METALS IN CONSTRUCTION

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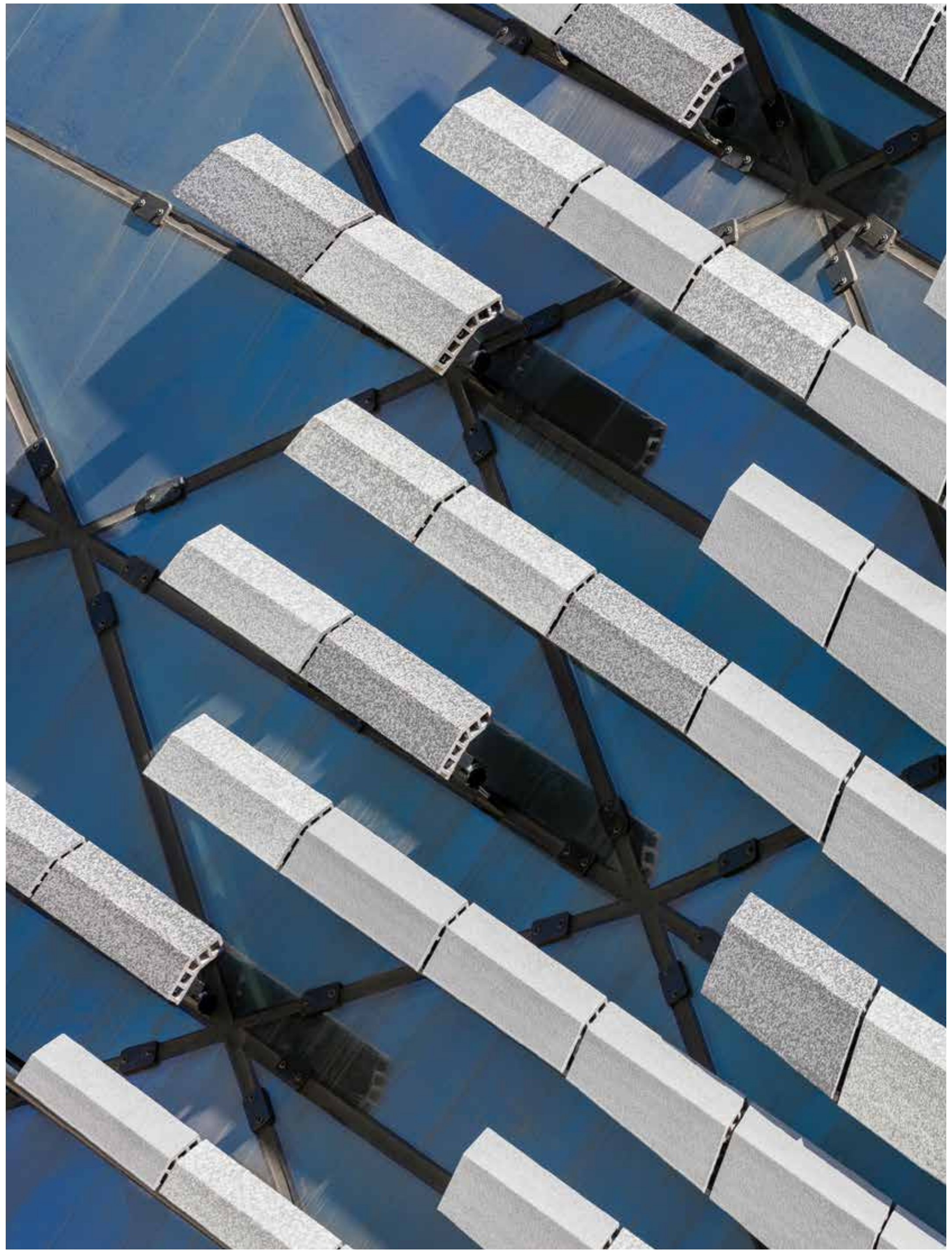

Published by The Steel Institute of New York and The Ornamental Metal Institute of New York

Above A detail of Tammany Hall's gray terracotta sunshades, part of a new glazed roof designed by BKSK.
Cover The layered facade of Columbia University's Henry R. Kravis Hall, designed by Diller Scofidio + Renfro in collaboration with FXCollaborative.

Cover: Iwan Baan; above: Christopher Payne

EDITOR'S NOTE

The Future of Enclosure Design

AS THE MAGAZINE'S CO-PUBLISHERS Steel and Ornamental Metal Institutes of New York mark this year as their 50th anniversary, the publication continues to highlight not only the highly technical work of Institute contributing contractors, but also the importance of this work in advancing critical human factors like occupant well-being. Two years ago, Indoor Air Quality (IAQ) captured the nation's interest as government warnings emerged concerning the way in which coronavirus was transmitted. For building owners, this meant quickly adopting design and technology strategies to safeguard the well-being of occupants. With weather volatility also becoming the norm, owners find they need to develop plans for protecting occupants from not just disease, but threats of flooding, windstorms, heat waves, and outages as well.

Whether a pandemic or an extreme meteorological event, mitigating such threats is heavily reliant on the building enclosure. More than just establishing the look and feel of a structure in its surroundings, the enclosure functions as a critical component in regulating the ever-changing conditions of life indoors. This is important to occupants because Indoor Environmental Quality (IEQ), of which IAQ is a subcomponent, affects not only one's physical well-being but also one's emotional and psychological welfare. Driving this home for all of us during the pandemic was the reality that avoiding infection meant spending 90 percent of our time indoors.

The lessons learned from these experiences underscored the importance of enclosure design. Beyond limiting energy consumption and greenhouse gas emissions, curtainwall enclosures must be able to adapt efficiently and dynamically in response to ever-changing environmental threats.

Envisioning such an enclosure was the assignment given to those entering the *Metals in Construction* magazine 2022 Design Challenge. In a departure from the magazine's usual policy of naming only one winner, two entries were selected to share in the grand prize. As you will read in this issue on page 44, each winner conceived of an entirely different solution to the problem. The jury announced the winning designs along with commentary in a March webinar that may be viewed on-demand via *Architectural Record*'s Continuing Education portal. Despite differences in approach and shortcomings, neither design strayed from the competition's underlying theme of how curtainwall design can impact occupant well-being. To find themes for each year's competition, we continually look to the projects featured in this magazine for ideas on innovations and questions that could be explored through the lens of a speculative design challenge. We are never disappointed.

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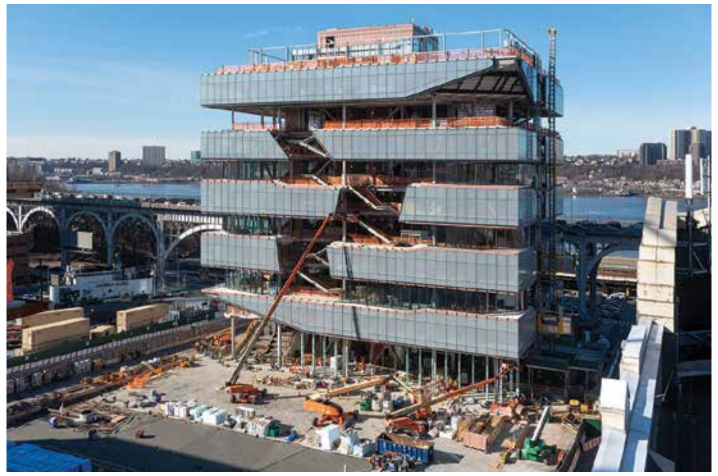
Henry R. Kravis Hall at Columbia Business School

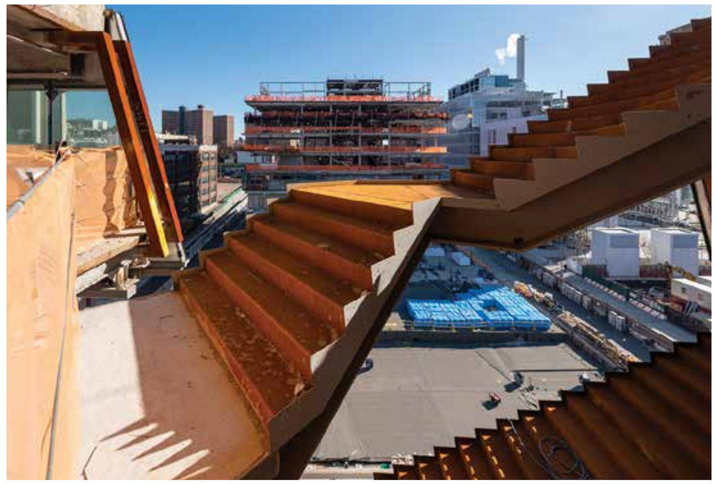
One of two buildings that create a new home for Columbia University's Business School, the Hall's structure works in concert with its facade to embrace the surrounding Manhattanville neighborhood.

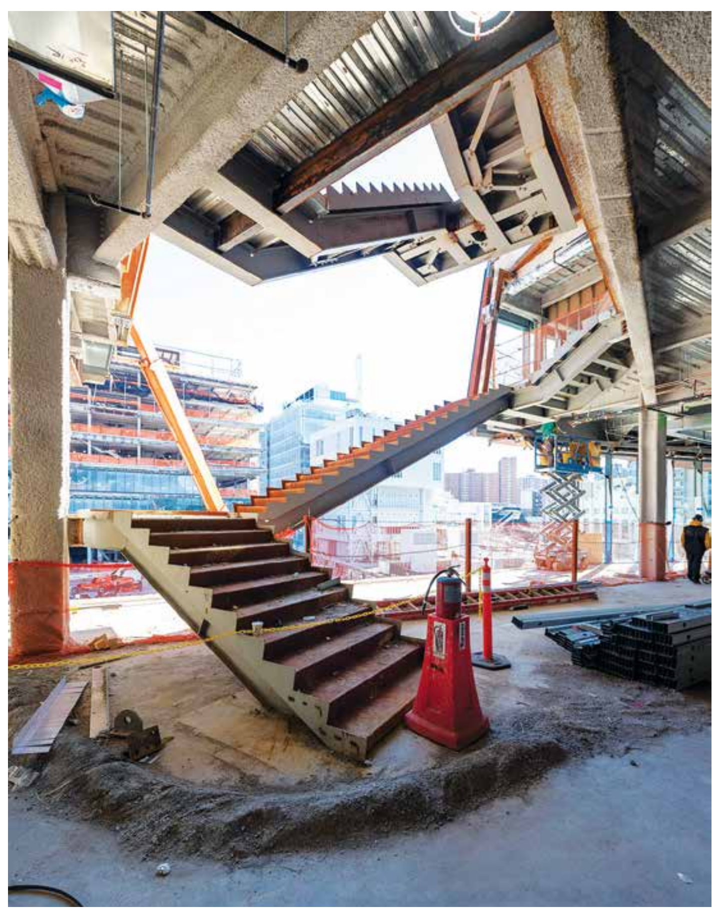
IF THE TRADITIONAL AMERICAN COLLEGE campus is a cloistered place that draws a clear line between town and gown, then Columbia University's burgeoning campus in Manhattanville is decidedly untraditional. To obtain regulatory approvals to develop this 17-acre parcel in West Harlem, the Ivy League school agreed to a package of community benefits that includes a local K–8 school and resident access to university facilities. Columbia's embrace of the neighborhood informed the master plan for the campus, in turn. The 6.8-million-square-foot scheme by Renzo Piano Building Workshop and SOM lacks gates and road closures, and it dedicates all buildings' ground-floor spaces to retail, health clinics, and other public uses—no keycards required.

In the two years after Columbia dedicated the Manhattanville property in fall 2016, the university constructed three buildings and an outdoor plaza in quick succession. The newly opened Henry R. Kravis Hall is part of the campus's most recent growth spurt. Designed by Diller Scofidio + Renfro (DS+R) in collaboration with FXCollaborative, the 11-story structure further embodies Columbia's commitment to community integration, thanks to a scintillating facade that reveals the comings and goings of students and faculty.

The business school is clad in alternating layers of milky vision glass with a ceramic frit and inset transparent glass planes.







Opening spread: Iwan Baan; this page: Timothy Schenck; facing page: Iwan Baan

Kravis Hall is one of two buildings that make up the new home of Columbia Business School. It faces the eight-story David Geffen Hall, also designed by DS+R and FXCollaborative, across a one-acre park designed by James Corner Field Operations. The pair of buildings comprises 492,000 square feet in total.

According to DS+R associate principal Miles Nelligan, Kravis Hall's facade is the outgrowth of Columbia Business School's desire to buck another tradition of higher-education buildings, namely the separation of faculty offices and student spaces. Inspired in part by guaranteed public access to the ground floor, Nelligan recalls that the design process "started with some very passionate conversations about breaking down spatial and population hierarchies; we were encouraged early on to integrate all the school's populations into one project."

To ensure that students and professors would commingle outside of the classroom, the design team organized Kravis Hall into alternating floors for learning and faculty use. Arup, which consulted on the project's structural engineering, envelope, and facade, devised a so-called skip-truss system to support that configuration. The overall building structure comprises ASTM A992 Grade 50 beams fastened to steel columns on composite floors, with webs placed throughout the grillage for additional bracing; the webs greatly increase in frequency on faculty floors to support the classrooms and other wide-open spaces on student floors.

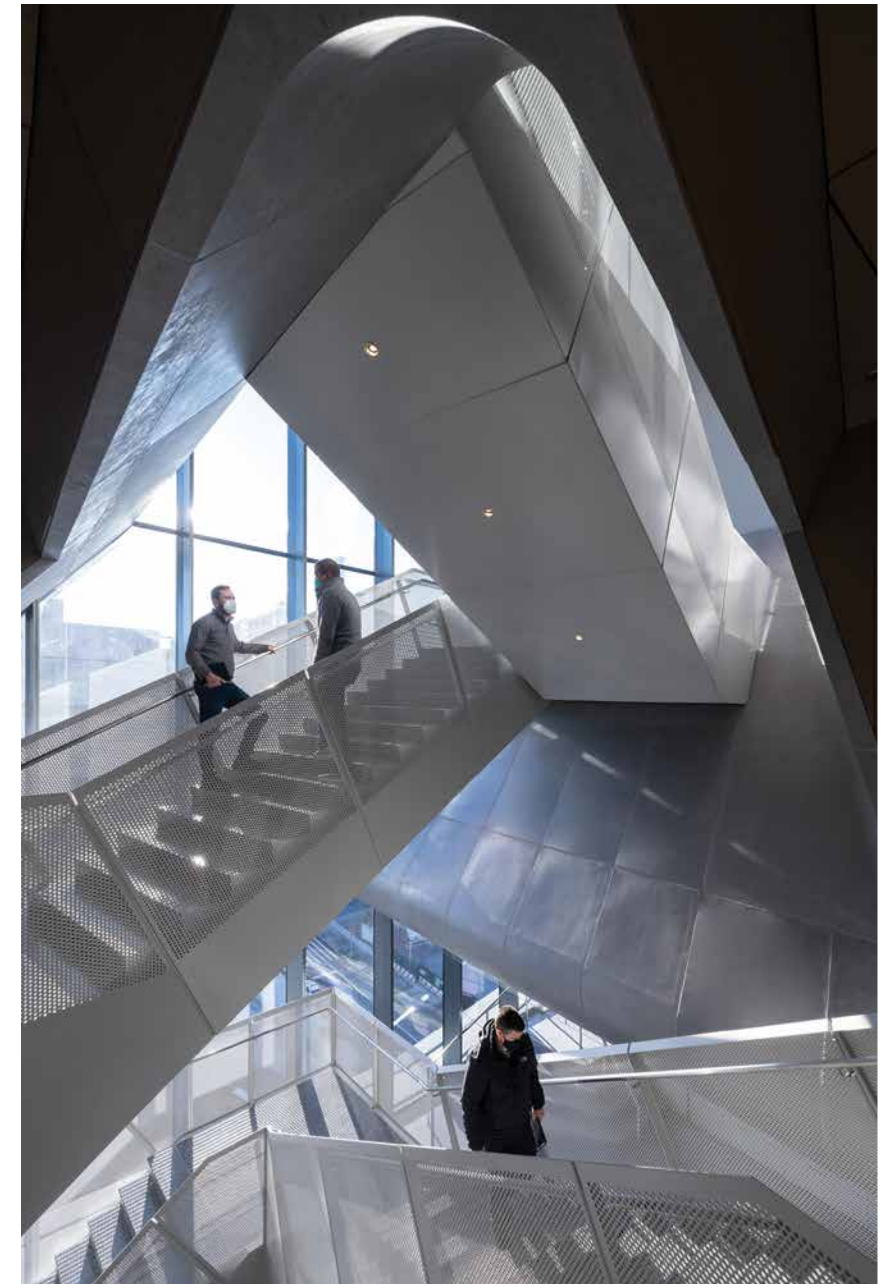
"There was an architectural interest and a client interest in shuffling the buildings into layers. We thought it would be interesting to do the same with the structure," says Arup principal Dan Brodkin, who adds that modular, highly partitioned faculty offices lent themselves to nesting within the more robust structure. Columns are typically W34 sections; beams range from W12s to W30s; and W10s, W12s, and W14s make up the webs. The system ties into the steel of an underground structure that had been commissioned separately.

Recognizing that professors or students could sequester themselves even in a layer-cake scheme, DS+R and FXCollaborative also pierced the building with two visually distinctive staircases whose landings are surrounded by multipurpose spaces. "This was a reaction to how and where education takes place in academic buildings, which is not only in the classrooms. It's about interactions, the time outside class, the group work, the socialization," Nelligan says of transforming conventional circulation into a vertical quadrangle. The routes inserted along Kravis Hall's west and east elevations are respectively earmarked for faculty and student movement. Because students tend to linger on campus despite not having a domain to officially call their own, landings that radiate from the student stair are especially commodious.

Both the alternating floors and unifying stairs are legible to passersby. Faculty floors are wrapped in a curtain wall whose vision glass includes a white ceramic frit on the exterior, which lends the surface a milky quality while modulating incoming daylight for the perimeter faculty offices. Student floors are finished in transparent glass planes that are inset from the floor plate's edge. The two stairs employ the same code, moreover: the faculty stair is expressed on the west elevation as a fritted-glass plane that zigzags among the horizontal wedges, and clear inset glass wends up the east elevation to reveal the student stair. As Nelligan puts it, "The building is very honest about what's going on inside."

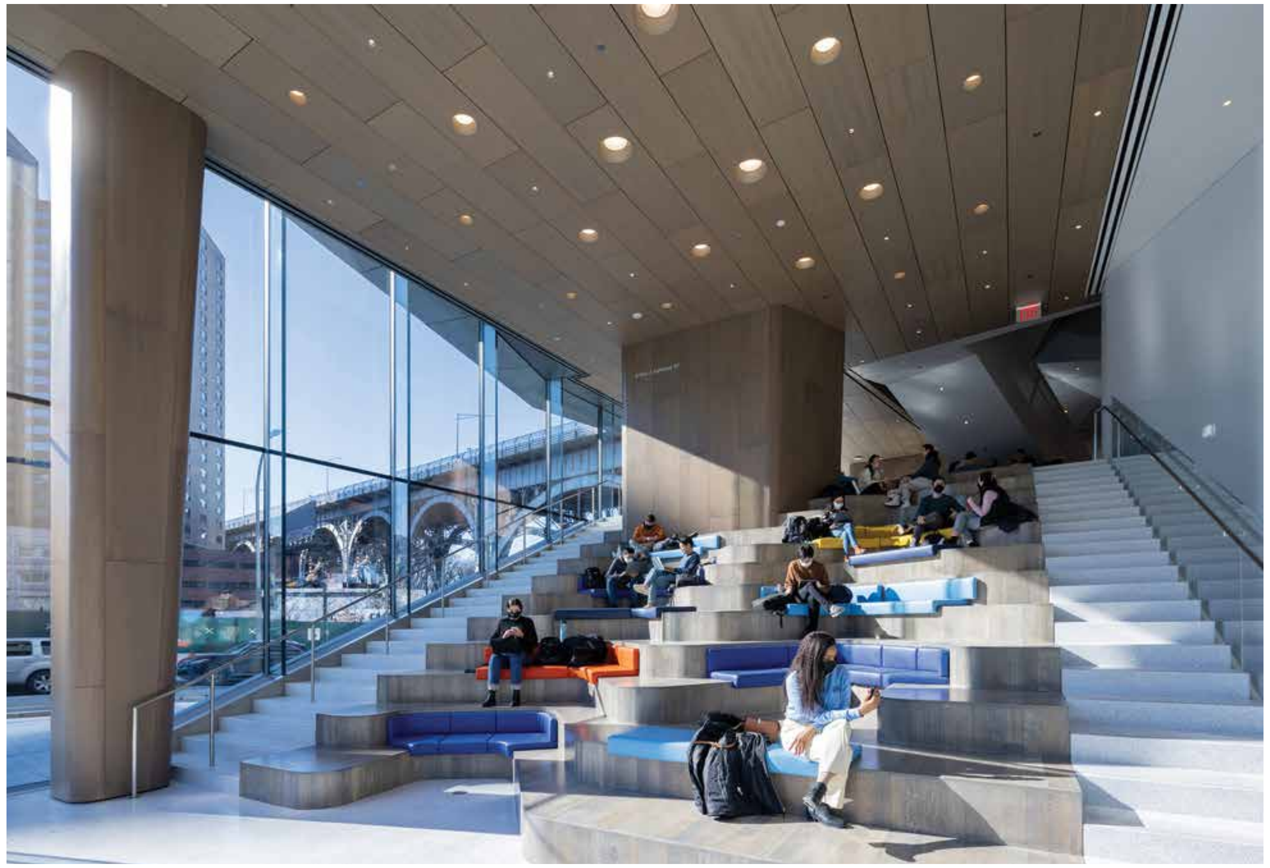
That the facade steps in and out alongside the alternating floors confirmed the need for Arup's skip-truss structure, says Jeroen Potjer, a senior structural engineer at the firm: "We couldn't place columns directly at the perimeter, because of the layered composition. The skip system is always perpendicular to the face, to accommodate those long cantilever conditions of approximately 12 feet." Arup also conceived a "ladder-truss system" to support those areas of glass that span multiple stories. In these places, two parallel ASTM A500 rectangular HSS are set in from the facade, and the tubes link via horizontal elements.

The project team then engaged W&W Glass in design-assist to create Kravis Hall's communicative skin. "Design assist helps us with constructability and installability," W&W project manager Ryan Malynn says of the delivery method, which inserts manufacturer feedback early in the design process. Malynn adds, "Because this building has a lot of unique setbacks and deep soffits, we were more in control of how our steel connected to the structure."



Facing page A skip-truss system devised by Arup supports alternating floors of faculty offices and student spaces.

Above The student stair is one of two main circulation routes through the building.



After performing its own load analysis, W&W worked with Arup to introduce kicker angles and other stiffening techniques, so that Kravis Hall's structure could support the company's preferred configurations and connections. In parallel, W&W determined to execute the faculty facades as unitized curtain walls. Meanwhile, the transparent glass of student floors are stick-built window walls that have their own structural steel support system at the head and concrete curbs at the sill. "Because of the way every other floor steps back, every single floor has its own starter track," Malynn also notes of the alternating systems. (Storefront glass wraps the ground floor.) All standard systems absorb thermal, seismic, and differential movements of approximately 1 inch, according to Malynn's fellow project manager Matthew Keefe.

The stick-built walls are hanging systems, in which the steel head dead-loads the panels. Keefe points out that W&W also had to take into consideration large live load and drift movements, given that the three east-facing walls abutting the student stair span two or three stories. The company responded by adding aluminum-clad, ASTM A500 50 KSI rectangular HSS mullions to the glass, setting them into the starter tracks with base anchors. The mullions were set in section and spliced in the field.

"It was quite a road to travel, to create a system that can adapt to all these bespoke situations," Nelligan says of W&W's efforts. Of making building activity and the urban context visible to one another overall, the architect adds, "at Columbia Business School, you know you're in New York."

This page: Iwan Baan

Timothy Schenck

This spread Spaces for learning, socializing, and studying extend vertically through the building. Kravis Hall's layer cake expression really shines at night.

HENRY R. KRAVIS HALL AT COLUMBIA BUSINESS SCHOOL

Location: **645 West 130th Street, New York, NY**
Owner: **Columbia Business School**, *New York, NY*
Architects: **Diller Scofidio + Renfro**, *New York, NY* In Collaboration With **FXCollaborative**, *New York, NY*
Structural Engineer and Curtain Wall Consultant: **Arup**, *New York, NY*
Mechanical Engineer: **Buro Happold**, *New York, NY*
Construction Manager: **Turner Construction**, *New York, NY*
Structural Steel Fabricators: **Cives Steel Company**, *Gouverneur, NY*, **Berlin Steel** (feature stairs), *Kensington, CT*
Structural Steel and Metal Deck Erector: **J.F. Stearns**, *Pembroke, MA*
Miscellaneous Iron Fabricators and Erectors: **United Structural Works**, *Congers, NY*; **Post Road Iron Works**, *Greenwich, CT*
Architectural Metal Fabricators: **Rockfon**, *Chicago, IL*; **BAMCO Inc.**, *Middlesex, NJ*; **Vitrabond** (Aluminum Composite Panel System); *Bloomfield, CT*
Architectural Metal Erectors: **BAMCO Inc.**, *Middlesex, NJ*
Ornamental Metal Fabricators and Erectors: **JEM Architecturals**, *New Rochelle, NY*; **Champion Metal & Glass**, *Hauppauge, NY*
Curtain Wall Erectors: **W&W Glass**, *Nanuet, NY*; **IDA Exterior Systems LLC**, *Derby, CT*

Built within the 1914 shell and steel frame of the Mid-Manhattan Library which it replaces, 180,000-square-foot building is topped with an angular roof and public rooftop amenities overlooking Fifth Avenue.

Stavros Niarchos Foundation Library

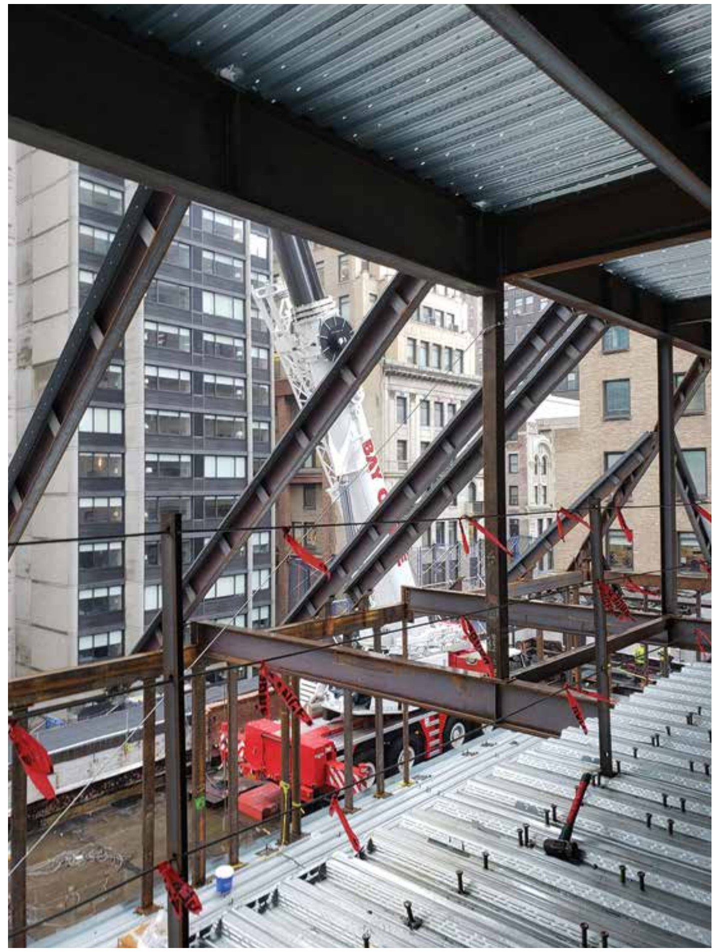
The largest circulating library in the city puts its original 1914 structural steel frame to work, improving accessibility to its open stacks and adding an exciting rooftop venue for the community it serves.

NEW YORK'S NEWEST CENTRAL circulating library, The Stavros Niarchos Foundation Library (SNFL), had a quiet beginning when it was completed just two months into the pandemic's start in May 2020. At first the long-awaited renovation of the Mid-Manhattan Library (MML) was only open for grab-and-go book collection and limited occupancy, but now the New York Public Library's largest circulating branch is proving that libraries are no longer just for hushed studying. In addition to 180,000 square feet of renovated spaces including open stacks, children and teen areas, an adult learning center, and meeting rooms, the building is topped with an attention-getting angular roof and public rooftop space that has become a landmark on Fifth Avenue—and the only free, publicly accessible rooftop terrace in all of Manhattan.

Designed by Dutch architecture firm Mecanoo in collaboration with Beyer Blinder Belle Architects & Planners, the project aimed to add 35 percent more public space to the building, which receives approximately 1.7 million visits every year. The MML was originally located within a former 1914 department store, which it occupied in 1970, and its interior retained many of the spatial constraints and systems of the retail space, including varying ceiling heights, an escalator, and poor ventilation.

One initial focus for Mecanoo founding partner Francine Houben was an opportunity to design a contemporary complement to NYPL's Stephen A. Schwarzman Building (SASB), located across Fifth Avenue from SNFL. (Mecanoo and Beyer Blinder Belle have collaborated on programming and design across both locations.) That building, designed by Carrère & Hastings and opened in 1911, shares a Beaux-Arts style with neighbors on Fifth Avenue, and the architects used that influence along with neighboring copper-clad mansard roofs, as a jumping-off point for the SNFL's signature rooftop design. The other major goal of the renovation was to make use of an unusual floor plan, which had one long leg between 39th and 40th streets where the department store's loading dock had been.

"We came up with the idea of the Long Room, named after the library of Trinity College



Opening spread: John Bartelstone; this page: Courtesy of Matt Messing

This page: John Bartelstone

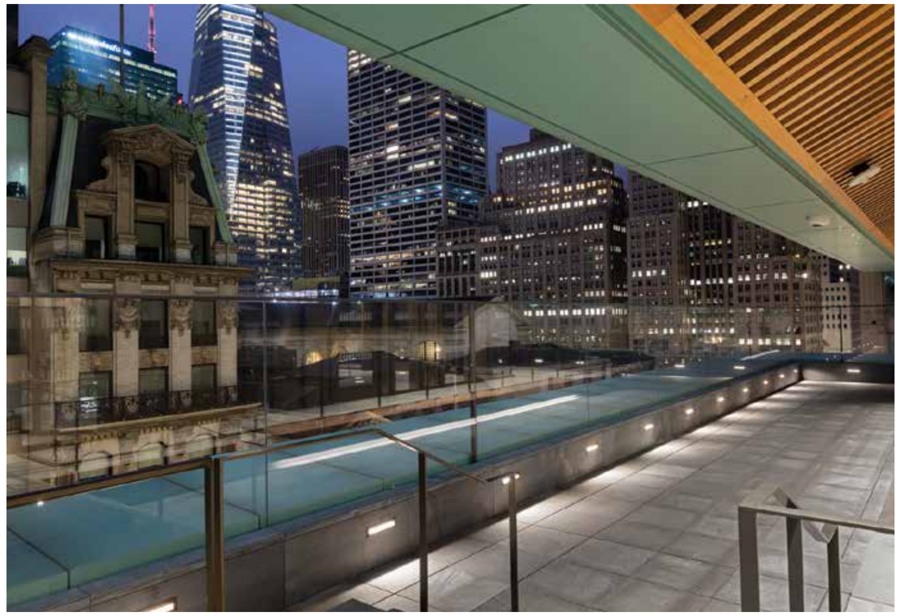
Facing page, top row and bottom left Structural steel reinforcements of the library's existing roof framing support the loading of its new vertical addition, which sits on a platform of new steel. **Facing page, bottom right** Following demolition of third- and fourth-floor slabs, new steel framing was engineered to support the library's open stacks. **Above** The Long Room features a triple-height void rising to a ceiling artwork by Hayal Pozanti on one side and five stories of stacks on the other.

in Dublin," says Houbin. This solution allowed the architects to use the oblong floor plate to create completely browsable and accessible stacks for the library's 400,000 books and other materials. To house that much media, the team that included Silman as structural engineer devised a plan to create five floors where there had previously been three. "We really wanted to use the columns," comments Houben, referring to the building's structural steel frame. The solution was to cut a triple-height void into the floor slabs, 31 feet wide and rising 85 feet from the second story to an abstract ceiling artwork by Hayal Pozanti to echo the famous muraled ceiling of SASB. Now, this linear atrium separates three floors of flexible, daylit reading areas on one side and five levels of book stacks on the other, an efficient solution to balancing the need for a browsable collection and the library's desire for more public reading room space. Through SNFL's 40th Street windows, passers-by can see the northern end of the book stacks, visible as a continuous vertical wall of book spines welcoming them to browse.

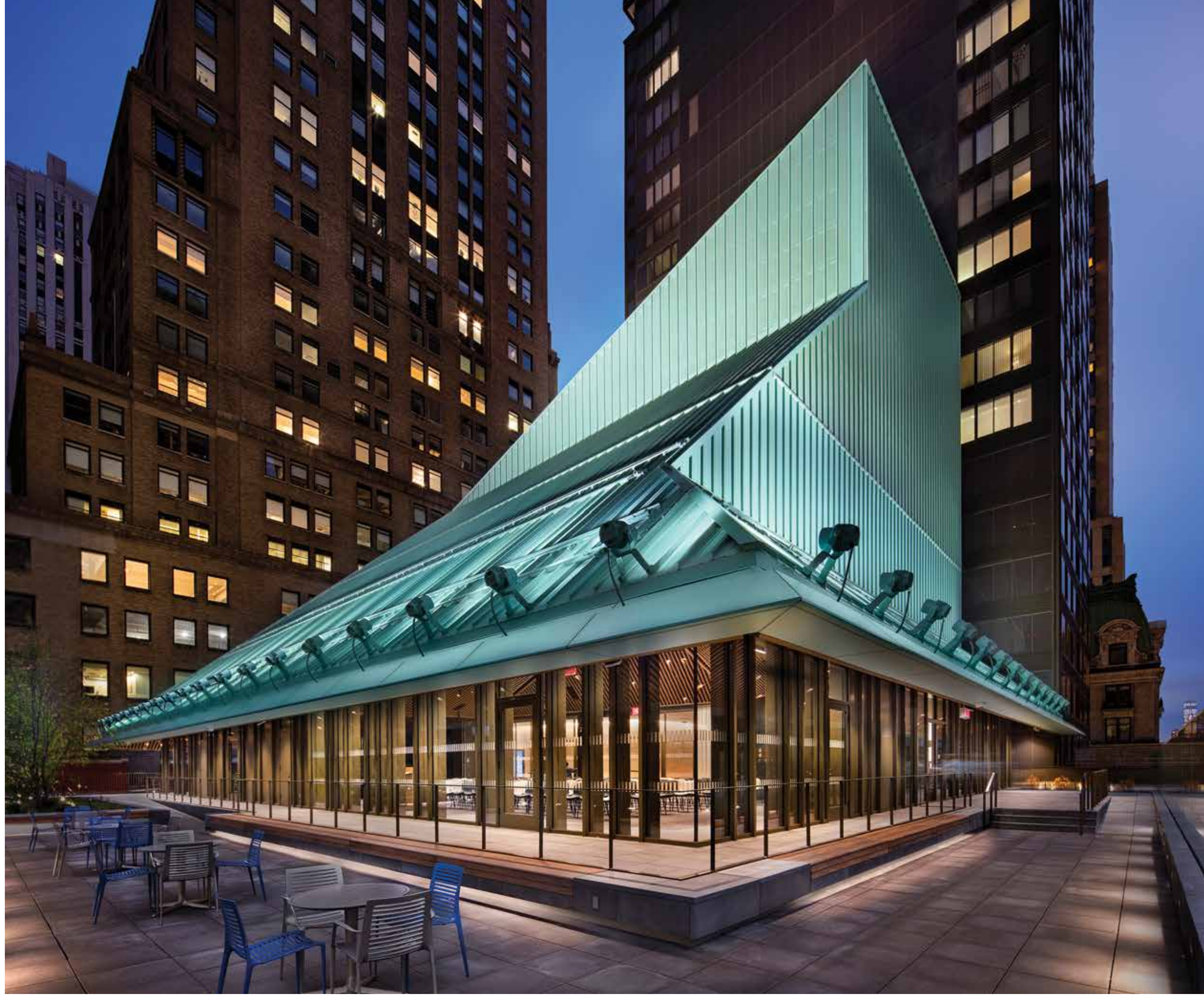
This alteration required the demolition of the third and fourth floor slabs at the east side of the building, which Silman replaced with four new framing levels for the stacks. The floor slabs adjacent to the Long Room were removed at consecutive levels to create a multi-level open space. Bridges connect the main floor levels to the tiered levels of the Long Room. Another two voids in the ground-level slab, which required simply subtracting the existing floor plate, supply natural light to the lower floor, which houses a Children's Library and Teen Center.

"The subtractions ended up being more complicated than the additions in a sense," says Elizabeth Leber, the partner in charge of the project for Beyer Blinder Belle. She describes how one of the more complex aspects of the project was the design of the new floor slabs for the Long Room. Those five floors were constructed with a long-span corrugated metal deck that is perforated for improved acoustics. "It does all of the work in a very shallow depth and air gets distributed along the walls so we don't have the drops of ductwork," says Leber. "It's a quiet detail and it was down to inches. The whole concept of the Long Room hinged on getting this to work, and therefore the capacity of books."

Another behind-the-scenes effort to make the Long Room concept come to life involves fire prevention within the vast void space. Because New York building code defines any void that connects more than two stories as an atrium, the design team devised a solution to integrate automatically retracting shutters that can close off the fourth floor. In the event of a fire, that curtain drops down and the void becomes a two-story opening.



Left The library terrace overlooks Midtown Manhattan and neighboring Beaux Art copper-clad mansard roofs, which provided inspiration for the roof's form and color.
Below Structural bridges connect spaces on either side of a double-height void.



Upon entering the library, visitors encounter an internal street that runs from the Fifth Avenue entrance to the welcome desks. The building's existing structural steel columns became a dramatic element, painted in dark brown and uplit to guide visitors into the library's public spaces. The columns are also used to structurally hang expansive work and display tables throughout the space. An existing mezzanine level was completely reshaped and hung from the level above using structural rods and columns.

Houben and team knew that no transformation would be complete without making a public-facing gesture on the building's exterior as well. Noting that city rooftops in the United States are often dedicated solely to mechanical equipment, Houben says, "I really wanted to use the roof." With a design fondly named the Wizard's Hat for its green chapeau-like form visible from the street, SNFL's rooftop now supports a flexible 268-occupant conference and event center. An L-shaped roof terrace runs above the 40th Street and Fifth Avenue facades and includes a roof garden and indoor café.

Silman designed reinforcements of the existing roof framing at various locations to support the loading of the new vertical addition. The new addition itself was designed on a platform of new steel supported on new columns that align with existing column locations. To allow for longspan spaces, the steel-framed addition has columns spaced 20 to 60 feet apart. The floors and sloping roof are supported primarily by a combination of steel brace frames, moment frames, and trusses, concealed within the finishes and the mechanical service levels above. The mechanical levels and the amenities below are topped with the hat, which reaches 184 feet above street level and is clad in factory-painted aluminum panels to mimic the patinated copper roofs of two 1904 Beaux Art rooftops visible from the terrace.

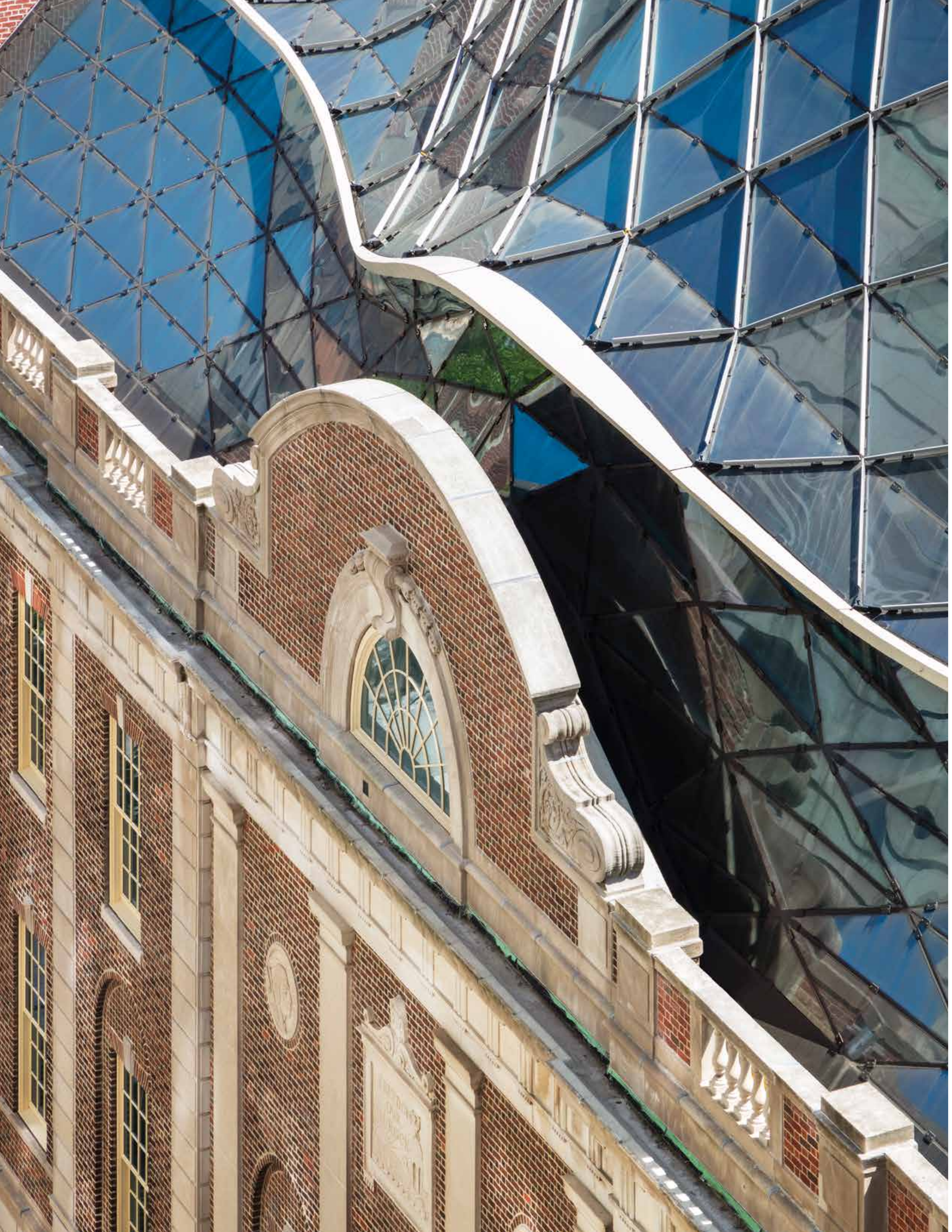
With new sightlines across Fifth Avenue to the Stephen A. Schwarzman Building and surrounding skyscrapers, the SNFL branch is perhaps more at home among its neighbors than it has ever been. Though the library had undergone small renovations in the past, the architects and patrons agree that the building, benefitting from the design flexibility of the original building's steel frame, is finally living up to its full potential as a community hub. "It didn't fully become a library until we did this renovation in a sense, though culturally it was beloved," says Houbin. "It is a testament to how an older building can be reimagined."

This spread: John Bartelstone

The library's new floor contains a flexible 268-occupant conference and event center. An L-shaped roof terrace runs above the 40th Street and Fifth Avenue facades.

STAVROS NIARCHOS FOUNDATION LIBRARY

Location: **455 5th Ave., New York, NY**
Owner: **New York Public Library**, *New York, NY*
Lead Architect: **Mecanoo**, *Delft, NL*
Architect of Record: **Beyer Blinder Belle**, *New York, NY*
Structural Engineer: **Silman**, *New York, NY*
Construction Manager: **Tishman Realty & Construction**, *New York, NY*
Structural Steel and Miscellaneous Iron Fabricator: **Orange County Ironworks, LLC**, *Montgomery, NY*
Structural Steel Erector: **Gabriel Steel Erectors, Inc.**, *Montgomery, NY*
Miscellaneous Iron and Metal Deck Erector: **Gabriel Steel Erectors, Inc.**, *Montgomery, NY*
Ornamental Metal Fabricator and Erector: **JEM Architecturals Inc.**, *New Rochelle, NY*
Ornamental Metal Fabricator and Erector (roof): **The Jobin Organization**, *Farmingdale, NY*



44 Union Square

Advanced building technology reinvents a landmark at Tammany Hall.

THE FORMER TAMMANY HALL HEADQUARTERS has a lively history, housing not only the New York Democratic Party organization but also, later, the International Ladies' Garment Workers' Union, the Union Square Theatre, and the New York Film Academy. For a mere three-and-a-half-story structure, the 1929 building by Thompson, Holmes & Converse and Charles B. Meyers has carried substantial weight among the city's institutions. Modeled loosely after Federal Hall, and landmarked in 2013, Tammany Hall underwent a gut rehabilitation to preserves the facade and adds a striking new domed roof, with a grid shell of 2-by-6-inch steel tubes supporting over 800 unique triangular glass units, extending the building's usable space to six stories.

The parametric steel-and-glass structure atop the neo-Georgian shell's brick, limestone, and terra-cotta tracery is a stylistic surprise but, to some observers, incongruously harmonious. Todd Poisson, partner at BKSK Architects, recalled the extensive historical research that led to the design after owners Reading International, a theater/real estate firm, invited architects to reimagine Tammany Hall. Recalling the competition brief, Poisson says, "They wanted to move away from the name Tammany, which referenced the Lenape chief Tamanend," a clan leader of indigenous peoples from the northeastern woodlands. But he and his colleagues took a contrary approach— "Why don't we re-embrace the name Tammany in a way that they wouldn't expect and look at Tammany's history?"—and won.

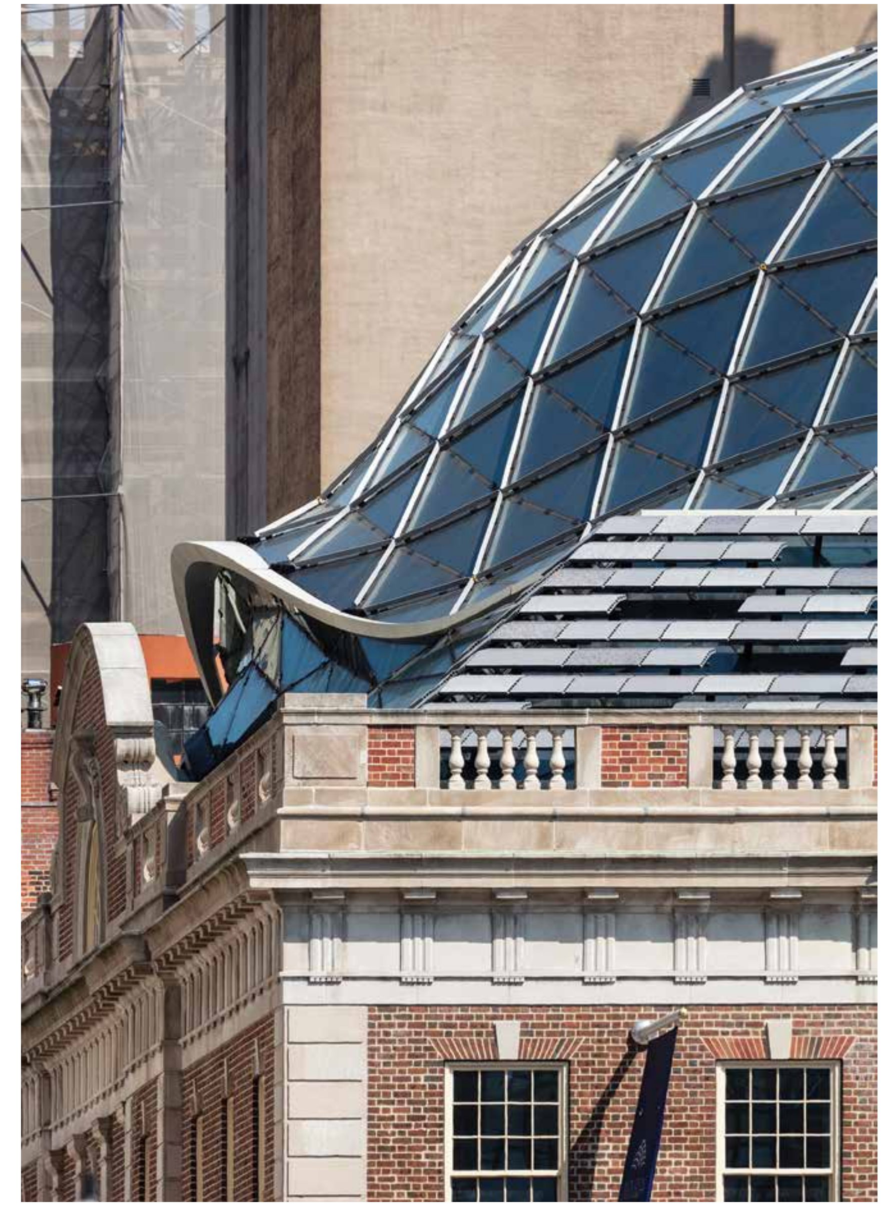
The architects consulted with the Lenape Center on questions of cultural authenticity and developed a parti that would replace the building's "pretty tepid slate hip roof" with a dome evoking not only a turtle shell rising from the sea (an image from the Lenape narrative of the North American continent's creation, and the icon of Tamenend's clan) but also the domes that were common in Georgian and neo-Georgian design. The Tammany Society's previous headquarters on 14th Street was domed, Poisson noted, and in England and the U.S., "there were some references we found that got their domes 100 years after they were built…. Using that as inspiration, and other classical domes throughout the history of architecture, we modeled our dome to honor Tamanend with a little organic source material," commingling Lenape and English heritage. Only this dome would be executed in steel and glass.

A structure driven by such symbolism required exceptional precision in design and construction. Stefan Zimmerman, senior branch manager at the Würzburg, Germany, branch of Josef Gartner GmbH, a member of the Permasteelisa Group, pointed out that the roof is a true free-form design, not a pure dome based on fixed circular radii or ellipses. "This means that every single member is different in shaping and different in geometry, different in angles," Zimmerman explains. "So the individual surfaces of the canopy have been broken down into triangles." Such a geometry, he adds, "creates angles between the tubes, it creates angles between the nodes, it creates torsional twists for the tubes, which all need to be accommodated in the node points." The tubes are relatively simple with a 90-degree end connection, and the complex node points are CNC-machined. Wrapping the dome frame above an arched pediment at the 17th Street entrance created particular geometric challenges. None of the glass is curved; the precise design and machining generates

Opening page: Christopher Payne; this page, clockwise from top: Christopher Payne, Jennifer Krichels, Christopher Payne

Top: Christopher Payne; right: courtesy of BKSK Architects

Opening spread BKSK added a domed, three-story addition to Tammany Hall's rooftop, preserving its historic brick, limestone, and terracotta facades.
This spread The self-supporting free form shell grid dome is composed of 800 triangular glazed units. Installation proceeded from the top down. (Drawing) A detail of the glazed terracotta sunshades, which match the angle and location of the original slate roof.



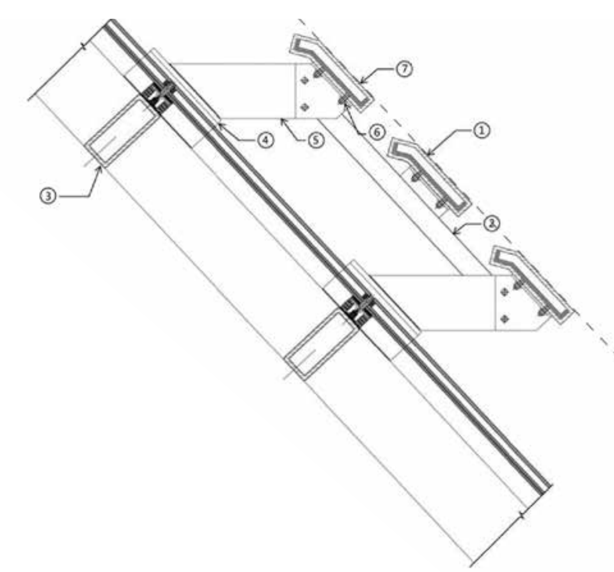
the appearance of curvature with large numbers of small straight steel members, joined at approximately 1,000 node points, supporting triangular double-pane insulated glazing units (IGUs), each combining SGG Cool-Lite Xtreme and Parsol Grey glass panels by Eckelt. "The upper dome glass on the fifth and sixth floors has a darker tint to address glare and thermal comfort, while the lower hipped roof zone glass is slightly clearer, as it is a clerestory glazing for the fourth floor, and is partially shaded by the terra-cotta sunshades," says Poisson.

Because of fire-protection regulations, Zimmerman says, "the wall thicknesses of the steel are higher than they would have needed to be for structure and for deflection requirements." The dome is fully self-supporting, and a new concrete liner wall at the perimeter takes the steel structure's entire load, with no columns touching the steel structure and no internal loading onto the floor plates. The unique shapes of all components called for exceptional logistical control on the job site, along with caution in packing and handling.

Prefabrication of tubes and nodes at Gartner's German factory included steel lettering to guide assembly. A system of offsite storage and regular shipments to "feed the site with the demand for the next two, three days" overcame storage limitations at the tight downtown Manhattan site.

Rayhaan Nagrath, project manager at Gartner's New York office, points out that the dome includes areas with two roof types, designated RT1 for the dome and "bull nose" (a protruding segment atop the western facade toward Union Square) and RT2 for the lower perimeter glass. "The bull nose breaks up the two systems," Nagrath notes, "and the frames for the RT1 and the RT2 are constructed differently." The RT1 frames include a node system, connecting node to node with horizontal purlins, with a hole in each node as a modular design feature allowing optional mountings, while RT2 frames are composed of purlins without nodes. Purlins include bolts for sprinkler attachment. Support brackets separated from the steel allow the entire structure to move under wind loads, preventing bending and glass breakage. Steel fins placed strategically 1½ inches above the glass articulate the form to help create a dynamic image from the street, and act as a net to disperse snow loads and prevent unexpected avalanches. A hip-roof segment below the dome uses terra-cotta sunshade panels in multiple shades of gray, helping control solar gain and providing visual variety.

"We really wanted to be harmonious with the landmark base building," Poisson comments. The fins "serve as further articulation of the shell, to make it more harmonious with the scale of both the

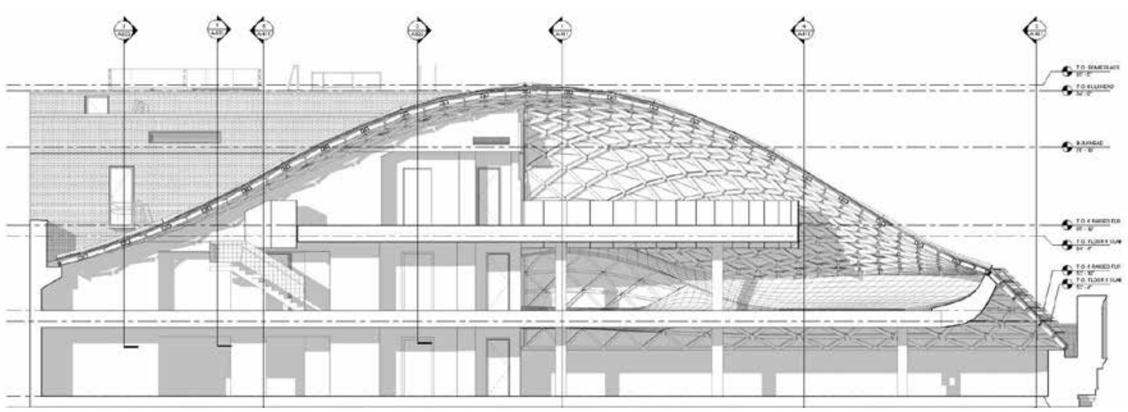


This spread A new concrete liner wall at the perimeter takes the steel structure's entire load. A hip-roof segment below the dome, facing northeast, uses terra-cotta sunshade panels in multiple shades of gray. (Detail) An east-west section drawing shows how the appearance of a curvature is achieved with small straight steel members.

stonework of the base and the tracery of the window mullions and muntins, especially at the second floor. There's a balcony with doors with beautiful tracery muntins above it, which we replaced in kind. So we were inspired by the details of the existing building for the scale and detailing of the dome. We wanted to have enough articulation so it did not appear alien."

After factory preassembly of the RT2 frames, installation of both the dome and the terra-cotta panels proceeded from the top down. The total assembly uses approximately 50 frames and 300 purlins to support its 800 glazing units; "pretty much every aspect of this job is unique," Nagrath says. With its custom components and a high degree of structural interdependence, plus limited space for shoring points during construction because scissor lifts needed room to move, tolerances throughout the frames had to be extraordinarily tight, meticulously checked, and adjusted at each step. The pace of construction, he reported, was "about a frame a day, plus some time for all the intermediate purlins," plus the glazing, averaging 13 glass units per seven-hour workday.

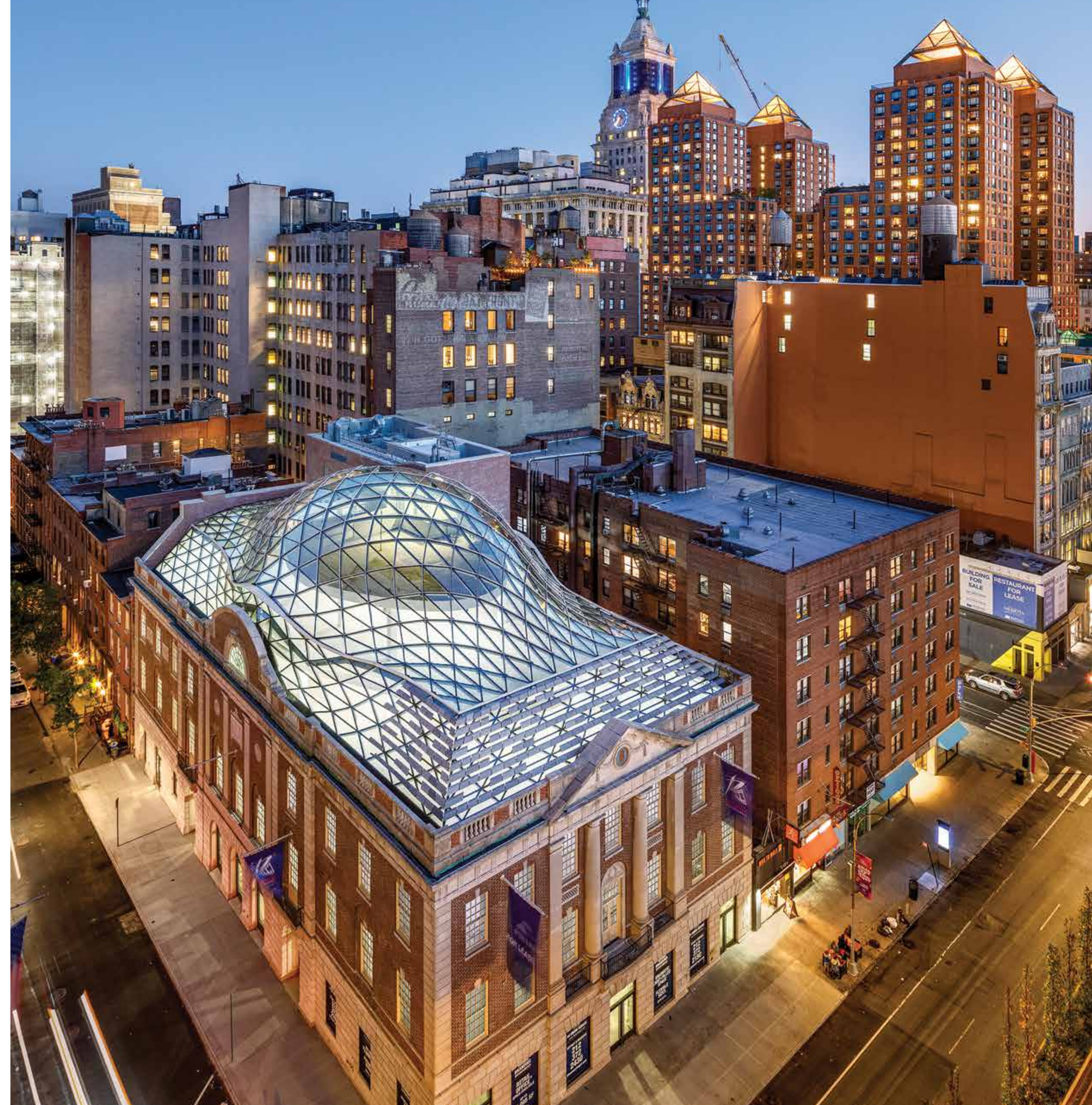
This painstaking process has yielded a building that has begun garnering honors before even opening, winning an AIA-New York QUAD Design Award in 2017. Zimmerman notes that Tammany may be a difficult precedent to replicate elsewhere. "This is more like a piece of art than a real building envelope," he says, and he knows of no comparable domes in New York. But the sentiment behind it is one that could inspire architecture the world over; it has restored one of New York's long-neglected treasures to the public eye.



Top: Christopher Payne; above: courtesy of BKSK Architects; facing page: Francis Dzikowski

44 UNION SQUARE

Location: **44 Union Square, New York, NY**
Owner: **Reading International Inc.**, *Culver City, CA*
Construction Manager: **CNY Group**, *New York, NY*
Architect: **BKSK Architects**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Facade Engineer: **Buro Happold**, *New York, NY*
Mechanical Engineer: **Dagher Engineering**, *New York, NY*
Construction Manager: **CNY Group**, *New York, NY*
Dome steel Fabricator and Erector: **Josef Gartner GmbH, a division of Permasteelisa**, *New York, NY*
Dome Steel Erector: **Tower Installation**, *New York, NY*



One Vanderbilt's tapering trapezoidal form towers above Grand Central Terminal.

One Vanderbilt

Visually aggressive and environmentally progressive, the new office tower overlooking Grand Central Terminal—a model of sustainable transit-oriented development, constructed under budget and ahead of schedule—looks beyond the COVID era to a day when East Midtown will thrum and thrive again.

THE VIEWS FROM HIGH FLOORS at One Vanderbilt, the 77-story Kohn Pedersen Fox tower that opened last September, can induce a moment of awe in even the most jaded New Yorker. Viewing the spires of the Chrysler and Empire State Buildings from above was once a perspective afforded only from aircraft. At 1,401 feet, One Vanderbilt is the tallest office tower in Midtown and the fourth tallest building in the city.

Any supertall skyscraper is, among other things, an embodiment of optimism. Who, after the past two years, has had much room for optimism? Employment rates and commercial rental markets have taken a hit. The *ad hoc* shift to work-from-home has reduced demand for office space either momentarily or permanently, as workers and organizations reassess which activities do and don't need physical presence. There will inevitably be observers who believe a major new Class A commercial building is the last thing the city needs, and not all of them are NIMBYs.

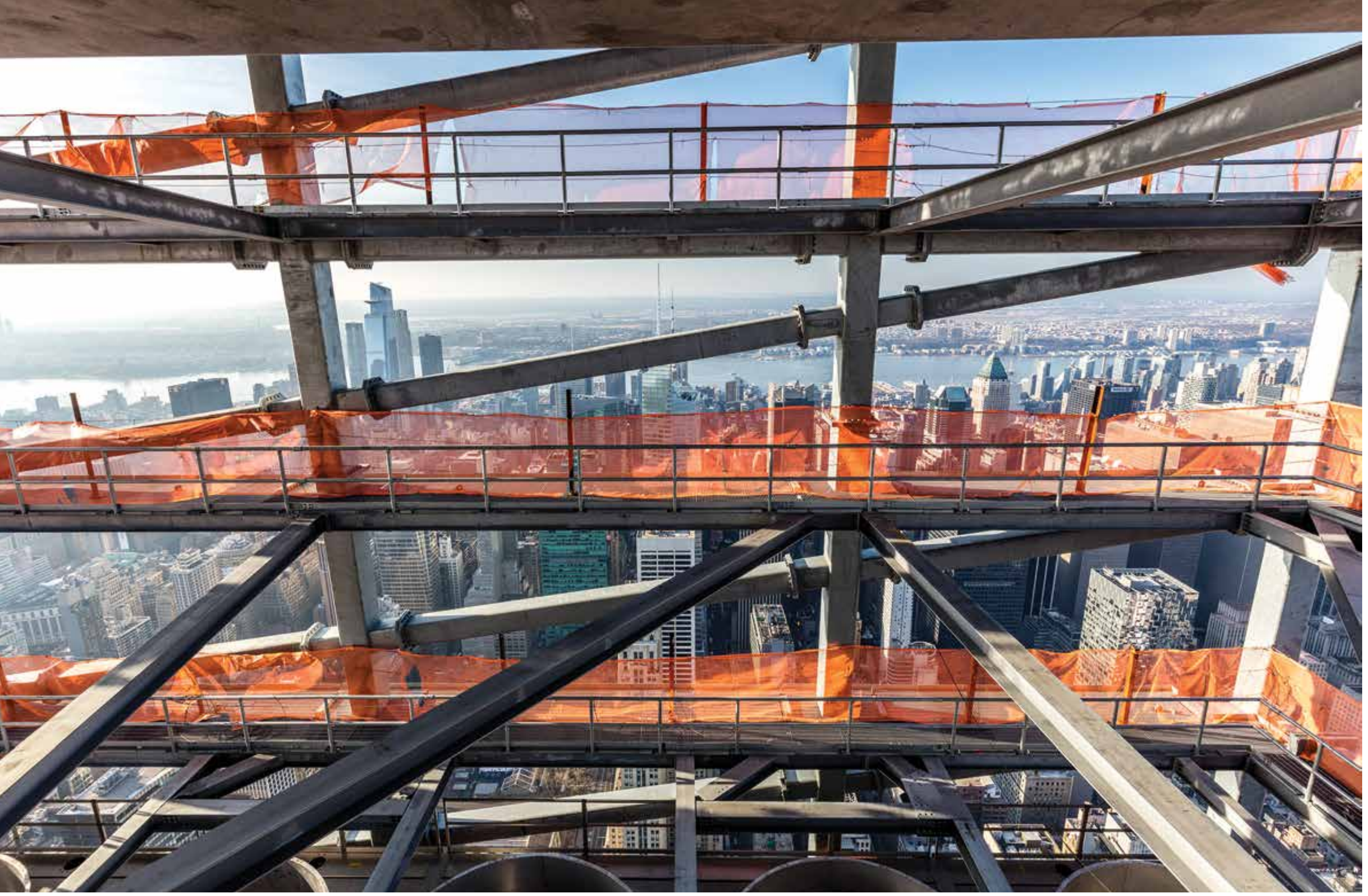
The team that gave the city One Vanderbilt, however, is looking beyond the present and near future. The new building, they contend, is more than just a paragon of sustainability, with $17 million worth of investment in features that give it an exceptionally low carbon footprint for its scale. It emerges from a pathbreaking public-private partnership involving the City of New York and the Metropolitan Transportation Authority (MTA). And it is essential to the reinvention of East Midtown, the 78-block area that City Council rezoned in 2017 with an eye toward relieving congestion, encouraging transit use, and upgrading aging building stock. Occupying the block bordered by 42nd and 43rd Streets and Madison Avenue, and replacing the lowest block of Vanderbilt Avenue with car-free space adjacent to Grand Central Terminal, the building may be the nation's most conspicuous example of transit-oriented development.

The neighborhood's need for up-to-date and uncrowded space is clear. One Vanderbilt not only contributes 1.7 million square feet of commercial space but integrates on multiple levels with the terminal. "The One Vanderbilt project included $220 million in public transit improvements," Moss says; these include a new subway entrance, a 4,000-square-foot transit hall inside the tower, and ADA elevator access to the subways and trains. "The improvements will allow for one more train to run on the congested 4/5/6 subway line per hour, which will help relieve congestion during peak hours."

One of the building's distinctive qualities is its deference to other elements of its neighborhood. "A major challenge was to design a supertall structure that would not overshadow, but complement, its neighbor Grand Central Terminal," Severud's Daniel Surrett says. By converting a block of Vanderbilt Avenue to a 14,000-square-foot plaza, redistributing space from motor vehicles to pedestrians and trees, One Vanderbilt increases safety while giving people more room to move and breathe. Its facade rises two stories west to east along its south face to expand views of Grand Central beneath its signature oblique cantilever and orange soffit. Jules-Félix Coutan's sculpture *Glory of Commerce* (1914), showing Mercury, Minerva, and Hercules surrounding Grand Central's exterior clock, is no longer obstructed from the west by a Modell's Sporting Goods.

With tapering trapezoids, One Vanderbilt loosely resembles an update of the diagrams that Hugh Ferriss drew to illustrate the principles of New York's 1916 zoning law, the regulation that established setbacks admitting light to the streets throughout Manhattan's business districts. Ferriss's sharp pyramidal forms were a transitional condition, an abstraction to which orthogonal wedding-cake setbacks aspired. One Vanderbilt dares to literalize such geometries, suggesting a tall ziggurat or, in the uppermost segments, a craggy iceberg. These nonorthogonal volumes and oblique load patterns called for careful handling by the structural engineers, whose close involvement with the designers from early stages resulted in time-saving, problem-solving measures on multiple fronts.

"Three faces of the building step outward at the fourth floor, including the southern face," notes Moss. "Cantilevered



Above One Vanderbilt's light steel frame was erected first, with the concrete core following about 10 floors below the steel.
Left An ironworker on one of the tower's top floors during construction.
Opposite The spire has notched corners (as does the building) to help account for wind loads.

trusses are provided to pick up columns at the fifth floor, while the outer regions of the fourth floor are hung from the top chord of the cantilever. As you move toward the east of the building's southern face, the transfer trusses become shallower, allowing the structure to fit within the angled facade profile. The uplift forces in the back spans of the cantilever trusses are resolved by connections to the core shear walls."

The prominent notch in the east facade is achieved by supporting perimeter columns on cantilevered steel trusses and plate girders that are tied back to a robust concrete core. Truss members are custom-fabricated out of ASTM A572 Grade 50 plates up to 8 inches thick and welded together, since the load demands exceed the capacity of standard rolled shapes. The plate girders are fabricated out of the same material and sizes. Connections at truss panel point nodes were built up out of laminated plates seam-welded together. In some instances, forces at nodes were so great that isotropic solid steel forgings with the greatest dimension exceeding 8 feet were necessary to transfer them.

Many of Midtown's older commercial buildings have 20x20-foot column grids, considered obsolete by tenants who prefer open floor plans. In One Vanderbilt, Surrett says, "there are no perfectly vertical steel columns in the building below the highest occupied floor, and an effort was made to keep the corners of the structure column-free." End connections of beams were designed to resist the lateral 'kick' forces induced by the slopes of the columns. The outrigger trusses on dedicated mechanical floors tie the perimeter columns to the core to engage them in the lateral system and effectively create a wider base to resist lateral shears and overturning moments. Outrigger trusses were skewed slightly along the four sides to hit shear wall intersections and provide the most direct load path possible. Column-free beam spans approach a maximum of 70 feet. Vibration of the floor systems was considered extensively, and in many instances controlled the design of floor beams over strength or deflection.

Severud's Edward M. DePaola points out several benefits of the non-orthogonal design. "The slope of the façade is always on the main axes of the building (either north-south or east-west), so floor spans remain consistent on every floor. The taper results in less width of building surface (sail area) with height." Because wind pressures are larger on higher floors, these reduced floor areas result in less wind-shear force on the building. Midtown's density can contribute to complex wind patterns as prevailing southwest winds move around other buildings; the design/construction team conducted wind-tunnel testing, using "a 'proximity model' that takes into account the surrounding neighborhood, the low and tall buildings, the avenues and the streets, so everything that may affect wind loads on the building [is] taken into account.... Together with the architect, we were able to 'notch' the corners of the tower. That shape helps break up the eddy currents that form downwind as the air mass travels past the building. The spire used the same concept," says DePaola.

Vibration from below posed a potential challenge for a building married to a major transit node, but "the mass of the cast-in-place concrete foundation walls and concrete core provide vibration and sound mitigation such that isolation pads in the foundations are not required," Surrett notes. DePaola points out that the only line adjacent to the property is the 42nd Street Shuttle between Grand Central and Times Square; vibration analysis indicated that the low-speed S trains, which stop west of Madison Avenue, have no impact on One Vanderbilt. Metro North tracks are also far enough away to have no effect. Another stabilizing element is a 520-ton tuned mass damper at the top of the building, which moves out of phase with building deflections to reduce wind-induced accelerations and increase comfort for occupants. "It is tuned to match, as closely as possible, the building frequency and period," DePaola says; its tuning makes it effective during one-year and ten-year storms. The damper's effect is sufficient, Surrett observes, that "space at the top of the building, with amazing views, may support uses as sensitive as fine dining."

KPF architect Andrew Cleary, speaking at an American Institute of Steel Construction panel in September 2019 shortly after One Vanderbilt topped out, noted that after breaking ground in October 2016, the project progressed ahead of schedule and under budget. Real-time parametric analysis accounted for much of this performance: using Rhino, Revit, Grasshopper, the modeling program Tekla, and Thornton Tomasetti's proprietary collaborative BIM system Konstru, the design process determined precise details such as exact beam lengths, bolts, and welds earlier

This feature: Max Touhey

Left One Vanderbilt is the tallest office tower in Midtown Manhattan.
Facing The erection of the spire.

than on conventional design-bid-build projects. Modeling allowed early coordination of all subcontractors and prevented onsite clashes. “If we catch one hitch that typically would happen during construction, we’ve paid for these guys to come in early,” Cleary noted; “if we catch two, we’re ahead of the game.”

One Vanderbilt is a structural hybrid with a steel frame and concrete shear walls. In a departure from routine practice, the light steel frame was erected first along with the main framing; the concrete core followed, about 10 floors below the steel, with the pouring of the floors. Moss describes “a lateral system that allowed for steel construction to be up to 12 floors ahead of core shear-wall construction. The steel members were designed to fit within the shear walls. We added shear studs to the steel members, allowing the shear walls to engage the embedded steel structure. This construction sequence required additional steel tonnage, but it allowed for a faster construction cycle.” DePaola credits firm founder Fred N. Severud with the steel-first erection sequence—“the Severud system, I like to call it,” keeping different trades from holding up each other’s progress.

Planning the steel and concrete operations required detailed advance measures. “Mechanical couplers for rebar splices were utilized in lieu of lap splices extensively to reduce congestion between the steel frame and the rebar and minimize” the thicknesses of the shear walls,” Surrett says. “Strategically placed copes and holes were provided in steel beams and connection plates to allow the continuity of vertical and horizontal reinforcement. Add to that the accommodation of shear wall penetrations for MEP distribution in and out of the core, and you have quite the puzzle to solve. Design concrete compressive strengths were up to 14,000 psi, and lab test results consistently exceeded expectations. One notable accomplishment was pumping over 4,000 cubic yards of concrete into the building’s mat foundation in a continuous pour in sub-freezing temperatures.” The 27-hour operation in February 2017 was one of the largest single pours in the city’s history.

The process, which DePaola likens to “a ballet,” has yielded a building with a well-integrated aesthetic presence as well. The oblique-angle motif of the cantilevered south facade is matched by ventilated spandrel panels at each floor, including 34,845 glazed white terra cotta tiles molded with an identical angled pattern rising left to right; upper unoccupied segments near the spire pick up the same motif, complicating the building’s verticality with a consistent visual rhythm. The facade includes 8,743 curtain-wall panels in 1,060 different configurations, composing 753,500 square feet of curtain wall.

Developer SL Green is a believer, not just an investor: the firm is moving its own headquarters into the building. They and other tenants will enjoy a 30,000-square-foot amenity floor with a 145-person auditorium, lounge, boardroom, and outdoor terrace, among other perks. On the 59th floor, an observation deck designed by Snøhetta, The Summit at One Vanderbilt,includes two glass ledges above Madison Avenue—a view to rival KPF’s other recent vertiginous project, the Edge at 30 Hudson Yards.

The supertall category attracts reflexive skepticism in some quarters, especially in the wake of Hudson Yards, where ten-digit public expenditures aided luxury-level private interests without arguably creating corresponding civic benefits. In the case of One Vanderbilt, however, skeptics will need to consider nuances and recognize the details of the public-private negotiations. Approval did not come easily here. In return, the city gets some badly needed transit upgrades, ample property taxes, the addition of a pivotal location to the local reservoir of vehicle-free space, and a model for the continued greening of future skyscrapers—plus a resounding rebuttal to those who believe New York’s glory days are behind us, that the future has no room for the exhilaration of thousand-foot views.

ONE VANDERBILT

Location: **1 Vanderbilt Ave., New York, NY**
Owner and Developer: **SL Green Realty**, *New York, NY*
Architect: **Kohn Pedersen Fox Associates**, *New York, NY*
Structural Engineer: **Severud Associates**, *New York, NY*
Construction Management and Modeling: **Tishman, an AECOM Company**, *New York, NY*
Curtain Wall Consultant: **Vidaris**, *New York, NY*
Structural Steel Fabricator: **Banker Steel Company**, *New York, NY*
Structural Steel Erector: **NYC Constructors**, *New York, NY*
Miscellaneous Iron Fabricators and Erectors: **Post Road Iron Works Inc.**, *Greenwich, CT*; **KKG Construction**, *Huntington Station, NY*
Architectural Metal Fabricators and Erectors: **Coordinated Metals**, *Carlstadt, NJ*; **Vision Enterprise of Queens**, *Westbury, NY*
Curtain Wall Fabricator: **Permasteelisa Group**, *New York, NY*
Curtain Wall Erector: **Tower Installations**, *New York, NY*
Metal Deck Erector: **NYC Constructors**, *New York, NY*

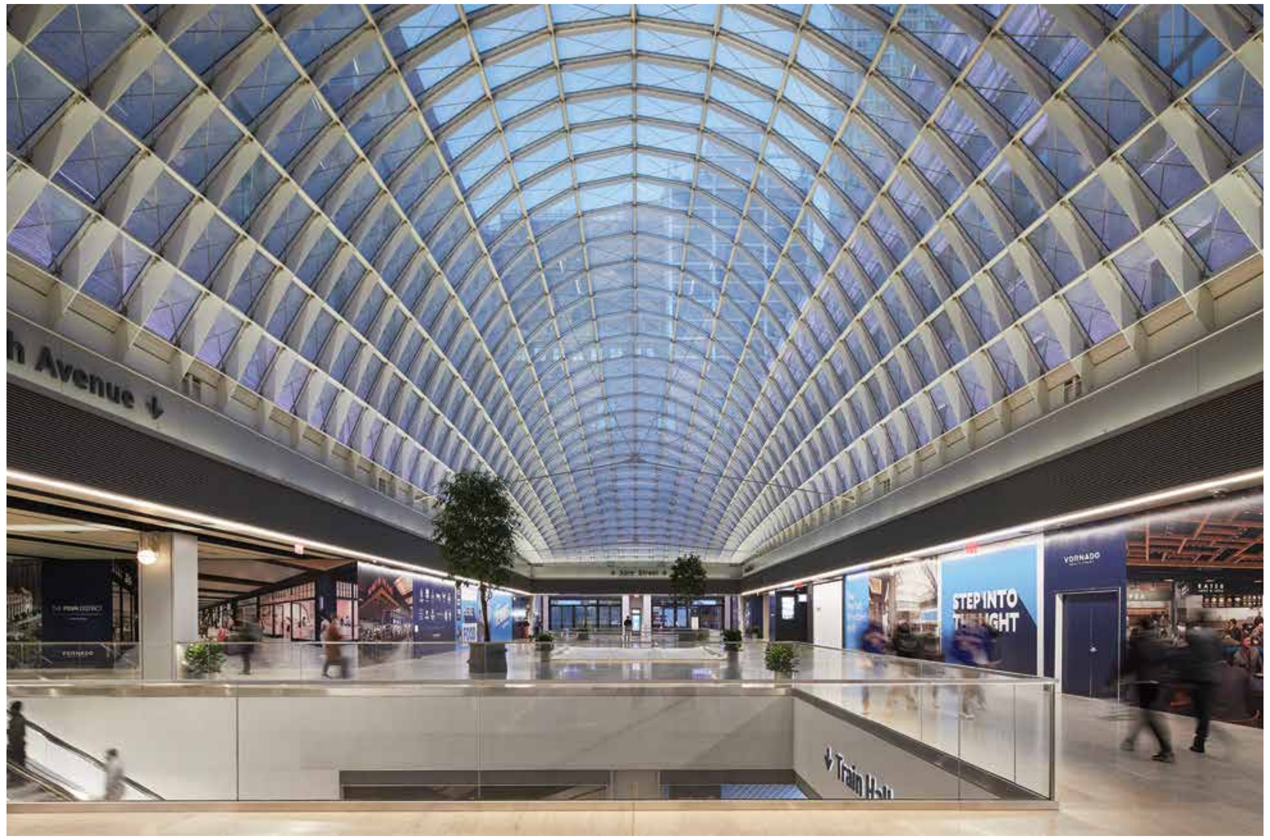
Moynihan's dramatic sky-lit train hall.

Moynihan Train Hall

Industrial grandeur is resurrected within Manhattan's newest transit hub, which builds on a legacy of inspiring transportation architecture with a dramatic glass canopy under which more than 700,000 riders pass daily.

IN 1993, SEN. DANIEL PATRICK MOYNIHAN, noticing that McKim, Mead & White's James A. Farley Post Office Building, built in 1912, was no longer the center of the city's mail-handling operations, proposed that conversion to a railroad station could help relieve Penn Station's notorious congestion. This problem-solving vision has finally been realized, with work by Skidmore, Owings & Merrill (SOM), Skanska, and their collaborators that transformed the bulk of the Farley building into rail platforms and concourse/retail space for Amtrak and the Long Island Rail Road (LIRR). The project's first phase, the West End Concourse, opened in June 2017 and expanded access to the two rail lines; the second phase, Moynihan Train Hall, opened in 2021.

The most dramatic addition is the undulating 92-foot-high glass canopy that covers the train hall. This "skylight" comprises steel diagrid members fabricated by Seele, arranged in four bulbous east–west segments supported by massive trusses from the original building: structural members that also enhance the building's muscular aesthetics, strengthened by new color-matched beams. An additional north-south glass vault covers a corridor west of the main hall at the center of the building between Eighth and Ninth Avenues, linking its 31st Street and 33rd Street entrances. New steel canopies at those entries are designed "to complement McKim Mead & White's Beaux-Arts architecture," says SOM design



architect Andrew Lee, and to “reflect the language that we see in the skylight,” introducing visitors to the hall’s balanced aesthetic upon entry.

The junctures between the glass canopy and the original building’s masonry are covered by metal paneling to create seamless connections around the hall; additional metalwork includes column-cover wraps, guardrails, handrails, handrail shoes, and functional grilles that support lighting and conceal ductwork. The uniform appearance is deceptive, because “every one of these panels and every one of these grilles is a different size,” notes Permasteelisa director of business development William Bueso. “Every item we’re doing is a custom one-off piece made specifically for this job … the only stock things we’ve ordered are the screws, nuts, bolts, and handrail shoes.”

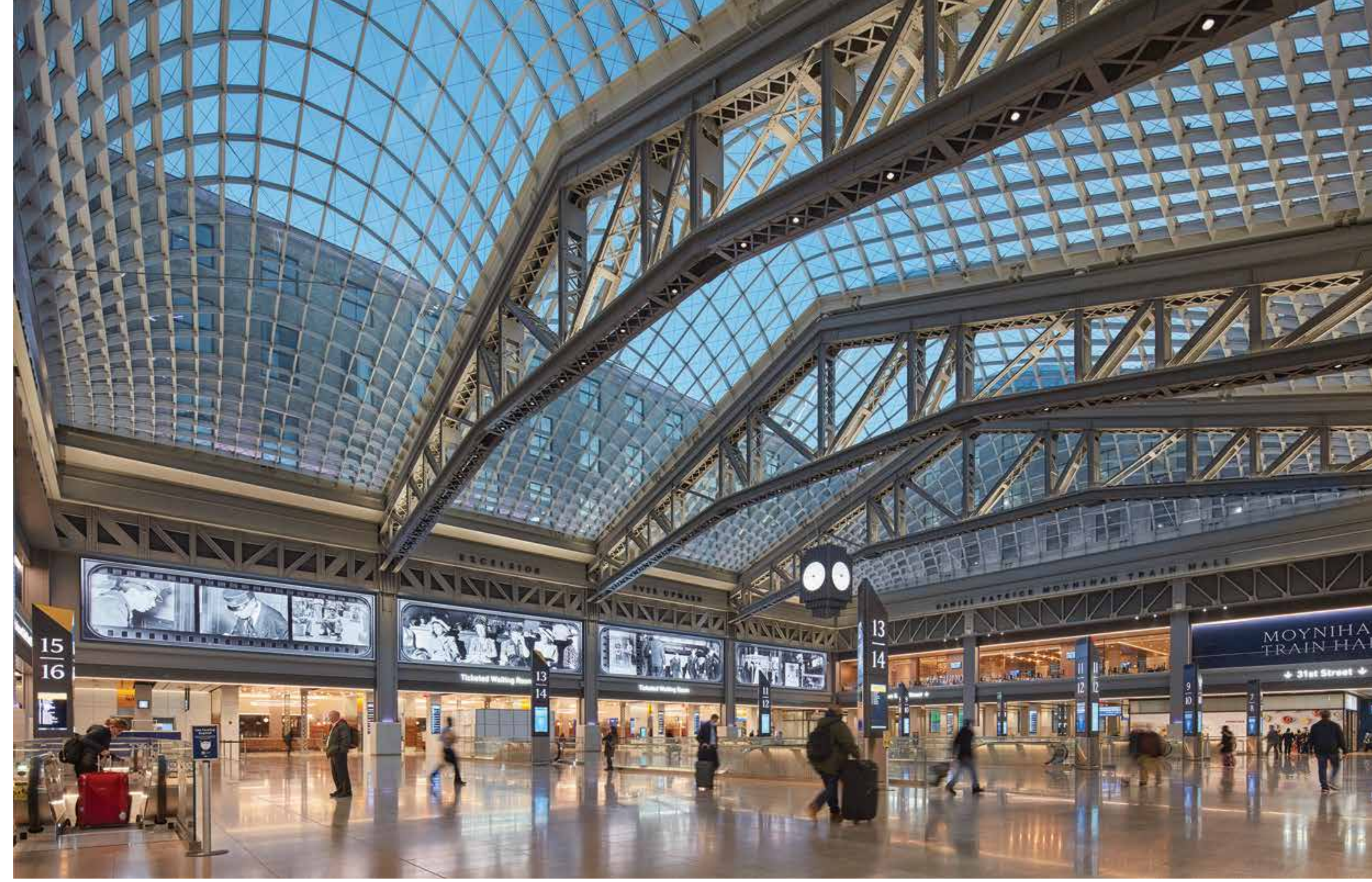
For Lee and his colleagues at SOM, the mission involved “celebrating the heritage of this building,” which is both an echo of the civic dignity of the original Penn Station and a no-nonsense functional facility. “It wasn’t an exactly thoroughly finished building; the inside was more of an industrial building,” Lee says. “We tried to reveal some of the existing structure by highlighting some of the articulation and the ironwork of the past rather than doing new applications of metal … taking that language and using ornamental metals to recreate some of it in areas where it wasn’t as highly finished.”

In a transit facility, Lee adds, “finishes at the human scale have to be extremely durable and stand the test of time.” The design team selected a material palette that is “not evoking some of the connotations that stainless steel typically has; it’s very institutional … there’s a way to finish it to a higher quality that maybe leaves out some of those connotations.” With ample LED signage and video displays, at any rate, the hall hardly needs the sparkle of reflective surfaces. Lee described the paneling and grillwork as “generally very quiet.... To really tread lightly in that train hall space, so that you let the skylight and the existing structure breathe.” At staircases between the concourse and platforms, he noted, glass guardrails “minimize the kind of visual clutter that would be in a very busy space to begin with,” optimizing sightlines to the platform level and aiding navigation—a distinct improvement over the abattoir claustrophobia that has provoked complaints over Penn Station’s traffic flow for decades. A grand staircase, seven elevators, and 11 escalators expand vertical circulation options.

Like any transportation center, Moynihan is a massive job; it is complicated by its combination of existing and new structures, marrying 21st-century steel to 1912-vintage masonry. Retrofits pose challenges that new construction does not, particularly where onsite investigations discover details that were not apparent at the design stage. “You can’t foresee some things that are on a 67-year-old truss,” observes foreman Will Jones. “They didn’t know it until you got inside.” Pointing during a site tour to various anomalies that the project’s design documentation did not predict—cross-bracing in old trusses; lighting wired through a truss; brackets that had to be replaced when onsite calculations revealed that a beam with attachments could not support a grille; beams that shifted when they were loaded with glass and wires were tensioned—Jones observes that a degree of improvisation goes with the territory. “One of the challenges with an existing building,” he continues, “is building things ahead of time to meet

Clockwise from top left 1) A north-south glass vault covers a corridor that links the 31st and 33rd Street entrances. 2) Massive trusses from the original building support the glass and steel roof in the main train hall, with color-matching beams. 3) A north-south section rendering shows how the glass and steel canopy connects to the original building’s masonry with metal paneling.

Opening spread: Dave Burk/© Empire State Development | SOM; above: Lucas Blair Simpson/© Empire State Development | SOM; facing page: top: Dave Burk/© Empire State Development | SOM; bottom: © ESD/Courtesy of SOM



Closing spread: Dave Burk & Aaron Fedor/© Empire State Development | SOM

the schedule, and not quite understanding, because you didn't have a chance to really dive into a lot of the details, how that's going to fit on the job site. On a new building it's a little easier to do that; on an existing building it's harder, because you open this up and boom! I uncover this site condition."

At Moynihan, energy-conservation features include radiant flooring on the concourse level, which will heat and cool the entire building; this required installing a piping system before pouring concrete, the type of up-front investment that saves resources by heating air efficiently from beneath occupied spaces and lowering the overall volume of ductwork throughout the hall. "We underestimated the existing-building component of the project," Bueso notes, speculating that general project cost overruns reach the 20–30 percent range—distinctly lower than found on the city's only comparable recent transit hubs, the World Trade Center PATH Oculus and Fulton Center.

Considering its spaciousness (255,000 square feet), its expanded connectivity (creating direct station access from Ninth Avenue for the first time, along with the midblock entrances on the two cross-streets), and the relief it offers to two of the three rail systems squeezed into Penn Station, Moynihan Train Hall is a critical upgrade on all fronts. The anticipated scale of passenger traffic ensures that the project is not so much a matter of "if you build it, they will come" as "since so many of them are coming, can we build a facility they can bear, possibly even enjoy?" The hall's balanced elements give the region's travelers a space that respects both its own history and their dignity.

MOYNIHAN TRAIN HALL

Location: **421 8th Ave., New York, NY**

Clients: **Empire State Development Corporation (ESD)**, *New York, NY*; **Skanska USA Civil Northeast (Design-Build)**, *East Elmhurst, NY*; **Vornado Realty Trust**, *New York, NY*; **Related Companies**, *New York, NY*; **the Metropolitan Transportation Authority**, *New York, NY*; **the Long Island Rail Road**, *Jamaica, NY*; **Amtrak**, *Washington, DC*; **the Port Authority of New York and New Jersey**, *New York, NY*

Architects: **Skidmore, Owings & Merrill**, *New York, NY*; **McKim Mead & White** (original James A. Farley Building, 1912), *New York, NY*

Design-Build General Contractor: **Skanska USA Civil Northeast**, *East Elmhurst, NY*

Structural Engineer: **Severud Associates**, *New York , NY*

Skylight Structural Engineer: **Schlaich Bergermann Partner**, *New York, NY*

Construction Manager: **Skanska USA Building**, *New York, NY*

Skylight Consultant: **Gordon Smith Associates**, *New York, NY*

Structural Steel Fabricators: **Crystal Steel Fabricators**, *Hatfield, PA*; **L&M Fabrication & Machine**, *Bath, PA*

Structural Steel Erector: **Skanska USA Civil**, *New York, NY*

Miscellaneous Iron Fabricator and Erector: **Crystal Steel Fabricators**, *Hatfield, PA*

Architectural Metal Fabricator: **Permasteelisa North America** (metal panels), *New York, NY*; **WBE Sheet Metal** (louvers, metal panels), *Amityville, NY*; **Infinite Glass and Metal** (metal panels), *Franklin Lakes, NJ*

Architectural Metal Erectors: **Genesis Architectural Metals**, *Willow Grove, PA*; **Permasteelisa North America**, *New York, NY*; **WBE Sheet Metal**, *Amityville, NY*; **Infinite Glass and Metal**, *Franklin Lakes, NJ*

Ornamental Metal Fabricator and Erector: **Permasteelisa North America** (glass and metal guardrails), *New York, NY*

Ornamental Metal Erector: **Permasteelisa North America**, *New York, NY*

Skylight Fabricator and Erector: **Seele LP**, *New York, NY*

Metal Deck Erector: **Skanska USA Civil**, *Carteret, NJ*; **Northeast Structural Steel, Inc.**, *Yonkers, NY*

Left, top and bottom The roof structures join up with the existing steel structure and consist of a gridshell of welded steel T-sections with tensioned cables. Separate aluminum-and-glass elements are fitted into the gridshell structure. A total of 3,384 insulating glass units and 670 tons of steel were required for the structures.
This page: The roof over the train hall is formed by four 52-foot-wide curving barrel vaults.

A soaring pedestrian bridge with exposed trusses stretches over taxiways.

LaGuardia Airport Terminal B

New York air travelers are finally reaping the rewards of patience, as LGA emerges from its reconstruction cocoon. Its central Terminal B solves site-squeeze problems through an islands-and-bridges design, both functional and symbolic, thanks to its design team's creativity with structural steel.

NO MATTER HOW FREQUENTLY OR infrequently one takes to the clouds, shouldn't air travel be an uplifting experience in a nonliteral sense, a reminder that every flight is a victory over gravity? Airports in recent decades have accommodated tighter security and morphed into malls; still, if an air terminal doesn't blend a touch of poetry along with efficiency and commerce, it misses a vital opportunity—merely colluding in the reduction of what was once an adventure into something closer to a bus trip in the sky.

The old LaGuardia, notorious for congestion, delays, and snafus throughout the passenger experience, could be mistaken for an overscaled Greyhound station. In 2014, then-Vice President Joseph Biden, a careerlong advocate of transportation infrastructure, famously assailed it as worthy of "some Third World country." Yet the airport that travelers have complained about for years is finally becoming one to be proud of. HOK Architects, WSP, Skanska-Walsh, and LaGuardia Gateway Partners (LGP, a private entity selected by the Port Authority of New York and New Jersey to coordinate this long-overdue project and manage it until 2050), working within spatial constraints and staging demolition and construction amid continuous airline operations (complicated by pandemic conditions), have transformed LGA's central Terminal B into a place that can elevate spirits as well as move bodies. Its physical form evokes greater New York; its technologies address critical functional problems; and its detailing provides what its predecessor lacked: a tangible sense of place.

The Port Authority's goal for air passenger facilities, says project director Jessica Forse, is nothing less than "to make them world class and best in class." The challenges to reach such a condition were obvious, with both landside spaces and airside operations stretched past their capacity. "Anybody that knows LaGuardia," says Paul Auguste, HOK's director of aviation and transportation, "knows you get in the plane and you're sitting on the taxi lines for minutes, hours, whatever it is, trying to queue up to get to the runway." The airport needed to replace its crescent of four terminal piers and expand airfield space for aircraft and service vehicles. Yet LGA, sandwiched between Grand Central Parkway and Long Island Sound, lacks the lateral greenfield area that other airports might expand into. Reconfiguring it was not unlike building a ship inside a bottle.

The Port Authority's initial plan, Auguste says, called for a linear headhouse with a series of piers, "very similar to what was there," requiring a complex construction process that "would have made the existing operations impossible." Instead, HOK and partners "looked at how we could phase this to save time and money," Auguste says;" because the crescent-shaped headhouse was there, and you need to maintain operations for departures and arrivals, we changed our design to fit the site." HOK and partners moved the headhouse as close as possible to Grand Central Parkway, some 600 feet south; removed a 3,000-space parking garage; and created two separate concourses in the form of islands connected to the headhouse by pedestrian bridges stretching over taxiways. This arrangement recaptured about 40 acres of airside land and gained two miles of usable taxiway, allowing aircraft two paths to each of the 35 gates (instead of pulling in and backing out) and easing services such as fueling and baggage handling. The skybridges also give pedestrians a striking view of planes passing underneath as well as panoramic views of the Manhattan skyline. Terminal B is now a microcosm of New York, a city of islands linked by bridges.

Derek Thielmann, LGP's project director for design and construction, says the revised plan meant "we could build a new headhouse without impacting traffic to the existing terminal, and then we had other real estate to the east," where they placed a new central heating and refrigeration plant, additional apron, and a concourse, then figured out how to connect the components. "We came up with a phasing plan that basically shrunk the Port's plan from 16 phases down to five.... We were maintaining existing airport operations while we were able to construct all-new infrastructure, and our phasing allowed us to actually frontload the construction, so in the first three and a half years, we were

essentially delivering about 75 percent of the project." The island concourses allowed some construction to take place above the old terminal before demolition, saving time and costs; only one gate had to be closed at a time. The new 850,000-square-foot terminal uses 40,000 tons of steel, including nearly 10,000 pieces in the Arrivals and Departures Hall, weighing 12,000 tons (heavier than the steel in the Eiffel Tower).

"From the airlines' perspective," Auguste comments, "it was brilliant... one day overnight, they went from the old facility to the new facility." Aircraft now "have multiple avenues to taxi around all the operations of Terminal B and get to the runways quicker, so we have greatly reduced the congestion; it greatly reduced the time it takes to get to the runway, so it's going to be a win-win for airport operations, airlines, and passengers. You'll never have those crazy 20-plane piers trying to get to the runways any more."

Interior dimensions are also generous, Auguste adds: "The old concourses were about 60 feet, 65 feet wide, with eight-foot ceilings. The new concourse has 55- to 60-foot ceilings and is 120 feet wide." With 1.3 million square feet of new terminal space, Terminal B gives passengers on five airlines (American, United, Air Canada, Southwest, and JetBlue) a capacious atmosphere, defined by verticality (the four levels include mezzanines) and generous light wells on both landside and airside. The building's form also "allows us to maximize the heat that's rising up and heating all the levels, not just dissipating underneath the ceilings and in other space. So we have an atrium design that really created this efficient mechanical model."

Though airports commonly locate long walkways underground, the LGP team ruled out tunneling to the island concourses after considering site conditions. "It had a number of challenges," Thielmann says, "just given the water table we have here at LaGuardia," as well as maintenance. "And so we elected to go above and go high," not only saving construction time but giving LGA an immediate pair of icons. The bridges, composed of structural steel trusses with glass curtain walls, are more than corridors; with furniture, discreet video signage, and ample headroom, they are high points in the passenger experience. "We've managed to incorporate some of our food and beverage offerings into both bridges," Thielmann continues, "so people can actually sit down, have lunch, and have planes taxi underneath their feet."

Opening page: courtesy of LaGuardia Gateway Partners; this page: Jennifer Krichels; facing page and closing page: courtesy of LaGuardia Gateway Partners

Local aerospace enthusiasts may recall Eero Saarinen's TWA Flight Center at JFK (1962) as an aesthetic triumph with dramatic concrete forms that quickly became impractical: its gates were too small to accommodate the next decade's jumbo jets. Here, the design is futureproofed. Skybridges A and B, spanning 500 and 450 feet long, respectively, are elevated about 60 feet above the tarmac, high enough to allow not only the Airplane Design Group III aircraft that use the terminal (with tail heights 30-45 feet high, as defined by the Federal Aviation Administration) but Group IV (45-60 feet) as well. "If for some reason a Group IV aircraft got lost and was headed that direction," Auguste says, "without any fuel in it, without any passengers in it, full air in all the tires, so it was high as it could be, it still clears underneath our bridge."

HOK structural engineer Francesca Meola points out that a proprietary parametric modeling tool, now called HOK Stream, allowed crucial calculations within a tight timetable. "We were able to quickly generate models to understand the behavior," she says, "and understand if the solution was cost-effective and if it was performing, not only from a structural standpoint for strength and serviceability criteria, but also for performance for vibrations, because with pedestrian bridges in particular, you have a mass of pedestrians walking at the same time."

Facing page, from top Construction of the arrivals and departures hall. The vertical trusses vary in depth from 20 to 40 feet above an eight-foot base and are connected with moment-frame beams in the vertical plane, and with horizontal bracings on the roof and in the plane of the bridge deck.
This page, from top Check-in counters and self-service kiosks in the streamlined departures hall. Skybridges are 60 feet above the tarmac.

The vertical trusses, with a depth varying from 20 to 40 feet above an eight-foot base concealing ductwork, are connected with moment-frame beams in the vertical plane, and with horizontal bracings on the roof and in the plane of the bridge deck, for lateral stability. The chords, Meola continues, are flat built-up I sections; the diagonals combine rolled sections and built-up sections, with grade 65 steel for the longer, shallower Bridge A and grade 50 for the shorter, deeper Bridge B. Braced frames for the longitudinal direction are necessary only on the concourse side, near escalators and elevators. "During construction," she says, "we were actually able to time the final base connections of the front row of columns to eliminate any permanent tension in the foundations that would have resulted from the north bridge towers acting as fixed elements. The capacity of the piles in tension is like a third of the one in compression, so this strategy allowed for substantial savings in not just the superstructure but even more in the foundation system."

The concourse roofs, Meola says, are flat on one side, "but then it folds to follow the line of sight, so we were able to follow the shape with these trusses," four feet six inches deep and bent. In addition, "we minimize the impact of the lateral system. Everybody complains about brace frames; nobody wants columns, and nobody wants brace frames; so we were able to locate those right where we have stairs, so they will not impact on the flow of people walking, and they would not be in the middle of the structure."

The bridges expose the trusses, clad in glass-fiber-reinforced concrete and gypsum (GFRC and GFRG), as expressions of the structure, implicitly conveying the scale, strength, and stability of the steel as well as maximizing views for departing or arriving passengers. Where the old LGA's generic, dingy spaces compelled hasty movements, much as Penn Station brings out every commuter's inner scurrying rodent, the new LGA's high ceilings and graceful members impart a welcome sense of calm.

The Arrivals and Departures Hall is a four-story structure with three separate roadways for different functions, Auguste notes: ground level for buses and other high-occupancy vehicles, the second for arrivals (including conventional taxis and private-car pickup), and the third for departures. Planned before the rise of Uber, Lyft, and similar ride-hailing services, the facility relegates for-hire vehicles to the new parking garage, geofenced, Thielmann says, to prevent motorcar tsunamis in the pickup area. From entrances to gates, Terminal B is designed for intuitive movement and confusion-free wayfinding.

Rethinking interior pedestrian traffic required a complete redesign of spaces built before Transportation Security Administration (TSA) screening became such a large and stressful component of a traveler's experience. In the old LGA, amenities appeared in pre-security spaces, Forse recalls; one sometimes ate before passing through security, a sequence hardly imaginable in the TSA era. In contrast, the new terminal is "designed for the way air travel occurs today," reproportioning pre- and post-security spaces to assign nearly all shops, restaurants, and services to the latter.

TSA is centralized and located off the main Departures entrance past 75 check-in counters and 105 self-service kiosks, with state-of-the-art features to smooth the process: dynamic video signage in the queuing area informing passengers of expected wait times, automated baggage-screening and tub-handling technology, and 16 screening lanes. Post-TSA recomposure spaces, a feature that few airports give adequate attention, are generous, with ample seating and tables, easily cleaned carpeting—so that, in Auguste's words, "you don't want to go through there like I do and feel like I need to take a shower afterwards"—and a large curtain wall. "All the time the passenger is going through," he says, "you know exactly where you go when you're looking through the window at the apron right out front; you have a sense of direction all the time."

Forse notes that the Port Authority's master plan calls for a central hall connecting Terminal B to Terminal C (privately owned by Delta Airlines and under separate renovation), with AirTrain access, another long-standing oversight.

New Yorkers and visitors have put up with disruptive site work since 2016, but we put up with the old LGA for much longer. Only time will reveal important metrics such as airline on-time performance, energy consumption, or improvements in accessibility once the AirTrain component is sorted out. Yet it is an excellent time to get used to a novel sensation: having an airport that makes us stop rolling our eyes in exasperation and start lifting them in admiration.

LAGUARDIA AIRPORT TERMINAL B

Location: **LaGuardia Airport, Queens, NY**
Owner: **Port Authority of New York and New Jersey**, *New York, NY*
Project Partners: **LaGuardia Gateway Partners**, *New York, NY*
Architect: **HOK**, *New York, NY*
Structural Engineers: **WSP** (lead and engineer of record, mechanical), *New York, NY*; **HOK**, *New York, NY*; **Thornton Tomasetti**, *New York, NY*
General Contractor (for design-build joint venture): **Skanska-Walsh**, *Queens, NY*
Structural Steel Fabricators: **Canam**, *Point of Rocks, MD*; Pedestrian Bridge A: **W&W AFCO**, *Oklahoma City, OK*; Pedestrian Bridge B: **Walters**, *East Hamilton, ON*; **ADF**, *Phoenix, AZ*
Structural Steel Erector: **Skanska Koch**, *Carteret, NJ*
Miscellaneous Iron Fabricators and Erectors: **Orange County Ironworks**, *Montgomery, NY*; **Transcontinental Steel**, *Newark, NJ*
Architectural and Ornamental Metal Fabricator and Erector: **United Structure Solution**, *Brooklyn, NY*
Curtain Wall Fabricator: **Josef Gartner GmbH - Permasteelisa Group**, *Vittorio Veneto, IT*
Curtain Wall Erector: **Tower Installations**, *New York, NY*
Metal Deck Erector: **Toral Welding**, *Jersey City, NJ*

The arrivals and departures hall is a four-story structure. The third floor departures hall is shown here.

As the New York Islanders new home, the UBS Arena features a 350-by-460-foot, column-free space, the seating bowl and robust rigging system for concerts and other entertainment events.

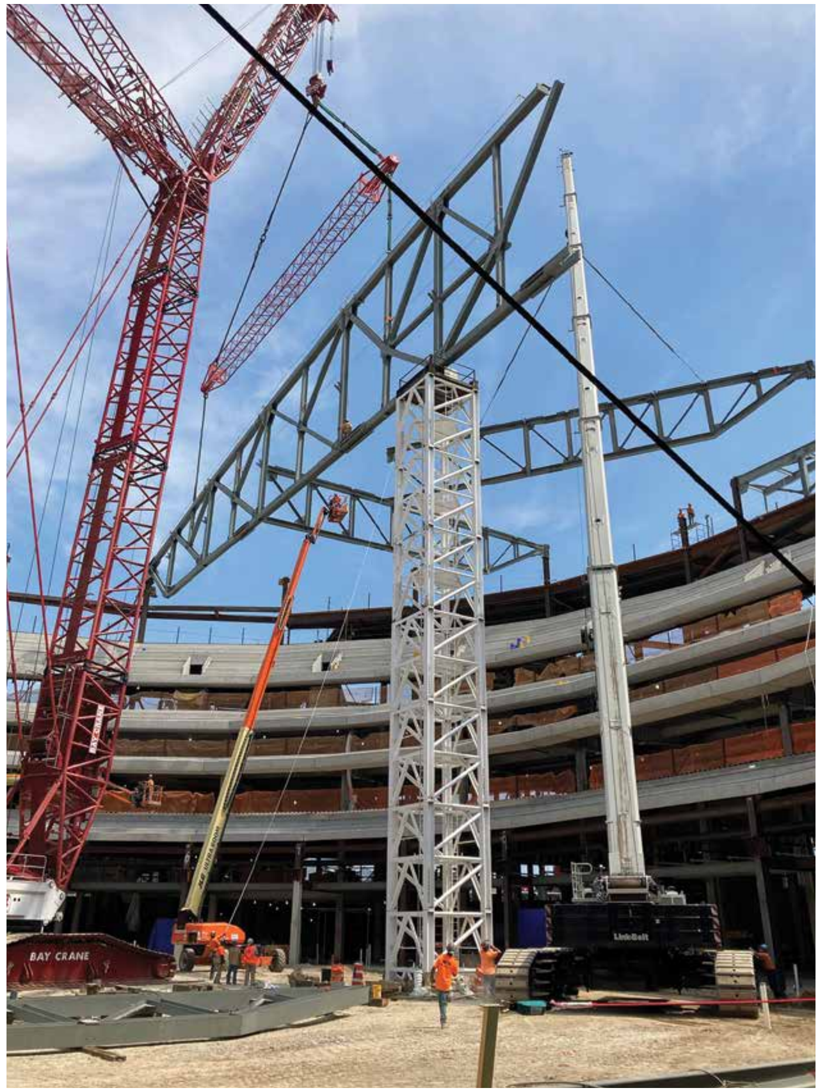
UBS Arena at Belmont Park

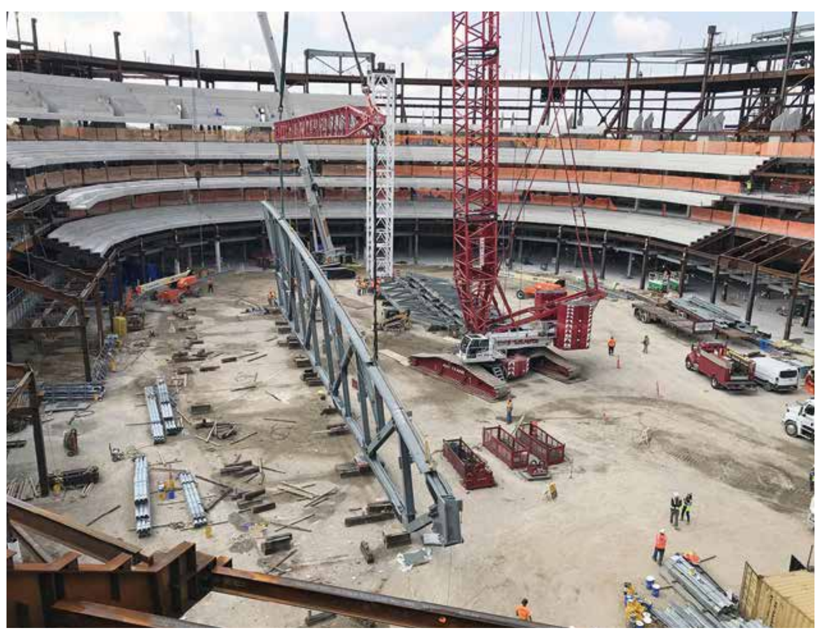
Challenged with COVID-19 rules and restrictions, a Populous and Thornton Tomasetti-led design team delivered an innovative steel superstructure with long span roof trusses, lateral load resisting braces in the elevator cores and perimeter and a large rigging capacity for concerts and sporting events.

THE NEW YORK ISLANDERS' NEW $1.5 billion UBS Arena in Elmont, New York, boasts some of the best sightlines and the largest arena scoreboard in New York State. However, bringing the project to near completion while complying with COVID-19 restrictions and safety requirements was no small feat.

Designed by Populous and JRDV Urban International, the 17,255-seat arena for sporting events (and 18,500 seats for concerts) opened in November 2021, and features clubs, suites and lounges, ten bars and concessions, a state-of-the-art sound system, an NHL locker room and player campus with a cardio mezzanine level and shoot room, and an updated sports lighting, ice mapping/projection system and 12 all-player tracking cameras.

One of the primary design goals for the 745,000-square-foot arena was to create a venue meant for hockey, rather than a building that had been adapted for the sport as had the Islanders' previous homes. Populous created hockey-specific sightlines for fans by designing the seating bowl to be closer to the ice than an arena that prioritizes basketball. This move produced an intimate experience that allows spectators to feel close to the action on the ice.





The arena architecture also supports current needs for immersive music concerts and other performances. A 400,000-pound rigging grid can support 300,000 pounds of equipment for an end-stage or center-stage setup (versus the 100,000 weight limit of most last-generation arenas). An industry first, the interior mezzanine catwalk above event-level premium spaces offers direct access to all utilities that serve the premium spaces from above, including Wi-Fi, gas, and electric. This prevents temporary closures or damage to ceilings, walls and other infrastructure, during possible repairs. There is also direct freight elevator access from the arena floor to the catwalk for continued ease of event operations.

A high level of structural engineering was required to execute the unique space. Its superstructure's gravity system is a steel composite beam/column system with a steel-braced frame lateral system. Four long-span roof trusses, each weighing approximately 180 tons and running 35 feet deep at the middle, support the primary roof and create a 350-by-460-foot column-free space for the seating bowl.

"The soils in the area are native Long Island sand with a very high bearing capacity of 10,000 psf," explains Eric Lumpkin, project manager for Thornton Tomasetti, who performed the project's structural engineering. "This meant the arena could be founded on shallow spread footings, which resulted in significant cost savings."

As opposed to a traditional basement wall, the team chose a 20-foot-high concrete retaining wall to structure the below-grade spaces, which allowed the contractor to backfill the wall almost immediately.

The structural engineers also decided not to place the braces for the lateral load-resisting systems in the back of the seating bowl, as is typically done, in order to avoid having braces obstruct the concourses. Instead, they located the vertical braces in stair cores and around the perimeter of the building.

"Drag struts were utilized to collect load from the inboard portion of the arena and distribute it at the braced frames in the outboard stair cores and perimeter façade line," explains Gary Storm, a senior principal at Thornton Tomasetti.

To help enable the 150 annual events scheduled for the arena, in addition to the hockey season, full-depth infill trusses span between the primary trusses to support the rigging grid for concerts and events, and a catwalk and platform system supports scoreboards, speakers, and sporting event lights. Lumpkin explains that the full-depth infill trusses are advantageous because the bottom chord also serves as a rigging beam for concerts.

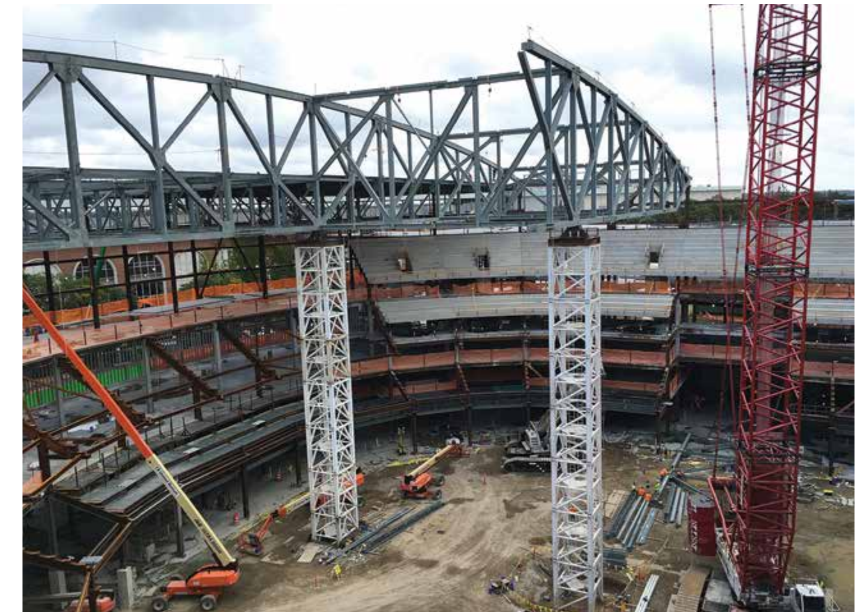
The long-span roof was designed for a center-hung scoreboard with a weight of 120,000 pounds and a 30,000-pound offset hoist to lift the scoreboard. Fully nested into a 60-by-60-foot hole in the roof, this location supports show loads for concerts positioned under the scoreboard.

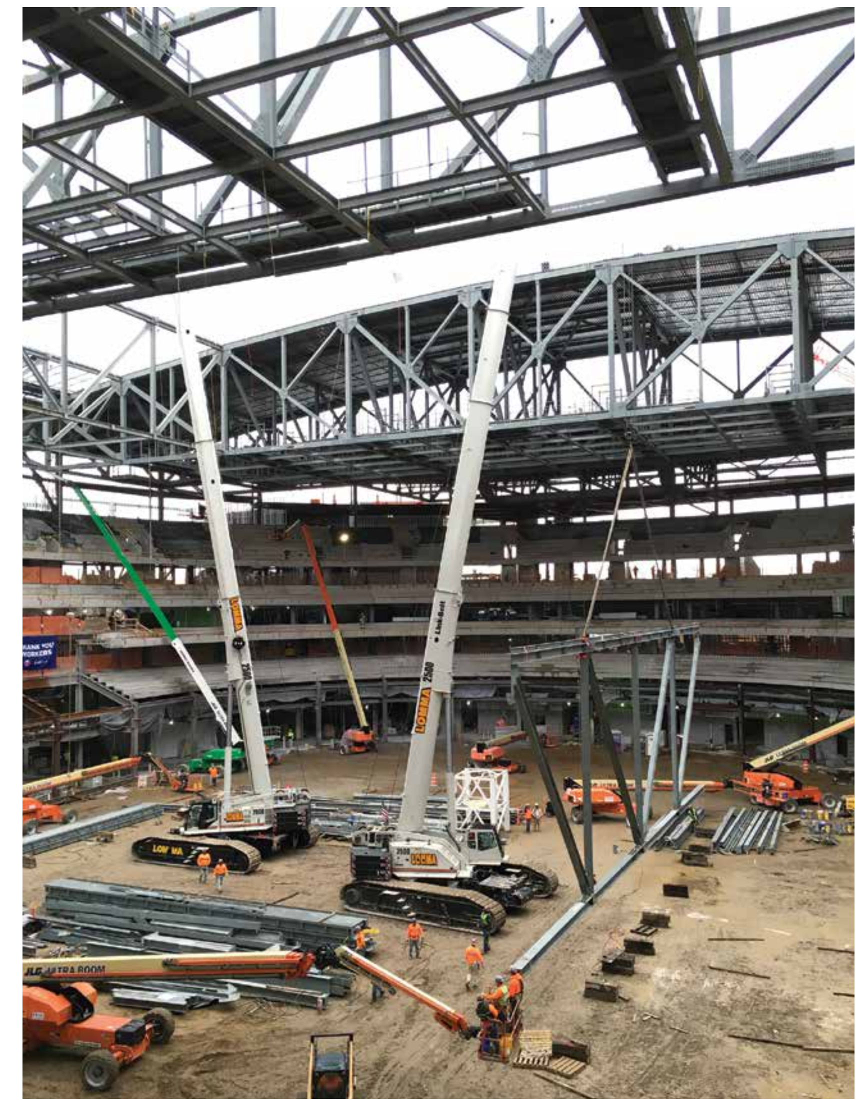
In addition to supporting the large rigging loads for speakers, video boards, lights, and other equipment, the arena is designed with a robust loading dock and marshaling yard.

"From an architectural standpoint, this meant increasing the number of loading docks and ensuring that the marshaling yard is large enough to allow for the delivery and movement of freight," says Storm. "To accomplish this, the structural engineering team had to design large column-free spaces in the marshaling yard areas." To create these spaces, a series of 10-foot-deep, 110-foot-long trusses were built over the marshaling yard to make sure that no columns would obstruct truck access to the arena.

Opening spread: Courtesy of Populous

This spread: Thornton Tomasetti





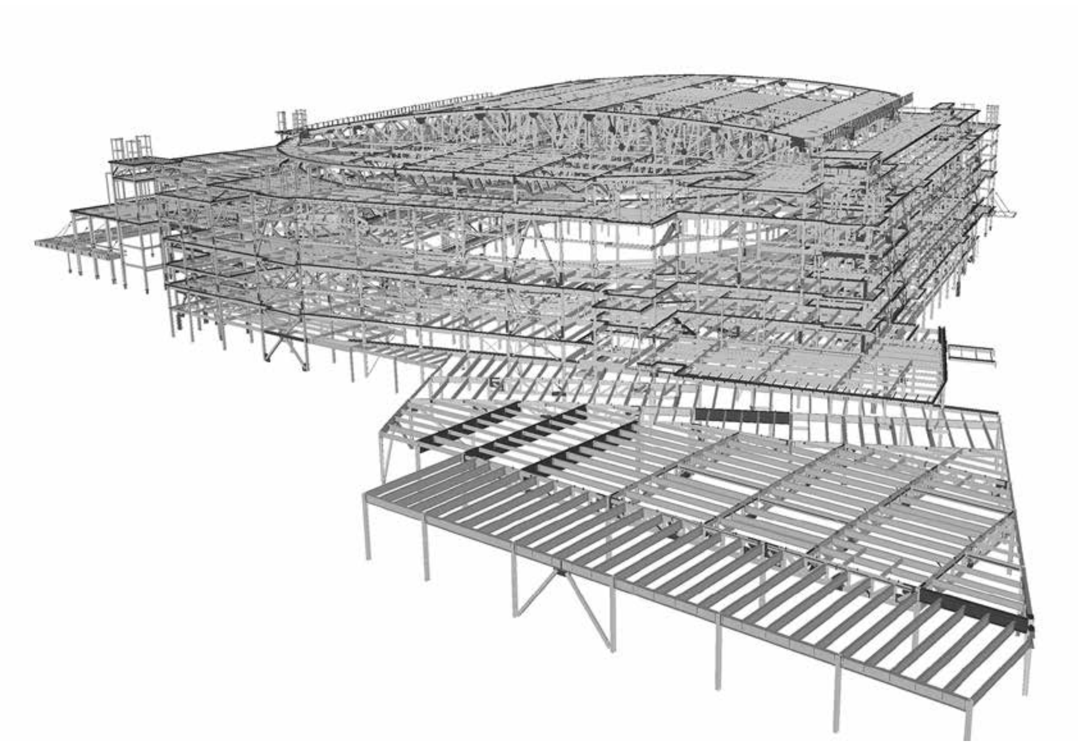
Clockwise from top left 1) The 100-ton erection pick of the first half of the T2 roof truss. 2) Bearing connection bolting for the T2 Roof Truss. 3, 4, 5) The roof truss lift in July 2020. The 350-foot long-span roof is supported by four main trusses each weighing approximately 180 tons.

Pointing out that the 60,000-square-foot marshaling yard is one of the largest in the industry, Jason Carmello, a senior principal and architect with Populous adds, "the yard is covered, enclosed, heated and provides ample power/data connections for 10-plus trailers, direct access to the loading dock and arena floor via ramp and creates one of the most accessible load-in/load-out sequences in the marketplace. The arena also has direct freight elevator access from the arena floor to the catwalk for continued ease of event load-in/load-out."

When COVID hit the U.S. in the spring of 2020, arena construction shut down for 50 days. When work resumed, New York State's mandatory quarantine for all out-of-state visitors prevented the Kansas City-based Populous architects from visiting the site, with the exception of two individuals who were New York residents.

Thornton Tomasetti was able to rely on local colleagues for handling any necessary site work. "Luckily, we had a great group of staff from our New York office who were able to make site visits and be the eyes and ears for the design team back in Kansas City," says Lumpkin.

"Each night, the design team would review site photographs taken during the day in order to give real-time feedback to site staff. Additionally, video calls over smart phones with site staff became a



regular occurrence to review complex conditions in the field," he says.

Quickly adjusting to these unique circumstances, the project team began using tools like HoloBuilder, which enabled the team to get a better look at slab reinforcing and structural steel with the software's high-resolution, three-dimensional images that rotate, pan, and zoom.

In response to the new health and safety concerns, the design team also modified food service operations, MEP and filtration systems, patron circulation paths with added doors and entry-egress routes.

Another interesting byproduct of the travel ban was the architects' ability to spend time that would have been lost to travel turning around Requests for Information and Submittals at a faster pace.

Fortunately, the majority of the structural materials—mainly steel, concrete, and rebar—were procured prior to the pandemic, so contractors AECOM Hunt and Barton Malow didn't run into any major supply-chain issues.

Though the steel design and procurement was performed pre-COVID, the fact that Thornton Tomasetti had built its own Tekla model of the steel structure allowed the engineers to fully coordinate construction drawings, connection design, and fabrication models, which sped up the beginning of the project, and ultimately helped keep things on schedule despite the shutdown.

"Our Tekla model had all of the connections fully detailed and modeled with plates, bolts, weld sizes, holes, etc.," says Storm. "The model was then passed along to the fabricator to generate shop drawings. The greatest advantage of this delivery method is the time savings achieved by eliminating the traditional pass-off to a third-party detailer and delegated connection designer."

The design team also utilized Revit BIM360 to generate construction drawings. With the full design team in a shared cloud model, this eliminated the need to pass models back and forth between design firms. "This is advantageous from a coordination standpoint because engineers could see any changes in real-time in other engineering and architectural models," adds Storm.

Digital modeling technology was also used to map out installation and track as-built progress for steel erection. With these geometric details precisely established, steel elements were positioned correctly the first time. The project site also worked to the team's benefit as the contractors had ample room for steel laydown and staging.

The cutting-edge arena also features robust Wi-Fi networks with 5G speed communications technology embedded within the seating bowl through thousands of connections, wiring and antennas. Patrons can participate in interactive events via smartphones and take advantage of convenient grab-and-go options like Amazon's Just-Walk-Out Stations. Targeting LEED certification, the arena incorporates renewable energy, reduced water and electricity consumption, and zero waste.

Alongside the new venue are plans for a 340,000-square-foot retail and dining complex, a 200-room hotel and a new Long Island Rail Road station which ran on a limited schedule last season and will be full-service later this year. The site is shaping up to offer something for everyone, especially dyed-in-the-wool Islanders fans who will celebrate the team's 50th anniversary this coming season, finally in an arena worthy of their enthusiasm.

In creating its own Tekla model of the steel structure, Thornton Tomasetti streamlined and sped up the process of coordinating construction drawings, connection design and fabrication models.

Facing page The entrance to UBS Arena, which is at the heart of a new development in Elmont, Queens.

This spread: Courtesy of Populous

UBS ARENA AT BELMONT PARK

Location: **2400 Hempstead Turnpike, Elmont, NY**
Owner: **New York Arena Partners**, *Elmont, NY*
Architect: **Populous**, *Kansas City, MO*; (exterior) **JRDV Urban International**, *Oakland, CA*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
Mechanical Engineer: **ME Engineers**, *Denver, CO*
Construction Manager: **AECOM Hunt-Barton Malow Joint Venture**, *New York, NY*
Structural Steel Fabricator: **Cives Steel Company**, *Gouverneur, NY*
Structural Steel and Metal Deck Erector: **J.C. Steel**, *Bohemia, NY*
Miscellaneous Iron Fabricator and Erector: **Berlin Steel**, *Kensington, CT*
Architectural Metal Fabricators: **ICON Exterior Building Solutions,** *Canonsburg, PA*; **Harriott Contracting LLC**, *Columbia, MD*
Architectural Metal Erector: **BAMCO, Inc.**, *Middlesex, NJ*
Curtain Wall Fabricator: **Jordan Architectural**, *Ontario, CA*

The GROW mixed-use high-rise building brings hexagonal geometries and an operable facade, including planted modules, to the skyline of lower Manhattan.

Metals In Construction Magazine 2022 Design Challenge

Dynamically Adaptive Facades Promote IEQ: GROW and EVOCON

NOW THAT CLIMATE CHANGE HAS become a global emergency—and after the COVID-19 pandemic placed many people under unexpected house arrest, even beyond the previous estimated norm of 90 percent of their time spent inside—ensuring indoor environmental quality (IEQ) has never been a higher priority for architects and engineers. The 2022 *Metals in Construction* Design Challenge, sponsored by the Ornamental Metal Institute of New York (OMINY), addressed this concern by asking entrants to design residential enclosures that respond to changing exterior environments and optimize occupants' well-being year-round. The winning concepts challenge the design and construction professions to develop facades that handle air, light, street noise, and energy as actively as the skin of any living organism.

Working on a site bordered by Canal, Varick, Grand, and Sullivan streets in Lower Manhattan, entrants envisioned facades with thermodynamically responsive components and environmentally responsible material choices. The competition required them to consider IEQ, enhanced resilience, constructability, and a building perimeter with a zero or near-zero carbon footprint. Two proposals emerged victorious and split the $15,000 grand prize, a first for the Design Challenge: a mixed-use green high-rise titled GROW (developed by Alvaro Arranz, AIA, RIBA, NCARB, LEED AP; Vicky Chan, AIA, LEED AP, BEAM PRO; Subhiksha Bhoovarahan; Andy Cheng; and Crystal Hu, BEAM PRO) and the EVOCON modular facade system (developed by Priedemann Facade Experts: Puttakhun Vongsingha, Natchai Suwannapruk, Avinash Nair, Jens Böke, Paul-Rouven Denz, and Lars Anders).

Entries were evaluated by jurors Berardo Matalucci, director of environmental design at SHoP Architects and adjunct assistant professor at Columbia GSAPP; Holger Schurzer-Ehring, principal at Buro Ehring; Jessica Young, principal at Heintges Consulting Architects and Engineers; and Mic Patterson, PhD, LEED AP+, Ambassador of Innovation & Collaboration at the Facade Tectonics Institute. In a webinar conducted last March 30 and hosted for streaming at *Architectural Record*'s Continuing Education portal, the first three jurors and Steel and Ornamental Metal Institutes of New York Director of Industry Development Gary Higbee (subbing for Patterson) discussed the evolving aims of contemporary facade design, the capabilities and limits of a speculative competition, and the distinctive qualities of the winning entries. As with previous Design Challenges, Higbee noted, this competition directed adaptations of the built environment toward a pressing environmental and social problem: IEQ (particularly its subcomponent, interior air quality or IAQ) has galvanized national attention during the coronavirus era, and facades are the building element with the greatest capability to protect people from contaminants as well as enhance their physical and psychological well-being while indoors.

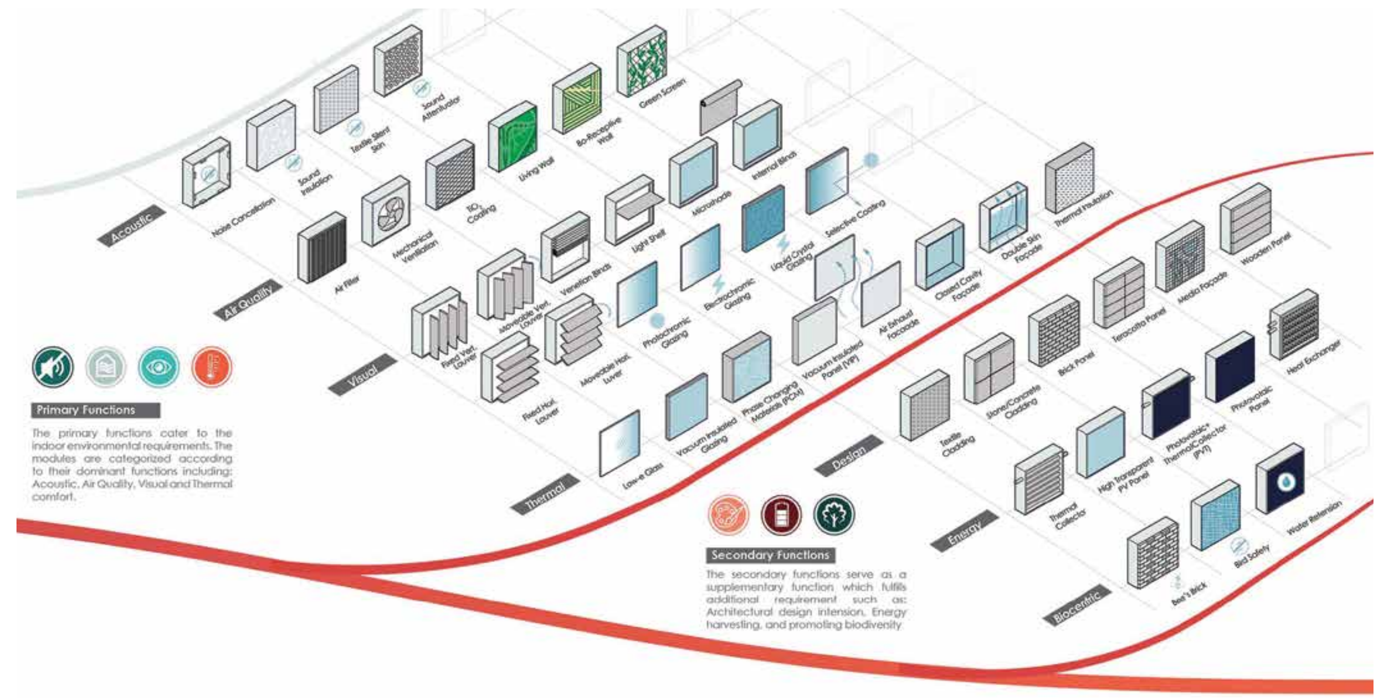
Although panelists commented that both winners were imprecise fits for the detailed competition brief, they decided that GROW and EVOCON were thought-provoking enough to advance the state of the art and merit recognition. GROW is the more flamboyant of the two, a honeycomb-like set of variations on a triangular planar element and a hexagonal volume, with nods toward Japanese Metabolist modularity and the diagrids of Norman Foster's Hearst Tower or OMA's Seattle Central Library. EVOCON is more a system than an object, offering reconfigurable "plug-and-play" facade components in four layers (exterior, infill, structure, and interior) that can accommodate an ever-growing repertoire of functional modules, the "EVOCON Catalog."

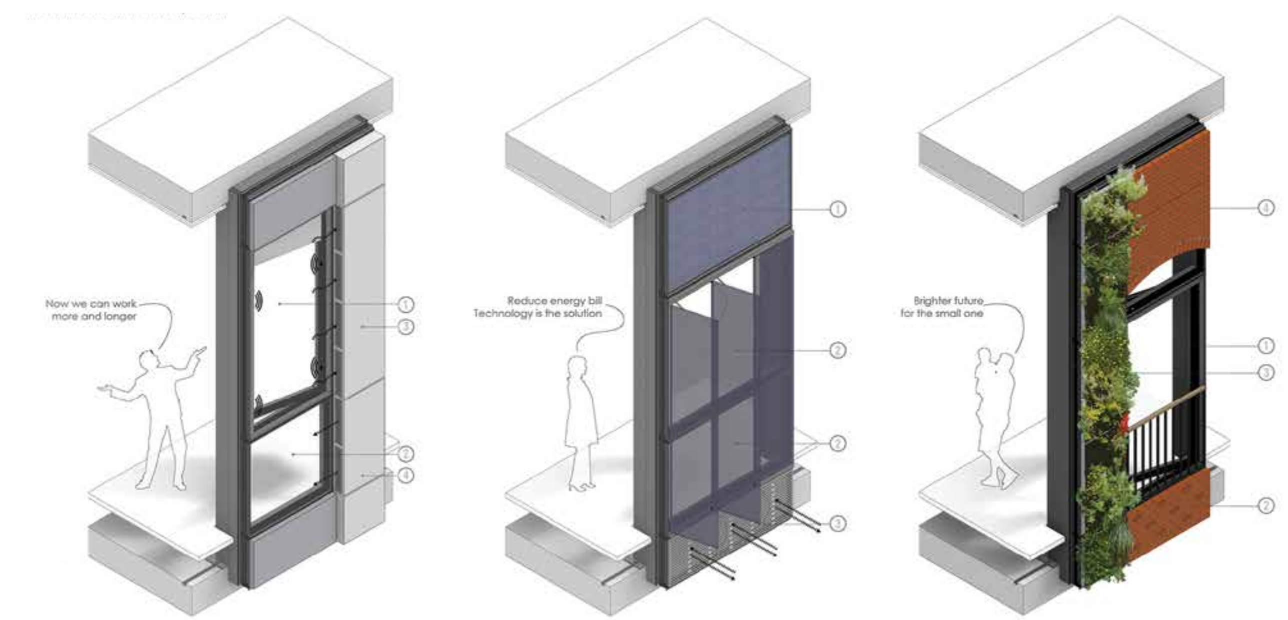
Noting in his overview comments that personnel costs generally outstrip operating costs for commercial organizations, meaning employee-retention measures make sense financially, Matalucci emphasized the aspects of facades that create favorable environments for occupants: visual and thermal comfort, high-quality natural light, favorable acoustics, protection from glare and downdrafts, mitigation of heat gain, and details that respond to our innate biophilia, including access to outdoor views. He noted the intermediate zone between indoors and outdoors is a natural space for passive design strategies, reflecting that interior-exterior relationships in modern buildings are a spectrum, not a binary. As climatic conditions and other priorities change—COVID, for example, greatly amplified public awareness of infection control and ventilation—facades' adaptability for new purposes will bring them greater value and require longer life cycles. Keeping a building's structure intact while exchanging other components, Matalucci observed, resembles upgrading trains or airplanes, offering opportunities for ongoing improvement of carbon emissions and other performance metrics.

Schulze-Ehring, presenting the GROW project in detail, described the components that allow it to pursue a Net Zero footprint through management of both operational and embodied carbon. GROW is a prefabricated building composed of honeycomb modules built offsite; its program combines retail, commercial, lodging, residential, and co-working uses. Features include timber floors, recycled structural and facade materials, vertical gardens and window-module-mounted plantings, ground-level bioswales to filter and recycle graywater, and an operable facade that not only allows seasonal natural ventilation (64 percent of the facade is operable over half the year, and 35 percent of the facade is green) but incorporates adaptive glazing with e-ink adjusting to light conditions, darkening the windows in winter to increase solar gain by 200 percent, then changing to reflective white for cooling in summer. Sensors and operable windows are integrated into a management system and central data cloud, so that the facade "learns" from its occupants' interactions with it. The design team claims a 70 percent

Opening spread: Courtesy of GROW Project

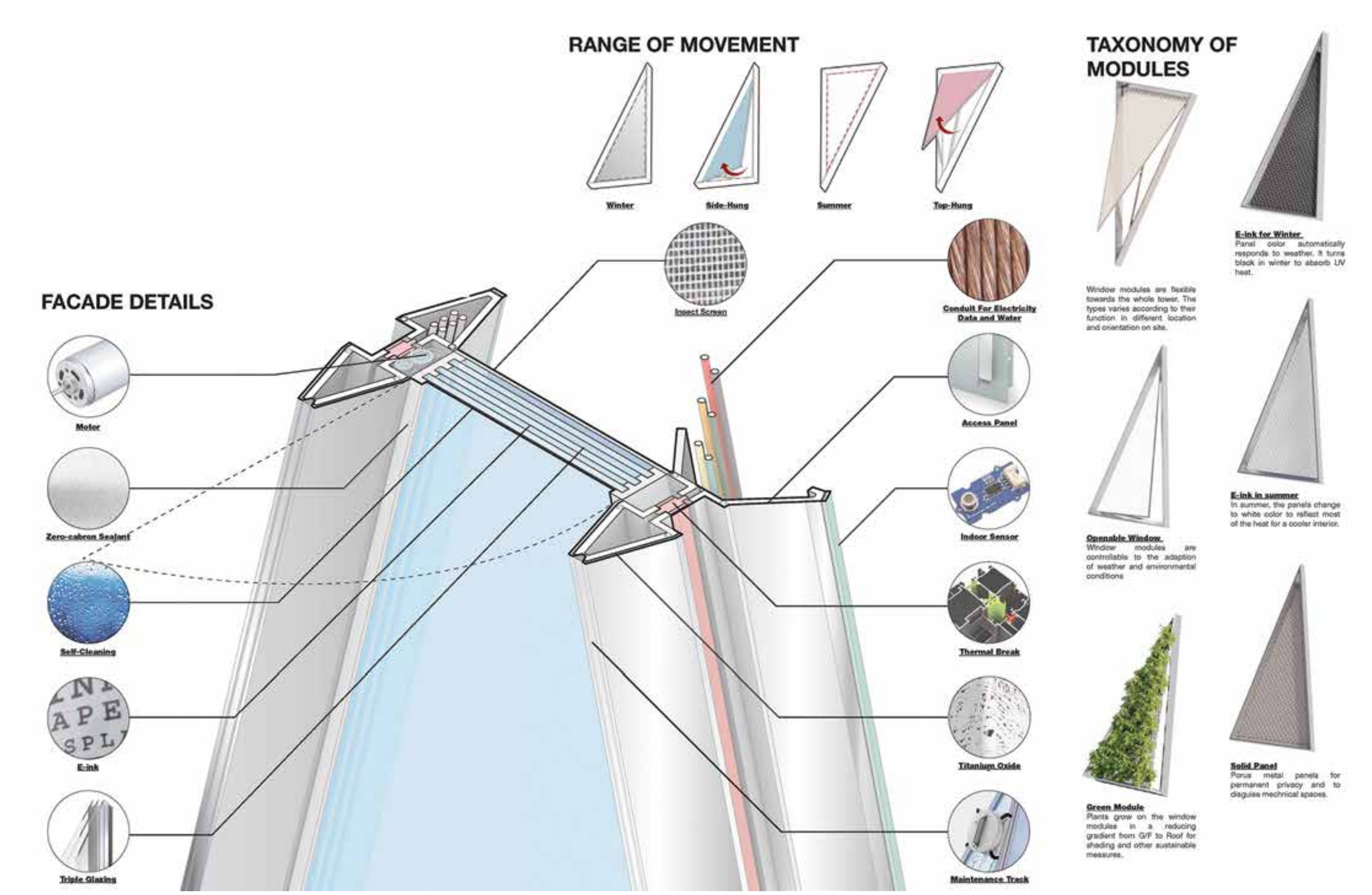
This spread: Courtesy of Priedemann Facade Experts





Facing page The EVOCON modular facade system can accommodate a variety of materials, from masonry to glass to living walls.

This page, top The "plug-and-play" building blocks of the EVOCON system allow adjustments for acoustics, air quality, daylighting control, and thermal management.
Bottom Imaginable configurations for EVOCON facades can emphasize IEQ improvement (left), energy production with photovoltaics (center), or biophilic architectural features (right).



reduction in overall operational carbon footprint.

EVOCON, presented by Young, emerged from analyses of changes in the physical environment and in occupants' behavior, including climatic history, anticipated changes, and unknowables; consideration of local building and energy codes and COVID-related adjustments in work and living spaces; and a focus on the lifespans of materials. The project emphasizes systems, local details, and lifecycle abstractions conceptually and visually, with only one image in 10 detailed pages showing a complete building volume at all. "Putting performance before aesthetics," Young commented, "was always an interesting move." The repertoire of functional plug-and-play modules, adjusting the facade's performance in response to ongoing assessment of IEQ, includes components serving two sets of functions deemed primary (acoustics, air quality, lighting, and thermal comfort) and secondary (potential for energy harvesting, biodiversity, architectural design, and materiality). This reconfigurable system adjusts to users' needs and allows for open-ended renovation, with components removed, remounted, refurbished, and in some cases reused at other locations.

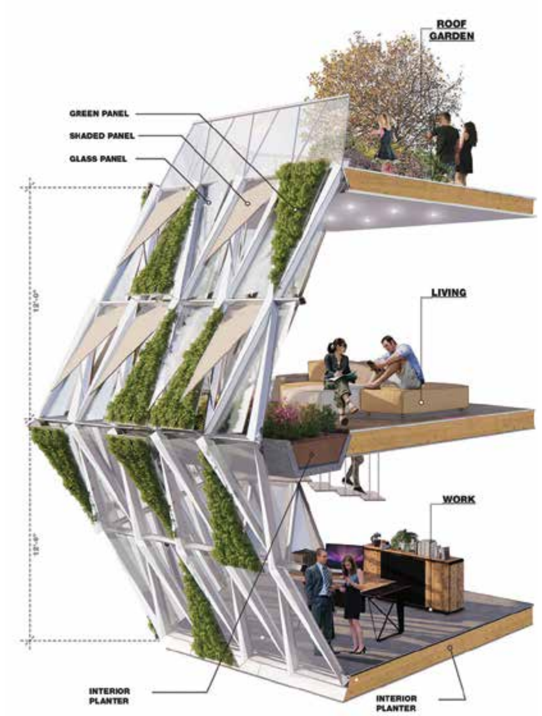
Panelists subjected the two projects to careful critiques on grounds of practicality and constructability, recognizing that conceptual thinking and complexity in these types of aspirational designs can sometimes overwhelm execution. The holistic approach of GROW impressed Schulze-Ehring, as its design team integrated the full building into the environmentally responsive mission. Matalucci hailed the "multifunctional adaptability, even over a 25-year lifespan" of EVOCON's system, while noting that site specificity was an element largely left aside after the initial analysis. The timing and onsite procedures for maintenance and adaptations at different points in EVOCON's lifespan, as one might expect in an ideas competition, remain challenges for another day.

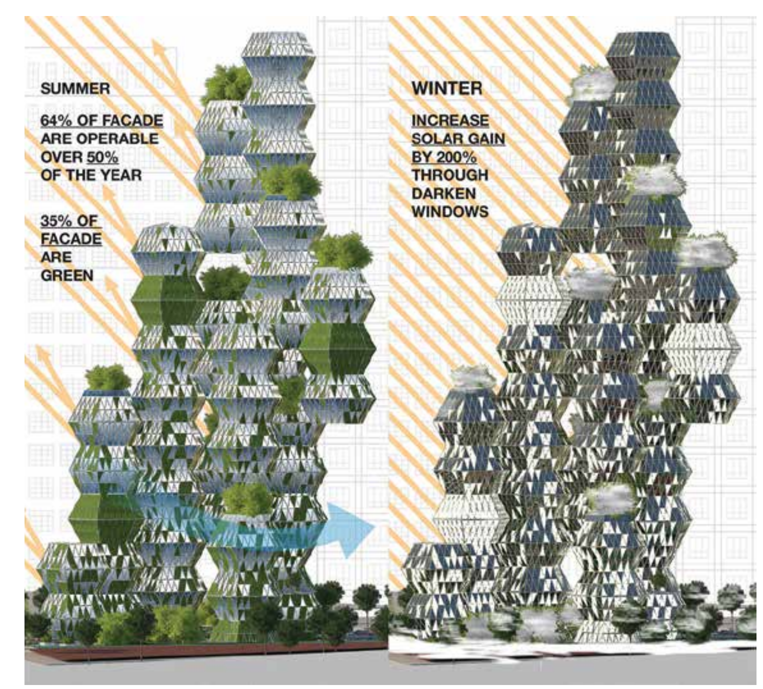
Both projects offer imaginative responses to the demands of 21st century urban design: humane interiors for residents and workers, lighter burdens for the planet, and flexible systems that help organizations cope with the foreseeable and unforeseen, from rising temperatures to novel airborne plagues. Whether these specific designs are someday realized or stand as models for others to adapt, they advance the profession's knowledge of what facades can achieve at the interface where built spaces meet the wider Earth.

This page The GROW facade comprises triangular modules that can be closed in winter with e-ink darkening to absorb ultraviolet radiation, either top-hung or side-hung for operability and air transmission in warmer months, solid with a perforation option, or planted.

Facing page, clockwise from top GROW presents a honeycomb-like profile in which different segments of the diagrid-based envelope contribute daylight, filtration, privacy, and organic components. The dynamic facade of GROW allows for seasonal adaptations, including wintertime window darkening that allows an estimated 200% increase in solar thermal gain. With 12-foot floor-to-floor heights and different arrangements of solid, glazed, and green panels, plus optional interior planters lit by the angled windows, GROW combines workplaces, residences, and roof gardens.

This spread: Courtesy of GROW Project

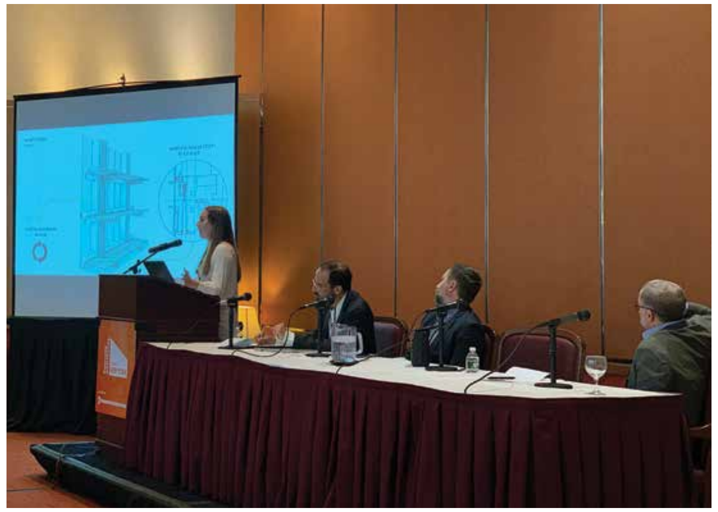




RECENT EVENTS

Carbon Crisis: Leveraging the Facade System for Carbon Reduction in Buildings

On May 11, the Ornamental Metal Institute of New York hosted the Facade Tectonics Institute's Forum: NYC at Manhattan's Club 101. The event was organized around the reality that buildings are a significant contributor to global carbon emissions and their facade systems play a major role in that contribution. This puts the building skin at center stage in the development and execution of carbon reduction strategies in the pursuit of carbon-neutral, or even carbon negative, buildings. Forum speakers explored practical and effective solutions for reducing carbon emissions along with the economic and ethical reasons for doing so.



To learn more about the 2022 Forum as well as upcoming FTI events, visit www.facadetectonics.org/events/forum-nyc22. Videos of the event are available at www.ominy.org/news.

A RANGE OF COURSE OFFERINGS FOR CE CREDITS, INCLUDING PDH

In addition to this magazine, the Steel and Ornamental Metal Institutes of New York publish a range of continuing education and webinar content throughout the year, providing opportunities for readers to earn AIA learning units. The Institutes are AIA Continuing Education Services (AIA CES) Approved providers, enabling them to offer continuing education in accordance with AIA CES guidelines. Architects who complete a course earn learning units (LUs) to fulfill their continuing education requirements as both AIA members and state-licensed professionals.

In many cases, the courses we sponsor may offer professional development hours (PDH) as well. This is permitted under New York State Education Department (NYSED) regulations. NYSED pre-approves all sponsors, such as AIA CES, that offer continuing education courses and activities through their approved providers. The courses don't have to be pre-approved, but it is the responsibility of the professional to determine if a course is relevant and appropriate to maintain his or her engineering licensure. Here are the Institute's most recent course offerings:

NEW ON-DEMAND WEBINARS

Dynamically Adaptive Facades: The Need to Improve Indoor Air Quality
With people spending about 90% of their time indoors during the global pandemic, indoor environmental quality (IEQ) has become of paramount importance. Indoor air quality is also fundamental to IEQ, and the facade system holds the potential to provide crucial natural ventilation while enhancing the thermal resilience for building occupants. Balancing occupant comfort with lifecycle carbon performance was the goal of the 2022 Metals in Construction magazine Design Challenge, a competition to generate ideas for an innovative curtain wall system to enclose a new, site-specific office building. During this webinar, competition jurors discuss the context of the Challenge and entries selected as winning examples of facades that can respond dynamically to a range of environmental conditions. *Watch the on-demand webinar and earn 1 AIA LU/HSW and PDH.*

Speed Framing: Revolutionary Designs That Accelerate the Speed of Steel Construction
Builders of steel-framed high rises already see faster erection times than those using other materials because of steel's inherent advantages during the fabrication, staging, and erection phases. But two recent innovations are poised to accelerate the pace of steel construction even further. The non-proprietary design concepts were developed by Magnusson Klemencic Associates (MKA), an international, award-winning structural and civil engineering firm headquartered in Seattle. In both cases, they achieve more efficient construction by replacing reinforced concrete with steel during the construction of high-rise buildings. *Watch the on-demand webinar and earn 1 AIA LU/HSW and PDH.*

NEW CONTINUING EDUCATION COURSES

Not Quite Your Grandfather's Steel: High-strength A913 in today's green construction
The strength, durability, and recyclability of structural steel make it an essential tool for architects and engineers with an eye on the future. Advances in metallurgical science and fabrication techniques make it possible for less material to bear more load and occupy less space, thus economizing on the material's quantity and cost without compromising its structural integrity. In a world where professionals, clients, and the general public are increasingly conscious of the carbon and energy footprints of building materials, and where minimizing resource extraction and waste is a higher priority than in the past, high-strength structural steel is a prudent and logical choice, even plausibly a sustainable one. *Take the course and earn 1.5 AIA LU/HSW.*

Adaptive Reuse of Commercial Spaces: Curtain Wall Solutions
The COVID-19 pandemic has changed many long-held assumptions about working conditions and commercial real estate in American cities. While working from home suits some workers and organizations better than others, these flexible operations have made considerable inroads against the 9-to-5 workday and the centripetal commute to central business districts. Few observers are confident that demand for urban office space will rebound fully. Even if the pandemic comes under nearly complete control and "Zoom fatigue" sours many workers and managers on home-office arrangements, some degree of ratchet effect on office-space demand is likely. *Learn more about how contemporary facade strategies help make adapting commercial buildings a reliable and resilient investment under today's evolving conditions and earn 1.25 AIA LU/HSW.*

All courses and webinars may be viewed via *Architectural Record*'s Continuing Education Center: continuingeducation.bnpmedia.com/library.

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

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

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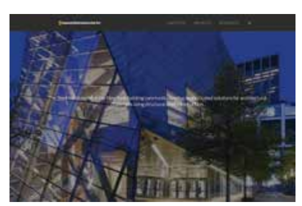

www.ominy.org
Ornamental Metal Institute of New York

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

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

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

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

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