METALS IN CONSTRUCTION

PUBLISHED BY THE STEEL INSTITUTE OF NEW YORK AND THE ORNAMENTAL METAL INSTITUTE OF NEW YORK
SPRING 17

7 LINE STATION AT 34TH STREET/HUDSON YARDS / 10 HUDSON YARDS / NEW YORK CITY POLICE ACADEMY / VIA 57 WEST / WORLD TRADE CENTER TRANSPORTATION HUB / CAPITAL ONE / P.S. 62 / PRISM TOWER

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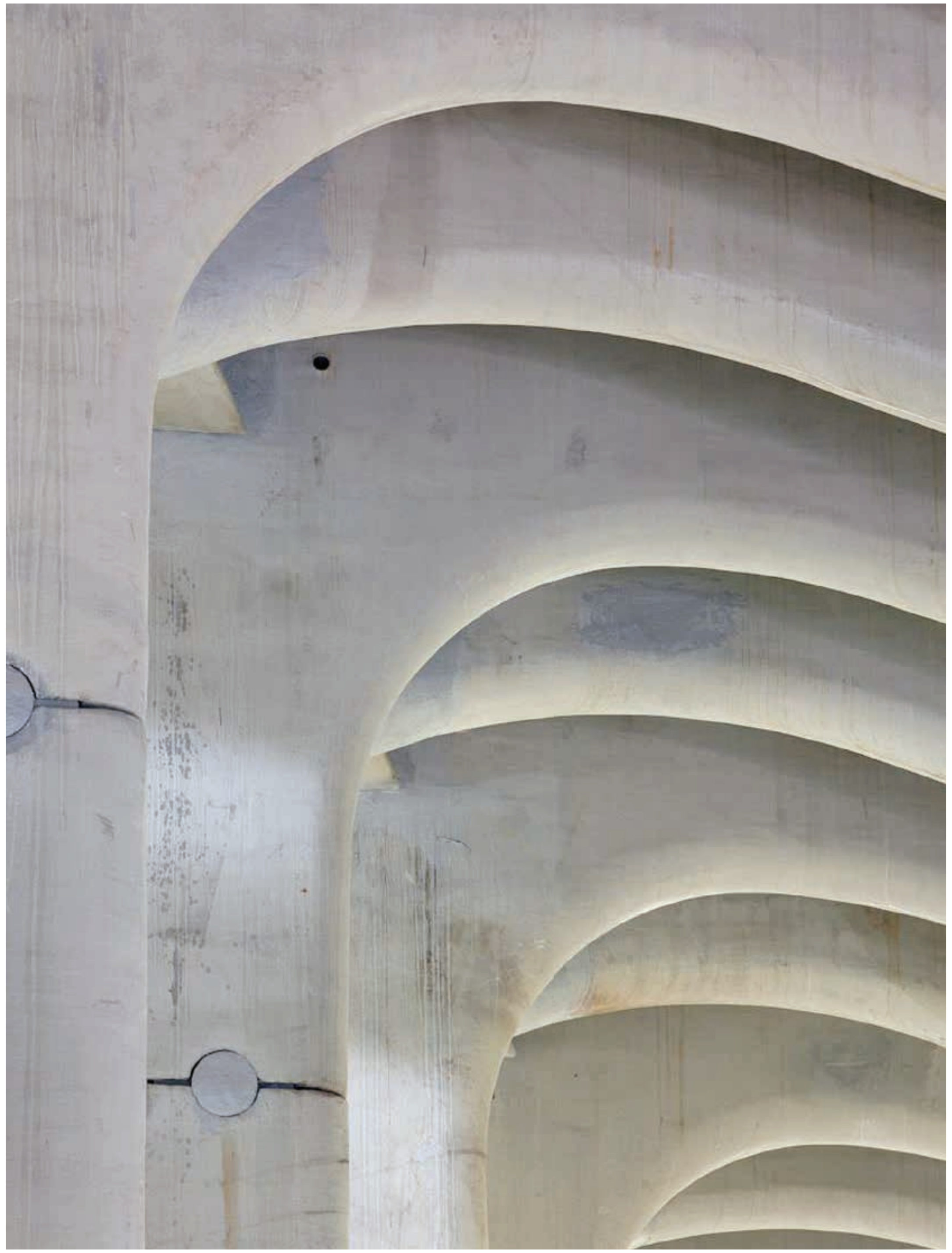
SPRING 17



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Above Structural steel elements of the World Trade Center Transportation Hub under construction.
Cover The eight-story staircase at the New York City Police Academy, designed by Perkins + Will.

James Ewing/OTTO; cover: Eric Laignel

EDITOR'S NOTE
Realizing the architect's vision

THE PROJECTS FEATURED in this magazine usually focus on design challenges and the innovative engineering and materials used to overcome them. Only briefly mentioned, but central to these stories, is the role of the highly trained, highly skilled union ironworkers who build them. The training, discipline, and dedication instilled by their union affiliation makes them a productive workforce that helps insure the success of every project in which they are involved. So I am using this space to acknowledge this role, and the preparation it requires. Ironworkers begin their careers with a three-year apprenticeship, attending regular nighttime classes at state-certified academies while employed full-time on construction projects to meet on-the-job training requirements. At the academies, they learn, among other things, to read construction documents, weld and cut steel, signal cranes and rig pieces for lifting. Most importantly, they learn to work safely in dangerous environments. They hone these skills on the job and gain experience in surmounting the unique challenges that come with building skyscrapers and bridges. After completing this highly competitive and rigorous apprenticeship, they become journeymen. But the training does not end here. Neither does the rigor of their apprenticeship. As journeymen, they have the opportunity to acquire advanced certifications, adding to the competencies they can offer employers. On a typical day, ironworkers arrive at the job site prior to an often 6 or 7 a.m. start of their shift in order to prepare for the day's assignments. The work is fast-paced, with every task and movement planned so that productivity and work quality remain high without sacrificing safety. This relies on each being a team member always performing at his or her best. It takes dedication, knowledge, good mental attitude, and not least, the ability to function in demanding physical, often brutal environments—especially when working at heights of several hundred feet exposed to frigid winter winds. Yet for the men and women who are ironworkers, completing a job under these conditions makes the work even more satisfying. So, when you read the articles in this issue and marvel at the design and planning that went into them, keep in mind that it was the ironworkers' dedication that played a key role in realizing the designer's objectives. Whether it is the skillful installation of a new sculpture at Capital One or the highly technical erection of Ten Bryant Park's multi-faceted curtain wall, the projects featured in this issue showcase the talents of the ironworkers and of the Steel and Ornamental Metal institutes' contractor members who employ them. Together they represent a vital asset within New York City's building community.

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The angled elevators promote both rider convenience and construction efficiency. “Had we done normal elevators which went straight down from this entrance,” says Richard Dattner, “that would have been half a block away from the station, and you would have had to go through a long, creepy, potentially dangerous-feeling tunnel. Putting the inclined elevators right next to the escalator, nobody feels cut off from visibility, so everybody feels safe. That was a very important consideration. Plus, it saved an incredible amount of tunneling through rock."

7 Line Station at 34th Street/ Hudson Yards

The structures and surfaces of the MTA’s new Hudson Yards subway terminal make the most of steel’s strength, elegance, and durability. Designed around deep, challenging site conditions and built to accommodate the area’s dramatic expansion, the 7 line’s westernmost station is the system’s futuristic flagship.

DESCENDING 125 FEET FROM STREET LEVEL to reach the platform at the new 34th Street/Hudson Yards station on the Metropolitan Transportation Authority (MTA)’s 7 line, a rider has a choice. To the right, the major segment of the trip (from the upper to lower of two mezzanine levels) takes some 50 seconds on an escalator, the New York transit system’s longest; to the left, it’s about two minutes in an inclined elevator, the system’s first. All other factors being equal, hurried commuters familiar with the different speeds would logically head for the escalator.

Still, some pick the elevator anyway. It may be te closest thing the MTA has to a carnival ride. Its shiny glass cars in large, well-lit tunnels, a refreshing contrast to claustrophobic counterparts at other deep-seated stations, offer a novel angle of descent. Riders on ascending and descending cars sometimes wave to each other as they pass. Close observers may notice the border between cut-and-cover construction and the long cavern mined through pegmatite and schist. If only briefly, a moment of childlike discovery brightens the everyday activity of getting around New York.

The MTA rarely adds stations. The system’s budgetary and operational challenges are well-known causes of complaint among New Yorkers (especially those who forget what a rare privilege it is to have 24-hour transit available at all); just keeping the system running in its current state is a stretch, and the addition of the Second Avenue line, planned since the 1920s, has taxed the authority’s resources further for years. Yet 34th/Hudson Yards, the first new station built since 1989 and “the largest single-line station in the system” according to Dattner Architects’ principal-in-charge Beth Greenberg is an ambitious work of infrastructure, a potent catalyst for the Hudson Yards mixed-use development. Its reliance on structural and stainless steel helps it overcome substantial site challenges and makes it the subway system’s most forward-looking component. At $2.4 billion, the project is not cheap, yet its design/construction team brought it in on budget and ahead of schedule. It reflects a long-term investment by multiple civic agencies in a better-quality transit experience, implying a new system-wide sense of what MTA passengers deserve.

The new station extends the IRT 7 line from Flushing westward into this up-and-coming neighborhood. Since the 7 crosses all major north-south lines in the system, its extension past Times Square makes the West Side accessible throughout the MTA’s service region, usually with only a single transfer. The station provides access to the High Line area and Hudson River Park, makes the far-flung Javits Convention Center reachable on foot at last, and brings riders within a few steps of Hudson Boulevard, the new four-acre angled greenway by Michael van Valkenburgh Associates bisecting the blocks

between 10th and 11th Avenues from 33rd to 39th streets. The station opened in 2015, well ahead of the ridership surge that will justify its size and relative opulence (carrying an estimated 30,000 to 35,000 passengers during daily peak hours); it is designed optimistically for the future.

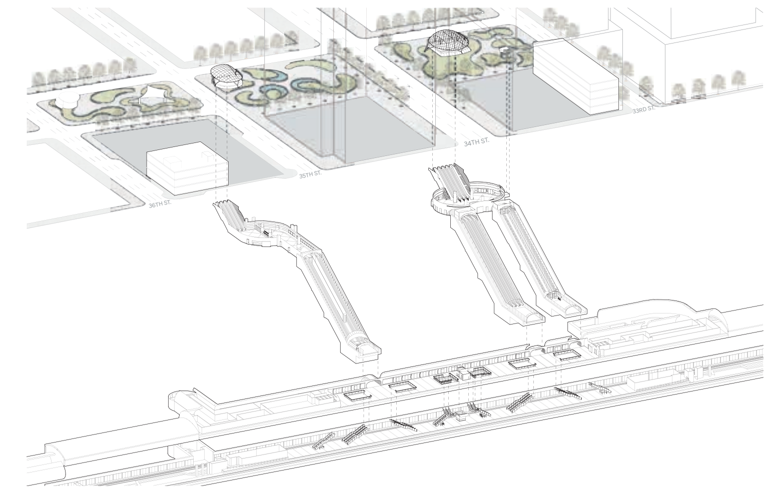
In the works for some 15 years since the Department of City Planning (DCP)'s Far West Midtown master plan under Mayors Giuliani and Bloomberg, 34th/Hudson Yards benefits from multiple stages of scenario planning. "In the original early phases of the design," Greenberg recalls, "we were also planning for a stadium [and thus] a stadium crowd": the West Side Stadium first intended as a keystone of New York's bid for the 2012 Olympics, then reimagined for Jets football, then scuttled amid community and political resistance. Collaboration among DCP, the Hudson Yards Development Corporation, the MTA, and New York City Transit was "one of the really unsung miracles, in a way, of this station," she continues.

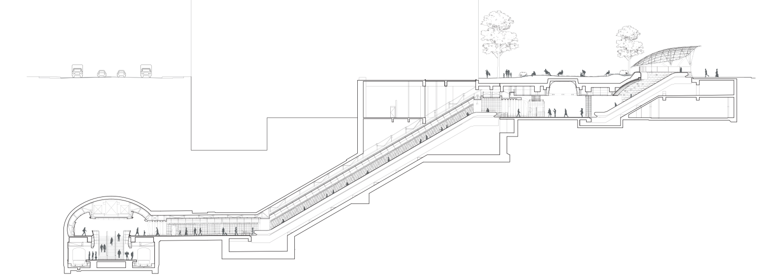
Subterranean conditions were complicated enough to make realization of the design even more miraculous. "Even though on the surface we were dealing with [a] vastly underutilized urban area," Greenberg says, "underground we were dealing with a very dense built-up infrastructure" that included Amtrak's Albany line and current Hudson tunnels plus the Lincoln Tunnel with its bus ramps into the Port Authority terminal. Within this dense transit nexus, the Dattner team's initial design allowed for two stations, one at 10th Avenue and 41st Street (proposed but deferred, depending on future funding) and the 34th/Hudson Yards terminal station that opened in 2015. The total rock excavation for the project by tunnel-boring machines came to 326,700 cubic yards.

Approaching such a deep platform beneath 11th Avenue, and mining through an ancient stream bed at 10th under the Lincoln and Amtrak tunnels, the station as built includes two intermediate levels, connected by five high-rise escalators and the pair of inclined elevators. An upper mezzanine 27.5 feet below street level, reachable by four low-rise escalators, two staircases, and an ADA-accessible elevator from the external park, houses the fairway and steel-and-glass "station service center" comprising the MetroCard/information booth and safety systems; a lower mezzanine 109 feet below street level leads to eight staircases and an ADA elevator descending the last 16 feet to the platform. There are interlockings (signaling systems) north and south of the station, facilitating the increased number of trains and improved service that this extension provides. A separate north entrance in Hudson Boulevard Park with four additional escalators is still under construction at this writing, with a structural shear wall between elevator banks for the Yards' overbuild integrated into the tunnel. Additional system buildings at 41st and Dyer Avenue, 36th and 11th, and 26th and 11th assist with heat exhaust; the station has the largest tunnel-ventilation fans in the entire subway system. The extension to 34th/Hudson Yards can more accurately be termed a complex of distributed components than a single station.

Dattner describes the station as "a hole in the rock with a concrete lining, but inside there, there's steel armature that really makes the tunnel, because all these things that you see there are hung off steel." Steel is essential to both the structure and the interior finish of 34th/Hudson Yards: the tunnel and escalator/elevator complex are supported by a large steel-truss understructure, and the facing of the lower mezzanine and platform is a system of porcelain panels supported by steel girts following the contours of the cavern. For the E2 tunnel structure above the finished ceiling, the arches are L5x5x¾ at 5 feet on center (OC); the center top of arch running the length of the tunnels is a WT8x20; arches are tied back to the cavern at approximately 10 feet OC by three sets of two L3xL3x½. The truss structure in the inclined elevators (the E1 tunnel) at top and bottom uses a truss width 7 feet, 4.58 inches and height 5 feet, 6.93 inches, a 140x140x8mm tube, an HLS 300 runway beam 11.02 inches deep, and runway beam/rail support at approximately 19 feet, 6 inch intervals over a length of 181 feet. The high-rise escalators' truss width is 5 feet, 4⅝ inches (typical), with an HSS4x2x¼ top chord and truss support at approximately 17-foot intervals. The 15-foot modules of tripartite panels between steel bands allude to the distance between steel columns found in many older stations, suggesting systemic continuity without actual columns interrupting the space.

Clockwise from above Steel girts following the contours of the tunnel support a system of porcelain panels. Diagrams of the station's angled elevator and escalator entrances. The entrance escalators of the station's upper mezzanine.





All photos © David Sundberg/Esto; diagram: Dattner Architects

Since the MTA's performance requirements included a ban on painted finishes to conserve maintenance labor, Greenberg notes, the station's interior uses a palette of three basic materials: granite flooring, perforated porcelain-enamel-coated steel for the upper walls and ceilings, and porcelain tile and stainless steel for the lower walls (textured stainless steel panels in between portal ribs, 14 gauge stainless steel Rimex panel, pattern 5-SM, finish/polish as supplied by the manufacturer; panels at ribs, fascia panels 16 gauge 316 stainless steel, polish #4; at the portal entry, ¼-inch-thick 316 stainless steel (shop-fabricated), polish #4; and between the lower-level mezzanine and platform, 14 gauge 316L stainless steel). The number and size of the perforations, she adds, were "carefully calibrated between the lighting requirements and the acoustic requirements"; the station is noticeably quieter than others in the system, owing to both the paneling and the use of resilient neoprene-padded rails, which minimize friction, heat, noise, and steel-dust generation by train wheels. The complex includes approximately 30,000 feet of running rail, and the station cavern (lower mezzanine and platform public areas) contains approximately 41,000 square feet of ceiling panels (stainless steel and porcelain enamel over steel combined), 6,500 square feet of stainless wall cladding, 6,000 linear feet of stainless trim of various heights (12 inches or less), and 2,000 linear feet of stainless railings, including about 1,000 feet with stainless mesh infill.

Another advantage of extensive panelization is that it facilitates access for upkeep and future modifications. A knockout panel in the lower mezzanine on the west side allows for future expansion: "should Javits or the West Side Yards choose to add another circulation element," Greenberg says, "either elevator or escalator or some combination, there is the potential for connecting directly into the station."

Dattner and Greenberg studied the Jubilee line of the London Underground, the connector to once-remote Canary Wharf, as a prototype for 34th/Hudson Yards. "I think we got from that, ideas of openness, transparency, allowing people to flow," he says. "We're using bright materials, good lighting, no columns"—qualities afforded by the structural steel framing. "We looked to modern prototypes rather than to the historic New York City stations." Transition portals between the mezzanines and escalator/elevator banks use a common language of steel arches with rhythmic ribs, organically suggesting pedestrian flows.

For such an advanced station to appear at a site that looks peripheral on the subway map may strike some observers as disproportionate. Another way to look at 34th/Hudson Yards, however, is to invoke Berthold Lubetkin's maxim that "nothing is too good for ordinary people," a principle that should arguably enjoy wider application in a democracy. The station's function and aesthetics both rely not on glitz but on the sturdiness of steel. As the West Side sprouts more residences, workplaces, and cultural magnets, New York's center of gravity is shifting; this attractive new gateway will help the whole region discover the city's promising western frontier.

Above The station's stainless steel and glass entrance canopy was designed by Toshiko Mori.
Facing Xenobia Bailey's *Funktional Vibrations* (2014) hovers above the entrance escalators and upper mezzanine.

7 LINE STATION AT 34TH STREET/HUDSON YARDS

Location: **34th Street/Hudson Yards Station, New York, NY**
Owner/Developer: **MTA Capital Construction**, *New York, NY*
Funding Partner: **Hudson Yards Development Corporation**, *New York, NY*
Architect: **Dattner Architects** (Richard Dattner, FAIA; Beth Greenberg, FAIA), *New York, NY*
Structural, Civil, MEP Engineer & Lead Designer: **WSP Parsons Brinckerhoff**, *New York, NY*
Consultant Construction Management: **HLH7** (joint venture of **Hill International**; **LiRo Engineers**, **Lemley International**, and **Henningson Durham & Richardson Architecture and Engineering**), *New York, NY*
Heavy Construction of Running Tunnels and Station Structures: **S3 II Tunnel Constructors** (joint venture of **Shea Construction**, **Skanska Construction**, and **Schiavone Construction**), *New York, NY*
Station and Systems Buildings Fit-Out Construction: **Skanska/Railworks, JV** (joint venture of **Skanska Construction, Inc.** & **Railworks Transit, Inc.**), *New York, NY*
Inclined and Connector Tunnels Heavy Construction and 33rd Street System Building Core and Shell: **Yonkers Contracting Company, Inc.**, *Yonkers, NY*
Structural Steel Erector: **Skanska Koch**, *Carteret, NJ*
Exterior Wall Systems/Cladding Erector: **Jordan Panel Systems Corp.**, *East Northport, NY*
Entrance Canopy Erector: **Enclos**, *New York, NY*

The 895-foot-tall 10 Hudson Yards, the first of 16 major buildings reshaping Manhattan's West Side, features an 82-foot-tall cable wall lobby façade and a trapezoidal 207-foot cable wall.

10 Hudson Yards

The first of 16 new developments on Manhattan's west side, a striking high-rise features an expertly crafted curtain wall system held together by high-tensile cables.

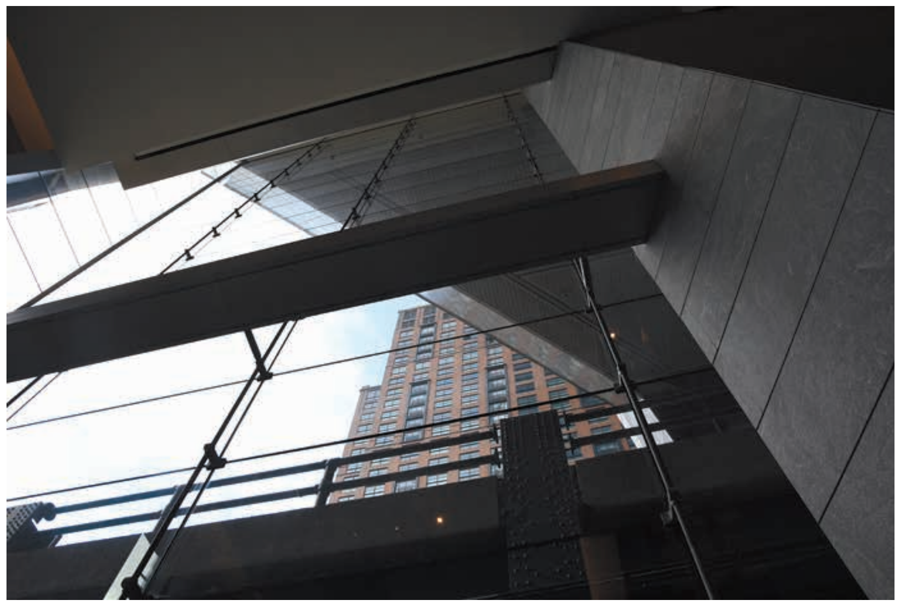
THE HUDSON YARDS PROJECT HAS been described as constructing an entire neighborhood from scratch. As the first of the development's 16 planned skyscrapers (and the only one not supported by two giant platforms over the East and West Rail Yards), 10 Hudson Yards showcases the beauty, engineering precision, and craftsmanship possible with today's cutting-edge curtainwall technologies. Designed by Kohn Pedersen Fox Associates (KPF), the 52-story building—anchored by the luxury fashion company Coach, Inc., features a multi-faceted shape and several intersecting curtain wall sytems.

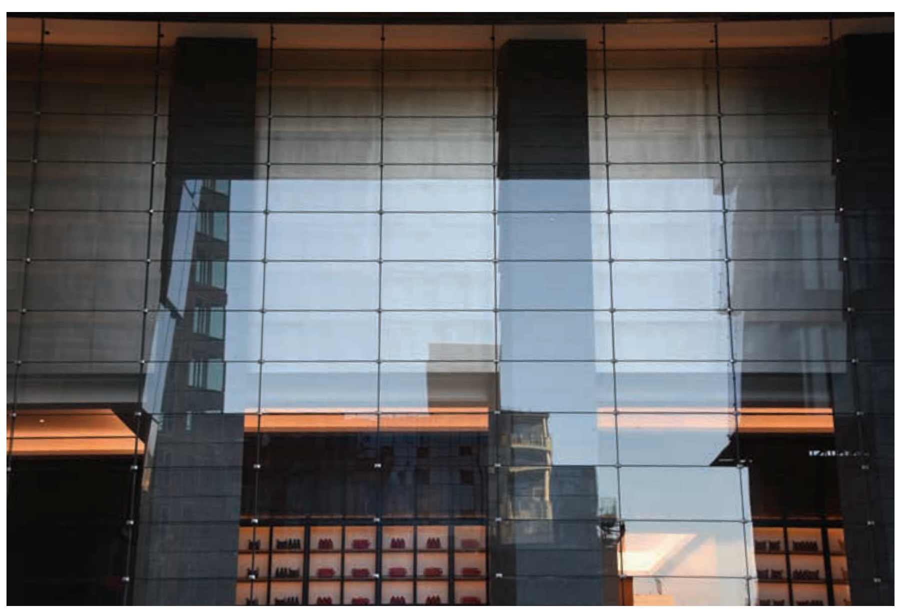
The southern façade of 10 Hudson Yards cantilevers over the 30th Street spur of the High Line, and the building's main lobby entrances to the west are directly accessible from the elevated park.

This unique siting made the creation of the lobby's 82-foot-tall cable wall façade and a trapezoidal 207-foot-tall Coach Atrium cable wall, which spans from the 6th floor to the 21st floor, a challenge for its designers and its installers.

Structural engineer Thornton Tomasetti, who provided structural and façade consulting services for the project, conducted a study of the atrium aimed at understanding the structural implications and façade issues involved in building a multistory atrium. The study led to the design of a one-way vertical cable system with intermediate beams supporting laminated glass panels through glass fittings. The tension façade system optimizes the façade's transparency, and provides the airy, open experience the design team desired for their tenants.

"In retail venues, the tension façade maximizes the available floor space for products





Top A stainless steel cast patch fittings on which cable wall glass is set. The fitting connects to a Galfan link locked tension cable—with such a large glass load, stainless steel cable was not an option due to limitations in stainless cable diameter and strength.
Center Glass was not drilled to create a connection to the fittings; instead, it is clamped in place at the corners to allow a specific amount of flexibility and rotation in the patch, allowing glass lites to safely deflect with the cable over the spans between structural members.
Bottom Tensioned cables support the Coach lobby façade, which runs along a section of the High Line.

This page and opening spread: W&W Glass

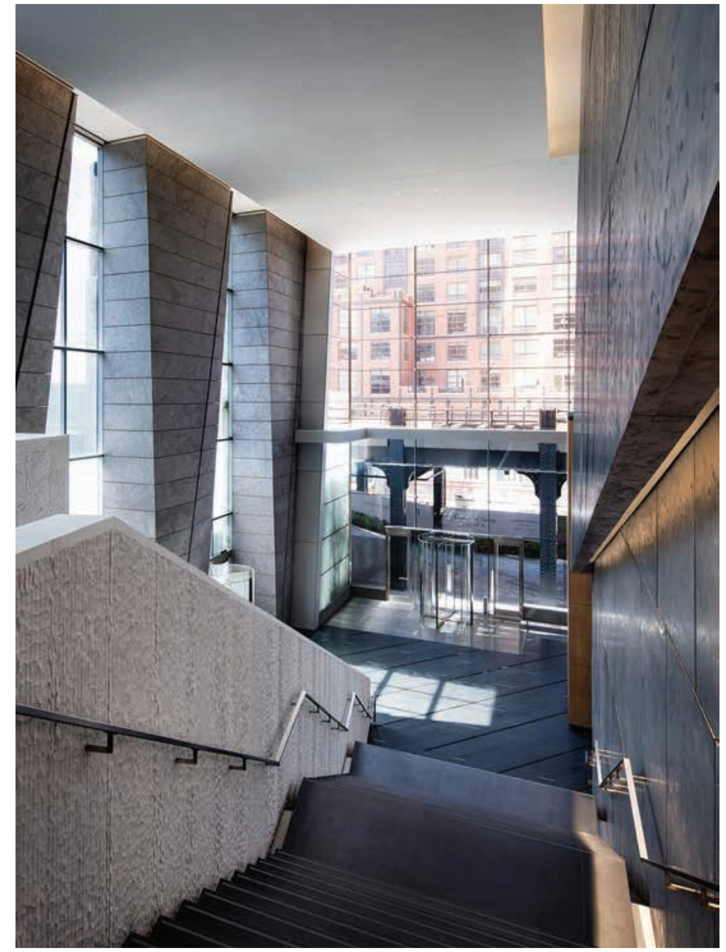
and services on display, while looking terrific, and in other public spaces, the lack of deep vertical mullions means easier and better circulation behind the façade," explains Michael Awad, an engineer for atrium and lobby curtain wall installer W&W Glass.

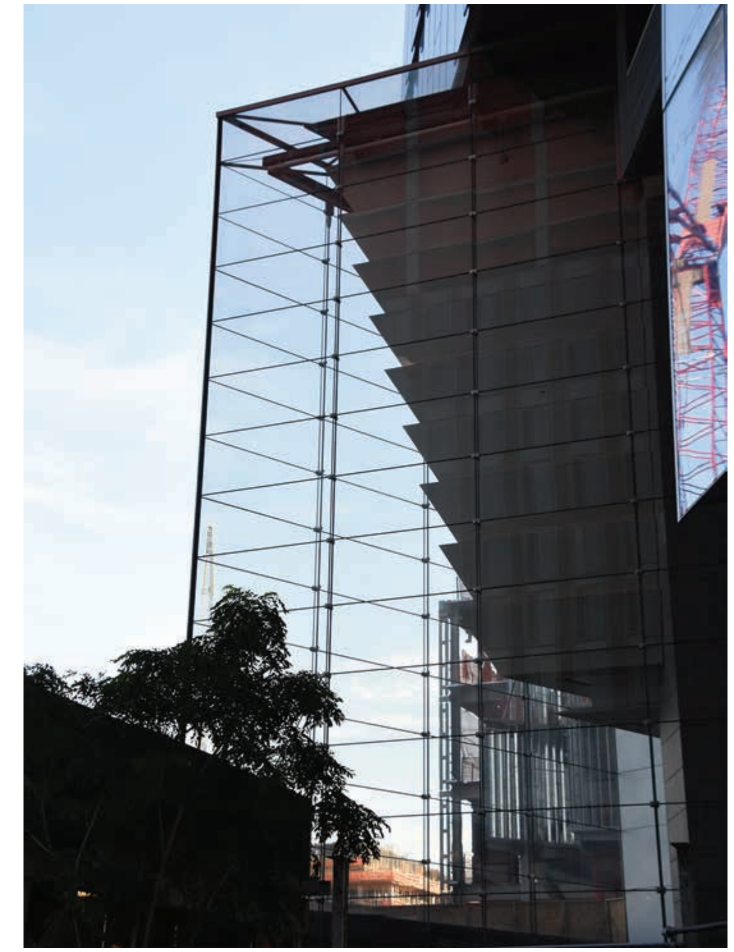
Analagous to stringing a tennis racket, the tensioning process involved imposing tens to hundreds of thousands of pounds on the surrounding structure, with large steel truss beams at the head of the opening and large reinforced embed plates at the sill. In spite of the additional steel and concrete required for this design, early planning for and coordination of the design among the entire project team helped control costs.

For the Coach wall, this design helped to cut down on the overall loading that otherwise would have been required at the head and sill of the 200-foot-tall wall by bracing the wall at every other floor laterally. A larger span would have required larger end reactions and cable diameters.

At the same time, designing, fabricating, and installing the tension façade system involved intensive structural analysis, performed by Thornton Tomasetti, taking into account details that are generally not critical in standard curtain wall design.

For this project, "there were many space limitations that affected the distance between the inside face of glass and the cable center," explains Awad. "This distance was important to both the macro structural engineering analysis and the detailed analysis of the hardware that joins the glass to the cable. Thus, it was critical to balance the size and spacing of the hardware that joins the cables to the building superstructure with the size and spacing of the fitting hardware that controls the glass to cable relationship."





Left A view of one of the building's entrances beneath the High Line from the upper lobby.
Right Exterior of the lobby cable wall that wraps underneath the tower at the southwest corner, connecting with the High Line and the shingled exterior façade above.

Left: Steve Freihon; right: W&W Glass

Due to the tension façade's heavy loads, stainless steel cable was not an option as it is not available in the diameter and strength levels required. So, as an alternative, the team selected a Galfan link-locked galvanized cable, which has an extremely high load-carrying capacity, for the Coach wall and the lobby walls.

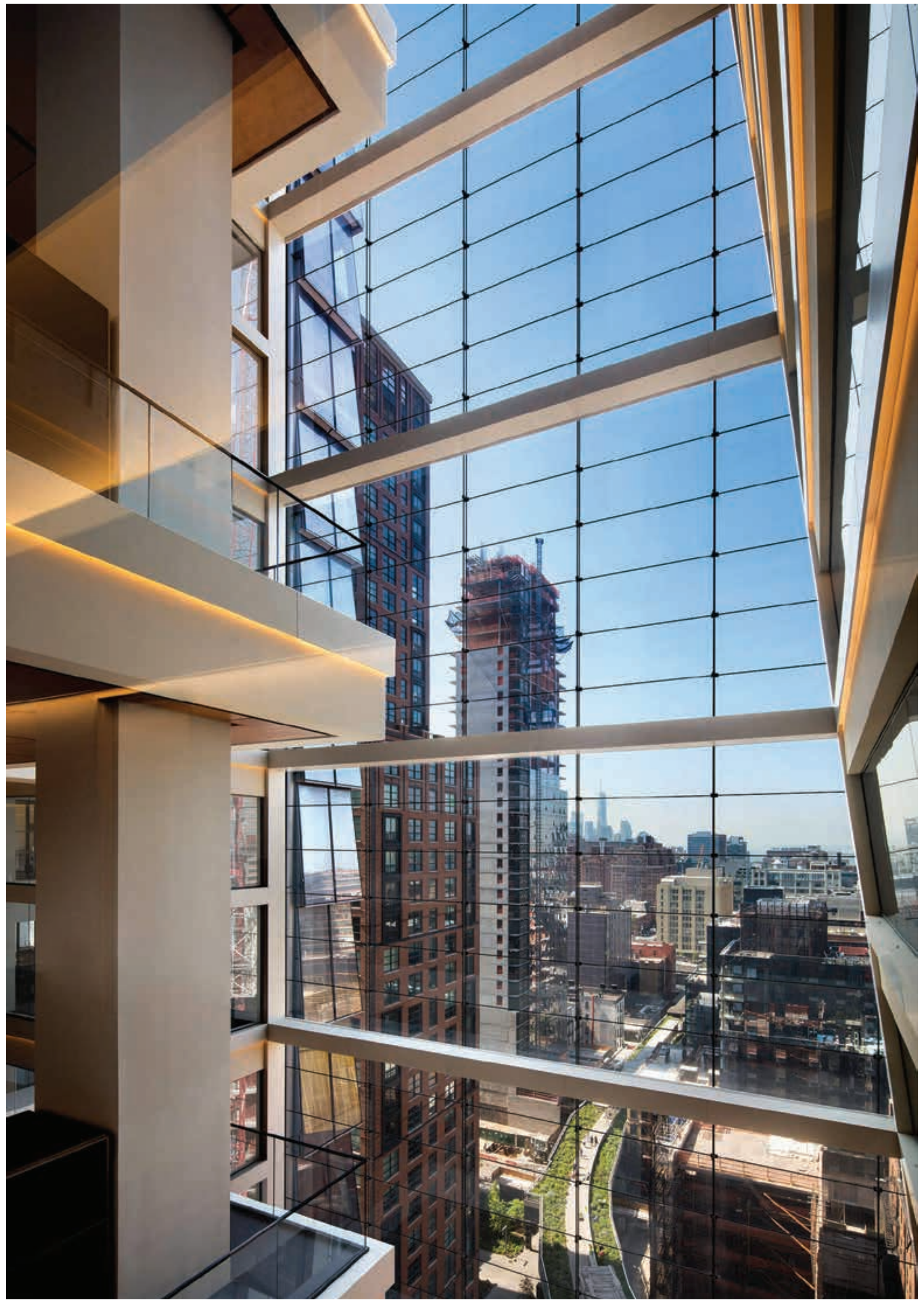
The "link-locked" cable is a stranded wire material made from wire that is drawn in a "Z" shape rather than a cylindrical section, according to Awad. "These 'Z'-shaped wires are wound together in the stranding process in such a way that the exterior of the stranded wire is extremely smooth, in contrast to typical wire rope and strand made from round wires."

The architects opted to clamp the glass in place at the corners to provide a level of flexibility and rotation in the patch fittings so that the glass lites would safely deflect with the cable over the spans between structural members.

As for the Coach Atrium wall, kickers tie back every vertical cable to horizontal steel beams every two floors, or approximately every 27 feet. The kicker tieback module was driven by both KPF's desired aesthetic and an interest in keeping cable diameters and cable end reactions to economical levels on the structure, per Thornton Tomasetti.

In order to support the façade's gravity loads from the 52-story tower, anchors embedded in the slab at the top of each unitized system unit carry the load back to the primary structure.

"Wind loads on glass panels are transferred through the split mullions to the top and bottom of the unitized panel," says Zach Wiegand, an associate with Thornton Tomasetti. "The top wind load is transferred directly to the slabs through the anchors, and the bottom wind load is transferred to the unit below via a splice plate, and then into the slab anchor. The anchors themselves are essentially aluminum angles or hooks bolted to the top of the slab in



Left The dramatic 21-story Coach Atrium offers a clear view of the High Line and downtown Manhattan. Its units are approximately 13½ feet high by 5 feet wide.
Facing The Coach Atrium is a 207-foot-tall trapezoid-shaped Pilkington Planar Optiwhite low-iron laminated glass tension cable façade spanning from floors 6 to 21. The wall is highly visible from the High Line from the south.

recessed pockets, located specifically for each anchor."

At the atrium cable wall, all dead load is transferred to the top through the pre-tensioned cables, he explains. Wind load is transferred equally to the top and bottom of the wall through axial tension in the supporting cables.

Reflecting back on this colossal curtainwall project, Wiegand suggests that detailing the unitized shingled façade was perhaps the most challenging aspect as there was no "natural" location to position the stack joint and mullion splices since adjacent units are not coplanar. To address this, special adapters were bolted to the top of the units to transfer the loads.

In addition, implementing the cable wall design was challenging because cable tensions result in large deflections of the supporting primary structure. "At the lobby, the cable wall actually wraps a corner, so shear straps were integrated in the horizontal glass joints to manage deflections at the corner," he says.

Moving on to the next project, 30 Hudson Yards is rapidly rising from the ground on its way to a 90-story summit. The 2.6-million-square-foot office tower, also designed by KPF and already committed with tenants, will feature a large curtain wall system, spanning the majority of the structure. In addition, the building will showcase a dramatically cantilevered observation deck, accessible to the public.

While 10 Hudson Yards slopes toward the river, 30 Hudson Yards will gesture toward the city, thereby creating a changing profile from different skyline vantage points. The two buildings will join together via a bridge occupied by shops, restaurants, and a new wave of visitors to a neighborhood like none Manhattan has seen before.

"The lack of deep vertical mullions means easier and better circulation behind the façade."

Michael Awad, W&W Glass

Steve Freihon

Courtesy Thornton Tomasetti

10 HUDSON YARDS

Location: **10 Hudson Yards, New York, NY**
Owner/Developer: **Related Properties**, *New York, NY*
Architect: **Kohn Pedersen Fox Associates**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Mechanical Engineer: **Jaros Baum & Bolles Consulting Engineers**, *New York, NY*
Construction Manager: **Tutor Perini Corporation**, *New York, NY*
Curtain Wall Consultant: **Thornton Tomasetti**, *New York, NY*
Curtain Wall Fabricators: (atrium and lobby) **Pilkington Planar**, *Hauppauge NY*; **Tripyramid Structures**, *Westford, MA*; (podium) **Coordinated Metals**, *Carlstadt, NJ*; (tower façade) **Enclos**, *New York, NY*
Curtain Wall Erectors: (atrium and lobby) **W&W Glass**, *Nanuet, NY*; (podium) **Coordinated Metals**, *Carlstadt, NJ*; (tower façade) **Enclos**, *New York, NY*

An eight-story stair connects the academy's office and training floors and creates a sense of community. **Facing** The campus's main entrance on 28th Avenue in Queens.

Eric Laignel

Ed Hueber

New York City Police Academy

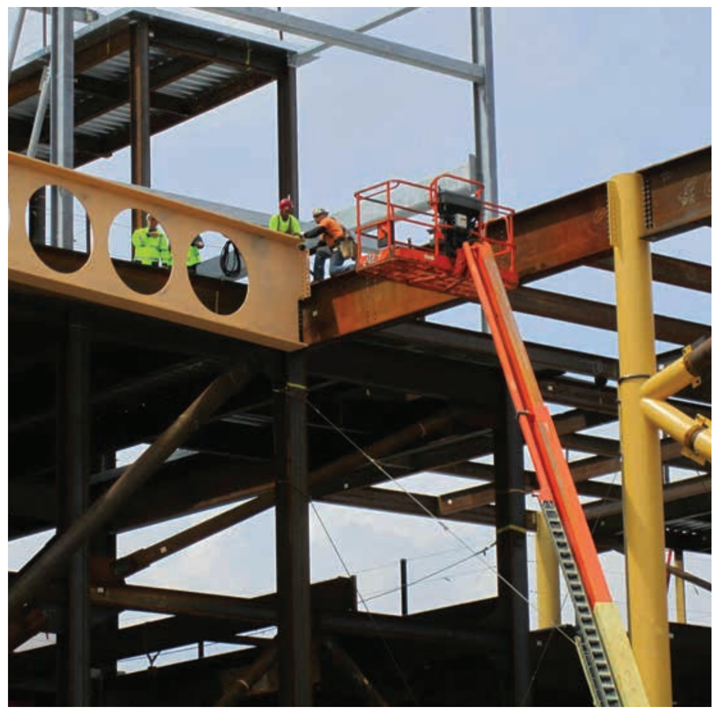
The largest public building in New York to achieve LEED Gold certification, a new campus prepares recruits for success with considerations for optimized training conditions, quickly evolving technology, and adaptation to future requirements for public safety.

IF YOU CAN MAKE IT here, you can make it anywhere. Or so should be the tagline of the New York City Police Academy's new campus in College Point, Queens. Its 730,000-square-foot phase-one facility triples the space of the New York Police Department's former Manhattan-based academy, and thanks to the project's tremendous scope, "this was our opportunity to dream big and to think long-term," says NYPD Inspector Michael S. McGrath, the commanding officer of the Cadet Corps. Now recruit officers train for urban water rescue in a designated aquatic center, read the nuanced body language of robbery in a mock bank environment, and outsmart virtual threats in cyber-terrorism classes. Whatever a young police officer may encounter in her service to New York, she will likely have confronted its simulation inside this city-within-a-city first. Realizing this facility required as many structural solutions as there are training scenarios.

Although first proposed in 1985, the project as it is now completed got its kickoff in 2007, when city officials selected an NYPD tow pound near Flushing Bay—a wetland landscape—for conversion into the campus. Shortly thereafter the city's Department of Design and Construction, which supervised redevelopment, contracted with architect Perkins+Will with Michael Fieldman Consulting Architects, and the academy was formally dedicated last December. In the interim it earned two superlatives—as the first consolidated police academy campus in New York history, and its largest public building to earn a LEED Gold rating.

Perkins+Will senior project manager Laurie Butler remarks that, to accommodate the academy's diverse program, the designers had to tap deep expertise in educational and office buildings, "and we partnered really well with the police to develop physical training facilities. These typologies aren't unusual, but the accumulation of them all in one place is." In turn, the team made sense of the various uses by distributing them into a Recruit Academic Building and Physical Training Building along an east–west axis.

Standing eight stories tall and organized around a glass-walled atrium, the academic building includes classrooms, a naturally illuminated auditorium that seats 800 students, library, and offices,



as well as mock environments like that vulnerable bank. Meanwhile, the so-called PT building includes the cafeteria, 75-foot-long pool, and 45,000-square-foot gymnasium that spans 180 feet without interruption. An intertidal canal divides the two volumes, while the wings are bridged by an artery known as Broadway: The glass-enclosed circulation volume integrates with the south elevation of the academic building, emerges from it to traverse the canal, and then meets the PT building at its eastern elevation. By straddling the waterway, the program-led organization of the campus both enhances wayfinding and minimizes impact on local ecology.

The wetland landscape did present other challenges to the structural engineering team comprising Silman, Guy Nordenson and Associates, and Weidlinger Associates. Prior to serving as a tow pound, this area of College Point was ostensibly constructed from fill, subjecting the contemporary site to significant settlement concerns that require transferring structural load to bedrock via deep piles. According to Thomas Reynolds, an associate at Silman, the academy stands atop more than 3,000 of these 14-inch-diameter steel pipe piles, which were driven 165 feet below grade on average and filled with concrete. In addition to the buildings, phase one of the campus includes a central utility plant located immediately to the west of the PT building.

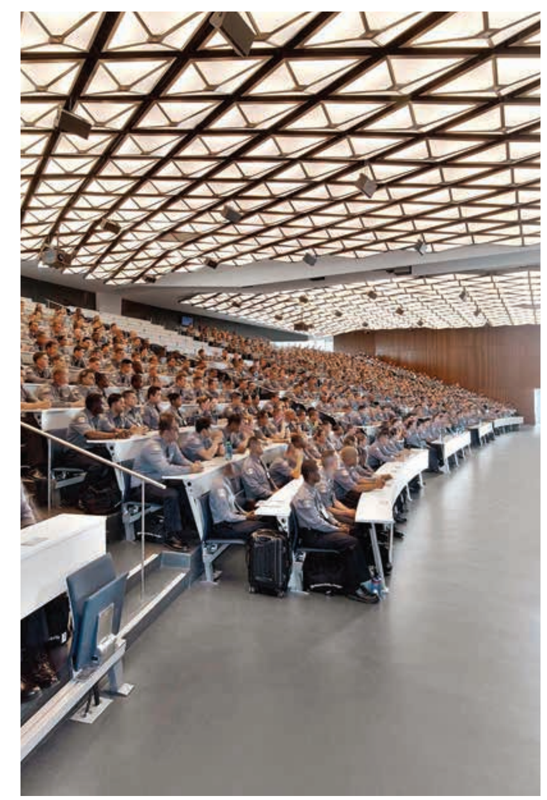
While security prevents disclosure of detailed structural solutions, those same concerns figured

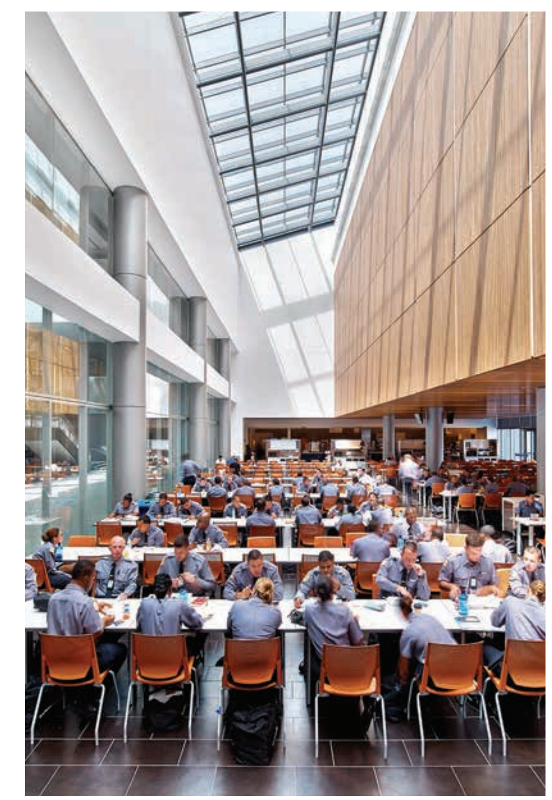
Clockwise from top left A connection point for Vierendeel truss columns. Installation of 60-inch-deep cellular beams every 10 feet on center over the academy's long-span spaces. Ironworkers from Stonebridge Steel Erection move a cellular beam into place. Concentric braced frames visible from training areas are made of 20-inch-diameter concrete-filled pipe columns and 16½-inch-diameter braces.

This page: Stonebridge Steel Erection

This page: Eric Laignel

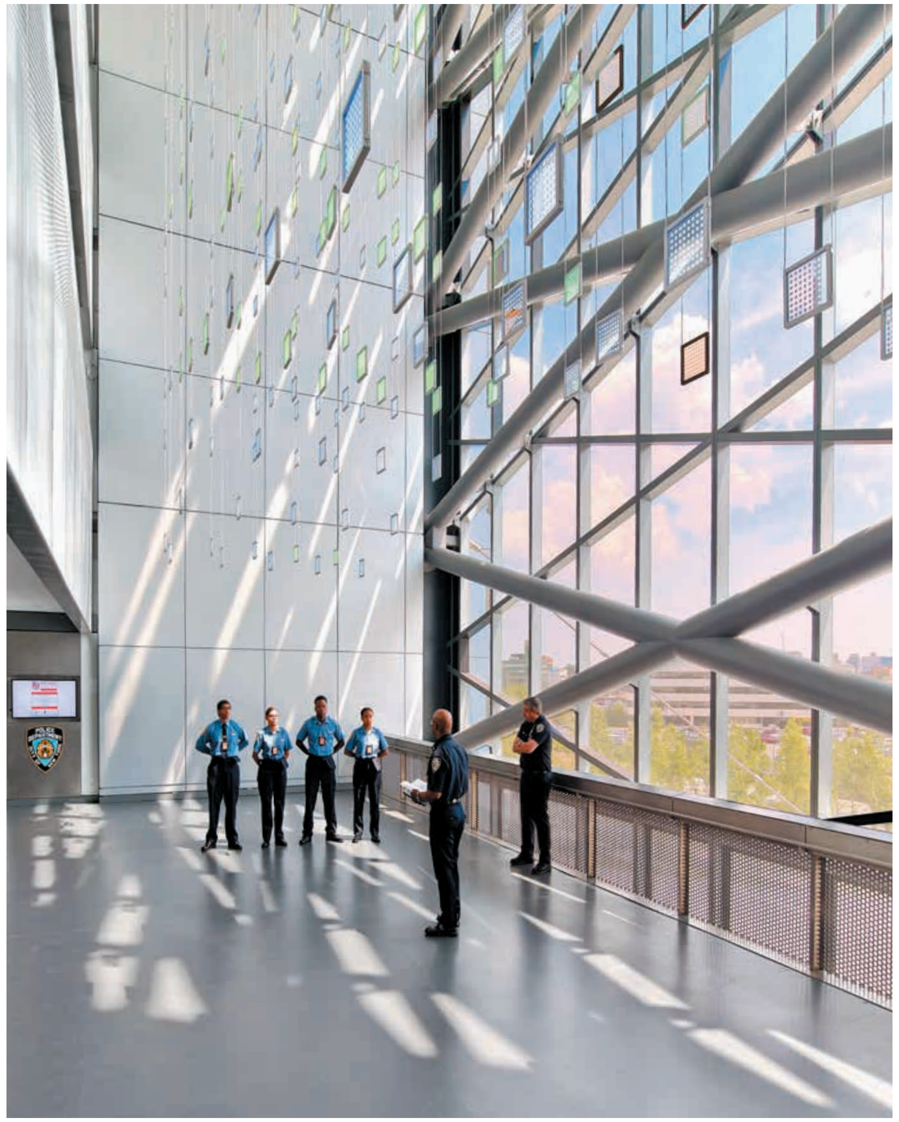
Clockwise from top The 45,000-square-foot gymnasium spans 180 feet without interruption. A skylit cafeteria space can seat 800 cadets at once. Lit naturally, an auditorium also seats 800 students.





largely into the structural design of the utility plant and buildings, such as the requirement that it prevent progressive collapse. "In addition, the owner chose to voluntarily upgrade the building to a higher structural occupancy category, so the campus could function as a staging area for emergency response teams during a natural disaster," Reynolds says. "The decision created need for a more robust structural design than what was required by code based on usage classification."

The team considered eleven different structural systems to accommodate these worst-case scenarios, and ultimately chose



steel frame with concrete-on-metal deck floors. Reynolds says of the decision, "It was most sensible in terms of progressive collapse, flooding, and cost efficiency, and it allows the NYPD the most flexibility to make future changes." McGrath underscores the latter point, observing, "Before 9/11, we were a traditional police department that looked for the bad guys. Who knows what the next change will be? We train for all of it."

In the central utility plant, bays averaged 20 feet by 35 feet to accommodate large MEP units, with W24x55 infill beams with thirty-four ¾-inch-diameter shear studs spaced 10 feet on center. Typical bays in the physical training building were much larger, to accommodate column-free space in dining, aquatic, and gym spaces, Reynolds explains; these bays mostly measured 60 feet by 30 feet through the second floor and were framed with 60-inch-deep cellular beams at 10 feet on center. Thirty-by-thirty-foot bays in the academic building feature W18x50 infill beams with twenty-four ¾-inch-diameter headed shear studs welded 10 feet on center.

Preparing the NYPD for its array of present-day training needs also meant deviating from these norms. Reynolds says the various solutions demanded that fabricator Cives Steel Company produce "wide flanges, heavy shapes you roll only twice a year, some types of tubes, you name it." The building uses 6,000 tons of steel in all, much of it A992 Grade 50 structural steel.

In the cavernous gymnasium, for example, the 180-foot spans comprise 66-inch-deep AESS cellular beams that weigh 290 pounds per foot and feature cambering 10 inches at the center, and they are spaced 30 feet apart perpendicular to the long span. The cellular beams are framed into W40 girders on each end, but not before they were spliced together on the ground in 60-foot-long sections and lifted into place. "The beams also had to be specifically detailed to retain composite action, with a skylight cutting through the center of the span," Reynolds adds, "and this was done by welding a tube to the top flange of the cellular beams and filling the tube with concrete and studs."

While the academy conceals many other custom solutions—Vierendeel trusses support a 90-foot-high visitor entrance, for instance—many others are incorporated into the experience of the architecture. In addition to the gymnasium's mighty roof, special concentric braced frames are visible immediately behind the glazing of Broadway and the atrium; their 20-inch-diameter concrete-filled pipe columns and 16 ½-inch-diameter braces feature both AESS and structural steel. According to Reynolds, an astute visitor will also sense a glaring absence of posts or hangers in the PT building's switchback stair, for which the project team attached cantilever to cantilever to create the impression that it is freely floating. Inspector McGrath remarks that putting structural derring–do on display, combined with the academy's highly dimensional façades (in which panelized aluminum was fluoropolymer-coated on the production line and then anchored into the building slabs) influences outsiders' perception of local government. "We're new to the neighborhood, and we didn't want to build a concrete silo that was solely concerned with structural integrity and counterterrorism."

The head of cadets adds that the surrounding community has responded positively to that sensitivity, while envoys from other police departments are treating the project as a model for emulation. As for Reynolds, the New York City Police Academy is a living textbook. "This project had every kind of structural challenge you could think of," he says. "You rarely see all this in one place, and when I work with younger engineers, we always go back to the Police Academy for reference."

Left A seven-story atrium marks the entrance to the eight-story classroom and office building.
Above The main campus building at night. Due to increased structural capacity afforded by the steel structure, the entire campus could operate as a base for emergency response teams during a disaster.

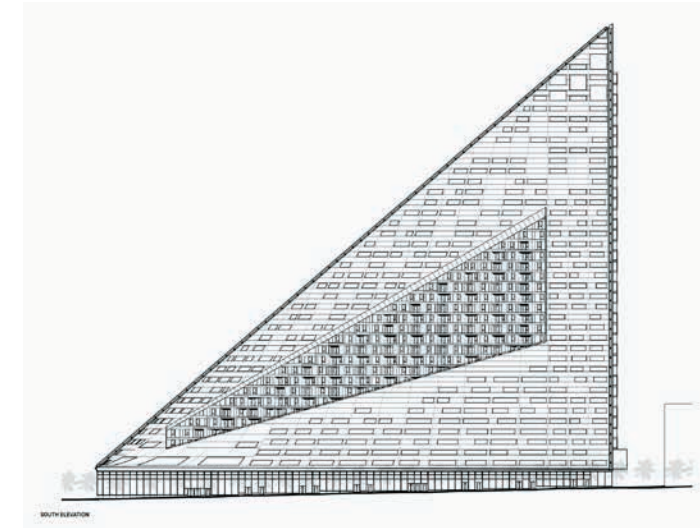
Eric Laignel

Ed Hueber

NEW YORK CITY POLICE ACADEMY

Location: **130-30 College Point Blvd., College Point, Queens, NY**
Owner: **NYC Department of Design and Construction**, *New York, NY*
Architect: **Perkins+Will**, *New York, NY*
Consulting Architect: **Michael Fieldman Architects**, *New York, NY*
Structural Engineers: **Silman Associates**, *New York, NY*; **Guy Nordenson and Associates**, *New York, NY*; **Weidlinger Associates**, *New York, NY*
Mechanical Engineer: **WSP Flack + Kurtz**, *New York, NY*
Construction Managers: **STV Construction**, *New York, NY*; **Turner Construction**, *New York, NY*
Structural Steel Fabricator: **Cives Steel Company**, *Gouverneur, NY*
Structural Steel Erector: **Stonebridge Steel Erection**, *South Plainfield, NJ*
Miscellaneous Iron Fabricators and Erectors: **Empire City Iron Works**, *Long Island City, NY*; **Post Road Iron Works, Inc.**, *Greenwich, CT*
Ornamental Metal Fabricator and Erector: **J-Track LLC**, *College Point, NY*
Curtain Wall Fabricator and Erector: **Gamma USA, Inc.**, *New Rochelle, NY*
Metal Deck Erector: **Stonebridge Steel Erection**, *South Plainfield, NJ*

The south façade of Via 57 West features alternating San Francisco-style bay windows and nested balconies for every apartment.



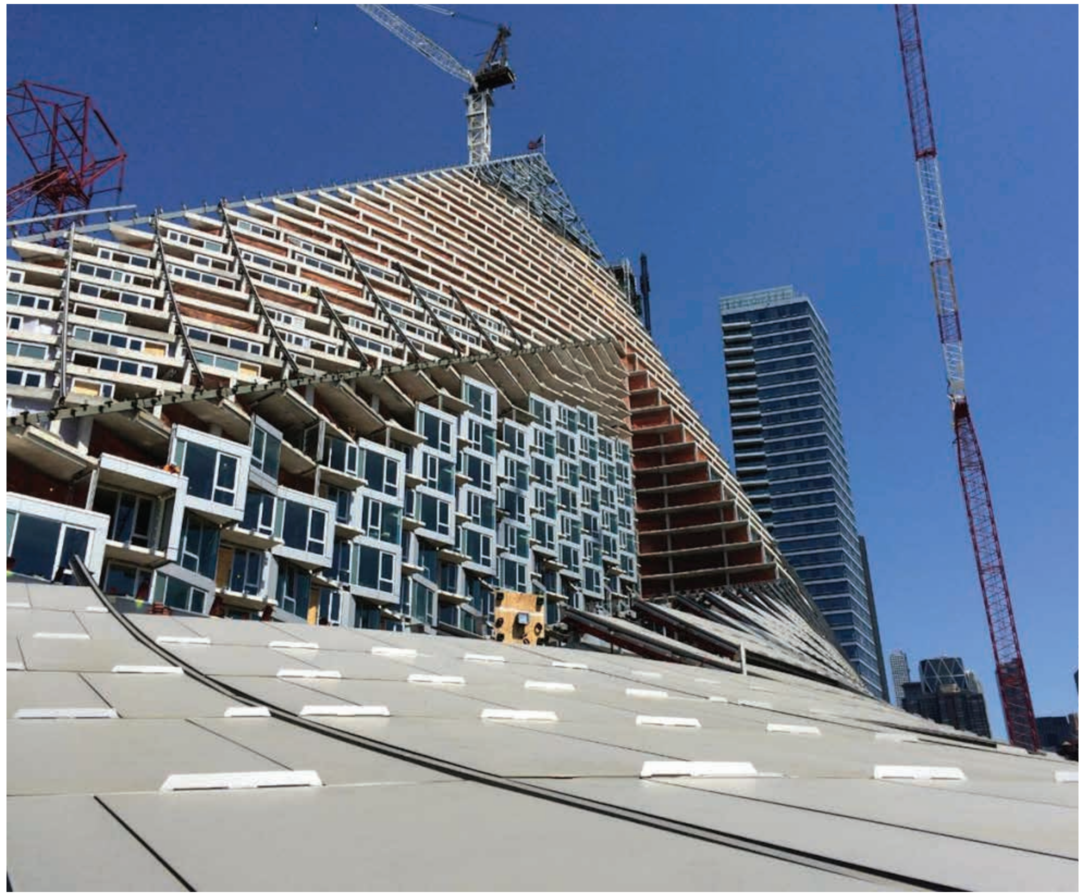
Via 57 West

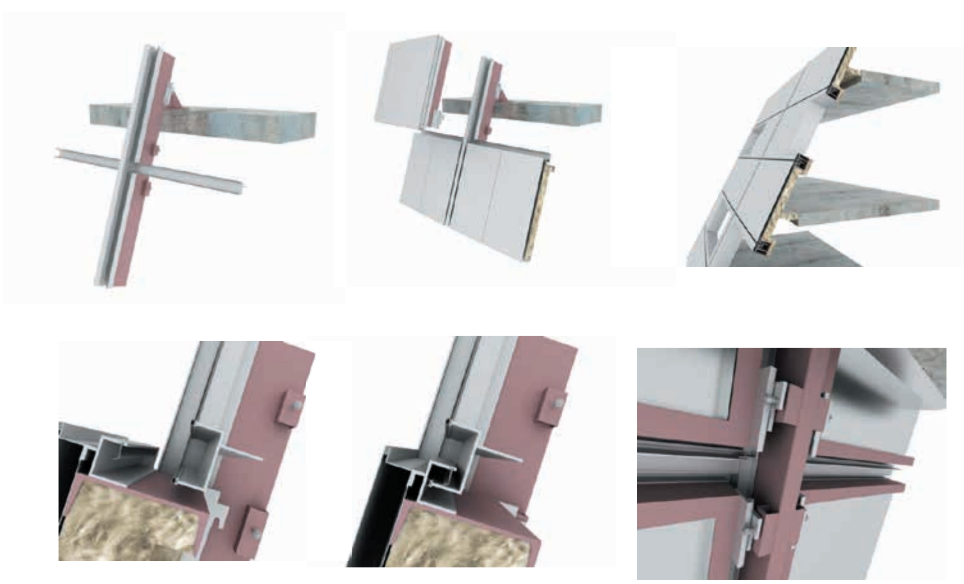
A fantastical yet functional residential building required several façade systems and thousands of unique components, even borrowing laser technology from the auto industry to achieve the hyperbolic paraboloid form of its southwest face.

EVEN IN A CITY THAT has seen it all, a new pyramid-shaped building on Manhattan's west side waterfront is a head-turner. Designed by Bjarke Ingels Group (BIG), Via 57 West brings a hint of its architect's home country, Denmark, to the city with a courtyard-centric design that gives the building a sail-like shape on the edge of the Hudson River. Ingels has said the building was conceived out of the idea of combining the density of a Manhattan skyscraper with the courtyard communal space traditionally found in Danish residential buildings. The result is a new typology called a "courtscraper" by the architect and its developer, The Durst Organization, who began discussing the 709-unit, 831,000-square-foot project with BIG in 2007.

The site did not immediately jump out as an ideal residential location. Framed by a power plant, a sanitation garage, and the West Side Highway, the building needed a sense of place and respite amid the city infrastructure. The courtyard, which intentionally has the same proportions as Frederick Law Olmsted's design for Central Park, creates this sanctuary at the center of the block between West 57th and 58th streets.

The building's tetrahedron shape, "came about from our conversations with Durst that were interested in trying to explore a mid-rise typology for the site because they actually had a rather large footprint with less density than you might normally have in a skyscraper situation," Ingels explains in an interview with the Council on Tall Buildings and Urban Habitat. Wanting to take advantage of the low buildings to the south of the site and its position at one of Manhattan's





Top The building's south façade during erection. Above the 31st floor, the mechanical level that typically tops a residential high-rise is incorporated into the top of the pyramid. Façade openings that reveal terraces below become vents for the building's systems at this level.
Above Diagrams from an Enclos PowerPoint presentation illustrate installation of the south face's vertical gutters and façade megapanels.

widest points, BIG began creating iterations of what a rectangular courtyard building would look like and discovered they could achieve the desired Manhattan density by pulling the northeast corner into a point 470 feet in the air. The silhouette leaves water views uninterrupted for the neighboring Helena Tower, also owned by Durst.

Via 57 West's asymmetry allows sunlight to enter the courtyard and grants residents views of the river (inside, units are laid out in a herringbone pattern to orient views toward the water). From the east, the building reads as a slender spire. Thanks to its shape, it has no real roof, but instead a three-sided façade that at its most dramatic angle, facing the water, warps into a hyperbolic paraboloid, a double-curvature that slopes toward the ground. To the north and east, the façade is composed of an undulating exterior wall with high-performance glass and aluminum spandrel panels, which transition into a stainless steel curtain wall skin on the sloped portion of the façade.

This largest face of the building required complex problem solving from the start. Working with façade consultant Israel Berger & Associates, now part of Vidaris, BIG tapped façade engineering and curtain wall design company Enclos to provide comprehensive design/assist-design/build services for the north elevation's fishbone patterned curtain wall system, south facing unitized stainless steel sloped wall system, and the east- and west-facing custom curtain wall systems.

Alessandro Ronfini worked with BIG for part of the project before joining Enclos to work on Via 57 West as a senior designer in the company's Advanced Technology Studio. "There were two major challenges: waterproofing and fabrication," he says.

In order to optimize the cost of the project, Enclos designed completely pre-assembled systems in order to minimize the work in the field and save on the high cost of workmanship and logistics in New York. To do so, they designed all the vertical façades of the building as prefabricated curtain wall systems. For the hyperbolic paraboloid façade geometry, a similar approach was used: They subdivide the entire

Opening spread photograph: © Iwan Baan; drawing: BIG; this page: Enclos; facing: © Iwan Baan

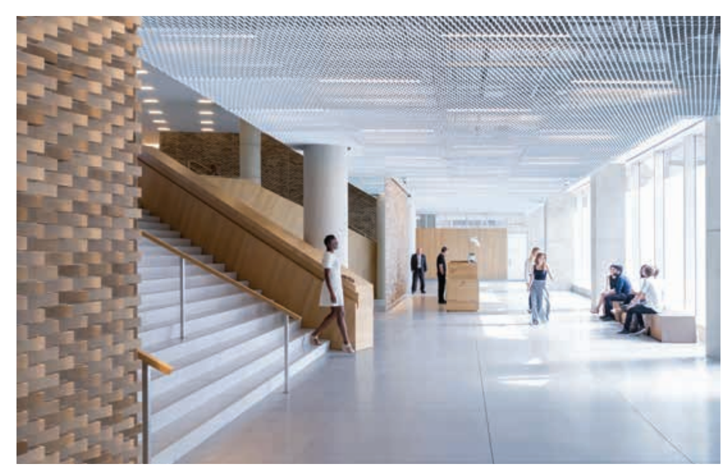
Right The landscaped courtyard creates a sanctuary for residents among the building's industrial surroundings.
Below The lobby's grand stair (left) and one of the building's residential units overlooking the courtyard.

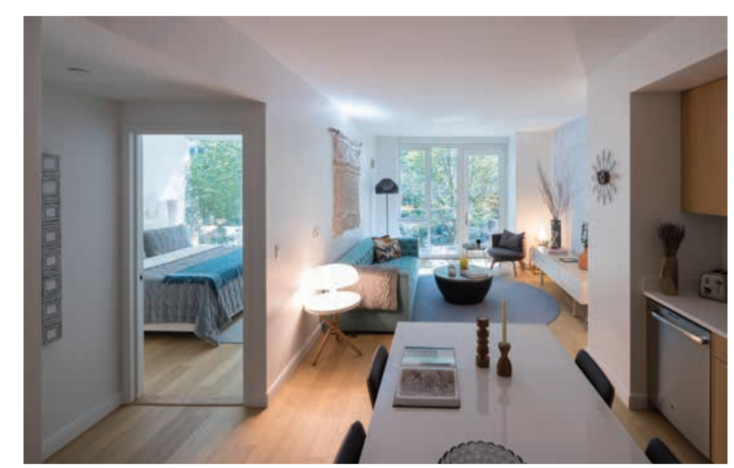
double-curved surface in more than 1,200 unique prefabricated mega panels, each 5 feet tall and spanning anywhere from 18 inches to 30 feet in height.

In order to fabricate curved and twisted components according to tolerance Enclos introduced a new technology, borrowed from the automotive industry: laser metrology. "Through this extremely accurate 3-dimensional scanning of each component and of each assembled mega panels we could guarantee that all the materials sent to the jobsite would fit and work together to create the unique curvature of the building's main façade," says Ronfini.

The outer, finished surface is made of stainless steel with a sandblasted finish. This non-directional finish allowed Enclos to optimize the orientation of the panels during the laser-cutting process to reduce the material waste. The material was also chosen for its soft, non glaring appearance in sunlight, and its resistance to corrosion; the building's location next to the Hudson River puts it in a coastal environment with high salinity in the air, and corrosive conditions are exacerbated by pollution from the West Side Highway. Stainless steel is the ideal material to resist this aggressive environment.

Each of the several thousands of stainless steel panels required to create the megapanels





is unique. Enclos used Rhino and Grasshopper software to generate the panels in 3-D, then automatically output fabrication drawings for each one of them. All the panels where fabricated and assembled in the Enclos facility in Richmond, Virginia, and shipped to the jobsite. Once there, each panel was picked by a crane and installed in its precise location.

The angle of the sloping portion of the façade (measured to the horizon) varies constantly from 0 degrees at the lowest corner to 67 degrees at the top of the building. "Because of all the issues that this constantly varying angle would have created to a typical stack joint, we decided instead to go with a different approach and treat the units similarly to skylights," says Ronfini. To structurally support the façade, Enclos built a network of sloping vertical rafters (these also act as tracks for the façade maintenance program) and horizontal gutters, which receive the water not shed by the stainless steel panels. "This water management system, even if more time consuming to install, was efficient and helped tremendously to locate any leakage during the construction," he adds.

With such a large surface area, water management is the sloped façade's hidden talent, preventing leaks between the complex geometries of the panels. There are two main lines of defense. The outer stainless steel panels work as a rainscreen barrier, shedding most of the water. Each stack joint is protected with a gasket to prevent as much water as possible from getting into the inner layer. The second line of defense, the network of horizontal and vertical gutters, directs additional water to a gutter at the base of the sloped façade, where it is collected and reused for irrigation. The water collection happens entirely on the outside of the façade, so no drains penetrate the skin.

Each of the rafters were prefabricated, shipped to the site and installed using custom-designed, top-of-slab steel anchors capable of 6 degrees of freedom to accommodate the inevitable tolerance of the concrete structure. The panels were then installed between rafters using adjustable hook-and-fist aluminum anchors, four for each panel (two dead-load anchors at the top and two wind-load anchors at the bottom).

"The entire geometry was unusual and the approach of prefabricating such a complex geometry was unique and as far as we know, not done before," says Ronfini. In 2015, BIG released a book entitled, *Hot To Cold, an odyssey of architectural adaptation*, presenting case studies on how the firm's work responds to a range of climatic conditions. In a chapter about Via 57 West, Ingels recalls asking Douglas Durst at one of their earliest meetings, "If they had ever considered allowing the design of the building to be directly informed by the building. In short, my question [was]: 'Why do all your buildings look like buildings?'" Years later, the building is a symbol of that question, and its answer by one architect. It's a place that mitigates the extremes of New York for its inhabitants, while showing how extreme architecture can advance the city's skyline in the future.

Above The building viewed from the west, across the Hudson River. The building's slope allows a transition in scale between low-rise structures to the south and high-rise residential towers to the north and east.
Facing An aerial view shows the courtyard, which was inspired by residential buildings in Copenhagen.

This page and facing: © Iwan Baan

VIA 57 WEST

Location: **625 West 57th Street, New York, NY**
Owner: **The Durst Organization**, *New York, NY*
Architect: **Bjarke Ingels Group**, *New York, NY*
Architect of Record: **SLCE Architects**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Mechanical Engineer: **Dagher Engineering, PLLC**, *New York, NY*
General Contractor: **Hunter Roberts Construction Group**, *New York, NY*
Façade Consultant: **Israel Berger & Associates** (now part of Vidaris, Inc.), *New York, NY*
Curtain Wall Fabricator and Erector: **Enclos**, *New York, NY*

The operable Oculus skylight will be opened annually on September 11.

World Trade Center Transportation Hub

Cost/benefit calculations aside, Santiago Calatrava's beam-sculpture may be seen as one of New York's great public spaces, thanks to ingenious engineering.

RARELY HAS A MAJOR PIECE of transit infrastructure drawn as much press, before even opening, as the World Trade Center (WTC) Transportation Hub. First unveiled in its original design in January 2004, then revised, security-hardened, and value-engineered over a decade of design and construction work in a densely politicized atmosphere, the Hub held its "soft opening" in March 2016, with Port Authority Trans-Hudson (PATH) trains in service, then unveiled its retail component later in the year.

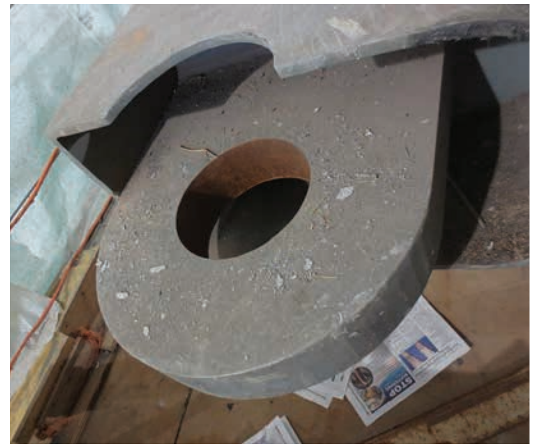
On one level, it's a PATH terminal, and New Jersey commuters are so unaccustomed to civic elegance that the Hub's soaring beams, white marble floors, and cantilevered observation decks, with nary a straight line in sight, can seem outlandish. On another, it's part of the WTC complex, burdened with a complex history. People died here; anything built here, not just the Memorial and Museum, should honor them. Spaces here should inspire ongoing generations to move with purpose, dignity, and reflection, not simply pass through. It's easy to forget this whenever a bean-counting scribe pounces on Calatrava for indulgence, and charges that X number of dollars might have been redirected from artistic intangibles to Y number of subway upgrades, salaries, or potholes repaired.

With those perspectives acknowledged but not overemphasized, questions about how the Hub achieves its effects remain fascinating. Its Oculus, the elliptical transit hall named for its signature feature, a 330-foot-long, 160-foot-high arching glass aperture intended to open on special occasions and temperate days, is a column-free, self-supporting composition of steel ribs (reports of total tonnage vary from about 14,000 tons to 15,250 tons, the Calatrava office's official figure). "When you look at it, it's hard to envision how it holds itself up," says James Durkin, senior vice president at AECOM's Tishman Construction and project manager on the Hub, "but it really is a kind of bridge." Under the unique conditions of a site whose grade-level plaza had to be completed by the 10th anniversary of the 9/11 attacks, constrained by the position of PATH and Metropolitan Transit Authority (MTA) tracks, working around operating train service, and responding to midstream security mandates, the Hub's design and construction team achieved feats improbable enough to border on miraculous.

The Hub comprises three chief components: the Connector from the Fulton Street station, the Oculus, and the Concourse leading to the PATH hall and, beneath Route 9A (West Street), to Brookfield Place, the former World Financial Center, which will finally be accessible without vehicle-pedestrian conflict or lengthy searches for scarce skyways. The Concourse, like the Oculus, features the signature steel ribs, painted bright white with Interchar, a two-part epoxy intumescent fireproof coating by International Paints, a material derived from the aerospace industry ("it was used on the butt end of the Apollo capsule," says architect James Howie, professor of construction and facilities management at Pratt Institute, who served as project manager for fireproofing at the Hub for Composite Technologies.

"Early on in the design, it was contemplated that Calatrava wanted to use concrete," reports Durkin. "The steel itself is extremely complicated to fabricate"—so much so that only a handful of firms in the world, all foreign, could handle the job. Above-grade steel members for the Oculus were custom-fabricated by the Venetian-area firm Cimolai, test-assembled to check the precise fit before shipping 4,700 miles from Italy to the Red Hook port, then escorted to the site. Below-grade steel and some of the decorative steel were by the Spanish firm Urssa. New York-based Skanska fabricated and erected approximately 11,000 tons of structural steel, including the Hub's portals, arches, and rafters.

Pieces were extremely large, Durkin recalls, to minimize the number of field connections; constant, challenging calculations by Vancouver-based erection engineers Buckland and Taylor ensured "extremely tight tolerances" onsite, he reports, "about a quarter of an inch" amid constant temperature-driven fluctuations. "It was extremely challenging to erect those tight tolerances. There's no fake structure; there's no covering structure between the steel and the glass. The ribs are the mullions for the glass." Moreover, "the fabricated pieces don't necessarily fit until they're all put together, so as you're setting the structures, the underlying supporting structure is deflecting. That's really some fantastic engineering that was done by



AECOM that predicted the amount of deflection; when you're adding these 14,000 tons of steel on top of an existing structure, you know it's going to deflect."

Steel overcomes its reputation as a rectilinear material in this space, offering both elegance and feasibility. Projects like this are often first contemplated in concrete because of the shapes possible with that material. But structurally those would have added too much weight and been structurally unachievable. Howie was initially surprised at the material choice: "Until I got to the area above the Concourse where he was doing these significant spans and doing his gymnastics with the shapes of them. And that's obviously why it had to be done in steel."

The roof of the Concourse had to be built from the top down to avoid deep excavation disturbing Memorial Plaza construction, without columns supporting the MTA 1 line, which runs down the middle of the project. Steel "micro-piles" were driven down about 100 feet, Durkin reports, as the crew excavated four levels in 15-foot segments, pouring concrete slabs at each level. "The original concept would have been to put a temporary structure all the way down to the bottom and then build back up. That probably saved at least a year, if not more.... That had been done before outside New York; it's the first time to my knowledge it was done in New York City."

The Oculus beams needed support from portal frames resting on a compression ring, with all the temporary supports in place until the assembly was complete. "The major structural piece, the Vierendeel truss [that] runs down the center, was the last piece to go in the rafters," Howie says. "They jacked down the structure from its temporary shoring and placed the load on the actual structure, and then they took out the temporary steel. There was another building underneath all of this; no one recognizes the complexity of building this.... Although it may seem very light and open, it's actually a very complicated structural and construction problem."

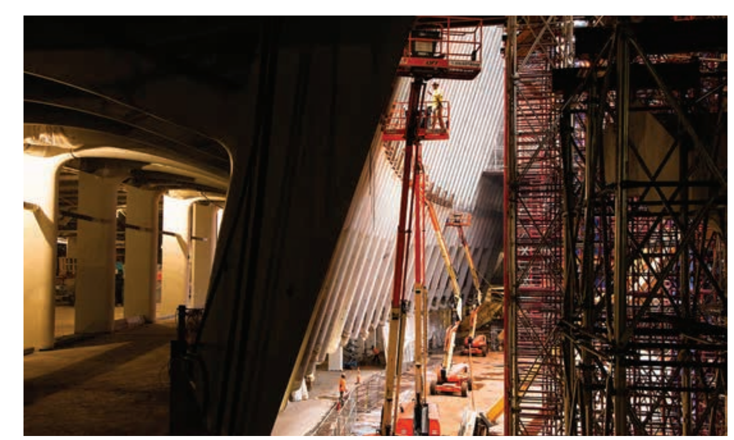
Not all the ribs are necessary to carry the load structurally. The many changes since the initial 2004 design included a doubling of the number of ribs in response to Police Department orders regarding blast safety, reducing 11-foot modules (matching those of the retail areas) to 5 feet, 5 inches, "leaving a glass space of 4½ feet," Howie reports. "The architectural pattern of the roof is at 5½ feet. Now, no one has mentioned that at all, [but] that doubled the cost right there in the steel. Doubled the cost of erection; doubled the cost of temporary structure." The Oculus, one of the project supervisors told Howie, contains "52 miles of welding. In my career, I've specified welding in feet or inches."

Only those who saw the Hub take shape may fully appreciate its scale and sophistication. Howie recalls "a forest of columns that was supporting [the 1 line] until they put these massive girders... 18-20 feet high, basically railroad bridges underground. And only when those were done could they remove the shoring; put in the concourse flooring; put in the

Left Construction at the Hub ca. February 2013.
Above top and bottom Connection joints for the structural steel elements of the Oculus ribs.
Facing clockwise from top An aerial view looking south on the World Trade Center site. Construction of the Hub's bonelike structure. An interior view of the WTC Transportation Hub during construction. View from 7 WTC of construction on the Hub, 3 WTC and completed 4 WTC in the background. A crane lifts one of the 114 rafters that were installed on the Hub.

Opening spread: James Ewing; This page: Steel Institute of New York

This page, clockwise from top: Silverstein Properties (1, 2, 4); Joe Woolhead (3, 5)



underside of the trusses, which is all-concrete; and then start to do all the finishes. So in addition to the structural steel that you see, there are pieces of steel that I have never seen in my career, 4 or 5 inches-thick steel, that are part of this trusswork."

Calatrava, among his official statements, refers to the Oculus as "a piazza for New York, the same way the piazzas were traditionally understood in Europe: as a place for visiting and gathering in which the access to the main locations of the city are articulated." With its high-end retail offerings, the Hub has forever blurred the lines between public space, luxury shopping mall, and transit station.

Skepticism follows opulence as naturally as fresh air rushes into a vacuum. And the Hub alone can't untangle New York's transit dilemmas. The public who ride the trains, traverse the public spaces, and try to assess what it gets for its four billion dollars—no one discussing the Hub omits that figure—expect a lot from this facility. Yet the experience of standing beneath the enormous oculus, among New Yorkers who uncharacteristically drop their freneticism, raise their eyes, and stand as still and respectful as choristers, is a sensation unlike any other in the city. Durkin reads that recurrent response in kinetic terms, generated by the visual rhythm of the fluid, parametrically varied ribs: "If all the pieces were symmetrical, I don't think it would have the same impact. I think that conveys motion."

"No one's seen anything like this before," says Howie. "It is certainly and undeniably an extravagance. But it's a pretty spectacular extravagance."

WORLD TRADE CENTER TRANSIT HUB

Location: **World Trade Center, 290 Broadway, New York, NY**
Owner: **Port Authority of New York and New Jersey**, *New York, NY*
Architect and Structural Engineer: **Santiago Calatrava LLC**, *New York, NY*
Architect, Structural Engineer of Record, Mechanical Engineer: **The Downtown Design Partnership** (STV/AECOM joint venture in association with Santiago Calatrava and Parsons Transportation Group), *New York, NY*
Construction Manager: **Tishman Turner JV**, *New York, NY*
Structural Steel Fabricator: **Skanska Koch**, *Carteret, NJ*
Structural Steel Erector: **DCM Erectors**, *New York, NY*; **Skanska Koch**, *Carteret, NJ*

This spread: James Ewing

The Oculus stands as both a monument on the World Trade Center site and as a functional piece of New York City transit. **Facing** Steel ribs reach 160 feet into the air from the main hall. They are coated in bright white intumescent fireproof coating, a material derived from the aerospace industry.

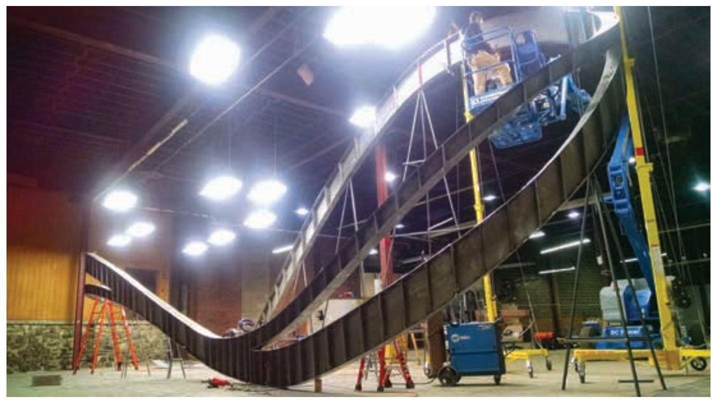
Capital One

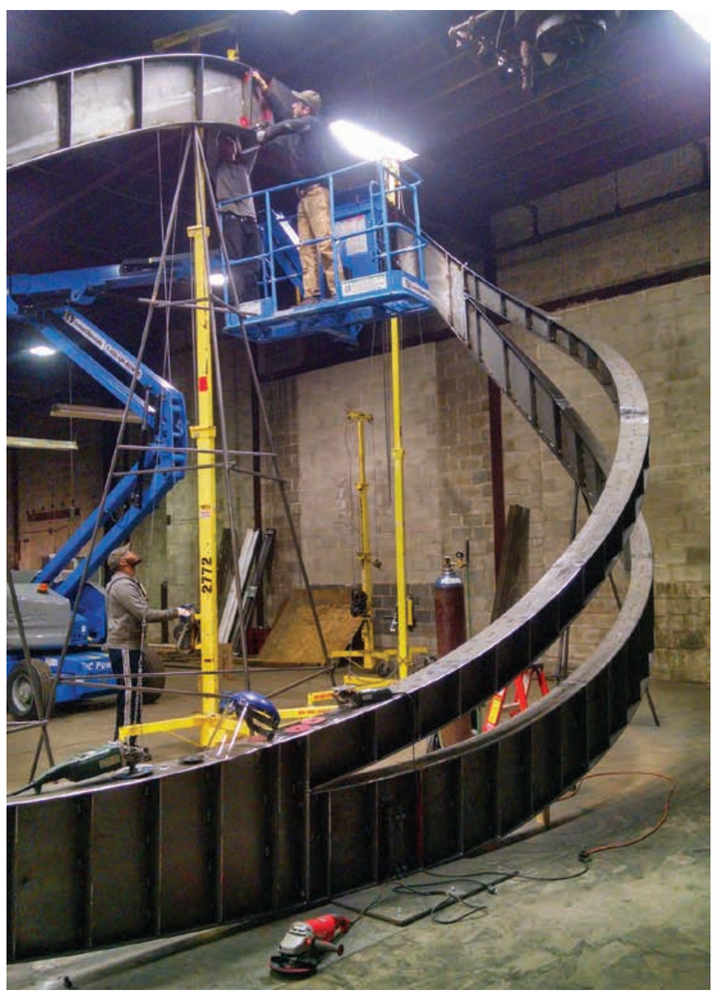
A carefully engineered installation at a Midtown banking center brings together cutting-edge design modeling software with the age-old art of steel fabrication.

DESIGNED BY EMERY ROTH & SONS and opened in 1967, 299 Park Avenue is a stalwart of Midtown East. Alternating polished and matte stainless steel mullions emphasize its 42-story height, its glazing reading as almost black from the street, except at ground level. There, Capital One Financial Corp. has made its new commercial-banking headquarters known with a swooping sculpture that conveys a sense of energy to those who pass by. The piece was installed last year to mark the bank's long-term lease of 250,000 square feet of the building, including a 5,500-square-foot, double-height retail space facing Park Avenue and 49th Street.

Because the building's North Pavilion, as it is known, sits on a podium a few steps above the street, the sculpture, which is more than 19 feet tall, almost 55 feet long and almost 17 feet wide, appears to almost hover in air. Touching the floor at just two points, the 14,000-pound piece curves lightly through the pavilion, which along with the sculpture was designed by a Gensler team led by Laurent Lisimachio. The architecture firm worked closely with Amuneal, a Philadelphia-based fabrication company awarded a design–build contract for the sculpture, to realize the installation. Though it is a sort of extrapolation of the bank's logo, the client, "didn't see this as a sculpture as much as a part of the architecture," says Adam Kamens, CEO of Amuneal, who took over the family business from his parents and grew it from a technical metal fabrication shop to a firm that specializes in a range of custom architectural applications.

Before the team could begin to consider how to install such a massive piece within the glass-enclosed space, they first had to consider the site's constraints. The building sits over a Metro-North rail line, a factor that complicated its original engineering and also created a challenge for the sculpture's design and fabrication. Because any reinforcements for the piece could only penetrate the floor slab a few inches, the project engineer, Thornton Tomasetti, and Amuneal's in-house engineer worked together to develop a structural framework that would allow the sculpture to touch





the floor lightly but be fully supported beneath the terrazzo flooring.

With two structural steel beams running laterally beneath the pavilion space and tying into the building's existing structure, the engineers were able to stabilize the installation with two nested hollow structural sections (HSS). "Instead of having the anchoring points that go deep into a slab, we have anchor points that come up almost 2 feet into the sculpture," explains Kamens. A cross-section of the sculpture would show one HSS welded to the structural member below, with another 4x4 HSS within the sculpture sliding, like a sleeve, over it. During installation, the two HSS were welded together onsite.

The aluminum and steel structure of the sculpture took nearly 195 hours of engineering and modeling, 2,660 hours—over a year—of fabrication, and nearly 1,600 hours of installation time. Working from a ¼-scale wood model they milled with a 5-axis CNC machine at the project's onset, Amuneal welded more than 2,000 square feet of steel to create the individual pieces of the final sculpture.

The team's earliest design conversations focused on how to realize the Mobius-strip shape of the structure. Amuneal presented a few subtle variations of the design, each with the same footprint: one was a purely rectangular form; another had bottom plane narrower than its top plane, "so as it turned through the space it would force change in elevation and form," says Kamens. From a fabrication standpoint, the trapezoidal form was more complex, but, "we thought it would bring more light and life to it," he adds. The client and architects agreed.

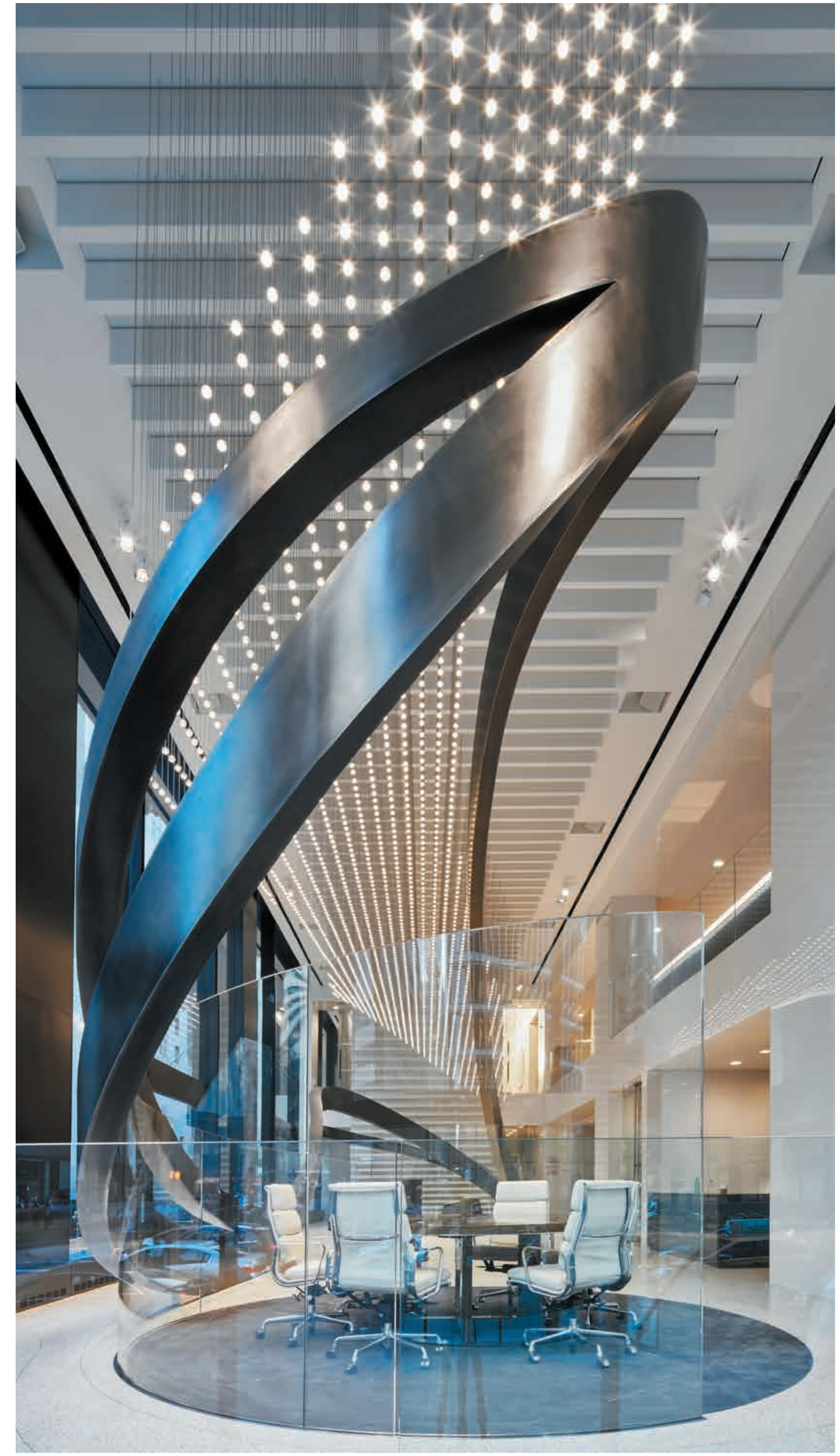
Other important conversations focused on how the structure would touch the ground. Amuneal created a full-scale, 12-foot-long section of the shape to test deflection and fit, locking the piece to two anchor points that represented the permanent anchors at 299 Park, which allowed for only ¼-inch of tolerance throughout the entire sculpture.

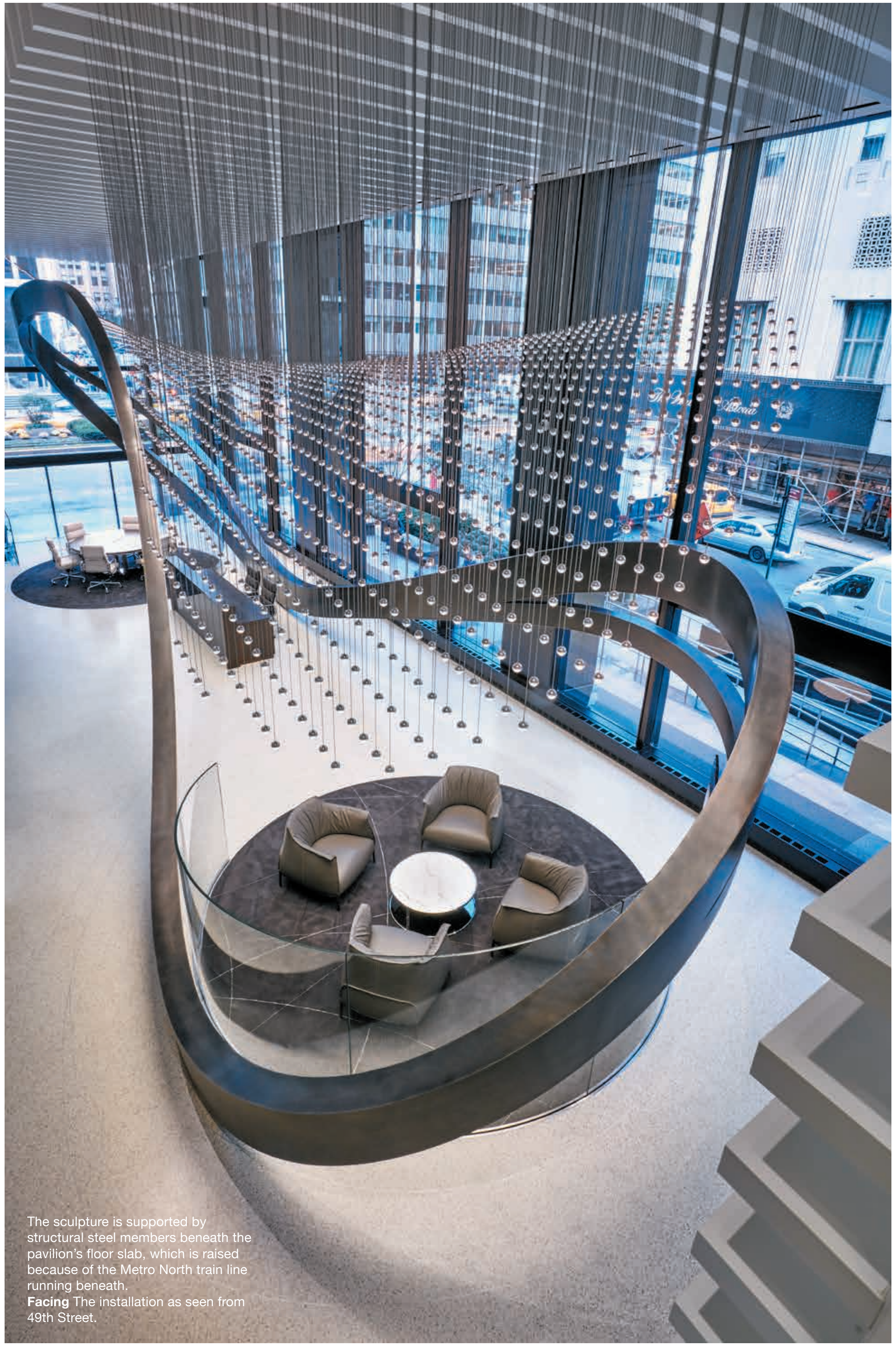
Modeling software facilitated collaboration and productive problem-solving throughout the design and fabrication phases. Working with Gensler's Rhino model, Amuneal's engineers created a type of translator between Rhino and their modeling software, Solid Edge. "The reason we use this specific software package is that you can't engineer something you can't make," says Kamens. "In Rhino or other modeling packages you can create any shape you want, but in our package, if you can't actually form that in metal, it won't let you create the shape." In other words, it forces the user to figure out a form that can be fabricated in real life, not just onscreen.

Once the design had been translated into Solid Edge, the software essentially "unfolded" its form and shapes, then generated laser codes and profiles for each to be rolled in the proper shape. The software also contemplated the entire form within a virtual two-story space to verify ADA compliance and mandatory distances from the pavilion walls. Putting the entire team on the same page about the forms of the installation, the software then allowed them to move on to conversations about their engineering approach. Amuneal worked with Thornton Tomasetti to determine weld conditions, material thicknesses, and the thickness of ribbed members required to stiffen the structure from within.

This page: Amuneal Manufacturing Corporation; all others: Garrett Rowland

Opening page and right Capital One's commercial-banking headquarters, designed by Gensler. The space features a 55-foot-long installation designed by the architects in collaboration with Amuneal Manufacturing Corporation. **Facing** In Amuneal's Philadelphia facility, the entire sculpture was fabricated and erected to ensure tight tolerances were met in the final installation in New York.





The sculpture is supported by structural steel members beneath the pavilion's floor slab, which is raised because of the Metro North train line running beneath.
Facing The installation as seen from 49th Street.

After the mockup phase, the Amuneal team constructed the entire structure at a Philadelphia warehouse. They designed individual buck forms for each of the negative spaces beneath the sculpture's curves, using the forms to ensure the entire piece was within the very tight tolerances. Inside the piece is a ½-inch thick carbon steel fin running through the entire structure, with hundreds of ½-inch-thick carbon steel ribs on either side of the fin. That skeleton is enclosed in a ¼-inch-thick outer skin. This was pre-finished through an abrasive grinding and patina process using a series of chemical solutions to bring out various minerals and oxides in the steel to achieve the desired coloration. Then, each corner was burnished, and the entire structure was dismantled for delivery to 299 Park.

The installation arrived in New York in 16 pieces—the size of each segment was based on the length of the piece and the amount of curve that would fit through a single, not-so-large door, says Kamens. A crane picked up piece and got it as far as the door, then installers used a winch to pick pieces up inside the pavilion and place them onto a trolley to move into place. "It was like a big, primitive form of Jenga," jokes Kamens.

The piece was erected by Local 580 ironworkers at New York-based Freedom Ironworks. "When we were putting together the logistics plan we met with them onsite and collaborated with them," says Kamens. "We like to collaborate early on in the process. We want them to inform the process and make sure they're going to be comfortable with it."

In turn, the ironworkers were eager to collaborate on a piece that would have such a public audience. "They say they look forward to the projects that we work on because they can take friends to see it," says Kamens of the Freedom team, whose skilled work on other staircases, for instance, may sometimes be covered over by drywall or paneling.

In its finished form, the installation creates a sense of movement within the Pavilion, where seating areas sit within the curves at either end of the piece. But the space doesn't just shine during daytime meetings. A light installation of hundreds of bulbs suspended on vinyl-coated cables hangs over the piece, responding to its negative space with its cloudlike shape and providing illumination that ensures the sculpture adds its dynamism to busy street outside any time of the day or night.

CAPITAL ONE

Location: **Capital One North Pavilion, 299 Park Avenue, New York, NY**
Owner: **Capital One**, *New York, NY*
Developer: **Fisher Brothers**, *New York, NY*
Architect: **Gensler**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Construction Manager: **Richter + Ratner**, *New York, NY*
Architectural and Ornamental Metal Fabricator: **Amuneal Manufacturing Corporation**, *Philadelphia, PA*
Architectural Metal Erector: **Freedom Ironworks**, *New York, NY*

Thirty-foot-tall ribbed, precast concrete panels attach to the exterior of the interior building enclosure. Unlike a traditional brick wall with masonry ties puncturing the air and vapor barrier every 18 inches, this uninterrupted rain screen is free of thermal breaks.

P.S. 62

Officially named the Kathleen Grimm School for Leadership and Sustainability at Sandy Ground, the steel-framed, precast panel-clad P.S. 62 is the first net-zero-energy school in New York City and one of the first of its kind worldwide.

IN OCTOBER, THE NONPROFIT New Buildings Institute released its 2016 List of Net Zero Buildings in North America, which showed a whopping 74 percent increase from 2015 of buildings that have either achieved or committed to the goal of producing as much renewable energy onsite as they consume in a year (from 191 to 332 buildings).

As more cities and states take on stringent energy codes, zero energy buildings are becoming an increasingly popular way for homeowners, businesses, and municipalities to lower environmental impacts, improve energy security, and buffer their resilience against power outages and natural disasters.

New York City is no exception to these trends. With the city's 1,600 public schools representing 37 percent of municipal greenhouse gas emissions, it made sense to test out a zero energy strategy, which is what the New York City School Construction Authority (SCA) did when it built the Kathleen Grimm School for Leadership and Sustainability at Sandy Ground, on Staten Island. Located on an L-shaped, 3.5-acre site in a residential neighborhood, the school is named after its location, Sandy Ground, home to one of the nation's oldest surviving communities established by free blacks.

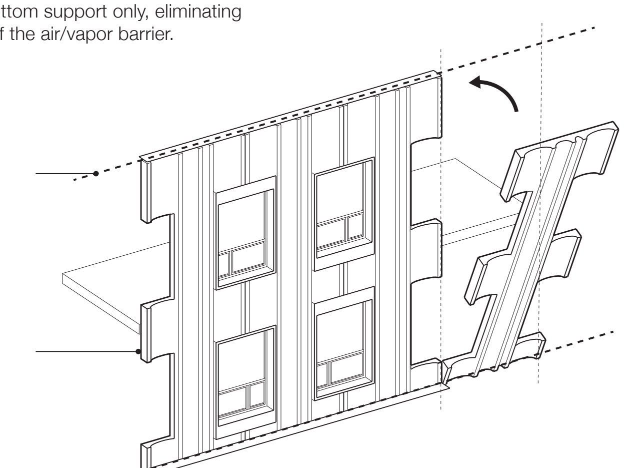
Designed by Skidmore, Owings & Merrill (SOM), the 38,000-square-foot, two-story school serves around 450 students from pre-kindergarten through fifth grade and is the first in the city—and one of the first worldwide—designed to achieve zero-net-energy. SOM, which won the SCA's invited competition, was asked to deviate from the authority's design standards. "It's a very small school, but this was the SCA's opportunity to experiment," says Jon Cicconi, SOM's senior design architect on the project. "They called it their 'lab.'" A team will meet for three years to review the building's performance and incorporate lessons learned into the SCA's guidelines.

This was also a first-of-its-kind challenge for SOM, whose designers couldn't have come up with a scheme for the building without help from sustainability and net zero consultants In:Posse and

structural engineer Disimone. To begin, the team had to maximize daylight and passive energy strategies while also creating a highly efficient thermal envelope. This led to the school's rectangular shape, with an interior courtyard. A steel-frame structure allowed efficient design of several double-height and long-span spaces that let daylight into the space. The typical steel dimensions within the structure are ASTM A992 (Fy = 50ksi) W18x35 shapes. All of the academic spaces are oriented to the north and south, where 30 percent of the façades are glazed, as opposed to the service spaces that are oriented to the east and west and are only 7 percent glazed.

But, most striking to any visitor to P.S. 62, as the school is also known, is the 1,600 panel photovoltaic array that—like a cresting wave—begins on the south façade, where PVs are angled 70 degrees, and flows over the roof to cantilever roughly 50 feet over the north façade, shading part of a running track. (The PVs were needed, in part, because the school wanted to be able to use the building at night and in the summer, doubling its energy use, says Cicconi. With the PVs, the team was able to reduce energy use by 50 percent per square foot. Energy modeling shows that the array produces 658,000 kwh annu-

Above In order to take advantage of passive methods of energy savings, the architects shaped the interiors around daylighting, painting walls white and sloping the ceilings to amplify skylights and clerestories.
Below A diagram of precast façade panels with a 30-foot vertical span and top and bottom support only, eliminating puncture of the air/vapor barrier.



Photos this spread and opening spread: James Ewing; diagram: SOM

The cantilevered roof shades punched windows in the north-facing façade and part of the running track.

Right Sixteen hundred photovoltaic panels—treated as a single panel and spaced tightly together—wrap the south façade and the roof of the school, generating energy and simultaneously reducing the school's energy consumption.
Below A north–south section of the school.

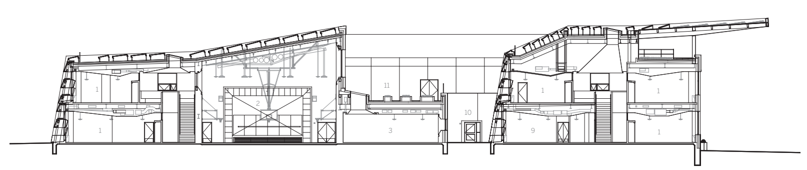


Photo: Stark Video Inc.; drawing: SOM

ally, which is much more than the school consumes. Another 400 panels cloak a parking lot.

For P.S. 62's façade, SOM needed to conceive a much tighter envelope than typical brick masonry because masonry ties puncture the thermal barrier every 18 inches. Instead, the team conceived an efficient window wall system with a precast concrete rainscreen composed of 30-foot-tall ribbed panels; from footer to roof, nothing punctures the air and vapor barrier. The pre-cast panels are notched to sit around the triple-glazed windows.

Figuring out how the façade and structural steel system would be constructed was a major challenge in such an uber-sustainable project, says Desimone's Natalie Bazile, the project engineer: "Because this was a green project and there were a lot of systems that needed to be tested in different stages, we decided to fully install part of the façade to test for leaks." Doing so led the team to realize that they had to create a secondary structural system. "Because we closed out the interior first, we had to come up with the system that didn't rely on using the beams and columns that were already there." This separate system, made of custom box girders approximately 3 feet deep with typically HSS14x6 beams framing in between the girders, supports the PVs and allows for easy removal and replacement without disturbing the roof or building envelope. Where the PV array cantilevers, Bazile says the team tapered the girders for a more elegant wing-like aesthetic. "It's a heavily stressed member, so we wanted to eliminate the excess steel that isn't contributing to the support," she says.

Inside, SOM kept finishes bright and white, for the most part. "It really is a sublime interior space," says Cicconi. The architects placed classrooms along the building's south and north perimeters, and brought in daylight with clerestories and lower lines of ribbon windows, or large windows to the north. Classrooms also have glazing facing the double-height, offset corridors, and benefit from skylights and reflective ceiling panels. In the double-height gym, Bazile designed streamlined steel trusses. "We tried to not to waste anything, and make things as simple and straightforward as possible," she says. Indeed, 15 percent of the school's materials are from recycled content.

Other sustainable measures include a solar thermal hot water system, geothermal wells, and energy-recovery ventilators that pre-treat the air. Permeable unit pavers for the parking lot, roads, and sidewalks allow for stormwater infiltration and retention tanks release it slowly back into the ground. A custom "Building Dashboard" provides real-time feedback on the building's energy use, providing moments to use the building as a teaching tool. And energy hogs like printers and kitchen appliances are grouped in staff workrooms, eliminating the need for teachers to each have their own.

P.S. 62 is also named after Kathleen Grimm, a deputy chancellor of New York City schools who died of cancer at 68 in 2015. She was known as smart and demanding, and a champion of students. She would probably be proud to be associated with an innovative building that serves as a testing ground to improve the design and construction of future New York City schools.

P.S. 62

Location: **644 Bloomingdale Road, Staten Island, NY**
Owner: **New York City School Construction Authority**
Architect: **Skidmore, Owings & Merrill**, *New York, NY*
Structural Engineer: **Desimone Consulting Engineers**, *New York, NY*
Mechanical Engineer: **AKF Group**, *New York, NY*
General Contractor: **Leon D. DeMatteis Construction Corporation**, *Elmont, NY*
Curtain Wall Consultant (Commissioning Agent): **Heintges & Associates**, *New York, NY*
Curtain Wall Erector: **Jordan Panel Systems Corp.**, *East Northport, NY*

The Prism Tower's unitized curtain-wall panels, thanks to Sotawall's "Zero/Zero sightline" operable sashes and Viracon's ceramic fritting, create a striking profile.

Wade Zimmerman

Prism Tower

Leave it to Christian de Portzamparc to find the implicit poetry in a New York zoning envelope. A long process involving three developers and several program revisions over 14 years has become a success story on multiple levels, giving its neighborhood a strikingly complex geometry, a livable community, and a technically impressive façade.

HUGH FERRISS'S 1929 METROPOLIS OF TOMORROW drawing series, elucidating New York's 1916 zoning laws, remains a paradigm of aesthetic value arising from civic practicality. Ferriss placed the iceberg-like forms of legally allowable setbacks for light and air alongside the structures achievable with his day's technologies, the well-known wedding-cake setbacks. Today's parametric design tools allow the conception, modeling, and construction of angular buildings closer to Ferriss's purer abstractions.

The profile of the Prism Tower, a 40-story, 472-foot rental/condominium building northeast of Madison Square, recalls those Ferriss sketches, with the façade itself doing the work of the setback terraces. Its strikingly angled curtain walls maximize vision glass, translating complex floor plans into bright, crystalline residences. "Dare not to be square," says architect Christian de Portzamparc, summarizing the parti behind his latest contribution to New York.

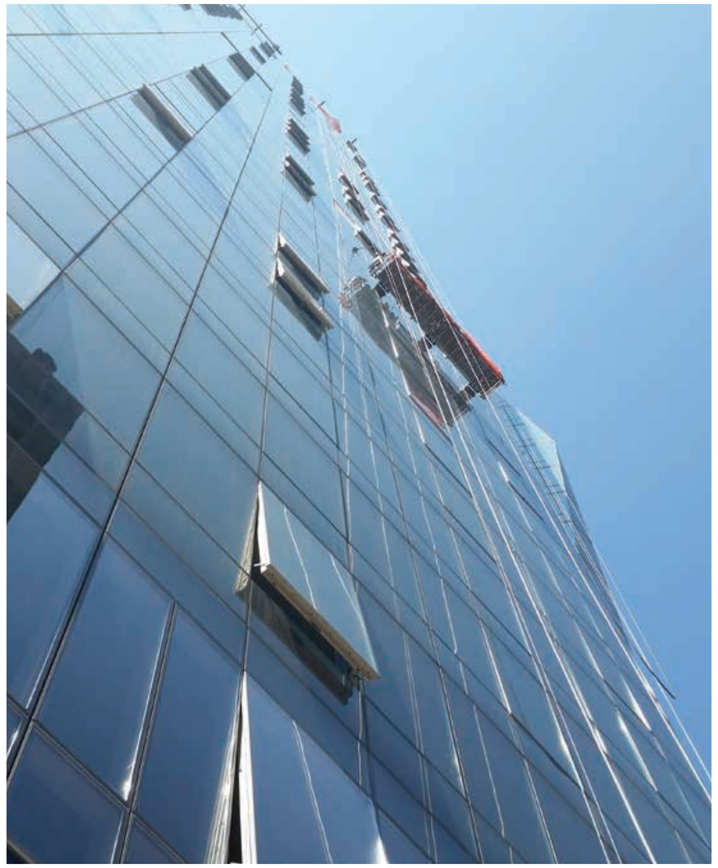
Portzamparc's design features gemlike contours, clean yet unpredictable lines, exceptional light quality, and unparalleled views of neighboring icons like the Metropolitan Life Insurance and New York Life buildings. The angles of the building's two main volumes and side pavilions deviate arrestingly from the orthogonal norms of its neighborhood. In its own way, the Prism complicates the Manhattan grid as boldly as the Guggenheim Museum did a half-century ago.

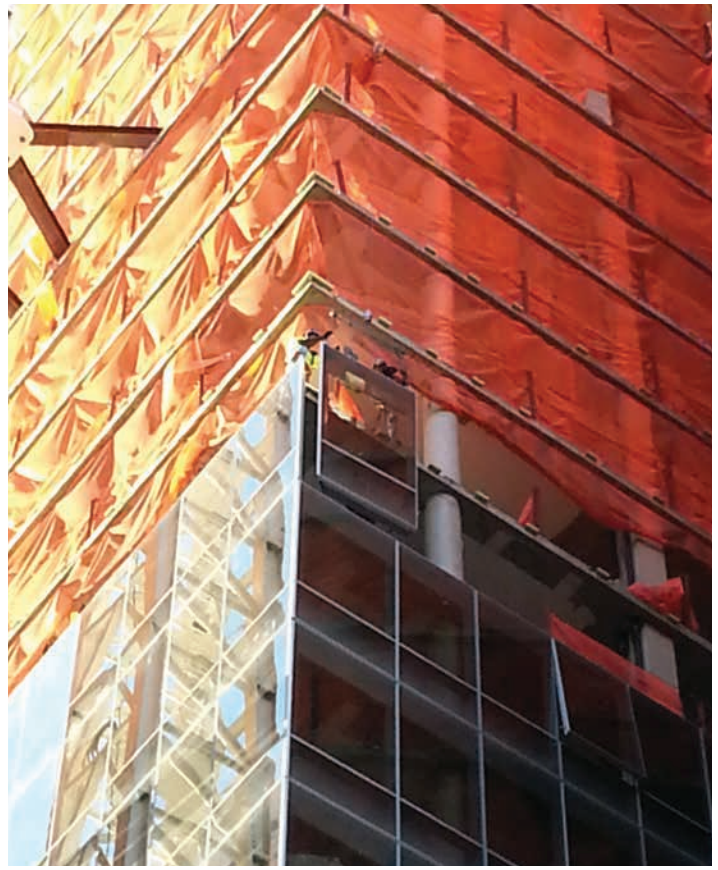
The Prism actually predates Portzamparc's better-known residential supertall, One57, if one considers the full period of design work (it was initially conceived in 2002) rather than the dates of construction. After a change in ownership in 2011, local architect of record Gary Handel made interior modifications but no drastic changes to Portzamparc's design. Occupying an L-shaped site at the corner of 28th and Park Avenue, the building officially opened in 2015 and saw its final segments, an integrated subway station and two ground-floor restaurants, completed in mid-2016.

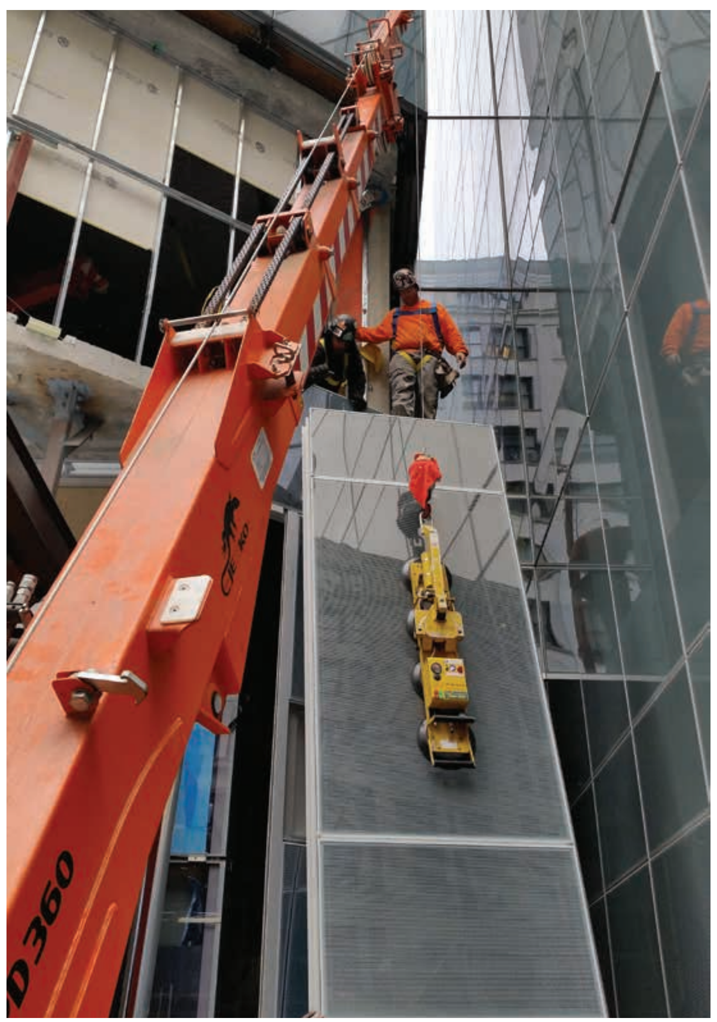
After bringing oblique angles and asymmetries to East 57th Street in the Louis Vuitton Moët Hennessy tower (1999) and challenging West 57th's sense of decorum with the fluid street-wall curves and pixelated, Klimt-inspired façades of One57 (2014), he contributes a skyscraper that balances infolded volumes and aggressive acute angles, standing alone with no party walls and maximizing views in multiple directions through oblique fenestration. Portzamparc credits zoning consultant Michael Parley for helping navigate New York's regulations, around which his design took form; his work also benefits from exceptional flexibility on the part of its construction team in translating his conceptions into material reality. The highly customized curtain walls, say participants in the process, were hard to execute but essential to the Prism's bracing atmosphere.

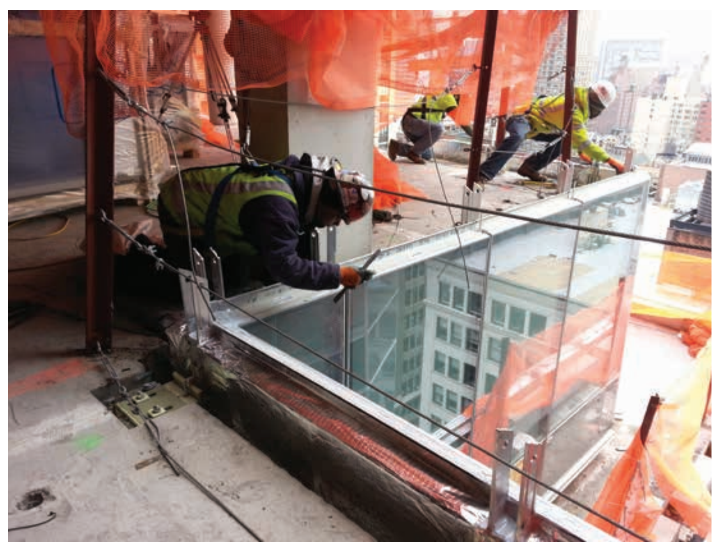
"The complex geometry of the building required tremendous amounts of computer modeling," recalls Patrick O'Neill, project manager at construction manager Lendlease. "Everybody's fear was the complicated three-dimensional jigsaw puzzle, and when we cut the pieces, they all have to come back together again at the end." With the purchase by Equity and Toll Brothers, the curtain-wall consultant role passed from Gordon H. Smith to Israel Berger and Associates (now part of Vidaris), who "set down the performance specification guidelines," O'Neill says. Sotawall fabricated the unitized curtain-wall panels at its facilities in Brampton, Ontario, using low-iron ceramic-fritted insulated glass from Viracon, cutting the extrusions, doing the joinery, and assembling the frames for shipping to the job site. O'Neill has special praise for Sotawall and installers W&W Glass for handling this complicated job, a true slab-supported curtain wall, distinct from the hybrid wall systems used on other projects.

The glass panels were typically 4 to 5 feet wide by one floor high, says Michael Haber, managing partner of W&W Glass, varying with the geometry of the building. "There are so many corners









Clockwise from top left Exterior façade inspections of the glass and joints. W&W Glass's team sets the unitized panels from a mobile mini-crane with winch positioned three floors above. The installers seal the tops of the unitized panels in preparation for the next floor of panels to be set. Panels are erected by a mini-crawler crane at the building podium.

This page: W&W Glass; facing: Wade Zimmerman

on each floor, and because the walls either are inverted or they slope, the actual floorplan changes almost every single floor.... All of the dies were completely new and custom for this job," allowing extrusion of complex shapes beyond what would have been readily available a few years ago. "The supporting hardware was all custom steel embeds that basically took a life of its own because of the complex geometry." Coordinating the geometries of the concrete and the curtain walls, he says, with walls simultaneously sloping and changing angle in plan, was the most challenging aspect of the job.

The fastening of the wall panels to the structural concrete used Halfen channel inserts embedded into the top of the slabs, O'Neill says, rather than face-to-slab connections. "From those Halfen channels, aluminum anchor plates with an end hook were installed," he reports. "When the unitized frames came, they had their associated engagement hook, which was bolted to the vertical mullions of the panel. Those had your typical barrel-bolt adjustments, which would deal with confirming the correct dead loading of the panel to the anchor as well as fine-tuning of the elevation of the panel [in] the exact location in the y plane of the frame."

"Handel did a great job integrating Portzamparc's concepts," Haber recalls, producing the working drawings and coordinating interior and structural elements. "With the advances of modeling that we have now, it was a little bit easier to take Portzamparc's concept and actually produce a product that mimicked [it].... You can achieve more complex shapes, now that we were able to model it in 3-D, a little bit better than we did 15 years ago." Spandrel glass is minimal on this building, and "vision glass pretty much went floor to ceiling," he continues; "the amount of natural light that was created into the building is tremendous, compared to the neighboring façades."

The building uses "a custom operable window, which we call a Zero/Zero sightline window," Haber notes. "You can't see the operable sash from the outside or from the inside. The aluminum mullions that hold the curtain wall façade in place are actually coped and notched to receive the operable sash, so when that sash is closed, there's not an extra sash line that you see. It's basically one big piece of glass." The outswing-awning-type operable vents are approximately 4 feet by 7 feet.

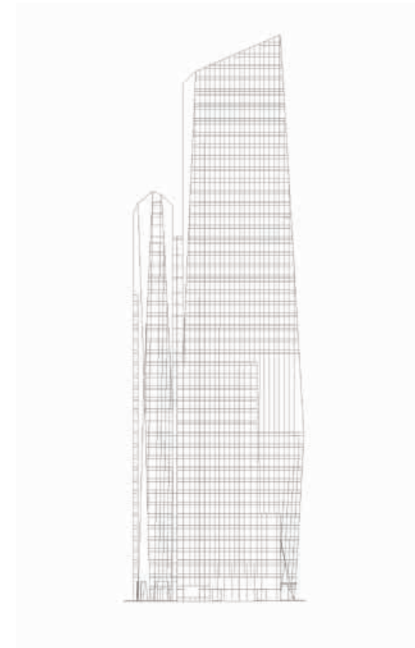
"It's a European design that we've brought to America," Haber continues. "There're not too many Zero/Zero sightline operable windows of that magnitude in the city." The system is not inordinately expensive, and W&W is now using it elsewhere. "Everyone wants to have more views of the outside as we get these buildings taller and taller; the Zero/Zero sightline basically achieves that.... We've taken the Zero/Zero-sightline mentality from the Prism Tower and made it a standard in our other residential wall systems for both rentals and condos."

The result is an operable curtain wall of uncommon uniformity and clarity. "If you're a bystander outside the building looking in," O'Neill comments, "it becomes not impossible to the trained eye, but for a layman's point of view it would be virtually

Above Christian de Portzamparc's design, assembling the building out of four main volumes and optimizing internal light penetration, means that nearly every floorplan is unique and calls for extensive customization of curtain-wall components.

The Prism's angular geometries extend to its integrated subway entrance.
Facing Sharply contoured volumes contrast dramatically with neighboring buildings, making the Prism Tower a local icon and a magnet for photographers.

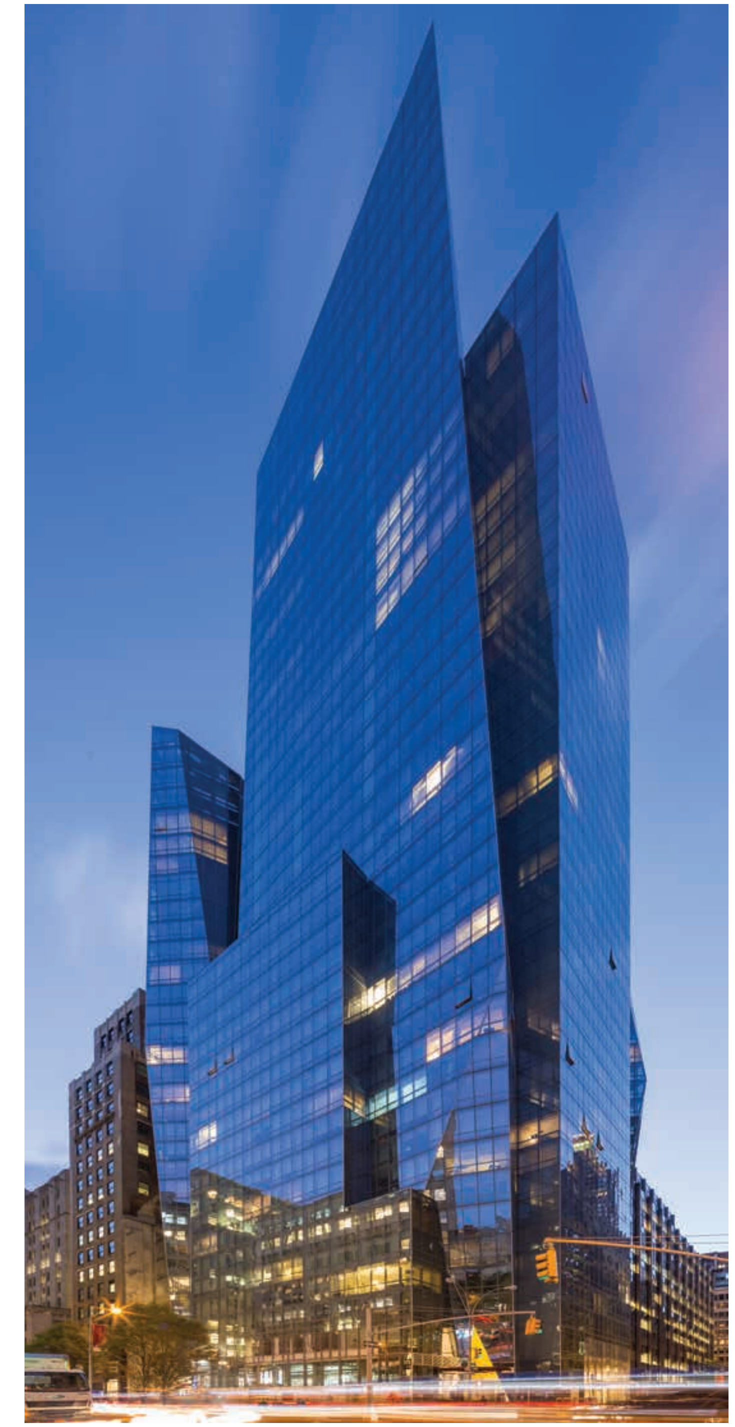
This page and facing: Wade Zimmerman



impossible to know which units had operable vents." Thermal performance is naturally critical in curtain walls with operable segments, particularly at each apex or transition point between planes; "in those areas there was a tremendous amount of aluminum," O'Neill notes, but "there was no major issue with the thermal performance of the vents. The building's aluminum components make key contributions to both its natural ventilation (and thus its overall energy efficiency) and its authoritative presence on the skyline.

Gerald Bianco, project executive and senior vice president at Lendlease, describes the flow of instructions and coordination among trades on this project as surprisingly smooth, despite the on/off/on history and the change of developers, culminating in the unusual dual-ownership arrangement. The building is unique in physical context as well as organizationally, he notes: "It sets back from the adjacent buildings to the south and west. Even [in] some of the lower floors, although they find themselves in some sense in a little bit of a canyon between the adjacent buildings, it affords you to have glass all the way around... there is an opportunity for light to come in and showcase [Portzamparc's] design all the way around the slab." Design consistency extends into the corner subway entrance, where "it was Portzamparc's desire to have the curtain wall evolve into the station," O'Neill reports. A polished stainless steel panel above the bend in the stairway to the platform gives mirror-quality reflection in and out of the station, extending the theme of high visibility below grade.

Though glazed façades on other recent high-end residential buildings may connote a certain corporate blandness, the Prism's sharp contours redefine the standards for the neo-modernist tower typology. Combining bold design thinking with rigorous construction procedures, Portzamparc's building marks a clear distinction between mundane luxury and pathbreaking architectural artistry.



PRISM TOWER

Location: **400 Park Avenue South, New York, NY**
Owners/Clients: **Equity Residential**, *New York, NY*; **Toll Brothers City Living**, *Horsham, PA*
Architect: **Atelier Christian de Portzamparc**, *Paris, France*
Executive Architect: **Gary E. Handel and Associates**, *New York, NY*
Structural Engineer: **Desimone Consulting Engineers**, *New York, NY*
Mechanical Engineer: **Cosentini Associates**, *New York, NY*
Construction Manager: **Lendlease**, *New York, NY*
Curtain Wall Consultants: **Gordon H. Smith Corp.**, *New York, NY*; **Israel Berger and Associates** (now part of Vidaris), *New York, NY*
Ornamental Metal Fabricator and Erector: **Coordinated Metals**, *Carlstadt, NJ*
Curtain Wall Erector: **W&W Glass**, *Nanuet, NY*

INSTITUTE NEWS AND EVENTS

IN-FILL-IN TEAM
Dimitrios Vitalis, *Façade*; **Duc Ngo**, *Architecture*; **Vicente Plaza González**, *Structure (Students of M.Sc. Building Technology, TU Delft)*

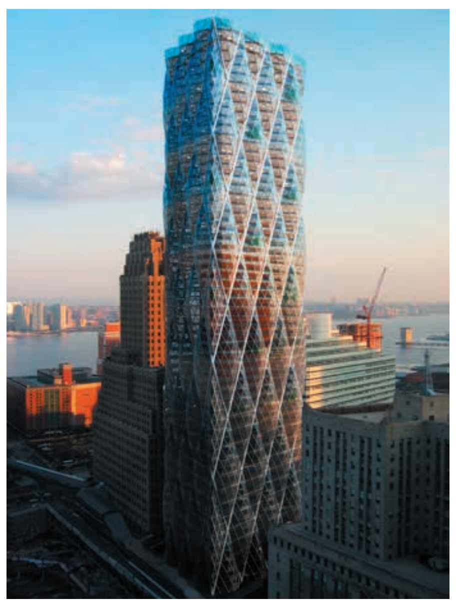
MEET THE WINNER AND FINALISTS OF THE MAGAZINE'S 2017 DESIGN CHALLENGE

Metals in Construction magazine has and a jury of architects and engineers has announced the winner of its 2017 Design Challenge, a competition for architects, engineers, students, designers, and others from around the world to submit their vision for combatting global warming by reducing the embodied energy in their design for a high-rise building.

The winning entry, named Orbit Tower, is the work of a team comprised of architects and engineers from ODA Architecture and Werner Sobek New York. View full competition entries at www.metalsinconstruction.org.

ORBIT TOWER TEAM
Mark Bearak, *Designer, ODA Architecture*
Heidi Theunissen, *Designer, ODA Architecture*
Sonia Huang, *Designer, ODA Architecture*
Nofar Ashuri, *Designer, ODA Architecture*
Juan Roque-Urrutia, *Director of Communications, ODA Architecture*
Bernhard Stocker, *Project Director, ODA Architecture*
Eran Chen, *Founder and Executive Director, ODA Architecture*
Enrica Oliva, *Director of Structures, Werner Sobek New York*
Michele Andaloro, *Specialty Structures Engineer, Werner Sobek New York*

The grand prize of $15,000 was awarded to the Orbit Tower team at a half-day conference at the TimesCenter in New York City on February 24, 2017. The jury also recognized five runner-up teams for their competition entries:

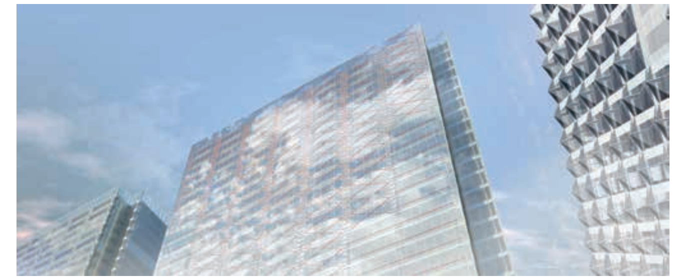


EMBOSS TOWER TEAM
University at Buffalo, The State University of New York: Jin Young Song, *AIA, LEED (Assistant Professor, Dept. of Architecture | Project Architect)*; **Donghun Lee** *(PhD Candidate, Dept. of Civil, Structural and Environmental Engineering | Structural Engineer)*
Skidmore, Owings & Merrill LLP: Chung Yeon Won, *AIA, LEED (Associate Director | Technical Designer)*; **Bonghwan Kim**, *PE, AIA, LEED (Associate Director | Structural Engineer)*; **Keojin Jin** *(Designer)*; **James Erickson**, *PhD, MSc (AA Dist.) Assoc. AIA, LEED (Arizona State Univ. | Environmental Designer)*

THE PEREGRINES TEAM
AECOM: Jason Vollen, *High Performance Buildings*; **Ross Wimer**, *Design*; **Rob Rothblatt**, *Design*; **Xiaofei Shen**, *High Performance Buildings*; **Aman Singhvi**, *High Performance Buildings*; **Annabell Ren**, *Design* **Geoffrey Lynch**, *Architecture*; **Mostafa Elmorsi**, *Structural Engineering*; **Ungelli Picardal**, *Structural Engineering*; **Alastair Macgregor**, *High Performance Buildings*; **Victoria Watson**, *High Performance Buildings*; **Amy Canova**, *Sustainability*

STRUCTURAL EXTERIOR ENCLOSURE TEAM
HOK: John Neary, *Senior Façade Specialist*; **Simon Shim**, *Senior Structural Engineer*; **Apoorv Goyal**, *Sustainable Design Specialist*; **Zhenhuan Xu**, *Design Professional*; **Zifan Liu**, *Design Professional*; **Michael Miller**, *Design Professional*; **Harsha Sharma**, *Design Professional*; **Mark Hendel**, *Senior Structural Engineer*;

For more information about upcoming Institute-sponsored events, visit www.siny.org and www.ominy.org.



Varun Kohli, *Sustainable Design Leader*; **Matt Breidenthal**, *Regional Leader of Engineering*; **Nathan Hoofnagle**, *Architect*

XO SKELETON TEAM
EYP Architecture & Engineering: Jason Olsen AIA, *Lead Designer, Principal*; **Rebecca Frink**, *Architecture*; **Tanner Halkyard**, *Architecture*; **Ivan O'Garro**, *Architecture*; **James Newman**, *PE, High Performance Design Team Leader*; **Eduardo Castro PE**, *Technical Director, Structural Engineering*; **Daniel Olsted PE**, *Senior Structural Engineer, Principal*; **Mark Kanonik PE**, *Senior Structural Engineer*; **Cody Messier PE**, *Structural Engineer* **CHA: Phillip Sutter**, *Structural Engineer*; **Renderers**; **Bluepost**

This year's panel of five jurors came from architecture and engineering fields and include some of the best known experts in sustainable design: Lise Anne Couture of Asymptote Architecture; Michael D. Flynn, FAIA, of Pei Cobb Freed & Partners; Hauke Jungjohann of Thornton Tomasetti; Craig Schwitter, PE, of BuroHappold Engineering; and Marc Simmons, BArch, BES, of Front Inc. Patrice Derrington, PhD, of Columbia GSAPP and CURE, moderated the jury's deliberations.

The jury sought to award designs that met the mandate to fully integrate the building's skin and structural systems to provide not only environmental protection but also resistance to wind and seismic forces. Entries were judged on the amount of embodied energy reduced in the form of building mass, as well as on the overall performance of the integrated systems.

"The competition was conceived to highlight the importance of addressing embodied energy in creating sustainable enclosures," says Gary Higbee, AIA, director of industry development for the Steel Institute of New York and editor of Metals in Construction magazine. "Studies show that the amount of CO2 emissions embodied in producing construction materials accounts for more than 50 percent of the energy consumed during a building's lifetime. The goal of the design challenge is to explore possibilities for reducing building mass, and therefore embodied energy, by employing a hybrid frame and skin structure."

The competition was inspired by President's Climate Action Plan and the Architecture 2030 Challenge. Meeting the aggressive goals for energy reduction established by these programs will require innovation in building design on a widespread scale. With this in mind, architects commissioned to design sustainable buildings must remember that the more highly energy efficient building operation becomes, the greater the percentage that embodied emissions account for in the building's overall energy consumption.

The 2016 competition was sponsored by the Steel Institute of New York.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The Steel and Ornamental Metal institutes of New York continue their series of AIA Continuing Education articles with Architectural Record and Architect in 2016, with topics ranging from responding to new energy goals with façade design to detailing structural steel buildings for optimized performance. More topics are available onlineat continuingeducation.bnpmedia.com and architectmagazine.com via the Continuing Ed tab.

UPCOMING EVENTS

Visit the Steel Institute of New York and the Ornamental Metal Institute of New York at siny.org and ominy.org or on Facebook for the latest information on Institute-sponsored events.

Correction: The Spring 2016 issue of Metals in Construction *should have credited Post Road Iron Works, Greenwich, CT as Miscellaneous Iron Fabricator and Erector for the National September 11 Memorial Museum (page 27).*

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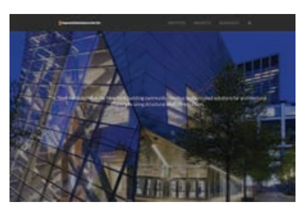

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Ornamental Metal Institute of New York

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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The institutes are a registered provider of the American institute of Architects Continuing education system (AIA/CES).

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METALS IN CONSTRUCTION

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211 EAST 43RD STREET, SUITE 804
NEW YORK NY 10017

PRSRT STD
U.S. POSTAGE
PAID
PERMIT NO. 161
LANCASTER, PA

PUBLISHED BY THE STEEL INSTITUTE OF NEW YORK AND THE ORNAMENTAL METAL INSTITUTE OF NEW YORK