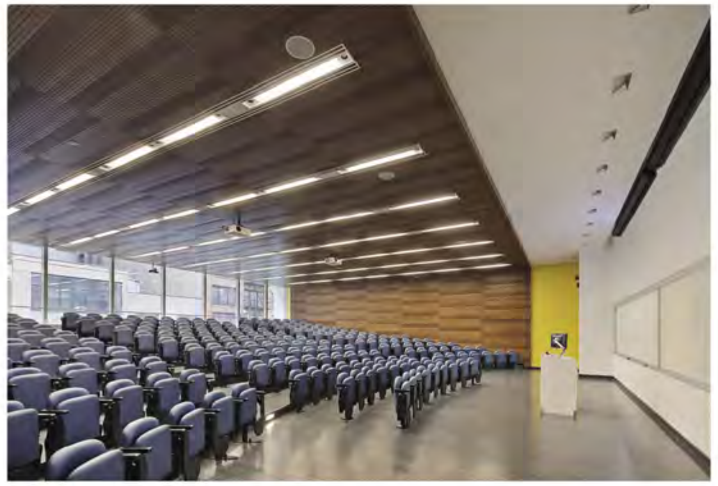
Leslie E. Robertson Associates

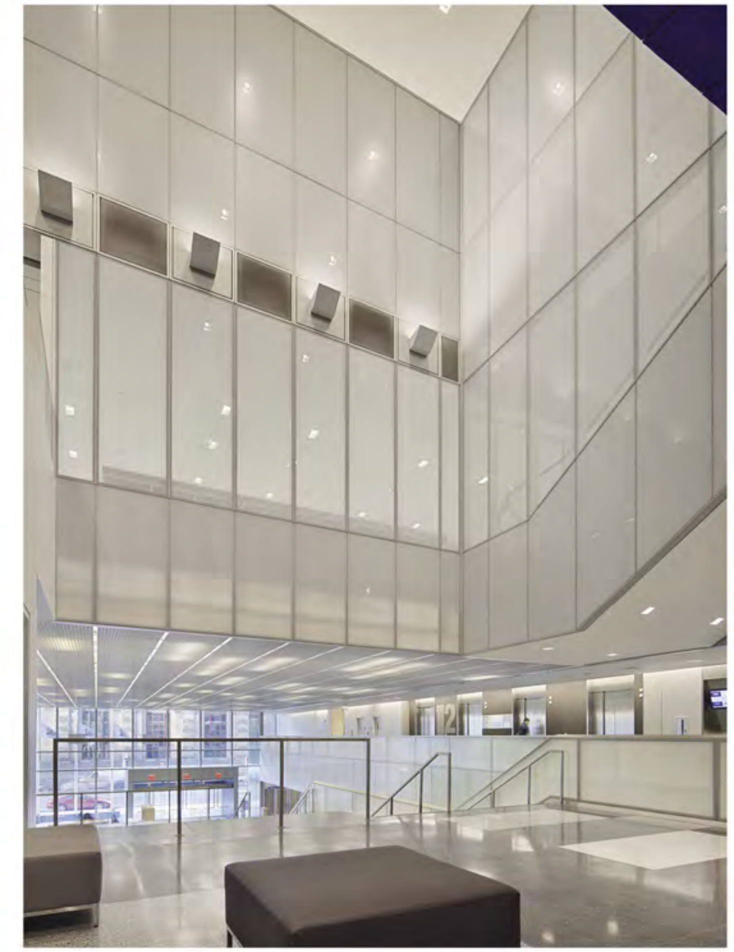
Eduard Hueber

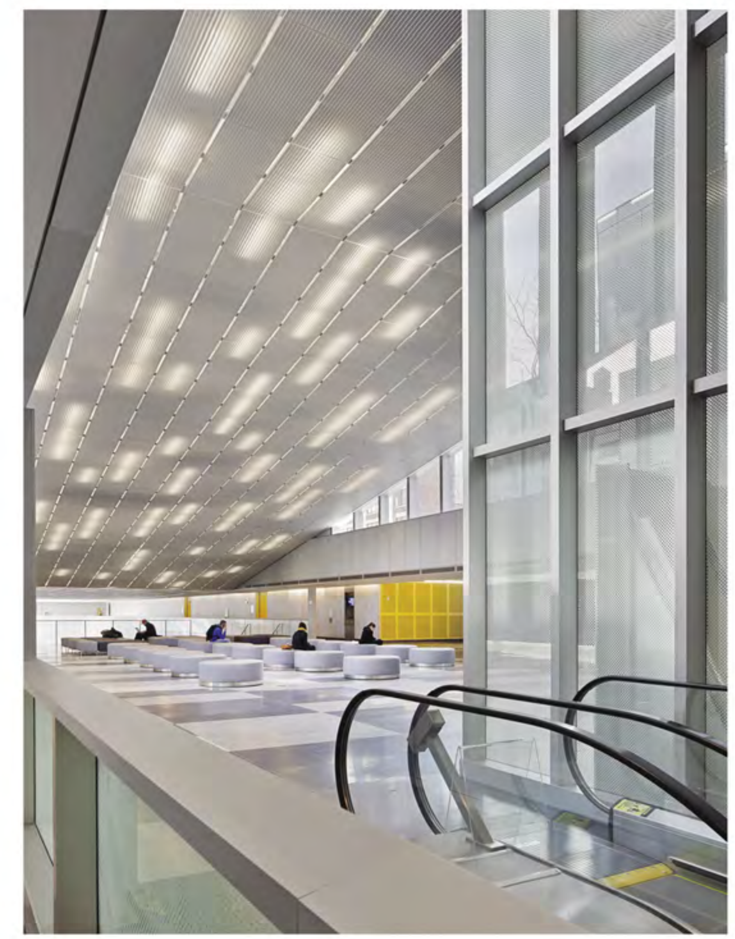
The other girder is a built up I-shape with 6-inch-thick flanges fabricated by welding a 3-inch-by-24-inch inner plate to a 3-inch-by-28-inch outer plate and a 2-inch web plate. The depth of both members is only 3 feet, 2 inches each, because this was the maximum dimension that would fit between the sidewalk and the Amtrak tunnel below. Vibration pads were used to isolate the building from the movement created by passing trains.

To erect the unusual structure, Local 40 ironworkers installed temporary perimeter columns at the 5th floor in order to complete topping out the structure. The hangers—designed to be in tension in their final state—had to handle compression forces during construction, so temporary angles were bolted onto them to stiffen them. The hangers were fabricated from plates ranging in size from ¾ inches thick by 8 inches wide up to 2 inches thick by 20 inches wide. (Spaced 30 feet apart, the hangers are concealed within partition walls without the usual bump-out, creating unimpeded views.) The floors were built to a height 3 to 5 inches above their final intended elevation so that, when the temporary columns were removed and the trusses began to deflect under the load, the floors would end up level. "We had to do a detailed analysis to accurately figure out how far different points of the floors were going to come down," says Stone. "It worked as predicted. In the end we were within a very small tolerance."

The building has two C-shaped cores that flank the 50-foot clear span areas of the tower. They are built up from wide flange sections that range from W14x109 to W14x665 and from HSS 6x6x⅜ up to HSS 8x8x⅜ sections used for vertical bracing. The trusses' top and bottom chords are built up of plates







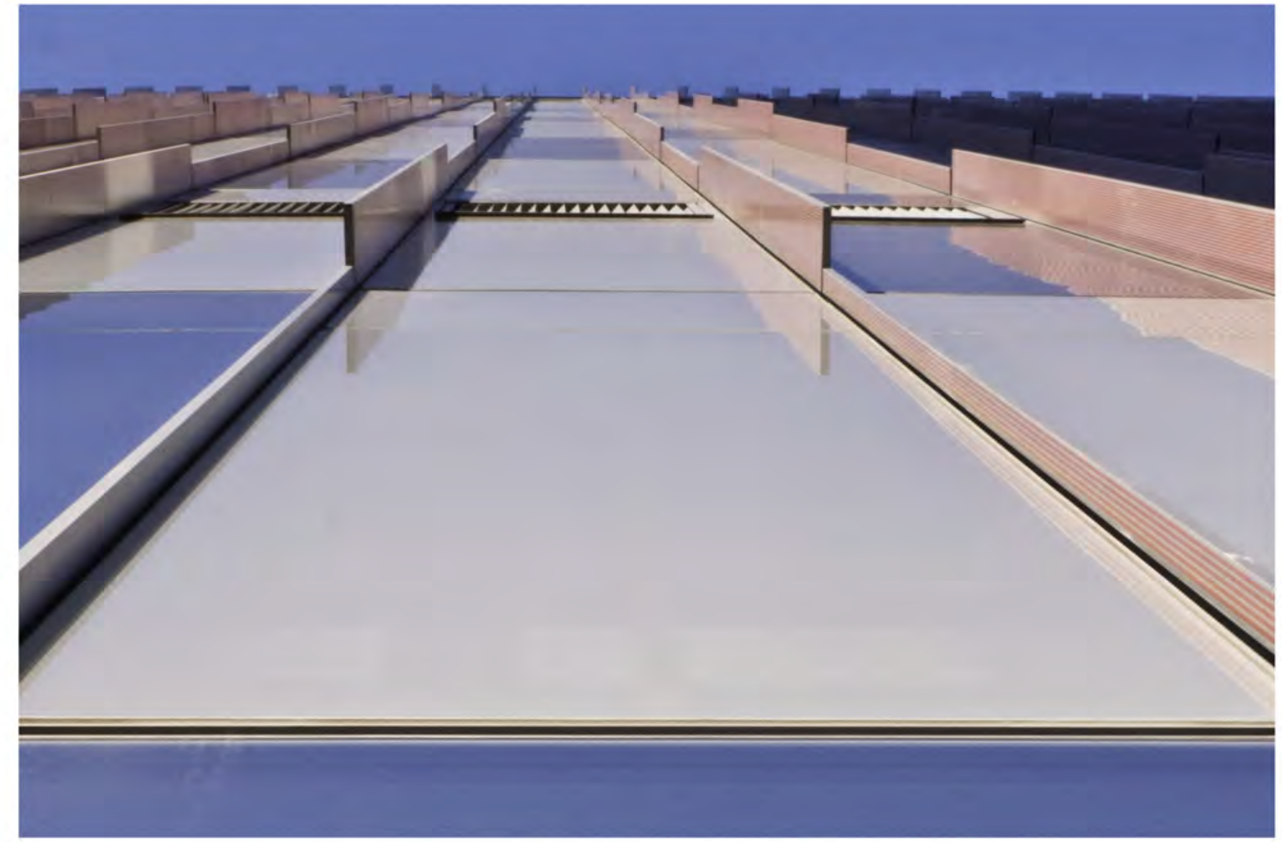
Above The interconnecting corridor called the "pedestrian cascade" includes large meeting areas and food service facilities.

This page The building has all-smart classrooms, as well as new resources like emergency management and high-rise simulator labs.

"Steel was the obvious choice because it's lighter than reinforced concrete and keeps the loads down. It was also the only option for the project's long span areas."

Jason Stone, Leslie E. Robertson Associates

This spread: Eduard Hueber



Eduard Hueber

Mic Patterson/Enclos Corp.

that range from 3x15 up to 4x28 welded to W18 floor beams. The truss diagonals range from W14x43 up to W14x550.

The horizontal podium's structure is of typical moment frame construction with a few exceptions. The columns are W8, 10, 12, and 14, but mostly W14s. The sizes of the W14s range from W14x68 to W14x159. The beams are W12 to W40 with the most common shapes being the most efficient ones—W12x22, W14x22, W16x26, W18x35, W21x44, W24x55, and W36x135. For the longer span girders and the cantilever conditions created by the open central circulation space the engineers went up to W40x583. Most of the heaviest members are at the fifth floor supporting the green roof and over the 59th Street entrance, which is recessed with structure spanning above.

All of the structural steel used in the project, a total of 7,650 tons, is A572 Grade 50. LERA worked hard to limit on-site welding to speed up construction so all of the built-up elements were shop welded, delivered to the site whole, and bolted into place with ¾-inch and ⅞-inch A325 bolts and 1-inch and 1 ⅛-inch A490 bolts.

LERA and SOM partnered closely with Owen Steel, the structural steel fabricator, and the steel erector, Cornell & Company. "There's a great relationship between all of us," says Stone. "Very much at the end we agreed it was a special job that required extra coordination and collaboration. They were on board right away and they were really great."

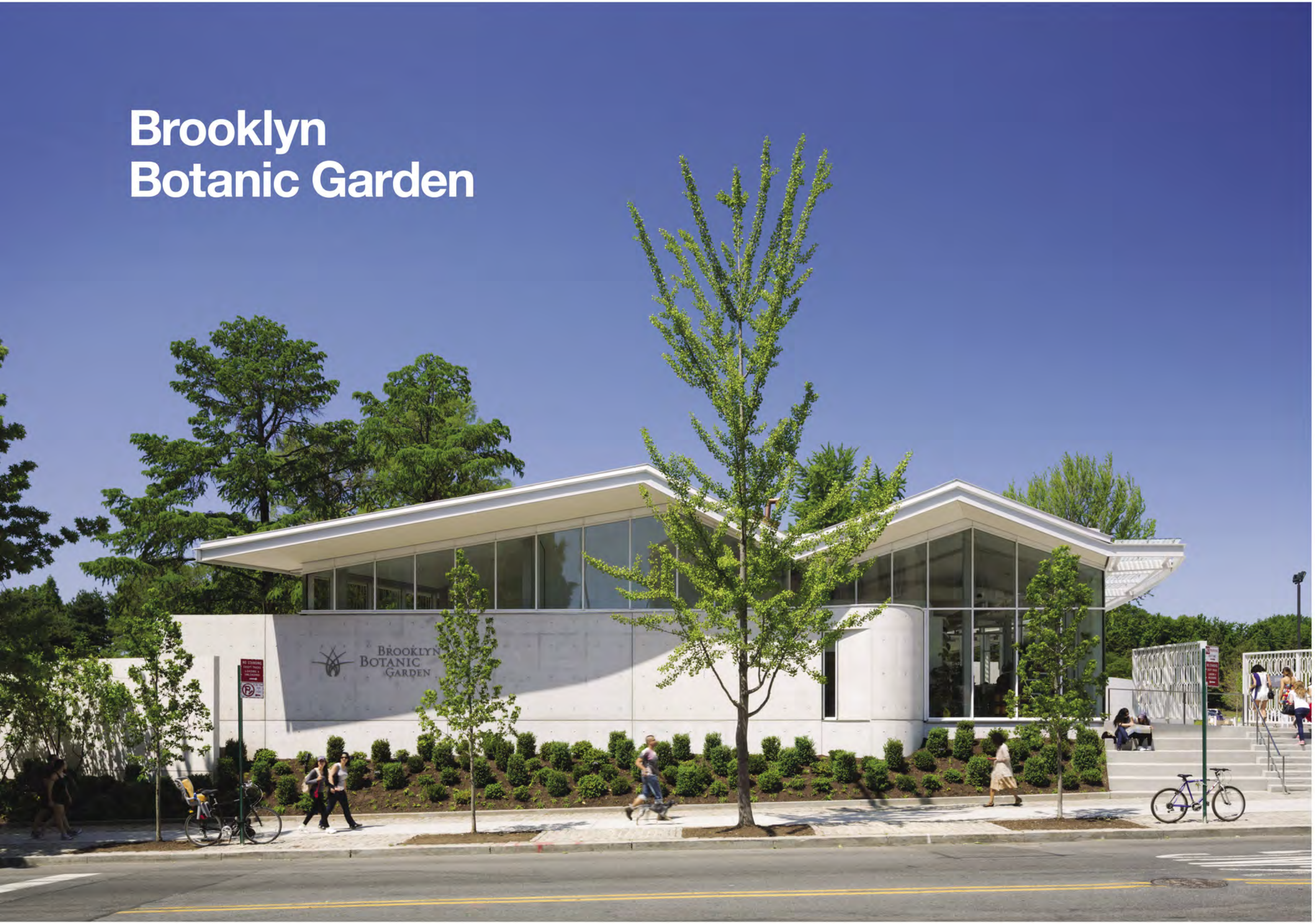
Facing The school's main entrance is on 59th Street. Framed glass setbacks highlight the building's diverse programming and the "transparency of justice."

This page The building's vertical fins are finished with silver mica-flake paint on one side and silkscreened with red dots on the other, making the building look red when approached from the east.

JOHN JAY COLLEGE OF CRIMINAL JUSTICE

Location: **524 West 59th Street, New York, NY**
Owners: **The City University of New York John Jay College of Criminal Justice**, *New York, NY*; **Dormitory Authority of the State of New York**, *New York, NY*
Architect: **Skidmore, Owings & Merrill LLP**, *New York, NY*
Structural Engineer: **Leslie E. Robertson Associates**, *New York, NY*
Construction Manager: **Turner Construction**, *New York, NY*
Structural Steel Erector: **Cornell & Company Inc.**, *Westville, NJ*
Miscellaneous Iron Fabricator and Erector: **United Iron, Inc.**, *Mt. Vernon, NY*
Curtain Wall Fabricator and Erector: **Enclos Corp.**, *New York, NY*
Metal Deck Erector: **Cornell & Company Inc.**, *Westville, NJ*

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.

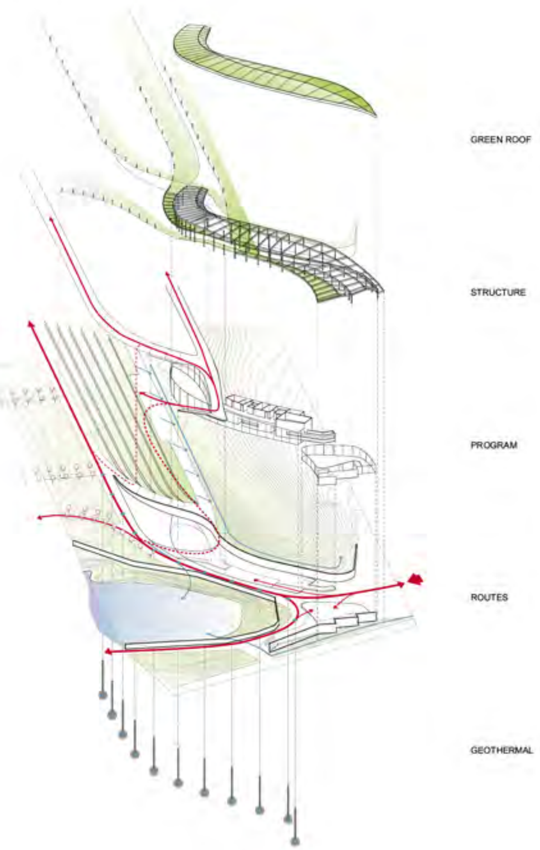
Though the structure accomplishes an elegant efficiency, it is meant to take a backseat to the garden. "One of the things that was key for the design was that visitors never lose sight of the gardens when occupying the space," says Petruccelli. "This was instrumental in why we have the glass curtain 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."

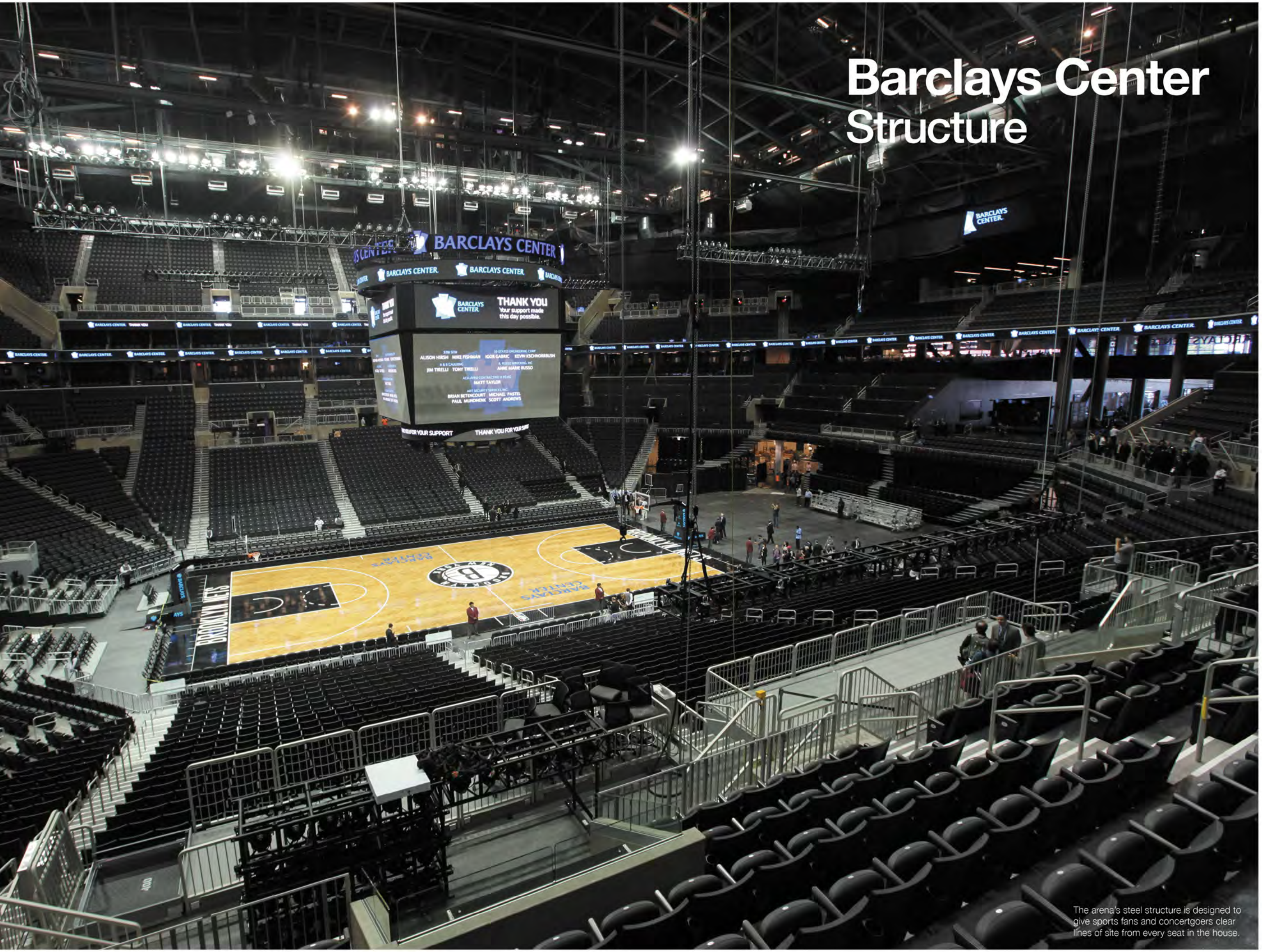
This spread: Albert Večerka/Esto

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.

Barclays Center Structure



The arena's steel structure is designed to give sports fans and concertgoers clear lines of site from every seat in the house.

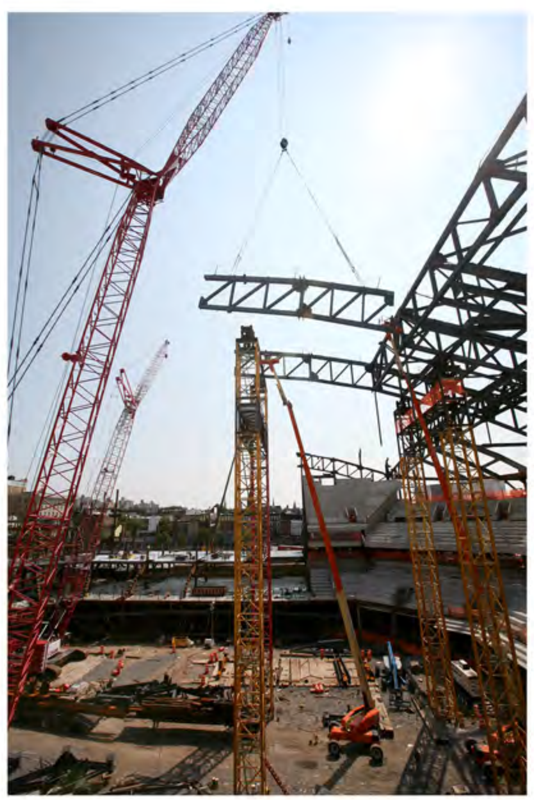
Brooklyn's new multi-purpose indoor arena relies on a structural steel geometry that will keep visitors coming back time and time again.

WHEN TICKETHOLDERS ARRIVED for the series of Jay-Z concerts that officially opened Brooklyn's new Barclays Center on September 28, they were treated to a dramatic view of the lighting cluster above the stage from the moment they walked onto the Center's main entrance plaza. The design team intentionally planned this experience so visitors could visually connect with the massive arena's interior while still outside at the corner of Atlantic and Flatbush avenues. Not only would this help them find their way into the building, but glimpses of the three-story, 70,000-pound central scoreboard would pump up fans on game days.

This seemingly simple gesture, which creates a quintessential only-in-New York street scene, relies in large part on several structural engineering maneuvers that nestled the 675,000-square-foot arena into its site on the northwest corner of the 22-acre Atlantic Yards development. As a result, unlike several new arenas developed in the last decades in other American cities, the scale of the Barclays Center does not appear to overwhelm its site. This was a critical gesture for Forest City Ratner Companies (FCRC), the Barclays' developer that had famously struggled to win community support for the overall development.

The seating bowl of the arena, which rises from approximately 30 feet below street grade and makes these visual connections possible, has similar sightlines to those of Indianapolis's Bankers Life Fieldhouse. That project, which like the interior of the Barclays was designed by Ellerbe Becket Architects and Engineers (now AECOM), relied on a concrete superstructure and steel roof trusses. SHoP Architects designed the exterior of the Barclays, as well as some interior architecture components (see the story about the Barclays Center facade on page 22 of this issue). "Everything in the design of an arena evolves from the bowl design," says Steve Duethman, AECOM's project manager for the Barclays: Ticket price points, luxury suites, and other requirements of the 19,000-seat arena all rely on the geometry set by the bowl.

Structural engineers at New York's Thornton Tomasetti (TT) developed a modified version of the



Above and left Precast concrete stadia units span between steel rakers.
Far left The steel erection sequence minimized strain compatibility between elongation of the roof structure's tension tie and the superstructure's lateral displacement.

Bess Adler/Thornton Tomasetti; facing page top and center: Bess Adler/Thornton Tomasetti; facing page bottom: Banker Steel; opening spread: Bruce Damonte

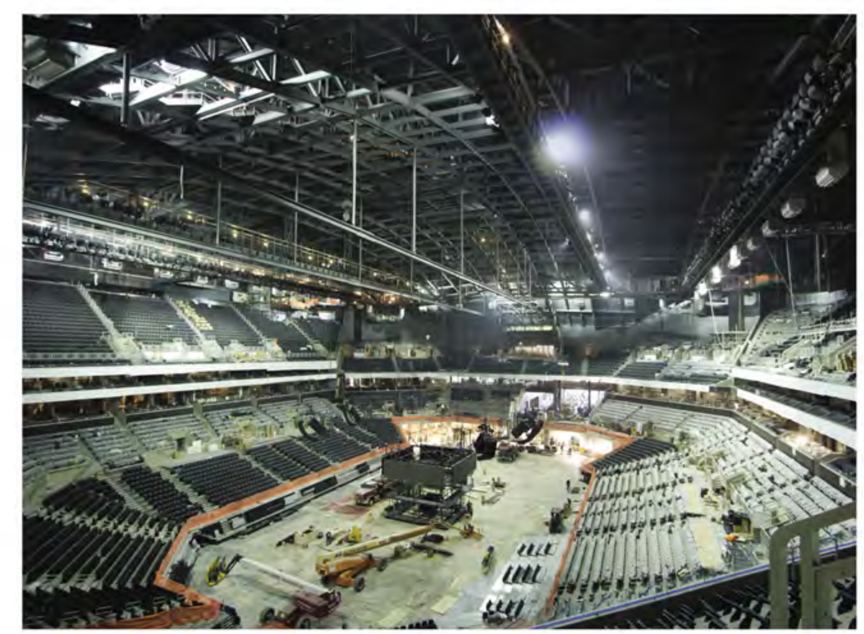
This page A tied-arch roof truss forms the 350-foot-long span of the stadium's roof. Structural engineer Thornton Tomasetti designed the connections at each end of the truss to transmit some lateral forces to the superstructure.

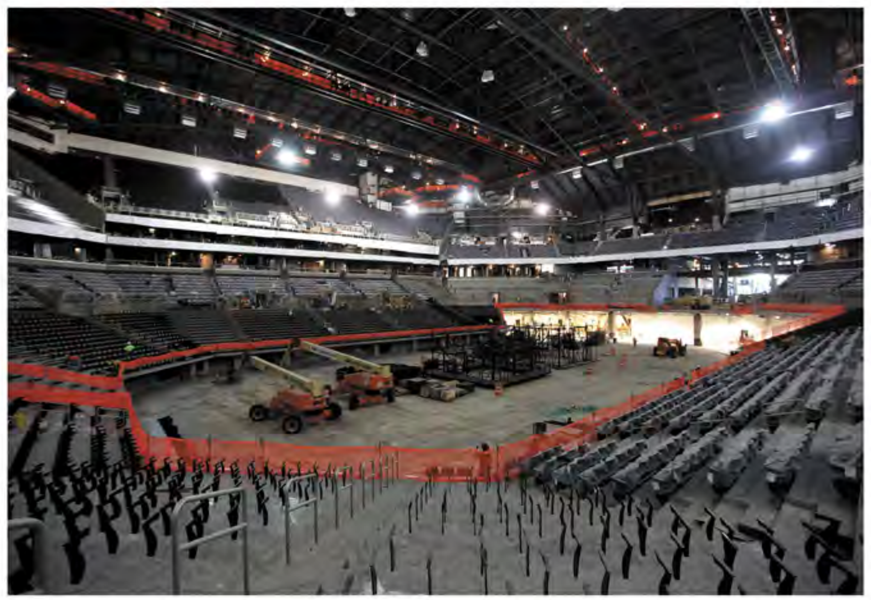
Indianapolis arena's structure for Brooklyn's project. Jeff Callow, TT's project manager for Barclays', says although the Indianapolis project provided a time-saving template, the congested site at Barclays, as well as market considerations, led the team to adopt a steel structure. This eliminated the potential scheduling challenges of having too many trades on the site at once. The primary differences between the Brooklyn structure and Indianapolis are the use of a tied-arch roof truss system, rather than a more conventional arched truss, a steel superstructure rather than concrete, and precast concrete stadia units spanning between steel rakers, as opposed to cast-in-place units.

Callow says the tied-arch system was used as an efficient means to achieve the 350-foot-long span of the roof. The Indianapolis arena resolved arch thrust forces using the lateral stiffness of the concrete superstructure. Due to the relatively tight urban site of Barclays, the design-build team determined it was preferable to construct the entire superstructure from steel to limit activity to one construction trade on site during the erection sequence. However, Callow says that, given the limited real estate on which to build, steel structure would not inherently have sufficient lateral stiffness to resist the arch thrust forces alone. By introducing the tension tie to balance the arch forces, the thrust forces imposed on the superstructure are greatly minimized.

Two main tied-arch trusses run in the long east-west direction, spanning approximately 350 feet. Each comprises a 12-foot-6-inch-deep arched upper truss, with chords made up of W14s that vary across the section and a tension tie, consisting of a 14x311 wide-flange member, which occurs approximately 50 feet below the top of the arched truss and 10 feet above the lower ends of the truss owing to the demands of sight-line preservation. The truss configuration was largely dictated by the limitations of shipping the trusses from the fabricator. The tie is hung by a series of eight, 8-inch vertical HSF pipes. Sixteen smaller trusses connect with the large longitudinal trusses and provide the free span of the arena with chord sizes varying from 14x90 to 14x159. Dead loads and lateral loads are resolved into the steel superstructure, with thrust forces from the trusses largely balanced by the ties.

Callow says one of the project's main structural challenges was connecting the tied arch to the steel superstructure that rings the Barclays and forms





This page The building team's use of Tekla to model the structure in 3-D and troubleshoot connection details contributed to a low overall number of RFIs.
Facing The arena's 70,000-pound central scoreboard is visible to pedestrians from the corner of Atlantic and Flatbush avenues.

its street-side concourse. In a conventional design, where the tension tie would connect at the ends of the truss, the truss would rest on a roller or bearing support that could allow the truss some movement. However, in the case of Barclays, the connection had to be able to transmit some lateral forces to the superstructure. While the introduction of the tension tie significantly reduces the amount of thrust imposed on the superstructure, but does not eliminate it completely due to strain compatibility between the tension tie elongation and the superstructure lateral displacement. To minimize this effect, TT specified a construction sequence involving leave-outs of elements to disengage the arch thrust resistance of the superstructure for de-shoring of the roof structure. This forced the tied-arch action to resist the initial dead load. After the roof was de-shored, these leave-out connections were completed, leaving the superstructure to resist thrust forces under future environmental and live load conditions.

Live loads are chiefly snow, which is prevented from sliding onto the sidewalk by a series of 16-by-16-inch tube steel members, approximately 1-inch off the roofing membrane, that form fences to spread the snow across the otherwise conventional built-up roof. A total of over 10,500 tons of ASTM A992 Grade 50 structural steel is used in the project, in addition to the 600 tons of steel used for the weathered steel panels on the facade.

Aside from the usual ice rink floor to support hockey games and entertainment events on top of a fairly conventional 6-inch slab on grade, the arena's interior includes an exceptional internalized loading dock on the basement level (approximately 30 feet below grade) that relies on elevators and a massive 180-degree turntable to get trucks in and out of the arena. The relatively cramped site meant a conventional street-level ramp to a loading dock could not be accommodated. Two truck elevators, with a capacity of 80,000 pounds each, serve in the same capacity as ramps, freeing up ground-level space for street-facing retail and large expanses of glass that make the Barclays feel more a part of Brooklyn's bustling downtown. And although the center abuts nearby tunnels for New York's subway system, no special structural accommodations had to be made outside of construction-stage shoring.

An 85-foot cantilevered canopy over the main entrance represented a last-minute challenge to the structural design. To support the added loads, Thornton Tomasetti designed two 12-foot-6-inch-deep primary trusses on each side and then laced them together with diagonals to create boxed trusses that tie back to the superstructure columns at the edge of the arena bowl.

In spite of the complicated design, Callow estimates only ten or so structural RFIs for the project. This was due, in part, to working directly for Hunt Construction, but also to TT's use of sophisticated modeling and design software, particularly Tekla for 3D modeling and connection details, SAP2000 for analysis, and RAM Structural System for floor framing. An integrated design and construction team approach saved much time by short-circuiting questions regarding connections and structural cambers that could reduce overall steel tonnage. The project is currently pursuing LEED Silver certification for new construction, but the success of recent concerts and the inaugural Brooklyn Nets basketball season has quickly made the Barclays seem as if it were always there, ready for New York to walk inside.

The congested site at Barclays, as well as market considerations, led the team to adopt a steel structure. This eliminated the potential scheduling challenges of having too many trades on the site at once.

Bess Adler/Thornton Tomasetti; facing page: Bruce Damonte

BARCLAYS CENTER STRUCTURE

Location: **620 Atlantic Avenue, Brooklyn, NY**
Owner/Developer: **Forest City Ratner Companies**, *Brooklyn, NY*
Lead Architect: **AECOM**, *New York, NY*
Design Architect: **SHoP Architects**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Mechanical Engineer: **WSP Flack & Kurtz**, *New York, NY*
Construction Manager: **Hunt Construction**, *Brooklyn, NY*
Curtain Wall Consultant: **Front Inc.**, *New York, NY*
Structural Steel Erector: **James F. Stearns Co., Inc.**, *Pembroke, MA*
Miscellaneous Iron Erector: **Berlin Steel**, *Kensington, CT*
Architectural and Ornamental Metal Erector: **Harriott Contracting**, *Columbia, MD*
Curtain Wall Erector: **Egan Architectural**, *Yonkers, NY*

Barclays Center
Facade

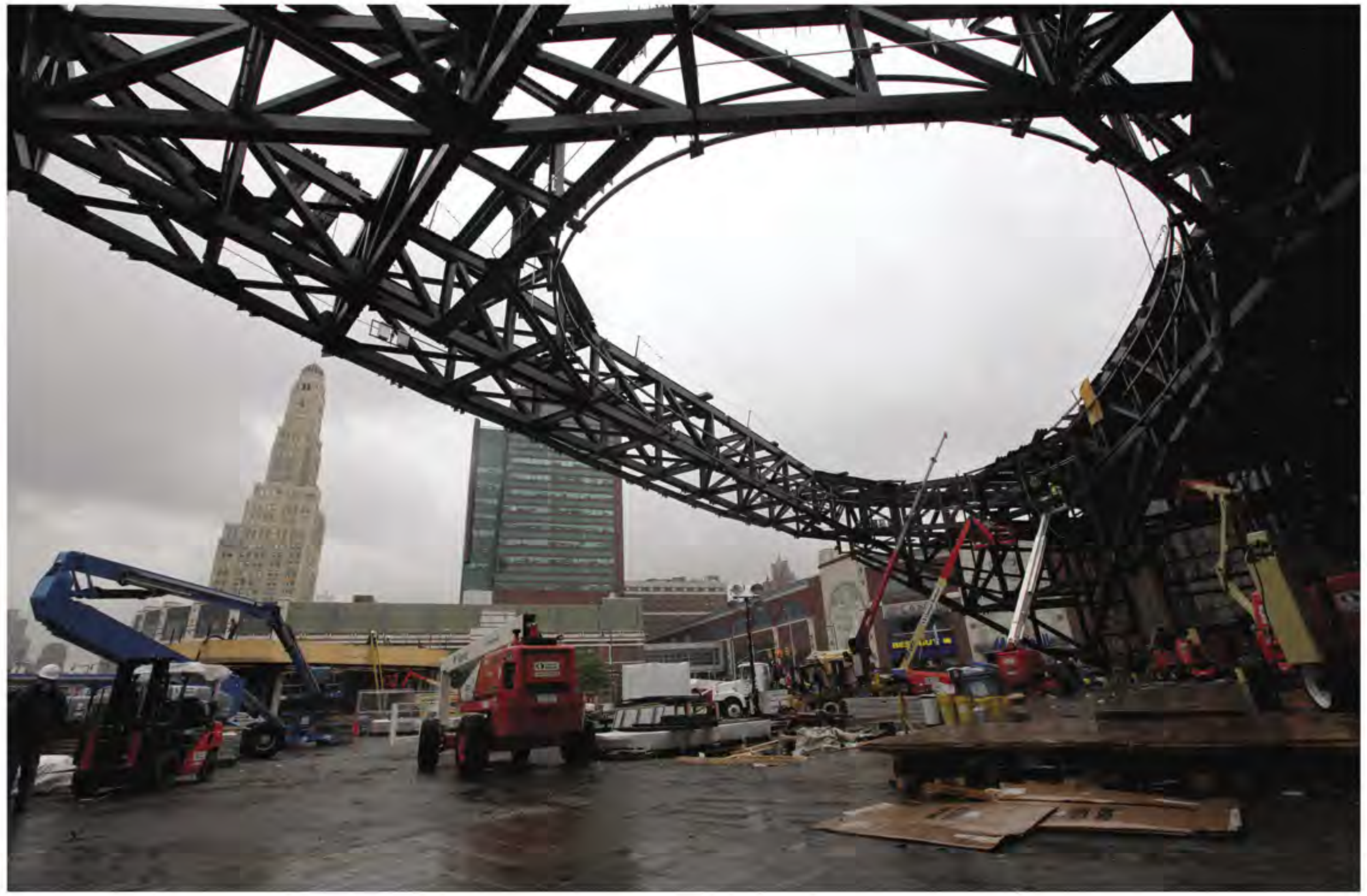
A pre-weathered steel shroud for Brooklyn's new arena took shape with parametric design software that links architectural forms with advanced fabrication techniques.

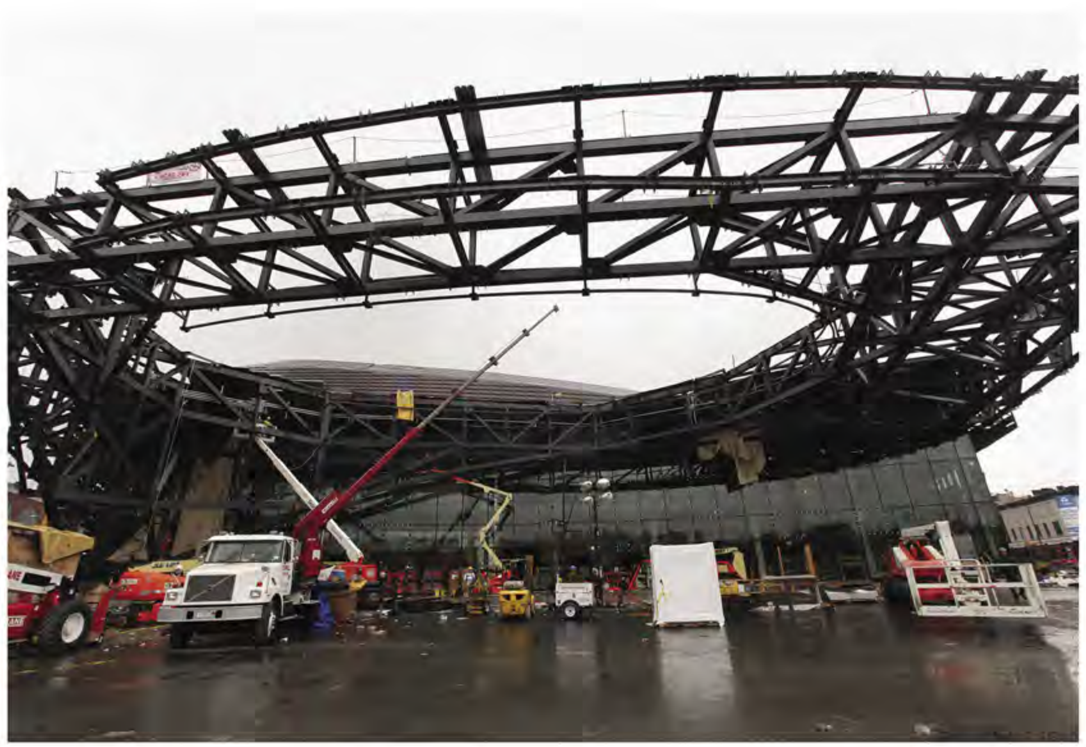
THE LATTICEWORK OF nearly 12,000 unique panels of pre-weathered steel arrayed around the swooping exterior of Barclays Center—Brooklyn's new 19,000-seat multi-purpose arena—is a daring symbol of how much one of New York's most well-known boroughs has changed. Consciously integrating elements of gritty, urban context in a sophisticated modern shape, the sculptured facade is both a nod to the creative class increasingly choosing to live in the arena's adjacent neighborhoods, as well a reminder of Brooklyn's industrial past.

The architectural firm behind the facade, New York-based SHoP Architects, has over the years honed a precise, mathematically rooted approach to digital fabrication and mass customization on a number of well-regarded buildings. However, none of those projects has approached the size of the 675,000-square-foot Barclays, the new home of the Brooklyn Nets basketball team and one of New York City's largest performance venues.

Jonathan Mallie, an architect and the principal in charge of the project for SHoP, says the challenge of integrating such a large project into the existing neighborhood scale was a foremost concern. "With the arena bowl and building sunken 30 feet below ground, the verticality of the structure was already broken down," Mallie says. "We wanted to further break it down by wrapping it in horizontal bands."

Diagrammatically, the Barclays exterior consists of three primary elements using both the steel panels, which cover 85 percent of the facade, and an otherwise conventional glass and aluminum curtain wall system. A top band of steel panels acts as what Mallie describes as a "halo" ringing the arena's roof. A second, lower band of panels skirts closer to the street level and then sweeps up at the main entrance at the northwest corner of the site at the intersection of Flatbush and Atlantic avenues. At this raised point, the lower band cantilevers out as a canopy structure toward an entrance plaza that visually links to the newly created MTA transit station with connections to several of New York's subway lines. As a public gesture, the canopy opens up with an 110-foot-wide, 60-foot-deep oculus internally ringed with an LED screen that has become an inescapable presence in the area at night. Behind the flowing waves of steel, the clear insulated glazed units of the curtain wall reveal the internal functions of the Barclays, allowing a surprising number of views directly into the arena and even of the massive scoreboard at the center of it all.

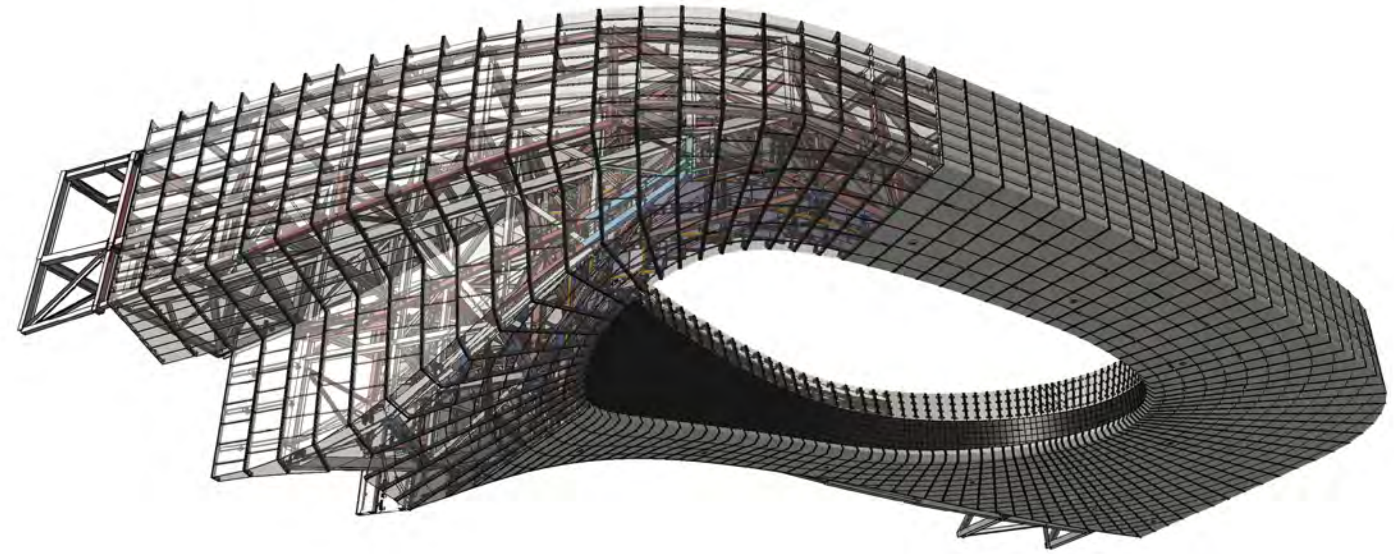


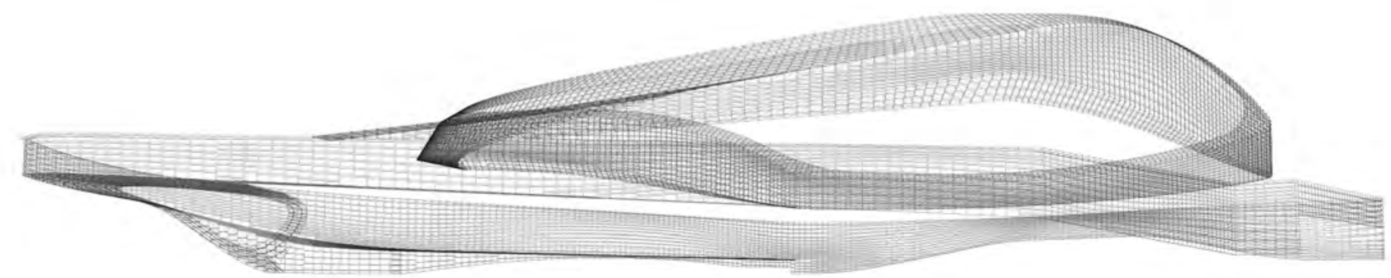


This page The center's cantilevered main entrance canopy is supported by two 12-foot-6-inch-deep primary trusses joined with diagonals, creating boxed trusses that tie back into the superstructure's columns.
Facing Design architect SHoP's diagrams of the 110-foot-wide, 60-foot-deep entrance oculus (top) and panel system (bottom).

Bess Adler/Thornton Tomasetti; opening spread: Bruce Damonte

SHoP Architects





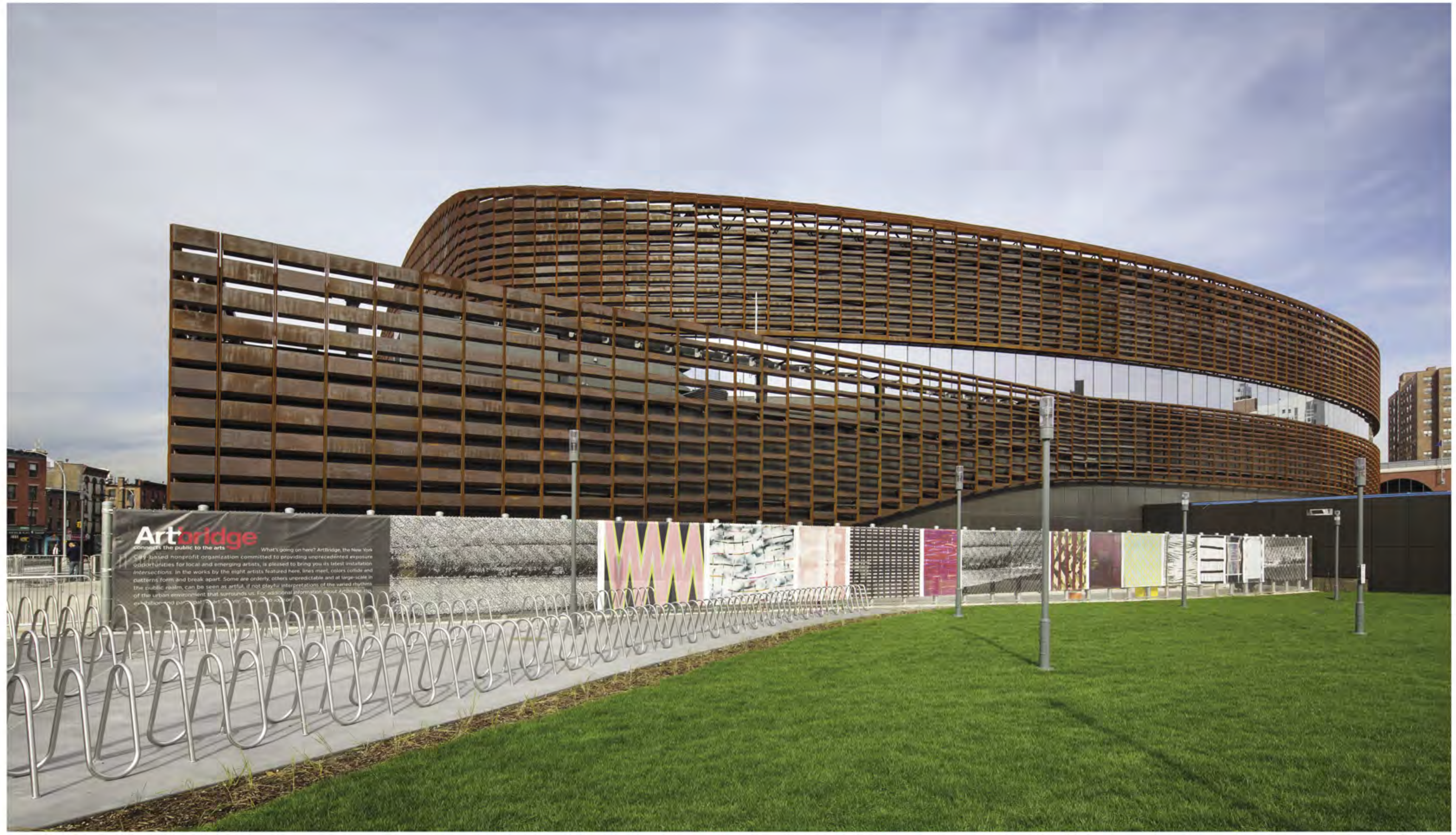
The architects further broke down the scale of the structure by adopting the lattice-like construction of steel panels, with 45-degree-bends in the $\frac{5}{16}$-inch-thick steel that create a shadowbox effect and which multiply the dynamic effect of the building's curves. Mallie says this effect helps to lead visitors' eyes down the street, as opposed to staying focused on a static object in the urban landscape. The A588 COR-TEN steel—a high-strength, low-alloy steel the architects sent through a three-and-a-half-month weathering process to form a dark, brownish rust out of respect to Brooklyn's long history as a shipyard—was milled in Alabama and fabricated in Indianapolis. Each panel is approximately 5 feet wide, but they range from 9 inches to 60 inches in height. Every third panel on the facade is also embedded with a white LED lighting system, which has the effect of making the otherwise heavy steel appear to dematerialize at night.

The steel panels are bolted to pre-weathered steel structural channels, which rest on painted steel structural trusses, approximately 72 inches deep, which attach directly to the curtain wall system of Viracon glass units and Alucobond metal panels. The weathering was achieved with a process in which each panel was exposed to up to 16 wet–dry cycles up to a total of 1,000 cycles, all of which approximated a nearly six-year natural weathering condition. This controlled oxidation process should prevent the panels from further rusting in place and leaking brown stains onto the sidewalk around the Barclays, since oxidizing the exterior of the panels will, in effect, shield the core of the panels from continued oxidation and corrosion. The panels also act primarily as a rain screen cladding, so any deterioration would not affect the structural integrity or weatherproofing of the envelope behind.

At a minimum, there were approximately 20 steel panels attached to 10-foot-wide by approximately 15-to-40-foot-high sections of the unitized curtain wall to form an entire "mega-panel," as the architects call them. Each of the 950 mega-panels was prefabricated, shipped directly to Brooklyn, and installed onto the building's steel structure with curtain wall anchors. No individual steel panels had to be hung on site.

Originally, Barclays was to be designed by Gehry Partners. Thornton Tomasetti (TT), the project's structural engineers, had worked on the Gehry scheme before SHoP came on board in 2009. SHoP also worked with the Barclays architect of record, Ellerbe Becket Architects and Engineers

Above Panels cover 85 percent of the arena's facade. The steel shroud helps to break down the scale of the 675-square-foot building.



Above Internal truck elevators and turntables eliminated the need for ramps to loading docks, allowing the arena to have more of a storefront presence in downtown Brooklyn.

(now AECOM), on the design of the interior public spaces. Because the primary structure of the arena was already well understood in terms of the size of the bowl and structural system of steel (see the related story on page 16 of this issue), TT had to quickly respond to the loading requirements of the new facade.

Jeff Callow, a structural engineer and TT's project manager for Barclays, says the pre-weathered steel panels are basically a second skin on the building. As a result, TT's engineers had to increase the size of the primary structure's steel spandrel beams. The elegant swells of the top band, or halo, also demanded a supplementary cantilever structure on the building's west side that extended approximately 20 feet from the top of the arena bowl structure and 20 feet out. The cantilever consists of extensions to the arena columns that in turn support trussed vertical frames with horizontal tube steel girts that hold the panels in place. There is also an 85-foot cantilever with boxed trusses at the main entrance for the canopy oculus.

SHoP developed a 4-D model of the project that married the building geometry to the construction schedule established by the Hunt Construction Group, the design-build contractor on the Barclays for developer Forest City Ratner Companies (FCRC). The geometry was created using Rhinoceros software and then digitally represented in a CATIA model, which is parametric design software that links architectural form-making with advanced fabrication processes. The architects created so-called "document templates" that act like computer scripts and write the logic of the panel construction across the geometry of the building. For each panel, the templates determine how the steel must fold, where the slots for bolting the panels must reside, the manner in which joints would align and be outwardly expressed, and how the panel would hang given the dictates of the building form.

This spread: Bruce Damonte

BARCLAYS CENTER FACADE

Location: **620 Atlantic Avenue, Brooklyn, NY**
Owner/Developer: **Forest City Ratner Companie**s, *Brooklyn, NY*
Lead Architect: **AECOM**, *New York, NY*
Design Architect: **SHoP Architects**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Mechanical Engineer: **WSP Flack & Kurtz**, *New York, NY*
Construction Manager: **Hunt Construction**, *Brooklyn, NY*
Curtain Wall Consultant: **Front Inc.**, *New York, NY*
Structural Steel Erector: **James F. Stearns Co., Inc.**, *Pembroke, MA*
Miscellaneous Iron Erector: **Berlin Steel**, *Kensington, CT*
Architectural and Ornamental Metal Erector: **Harriott Contracting**, *Columbia, MD*
Curtain Wall Erector: **Egan Architectural**, *Yonkers, NY*

Mic Patterson/Enclos Corp.

Jacob K. Javits Center

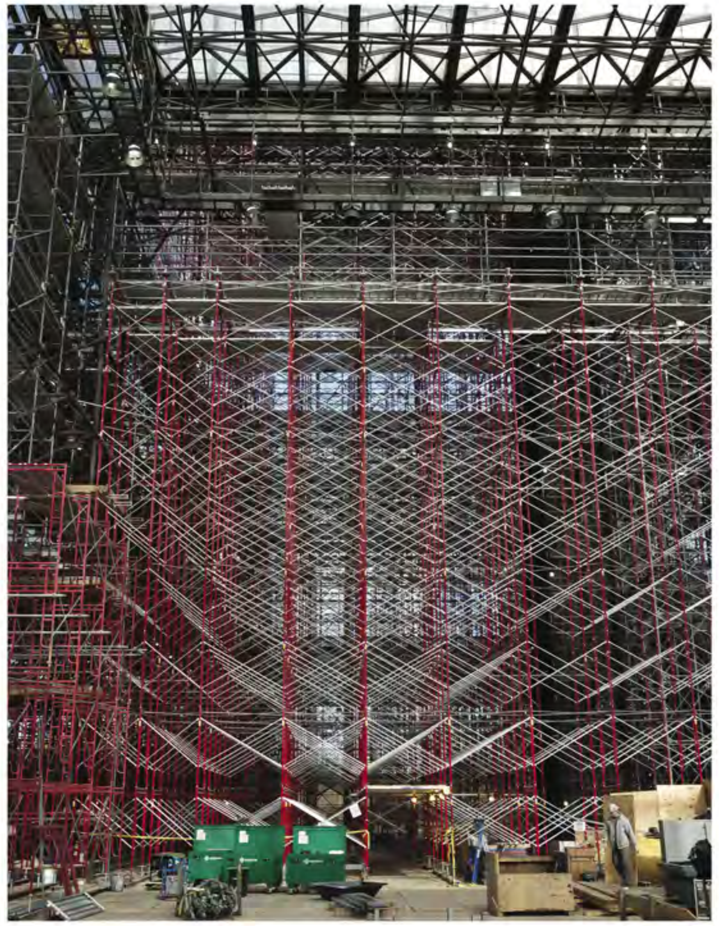
A new, energy efficient curtain wall transforms Manhattan's favorite convention venue into the crystal palace its original designer intended it to be.

NEW GLAZING TECHNOLOGY can dramatically increase building performance whether used to clad new buildings or retrofit existing structures. But advances in glass fabrication and installation can also increase building transparency—something that an architect like James Ingo Freed only dreamed of when he designed the Jacob K. Javits Convention Center in the late 1970s. While early renderings depict a glass-clad building with a transparent facade revealing an elegant steel space frame structure beneath, architects were forced to specify glass with a dark gray tint and bronzed reflective coating to avoid strain from solar heat gain on the building's HVAC system. While this solution provided the insulation values necessary during the early 1980s construction, it also blocked exterior views of the space frame's sophisticated geometry and resulted in a dimmer interior environment than desired.

Today, though, the building is close to achieving the transparency Freed originally envisioned thanks to an ongoing renovation by architecture firms FXFowle and Epstein Global that will apply 21st century technology in replacing the building's curtain wall and skylights. The recladding is part of the New York City Economic Development Corporation (EDC) overhaul of the center, which began in 2006. In addition to improving the building's appearance, the work aims to reduce the facility's energy consumption by 26 percent and achieve LEED Silver certification.

It is a job that called on the considerable skills of project team members, from the designers and fabricators to the Local 580 ironworkers tasked with installing the new cladding system. Much of the reason for this was the complexity and condition of the existing, 30-year-old curtain wall system. The center's existing system consisted of 10-foot-by-10-foot modules, each of which was further subdivided by mullions into four 5-foot-by-5-foot insulated glass units (IGUs). An analysis of the system determined that it was in a state of advanced failure. "The glass units had passed their life expectancy of 25 years, which is typical of IGUs of that time," says Larry Dalziel, senior project manager at Epstein. "The seals had started to fail. The pacifier scrim on the inside of the inner lite had begun to delaminate. The whole system had taken on an unsightly character." At first, the architects looked into maintaining the project's mullion frames and just replacing the glass units. However, no contractor would issue a warranty on a repair of the old system, and so the team decided on a full replacement.

Providing an entirely new enclosure system allowed the architects to take some liberties with the original design. In Freed's scheme, glass panels clad the entire structure, even the black-boxed convention halls where they act merely as spandrels. FXFowle and Epstein decided to take a more "honest" approach to the building envelope by cladding the opaque areas of the facade with stainless steel panels, especially the building's south face along 34th Street. Here, rather than keep to the original 10-foot-by-10-foot module, the team emphasized the Javits' horizontal nature by designing 5-foot-high-by-10-foot-wide modules. The panels installed in the slimmer modules were fabricated out of 14-gauge 316L stainless steel and given a No. 4 finish. Some of the panels were further treated with two additional patterns: 2-FL, which adds horizontal ribs to the brushed surface of the No. 4 finish, and 6-ON, a pattern of golf ball-like dimples. "The basic No. 4 stainless diffuses light so you don't get reflections of sky; you get more of a glow that acts differently in varying light conditions," says Bruce Fowle, senior



This page At its Advanced Technology Studio for facade innovation, curtain wall fabricator and erector Enclos Corp. went through design detailing and rapid prototyping of typical curtain wall details in two days.

partner at FXFowle. “The other two patterns are interwoven with the basic to make a transition from the glass to the stainless and to create interest as you move along 34th.”

New glazed modules also vary slightly from the building's original panels. The team did away with the vertical mullion present in the original 10-foot-by-10-foot panels so that each consists of two 5-foot-high-by-10-foot-wide IGUs structurally glazed into a 10-foot-by-10-foot frame. As with the stainless steel panels, this design choice emphasizes the building’s horizontal nature. Eliminating the vertical mullion in favor of larger panels of glass also creates more of a sense of openness to the facade and allows for the transmission of greater amounts of daylight into the convention center’s lobby and circulation spaces. For the glass units themselves, the team chose a Viracon product with a VNE 63 coating—a hybrid of traditional low-emissivity coatings and low-reflectivity coatings that offers low solar heat gain, low reflectance, and a subtle neutral color. The IGUs are composed of a ⅜-inch fully tempered outer lite, a ½-inch air space, and a ¼-inch fully tempered inner lite, and are structurally glazed into a partially thermally broken system of 4 ¼-inch deep aluminum mullions. The architects applied varying degrees of fritting to the glass to control the amount of natural light entering particular portions of the building, ranging from 28 percent frit to 48 percent frit. In some cases the team wanted a darker environment to allow conventioneers to supply their own lighting experiences. In the building’s “crystal palace” lobby, an architectural marvel that features space frame–supported glass boxes stacked into a pyramidal form, the fritting is densest at the lower levels and becomes gradually more sparse as it rises up the elevation.

Removing the old cladding and replacing it with the new—240,000 square feet of glass curtain wall, 88,000 square feet of steel panels, and almost 90,000 square feet of skylights—was a high-wire balancing act made all the more complicated by the fact that the building had to remain open and operational throughout construction, which began in 2010. This meant that Enclos, which fabricated and installed the system using Local 580 ironworkers, had to coordinate closely with the convention center’s schedule. The firm divided the job into small, easy-to-manage sections, completing the replacement on one before moving onto the next so that the building had limited exposure to the elements. In the crystal palace—the building’s highest point, a soaring atrium of glass cubes stacked in pyramidal fashion—the construction team, led by Tishman, an AECOM Company, constructed a temporary steel platform atop which scaffolding was erected to within 5 feet of the space frame, giving the ironworkers interior access to the nodes that connect the modules to the structure.

Each of these nodes is fitted with a single threaded rod that mates with an anchor on the outside of the curtain wall and is bolted tight by a single nut. As a result, replacement involved removing the nut and anchor, lifting the old panel away, setting a the new one into place, installing a new anchor, and bolting it tight with a new nut outfitted with anti-rotation clips. The work was accomplished using a combination of cranes and aerial work platforms. A hammerhead tower crane was required in order to pick the crystal palace’s panels and set them in place. The crane was first erected on one side of the palace module, completing half the job from that side, then moved to the opposite side to finish it. Panels on the lower sections of the facade were picked and set into place using a crawler crane.

While the system sounds simple enough, the job called on all of the skills of the installers. “This project had really tight tolerances,” says Evan Berger, Enclos’ senior project manager on the job, “especially in the vestibules where it was very difficult to get tight seams. This is not a normal building. It’s 30 years old and a lot of the structure has shifted. The Local 580 guys did great job. At the end of it there were no major injuries and the building doesn’t leak. You can’t ask for more than that.”

Mic Patterson/Enclos Corp.

R.A. Heintges Associates

Top left Architects replaced an extensive area of spandrel glass over concrete with a stainless steel skin. **Bottom left** Eliminating the original design’s vertical mullion’s created larger expanses of glass and improved daylighting.

Top right Incorporating IGUs and ceramic frit, the new facade will help reduce the building’s energy consumption by up to 26 percent. **Bottom right** The Javits Center as seen from 11th Avenue.

JACOB K. JAVITS CENTER

Location: **655 West 34th Street, New York, NY**
Owner: **New York Convention Center Development Corp.**, *New York, NY*
Architect: **Epstein Global**, *New York, NY*; **FXFowle**, *New York, NY*
Structural Engineer: **Weidlinger Associates**, *New York, NY*;
Leslie E. Robertson Associates, *New York, NY*
Mechanical Engineer: **WSP Flack + Kurtz**, *New York, NY*
Construction Manager: **Tishman Construction**, *New York, NY*
Curtain Wall Consultant: **R.A. Heintges Associates**, *New York, NY*
Structural Steel Fabricator and Erector: **Burgess Steel Erectors of New York, LLC**, *New York, NY*
Miscellaneous Iron Fabricator and Erector: **United Steel Products, Inc.**, *Flushing, NY*
Architectural Metal Erector: **Enclos Corp.**, *New York, NY*
Curtain Wall Fabricator and Erector: **Enclos Corp.**, *New York, NY*

UN CMP/John Woodruff and Peter Brown

United Nations Secretariat

Recladding the Secretariat tower allowed designers to bring back the glazing's original look while improving energy performance and security.

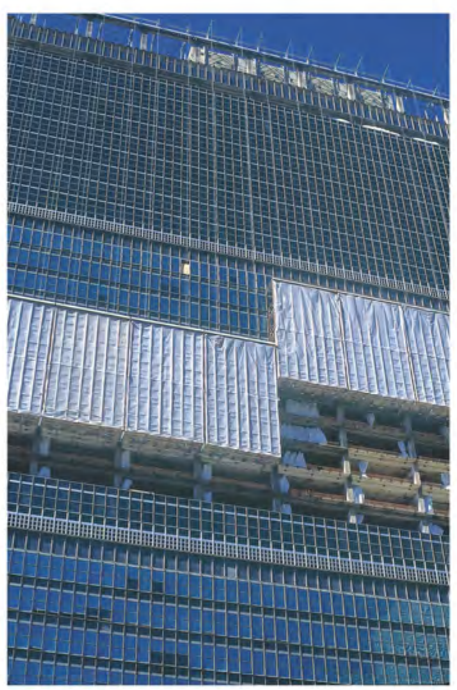
COMPLETED IN 1952, the iconic 30-story United Nations (UN) Secretariat was the first time ever worldwide that a unitized curtain wall system was used on a high-rise building. Replacing it required a solution that was above all respectful of the original design. Today, part of an ongoing $1.87 billion renovation of the entire UN compound in New York City, the wall that started it all has been succeeded by a contemporary unitized system that brings the Secretariat into the 21st century, while maintaining its mid-20th century looks.

"The new curtain wall has been designed to look like it did in 1952," says Michael Adlerstein, UN Assistant Secretary-General and Executive Director of the Capital Master Plan, "though it's greener, more sustainable, and safer against blast."

When the UN staff started planning the renovation in 2000, it first considered repairing the facade of the Secretariat rather than recladding it entirely. The decision to replace the wall entirely came about for a couple of reasons. For one, the existing system had deteriorated significantly. "The original wall was primitive," says Robert Heintges, founder of curtain wall consultancy R.A. Heintges Associates, which worked on the recladding project along with architecture firm HLW International. "It leaked water and air right away. Over the years they put up patch plates and smeared it with every variety of sealant that came along." In spite of these stopgap measures, the water intrusion led to varying degrees of rusting in the steel members that connected the wall system to the floor slab. Then came September 11, 2001, and the world changed forever. "Whether to repair or replace became a moot question post 9/11 when the UN knew that the facade would have to be security-enhanced," Heintges continues. "There was no way to make the existing wall bomb blast safe."

Once the decision to do a full reclad was made, the team unanimously agreed to recreate the look of the original wall as closely as possible. The result turned out to be somewhat different from how it had looked for most of its life. New Yorkers have grown accustomed to an East River view of Manhattan dominated by the minimalist slab of the Secretariat with its white stone-clad shear walls and green bottle fly-colored glazing. Most people didn't know, however, that the tower's viridescent glass is in fact a perversion of the transparent operable windows put in place by the building's original design team, a team that featured such luminaries of mid-20th century architecture as Oscar Niemeyer, Le Corbusier, and Wallace K. Harrison.

What today's viewers experienced was the result of "after-market" tampering to improve energy performance. Since the original wall was a unitized frame system, it meant that the frame was erected first and connected to the structure, with the double-hung windows installed in the frame later. After erecting the framing, it was discovered that the insulating glass the designers had wanted to use—a brand new product at the time—would be too heavy for the frame to sustain the load. And so, in an early example of value engineering, the team decided to use ¼-inch monolithic glass in the windows instead. While this created an admirably transparent facade, it also left something to be



Above Completed in 1952, the Secretariat was the first skyscraper in the world with a curtain-wall enclosure. **Left** The recladding is part of a $1.87 billion renovation of the UN's New York City compound.

Top: UN CMP; left: William Rivelli; facing page: William Rivelli

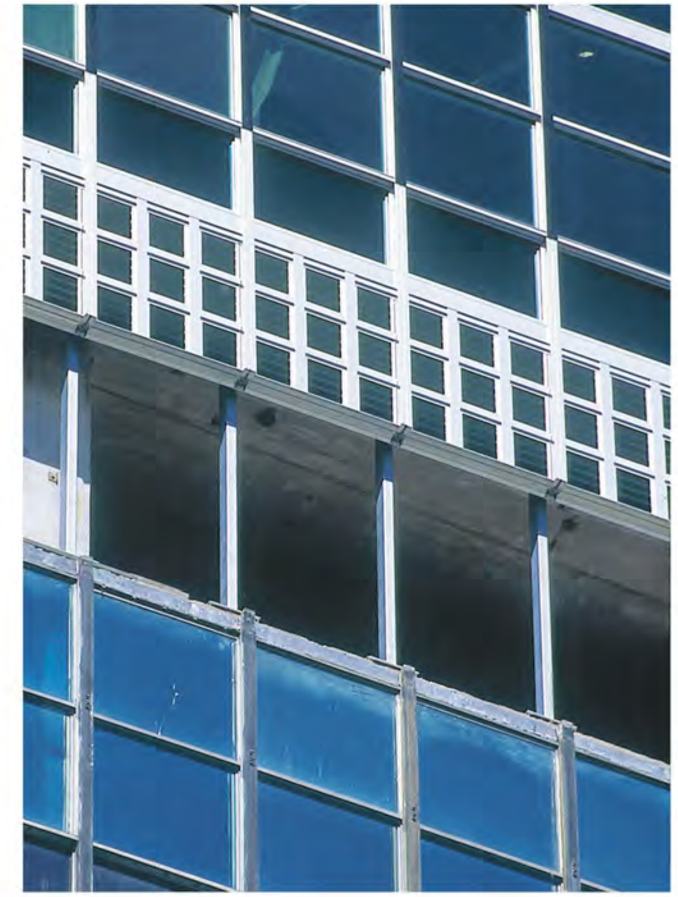
This page Installation of reflective film on the building's east and west facades in the 1950s eliminated its transparency. The recladding project team performed spectral analysis to determine the type of glass that would be closest in appearance to the original.

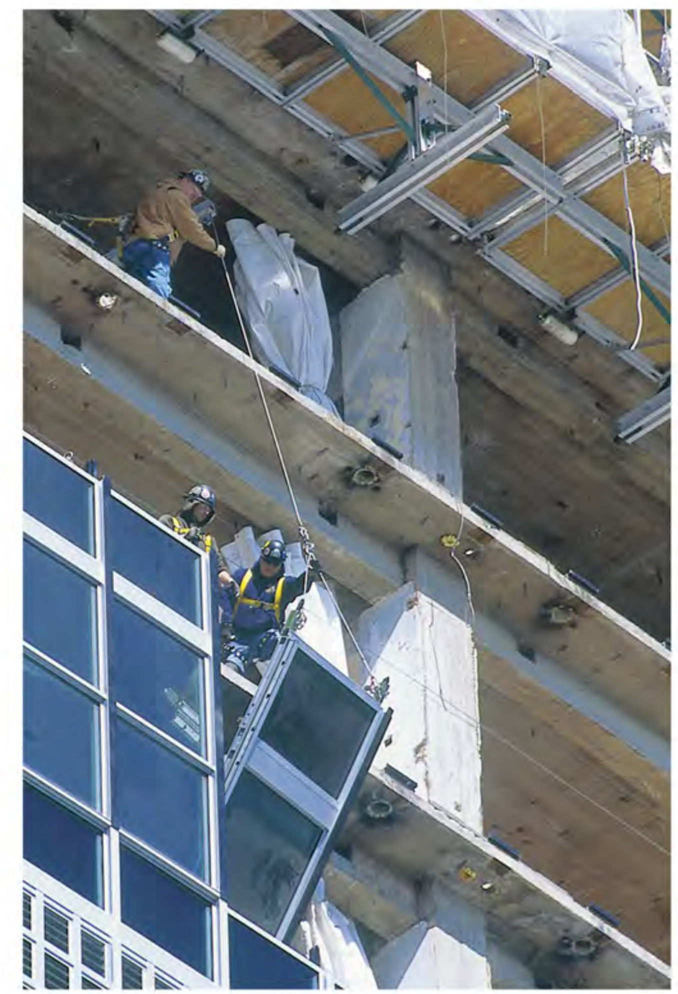
desired in terms of insulation. A series of reflective films was applied to the glass over the course of the 1950s to cut down on sun loading, which was overpowering the building's HVAC system and turning the offices into sweatboxes, and thus was born the well-known green facade.

The new curtain wall is a panelized system, factory built and installed on site. The panels match the dimensions of the original wall almost exactly, each featuring two roughly square glass modules 4 feet wide and 3 feet, 10 ½ inches high. Although the new windows are not operable (if a window were open during a blast event it would essentially negate any protection offered by the system) they were designed with an intermediate horizontal mullion that creates the look of the original double-hung window. The two glass modules in each panel are laid in plane, as opposed to offset, as would be the case in a true operable window. This was done in order to match the profile of the original mullion while adhering to current codes for wind-loading. Offsetting the modules would have required a thicker mullion, and the team determined through full-scale mockups that the panels satisfactorily matched the original in appearance.

The most difficult part of the process was getting the new glass itself to look like the original. "In the new system you have a really thick laminated IGU," says Heintges. "To get this thick of an assembly to resemble ¼-inch monolithic glass is challenging." Heintges' team performed a spectral analysis of various types of glass, studying their reflection patterns, and came up with a formula to represent them. They then developed a computer model and plugged in the different formulas, allowing them to analyze how the different types of glass might look at different times of day and light conditions. The team also took various material candidates to the site and compared them to an existing window whose film had been removed. Once the field had been narrowed down to four choices, they built a full-scale mockup on UN headquarters grounds in front of the Secretariat for final scrutiny. In the end, they selected a Viracon product with a low-e coating that did not cause a purple shift in reflected light.

Matching the look of the original aluminum mullions also proved challenging. When the UN was designed in the 1940s, the use of aluminum in archi-





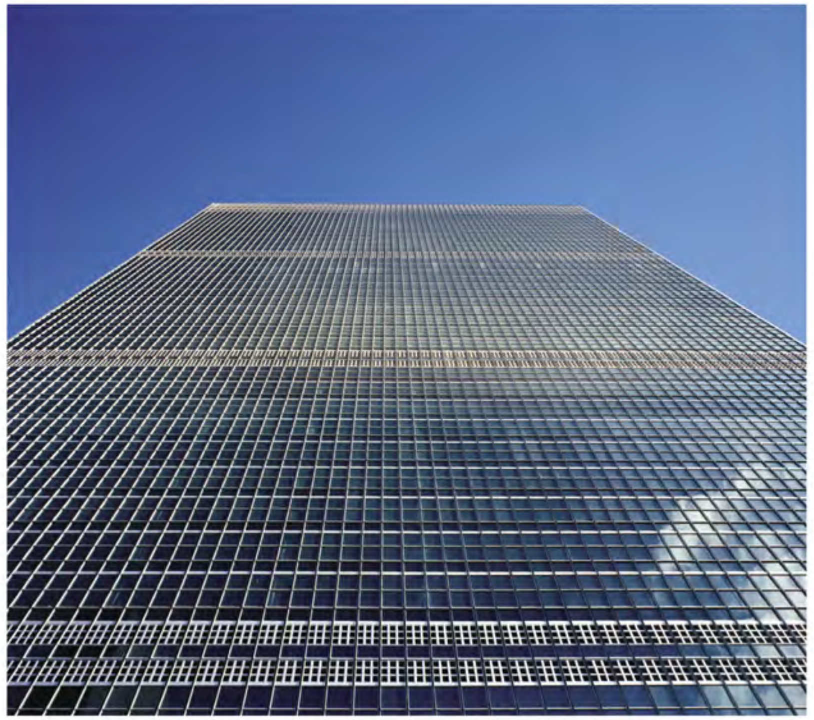
This spread: UN CMP/John Woodruff and Peter Brown

This spread Insulated glazing, a new technology at the time, was chosen for the original UN project, but was then eliminated because of cost and weight.

tectural windows was relatively new. Stainless steel, on the other hand, had been used quite a bit. So when the original design team specified aluminum they tried to make it look like stainless with a No. 4 finish. “That’s not a good finish for aluminum,” says Heintges. “All the scratches get filled with atmospheric contaminates and it starts to get dirty and pitted.” The recladding team couldn’t find a manufacturer who would finish aluminum in that way, so it compromised and gave the extrusions a gentler brushed look. Inside the building, the anodized aluminum was left exposed, as it was in the original. On the outside, it was given a protective coating with two types of fluoropolymer paint, one silver (PPG Duranar XL 3-Coat Metallic) to resemble the look of exposed metal, and the other black (PPG Duranar 2-Coat Non-Metallic), recalling the mullion caps of the original wall.

The old wall was stripped off, the asbestos abated, and the new system installed in three zones. Ornamental ironworkers with Local 580 worked from a three-story Beeche work access system suspended from the roof via a dedicated aluminum structure, which allowed work to go on in a safe, contained environment. They removed the old glass sashes from the aluminum and steel frames, then unbolted the frames from the existing anchors. Reciprocating saws were used to cut frames into more manageable pieces and the threaded studs that remained on the structure were ground smooth. Once this was complete, the ironworkers attached the new panels with connections that go directly to the Secretariat’s steel structure. Demolition of the old curtain wall and installation of the new went from the bottom up in three sections starting with the top third of the building, then the middle third, and finally the storefront and bottom third. The new curtain wall followed behind the old by approximately three floors. “Zipper” units were installed at the mechanical floors to join the sections of the facade.

The result of the project team’s careful design and planning, and the ironworkers’ fine craftsmanship, combined with new open-plan interiors by HLW, is a reborn UN, at once a spitting image of its younger self and an example of how far technology has evolved since 1952. “The look of the exterior is pretty consistent with what it was,” says John Gering, AIA, managing partner of HLW, “except for the fact that the original Secretariat had enclosed offices. When you looked inside you saw a wall. Now when you look through the glass you look through an open space.”



The reborn UN is at once a spitting image of its younger self and an example of how far technology has evolved since 1952.

UNITED NATIONS SECRETARIAT

Location: **1 United Nations Plaza, New York, NY**
Owner: **United Nations**, *New York, NY*
Design Architect, Architect of Record: **HLW International**, *New York, NY*
Architects: **Le Corbusier; Oscar Niemeyer; Wallace Harrison**
Architect of Record, Facade: **R.A. Heintges & Associates**, *New York, NY*
Engineering Consultant: **Ove Arup & Partners Consulting Engineering**, *New York, NY*
Construction Manager: **Skanska, USA**, *Queens, NY*
Curtain Wall Consultant: **R.A. Heintges & Associates**, *New York, NY*
Miscellaneous Iron Fabricator and Erector: **Empire City Iron Works**, *Long Island City, NY*
Curtain Wall Fabricator and Erector: **Benson Industries**, *New York, NY*

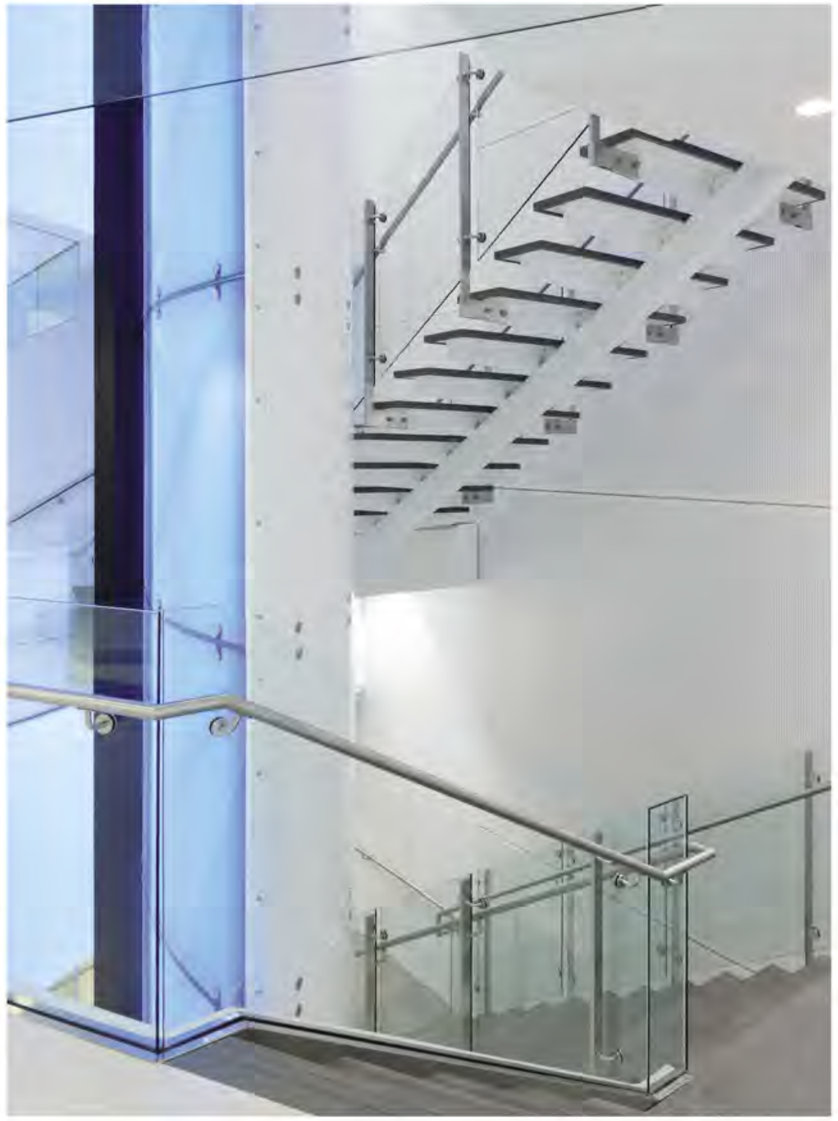
JetBlue Headquarters

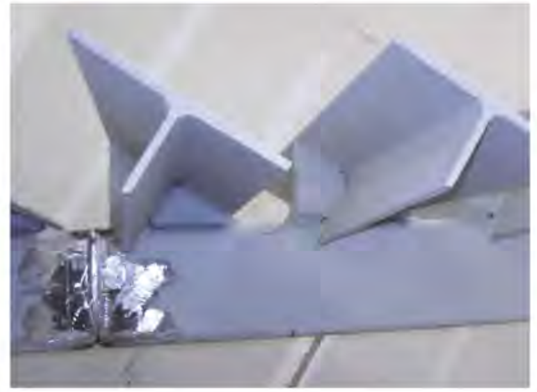
Working with two existing structural systems in the former building of an aeronautical manufacturer, the architects and engineers of the airline's new offices create a collaborative environment with twin three-story staircases.

SINCE THE AIR carrier's founding in the late 1990s, JetBlue has established itself as a design-savvy presence in New York, with graphic design and multimedia branding aimed at creating the friendly, upbeat image of "the city's hometown airline." In 2008, it opened a new primary hub at John F. Kennedy International Airport in a building designed by Gensler that sits next to the historic TWA Flight Center, the former Trans World Airlines terminal designed by Eero Saarinen. The design-driven strategy has not stopped with the company's public side. When it came time to consolidate its Forest Hills, Queens, and Darien, Connecticut, administrative offices, JetBlue turned to international architecture firm HLW to conduct an exhaustive multi-state study to locate a new headquarters building. The company finally found its home in Long Island City's historic Brewster building. Built in 1911 for the Brewster Aeronautical Co., the newly retrofitted space places JetBlue squarely in a historic context while its design, aimed at involving employees of all levels in the company's day-to-day operations, looks toward the future.

One of HLW's earliest objectives for the project was to facilitate a design process that was transparent and would involve a significant amount of "crewmember perspective" on workplace issues. The firm's research included one-on-one interviews, workshops attended by a representational 10 percent of the airline's staff, and an online workplace effectiveness survey. The team's findings resulted in a plan to create flexible, adaptable work areas and group-work spaces that would accommodate ongoing changes in business and team relationships. From an architectural standpoint, this collaborative environment would be facilitated best by a design that encouraged circulation.

HLW approached the challenge with a scheme that incorporates two staircases whose appealing design invites regular use. "The stair design was developed to reflect and reinforce JetBlue's culture and philosophy of openness, collaboration, and transparency," says senior partner Walter Zupancich. "Each run of stairs is composed of three 'visual' segments—top and bottom segments with a more solid and grounded appearance supporting a center span designed as a visually lighter, bridge-like structure."





Each stair is three stories tall, rising at either end of the 20,000-square-foot office space alongside 40-foot-tall, wing-shaped towers clad in curved aluminum, custom blue polymer backlit panels, and LCD monitors streaming company imagery.

Working with the existing structure posed some challenges to the design team. The new headquarters is composed of the 100-year-old aeronautical building constructed of reinforced concrete columns with terra cotta arch floor slabs and a more recent steel-framed addition. Because each structure contained one stair, details for each staircase were different. HLW and The Office of James Ruderman, structural engineer for the project, had to design two separate solutions for every phase of construction: demolition of floor slabs, temporary shoring during construction, the design of the framing for new slab openings, and design of the connections between the stair and existing structural columns.

In the existing concrete structure, imposed loading from the new stair was limited to the load-carrying capacity of the existing concrete members, so an entire bay of concrete joists was removed and new structural steel members were installed using steel plates fastened to existing concrete columns and girders with expansion bolts. In the existing steel structure, new steel members were framed into the existing steel girders and beams, which were reinforced as required.

"Originally, new concrete stairs were proposed but the weight would have required extensive reinforcing of the existing structures," says Steven Smolinsky, managing partner at Ruderman. Instead, the team chose two lighter designs. The stairs' top and bottom segments, which have a more solid appearance, consist of concrete-filled metal pan treads with two C12x20.7 outside channel stringers. The bridging, central portion of each staircase has a much lighter appearance. This portion's precast concrete stair treads are each cantilevered on a tapered ⅜-inch, T-shaped steel plate tread welded to a centered 8x4x⅜ HSS stringer. While the upper and lower stairs are supported by the building's existing floor construction, the floating landings are supported by ¾-inch diameter steel hanger rods.

The steel stair sections were fabricated off-site while contractors removed the existing floor slabs and shored and reframed of the new stair openings. Delivery of the steel stair sections to the job site was coordinated with the completion of the framing of the new stair openings, as well as with other construction progress on the floors. Installation of each included the welding of the stair sections in place and securing them to the new framing, followed by the installation of the precast concrete treads and glass balustrades. The 1 ½-inch stainless steel pipe handrails are attached to ½-inch tempered glass balustrade via fittings that penetrate the glass at regular intervals and are also mechanically attached to the precast treads at the top and bottom of each stair run.

"The challenge from a safety and fire code perspective was the fact that we were connecting three floors (the fifth, sixth, and seventh floors) with two open staircases," says Zupancich. The team presented its proposed design to the Department of Buildings in advance of a formal filing for a building permit and received pre-approval based on the inclusion of additional measures to prevent fire and smoke on one floor from spreading to upper floors: In addition to walls constructed at the back of each stair with a two-hour fire rating, a glass smoke baffle is installed along the ceiling plane at the perimeter of each stair with additional sprinkler heads placed at intervals of 6 feet on-center and 18 inches from the smoke baffle to protect it.

The building has come a long way since it first opened for business to manufacture the Brewster F2A Buffalo, a World War II prop fighter used by the U.S. Navy, but now it seems JetBlue couldn't have found a home anywhere but New York. The company even managed to license the use of Milton Glaser's I Love New York insignia, which now appears on many of its branded materials—an indication that the company, and the historic buildings to which it has attached itself, are ready to stand the test of time.

This page Two circulating staircases are composed of fixed top and bottom segments connected by "floating" landings supported by ¾-inch diameter hanger rods.

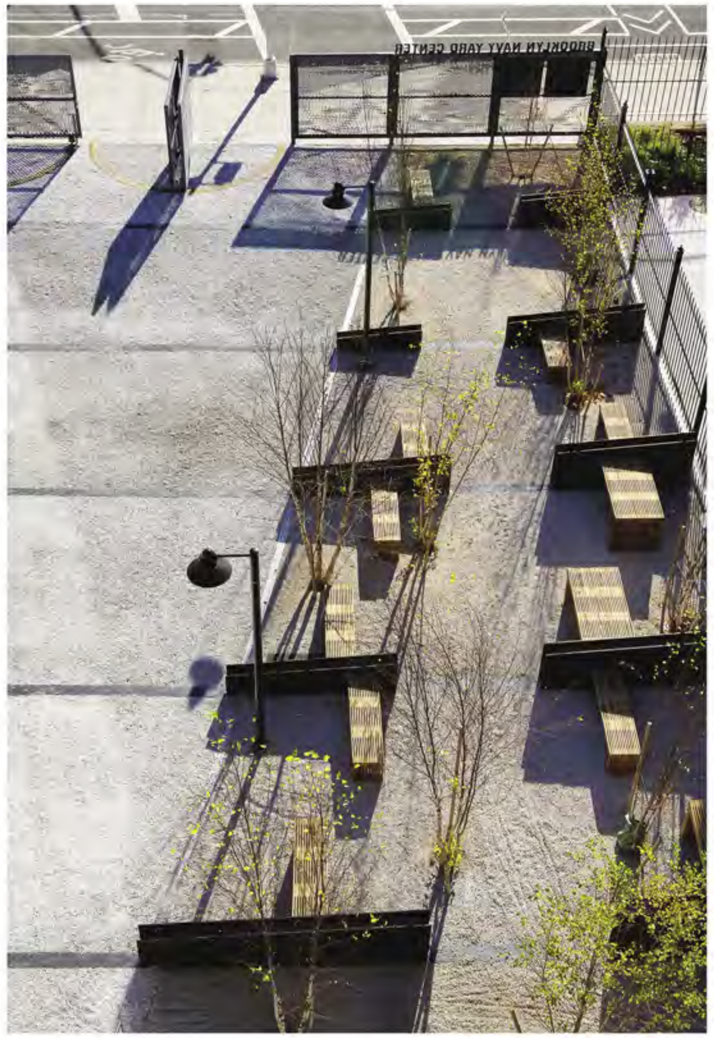
Clockwise from top: HLW, Adrian Wilson, Adrian Wilson

Adrian Wilson

Right Forty-foot-tall, wing-shaped towers are clad in aluminum and custom blue panels.

JETBLUE HEADQUARTERS

Location: **27-01 Queens Plaza North, Long Island City, NY**
Owner: **JetBlue**, *Long Island City, NY*
Architect: **HLW International LLP**, *New York, NY*
Structural Engineer: **The Office of James Ruderman LLP**, *New York, NY*
Mechanical Engineer: **HLW International LLP**, *New York, NY*
Construction Manager: **Turner Construction Company**, *New York, NY*
Architectural, Ornamental and Miscellaneous Iron Fabricator and Erector: **Burgess Steel Products Corp**, *Englewood, NJ*



BLDG 92

A renovated Brooklyn Navy Yard building becomes a new historical center with a digitally designed curtain wall that speaks to the evolving neighborhood's maritime past.

AFTER SURVIVING DECADE upon decade as a gritty and heroic fixture of Brooklyn's fabric—and more recently depicted in several action-adventure video games as a shady, barbed wire-enclosed bone yard teeming with mobsters on the make—the Brooklyn Navy Yard is enjoying a significant renaissance as a community attraction. Leading the revival is a structure known unassumingly as Building 92. Seen from the air, the 9,500-square-foot building appears small among its sizeable industrial neighbors on the East River waterfront. But restored to its former stateliness and expanded by an additional 20,000 square feet of space for public use, it now serves as a museum, exhibition hall, and information center, fulfilling the role of gateway to a historic shipyard of the United States Navy.

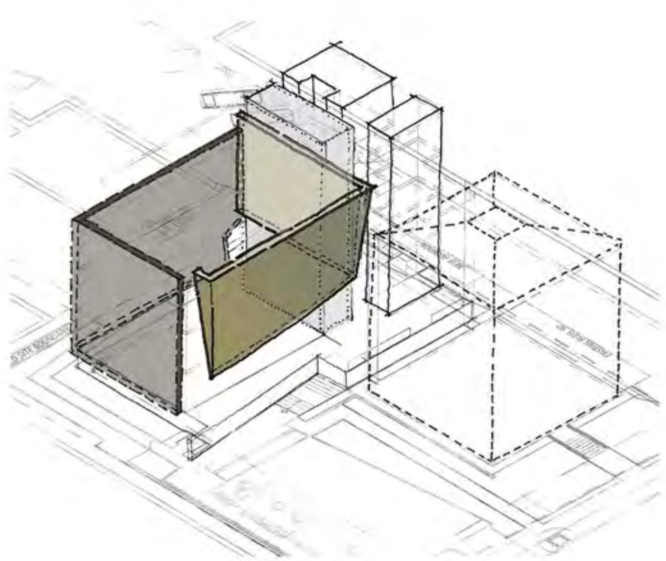
When New York-based architecture firms Beyer Binder Belle and Workshop/apd, collaborators on the design, began planning the rehabilitation of Building 92, they were confronted by a brick shell that had relinquished not only its windows and doors, but also its structural stability, to time. Built in 1857 and originally home to a former marine commandant, the Federal-style building suffered years of disuse and elemental wear and tear. The structure also exhibited significant shifting at one of its corners where the foundation was failing. "It was just a crooked shell," says Elizabeth Leber, a partner at Beyer Blinder Belle. "Even walking around on the inside of Building 92, you could see that it had gone uninhabited for so long that it would need a dramatic change."

Beyond the fundamental goal of adaptive reuse, the project team knew that Building 92 needed a new image, one that would celebrate not only its storied 155-year presence, but also its rebirth as a publically accessible center for visitors from the surrounding community and beyond. Inspired by the building's historical context amid shipbuilding foundries and machine shops, the team designed a laser-cut, perforated screen to serve as the addition's dramatic new facade, as well as to provide solar shading consistent with its new role as an energy-efficient structure. "Building 92's south side and forecourt needed to announce to all of Flushing Avenue that there was something new going on at the Navy Yard," says Leber.

Creating the new facade system called for a combination of modular and custom parts. Installed by ironworkers from Local 580, the customized ⅛-inch-thick, 8-gauge 3003-H14- and 6061-grade aluminum panels making up the perforated screen are fastened to outriggers forming part of a standard Kawneer curtain wall system with typically 78-by-48-inch panels. Matthew Berman, principal and co-founder at Workshop/apd explains, "The Kawneer system was set up to be a typical shading eyebrow on the storefront. We ignored the kit of parts and took the outrigger; we attached the screen

T.G. Olcott

Above Building 92's courtyard is bounded by a gate that echoes the facade's laser-cut aluminum screen.
Facing Building 92 showcases the history of the Brooklyn Navy Yard, once the nation's top shipbuilding facility, welcoming visitors with a 20,000-square-foot addition to one of the yard's historic structures.



Left The custom screen is fastened to an off-the-shelf curtain wall system.
Center The architects adapted the Kawneer curtain wall system to accommodate screen attachment without losing the standard manufacturer's warrantee.
Bottom A diagram of the building enclosure by Workshop/apd.

to a mechanically fastened, off-the-shelf portion of the curtain wall. As part of the window system, the manufacturer provided a clip tray that we were able to angle back into. The curtain wall is clipped to the steel frame, so it ties into it in both directions. We were able to meet a client-driven desire by over-exaggerating that louver system to turn it vertically and customize it, without losing the standard manufacturer's warrantee." The screen also averts the very real potential for Building 92's south-facing facade to act as a heat trap, helping the project target a LEED Platinum rating.

Another feature of the project that contributed to its LEED rating is its essentially modular steel construction. The design team faced the challenges of ensuring prefabricated modules would provide the necessary dimensional tolerances for both curtain wall and solar screen. "Eventually, prefab meets field conditions," says Berman. "Placing a perfectly square prefab module on a crooked foundation still makes for an un-level floor, so you have to ensure precision throughout."

The architects worked with a modular construction company whose business was located at the Navy Yard site, along with structural steel fabricator and erector FMB Inc. "You can't get more local than that in terms of procuring your materials," says Leber. And because the materials didn't have to travel across highways or through local streets to be delivered—it was less than a block from manufacturer to site—the teams were able to design a larger-than-typical module (just over two stories) desired by the architect. Says Leber, "Building 92 is considered half-commercial and half-institutional, and we had aspirations for a larger floor plate, higher floor-to-floor heights, and other things that made our module unusual." Consequently, the whole project from design to execution took 18 months, with screen installation spanning less than a week.

In addition to mitigating solar load, Building 92's public side would have to function as an iconic billboard for the building. The perforated facade's graphic design was realized using a photo of the USS Brooklyn from the Brooklyn Navy Yard's archives. The choice to use an image of a ship in dry dock (seafarers' terminology for "in fabrication") was

Left: Workshop/apd; top and center: T.G. Olcott

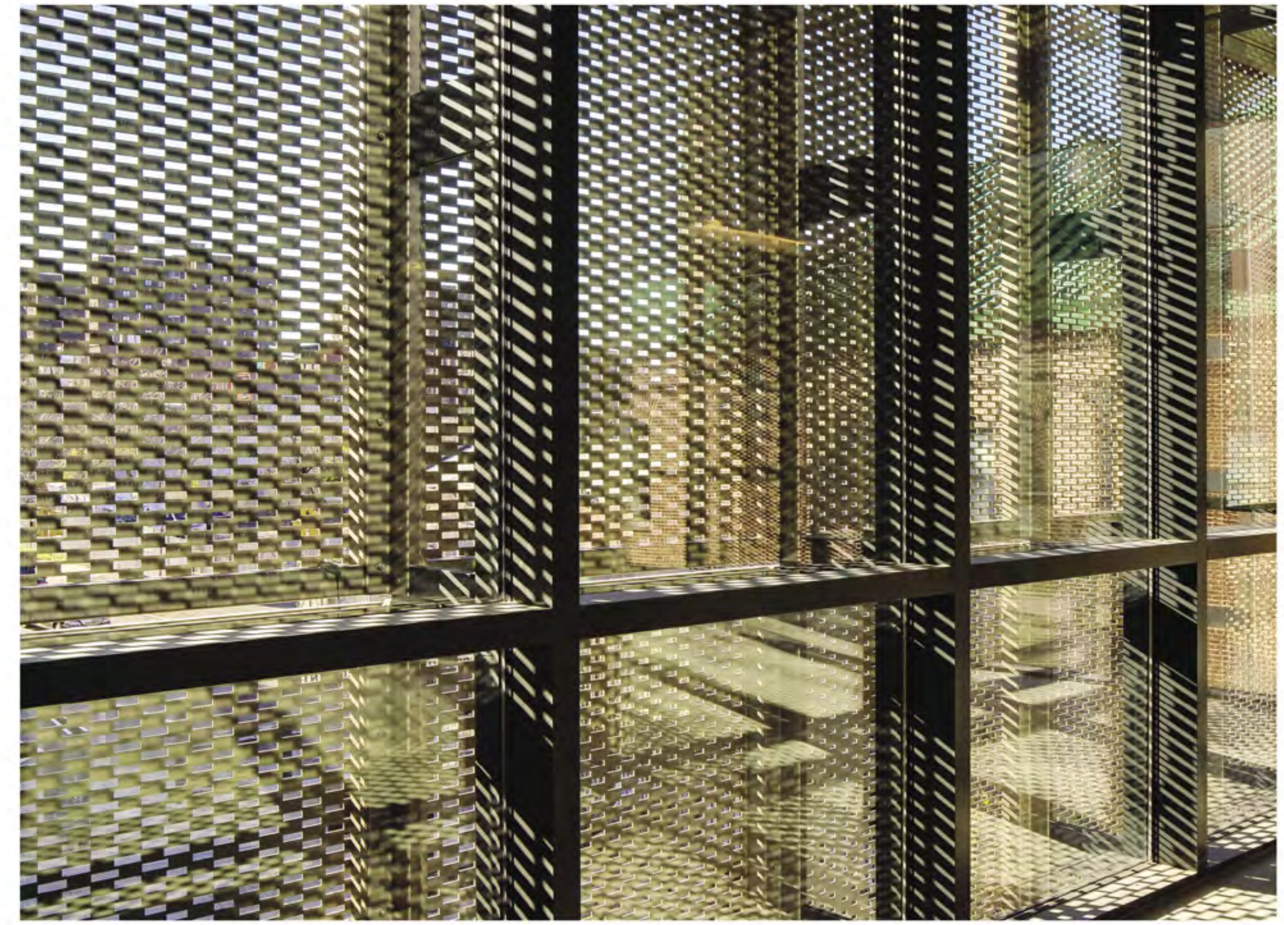
T.G. Olcott

This page The building houses exhibition areas, space for job training programs, offices, and a cafe.

befitting, considering that the Brooklyn Navy Yard once served as the nation's largest naval shipbuilding facility. The design architects at Workshop/apd digitized and interpreted the 1936 photograph into a CAD drawing, which was then translated into the perforations of various sizes on the screen. The contrasting shades of the original black-and-white image translate into a pierced surface that moderates the building's heat gain and nods to Brooklyn Navy Yard's nautical past. Perforation size was informed by LEED stipulations regarding the necessary mitigation of natural light, and architects balanced the dual goals of reducing heat load and allowing natural light and visual access to the outside.

"We took an original photograph, turning it from photo to model to CAD," says James Krapp, project manager for Workshop/apd. Remember when you were a kid and you'd go to Sharper Image where you'd hold up that toy with all the pins in it, and make an impression of your face or hand? We took a black-and-white 2-D image, gave it depth based upon shade, and extruded those conceptual pins though a plain—the aluminum screen—to create the holes. We were given the opportunity to celebrate this little jewel and we wanted the addition to be

This page The facade's design was abstracted from a photo of the USS Brooklyn that is held in the Brooklyn Navy Yard's archives.
Facing The building is expected to use 44 percent less energy than a code-compliant building of the same size and type.



T.G. Olcott

"One of the greatest impacts of the building's renewed visual presence is that people are realizing that the gates are open."

Elizabeth Leber, Beyer Blinder Belle

cutting-edge and forward-thinking while remaining deferential to Building 92's history."

The firms worked closely with Airflex Industries to develop the engineering and mockup of the solar screen, with the goal of achieving the appearance of clean detailing from both interior and exterior vantage points of the building. With both pragmatic and aesthetic results, the Navy Yard is drawing further positive attention and activity to its once-overlooked environs. "The building is turning heads on Flushing Avenue," says Leber. "One of the greatest impacts of the building's renewed visual presence is that people are realizing that the gates are open. They can come in and take in its history at the exhibit center. The solar screen and glass curtain wall were designed to be welcoming and contemporary, but also to serve as a respectful backdrop to Building 92."

BLDG 92

Location: **Brooklyn Navy Yard, 63 Flushing Avenue, Brooklyn, NY**
Owner: **Brooklyn Navy Yard Development Corporation**, *Brooklyn, NY*
Architect: **Beyer Blinder Belle Architects & Planners**, *New York, NY*
Designer: **Workshop/apd**, *New York, NY*
Structural Engineer: **Robert Silman Associates**, *New York, NY*
Mechanical Engineer: **AKF Engineers**, *New York, NY*
Construction Manager: **Plaza Construction**, *New York, NY*
Curtain Wall Consultant: **Kawneer**, *Bloomsburg, PA*
Structural Steel Fabricator and Erector: **FMB Inc.**, *Harrison, NJ*
Miscellaneous Iron Fabricator and Erector: **FMB Inc.**, *Harrison, NJ*
Architectural Metal Fabricators and Erectors: **Airflex Industries**, *Farmingdale, NY*; **FMB Inc.**, *Harrison, NJ*
Ornamental Metal Fabricator and Erector: **FMB Inc.**, *Harrison, NJ*
Curtain Wall Fabricator and Erector: **Airflex Industries**, *Farmingdale, NY*
Metal Deck Erector: **FMB Inc.**, *Harrison, NJ*

INSTITUTE NEWS AND EVENTS

February 13: Dynamic Facades Conference

On Wednesday, February 13, 2013, the Ornamental Metal Institute of New York will host the *Metals in Construction* magazine Dynamic Facades Conference at McGraw-Hill Auditorium, 1221 Avenue of the Americas, New York, NY. For today's architects and engineers, a building facade is more than the sum of its parts. Empowered by advances in materials, digital tools, fabrication techniques, and multi-disciplinary collaboration, project teams are using the enclosure to regulate entire building environments. Their cutting-edge ideas are saving energy while pushing the limits of envelope design to new, unprecedented heights. Come away from this all-day conference better understanding the exciting new frontier of dynamic facades, hearing directly from many of the industry's most innovative architects and engineers. It's time to bring your project into the twenty-first century.

Catherine Houska Courses on Stainless Steel

From January 7-11, 2013, Catherine Houska, an internationally recognized expert on architectural metals, taught a series of AIA/CES approved courses on stainless steel to practitioners in the New York area. Topics included: Sustainable Stainless Steel Design, Stainless Steel Specification for Corrosive Applications, and Advanced Stainless Steel Specification and Problem Avoidance. Houska is an architectural consultant for numerous industry associations including the Nickel Institute (NI), International Molybdenum Association (IMOA), Ornamental Metal Institute of New York (OMINY), and Specialty Steel Industry of North America (SSINA).

James Carpenter Lecture

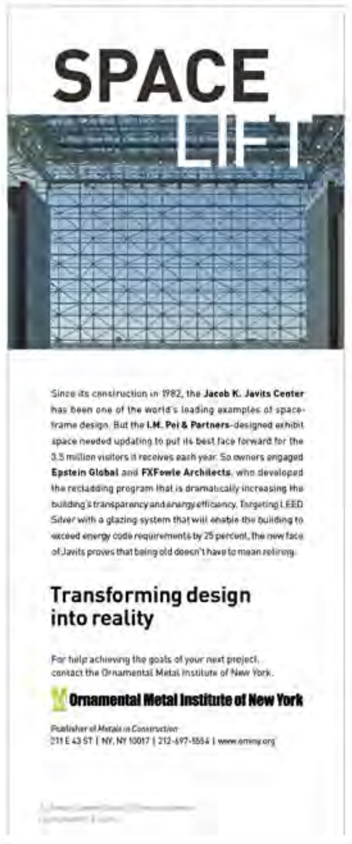
On October 15, 2012, the Ornamental Metal Institute of New York sponsored a lecture by James Carpenter at Pratt's Brooklyn Campus as part of the school's annual lecture series featuring some of the world's most accomplished architects and designers. James Carpenter Design Associates has worked on innumerable projects including 7 World Trade Center's Podium Light Wall as well as its lobby, the Time Warner Building, and the Hearst Building. Mr. Carpenter's guiding focus is how light transmission, reflection, and refraction inspire the design for a project and its environment.

Structural Glass Facades and Enclosures

Not simply a design or engineering book, *Structural Glass Facades and Enclosures* is an implementation resource for any of the stakeholders involved in a building project for which structural glass facade technology may be appropriate. The architect, engineer, owner/developer, general contractor, facade contractor, facade consultant, fabricator, material supplier, or erector will all find information relevant to their work, as will students. Author Mic Patterson is director of strategic development for Enclos, one of the largest U.S. specialty contractors with a focus on the design, engineering, fabrication, assembly, and erection of custom facade systems. Published by Wiley; ISBN: 978-0-470-50243-3.

For more information about upcoming Institute-sponsored events, visit WWW.SINY.ORG and WWW.OMINY.ORG.

Institute ads appear regularly in New York-area industry publications to let readers know that we can help turn their design aspirations into realities.



The labor to erect the structural steel on projects featured in this publication was provided by the following labor unions:

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Kevin O'Rourke
President and Business Agent

Daniel Doyle
Recording Secretary and Business Representative

LOCAL UNION NO. 361
International Association of Bridge, Structural Ironworkers & Riggers
89-19 97th Avenue
Ozone Park, NY 11416
(718) 322-1016

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LOCAL UNION NO. 14
International Union of Operating Engineers
141-57 Northern Boulevard
Flushing, NY 11354
(718) 939-0600

Edwin Christian
President and Business Manager

LOCAL UNION NO. 15 & 15-D
International Union of Operating Engineers
44-40 11th Street
Long Island City, NY 11101
(212) 929-5327

Daniel Schneider
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www.siny.org
Steel Institute of New York

www.ominy.org
Ornamental Metal Institute of New York

The Steel and Ornamental Metal institutes of New York are not-for-profit associations created in 1972 to advance the interests of the structural steel and the architectural, ornamental, and miscellaneous metal construction industries. They serve a geographical area encompassing New York City and the adjacent counties of Nassau, Suffolk, and Westchester. Each sponsors programs to aid architects, engineers, construction managers, and developers in selecting structural systems and architectural metals for optimum building performance. Programs in which the institute is engaged include:

- Consultations extending to the preparation of preliminary design and construction cost analyses for alternative structural systems
- Consultations on design and finishes for bronze, stainless steel, and aluminum for architectural and ornamental ironwork, curtain wall systems, window walls, and metal windows and panels
- Seminars covering structural systems, economy of steel design, curtain wall systems, design, and use of alloys and surface treatments for miscellaneous iron work, and issues important to the construction industry addressed to developers, architects, engineers, construction managers, detailers, and fabricators
- Representation before government bodies and agencies in matters of laws, codes, and regulations affecting the industry and the support of programs that will expand the volume of building construction in the area
- Granting of subsidies to architecture and engineering schools and funding of research programs related to the advancement and growth of the industry
- Publication of Metals in Construction, a magazine dedicated to showcasing building projects in the New York area that feature innovative use of steel

Institute staff are available with information regarding the use of structural steel and architectural metals for your project by contacting institute offices at

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