METALS IN CONSTRUCTION

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565 BROOME / PENN 2 /
GILDER CENTER, AMERICAN MUSEUM OF NATURAL HISTORY /
425 PARK / DISNEY HEADQUARTERS / THE SPIRAL /
PASSIVE HOUSE PUBLIC SCHOOLS PS 456 / KGIA / ONE MADISON AVENUE

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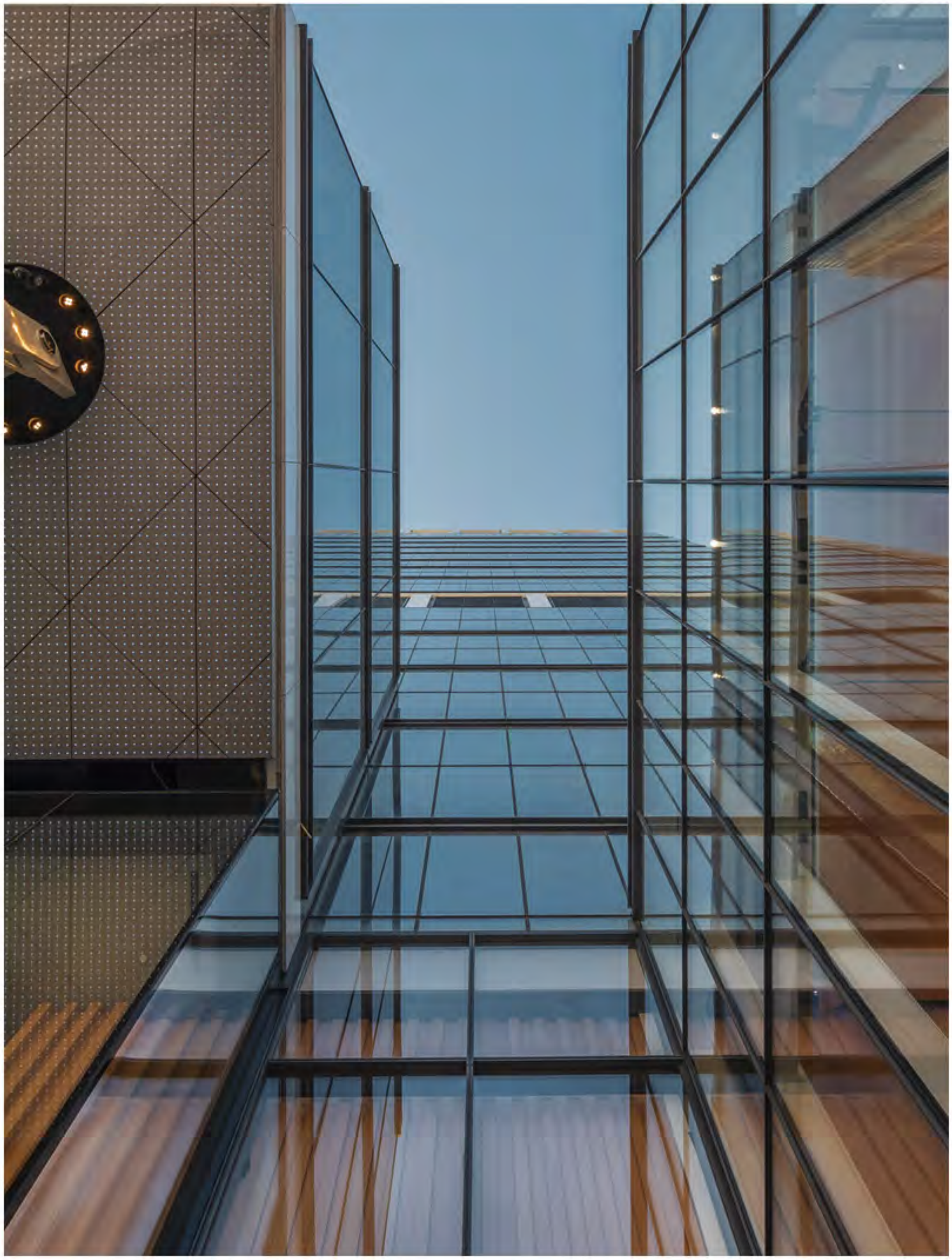

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Above View looking up at PENN 2
Cover The Spiral designed by BIG and Adamson Associates

Above: Courtesy MdeAS; Cover: Laurian Ghinitoiu

EDITOR'S NOTE
Office Towers in a Post-Covid Future

EVEN AS WE MOVE TOWARDS the more flexible work arrangements brought on by the pandemic, we know that the development of new office towers is important to the vitality of New York City. Among other things, it is critical to maintaining the city's prominence as the financial capital of the world. It relies on attracting workers back to the city to fuel this. Developers believe that providing a more healthful working environment is the key.

Featured in this issue are two of the most celebrated towers that have been successful at this: 425 Park and The Spiral, both erected by contractors whose support of The Steel and Ornamental Metal Institutes of New York makes this publication possible. Both towers are amenity-rich buildings set in landmark locations sought to provide a vibrant, dynamic environment attractive to the modern worker. Both towers include elements like quiet zones and outdoor spaces that millennials rank as essential mental health features of the desired workplace. At The Spiral, landscaped terraces cascade down the outside of this 2.85 million-square-foot skyscraper (shown on the cover). Designed by Bjarke Ingels Group for Tishman Speyer, the unique feature enables each office floor of the 66-story building to have ready access to an open-air natural setting. Foster + Partners 670,000 square foot 425 Park Avenue, designed in collaboration with Adamson Associates, incorporates a collection of sky gardens at various levels as its way of exposing occupants to a pleasing natural experience.

Both towers include collaborative spaces, floor-to-ceiling glass to maximize natural light, and sanctuaries for fostering worker well-being. Each tower not only received LEED Gold certification but was also commended for its focus on health and wellness. 425 Park was awarded Well Core Gold certification with The Spiral earning a 2-star Fitwel© rating. What should not be lost in marking these achievements is that confidence in workmanship was essential to not only attaining them, but even the undertaking of them. Building office towers of this standard in the post-Covid era will continue to rely on access to a skilled workforce. It is important to recognize not only the designers of 425 Park and The Spiral, but also the highly skilled ironworkers of Locals 40 and 580 who, working during pandemic conditions, helped transform these designers' visions into reality.

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565 Broome

Left Curved corner windows and slim mullions give the facade of 565 Broome a sleek and elegant profile.

Rising above the entrance to the Holland Tunnel, a glass tower by Renzo Piano Building Workshop blocks out the noise while welcoming views of the city and the Hudson River.

Renzo Piano Building Workshop (RPBW) has left its mark on New York's prominent institutions, bringing its combination of precise forms, industrial materials, and rigorous craftsmanship to the Whitney Museum, the Morgan Library, the New York Times headquarters, and Columbia University's Manhattanville campus. For a very different client, the global real-estate developer Bizzi & Partners, RPBW delivered a 25-story apartment building featuring understated elegance and arresting views. It is the firm's first residential project in the United States, the tallest residential tower in SoHo, and likely the city's first zero-waste luxury apartment building.

Though the ground-floor retail space along Varick Street remains unoccupied at this writing, lending the building a construction-site atmosphere when viewed at grade, the rest of 565 Broome stands as an exercise in architectural refinement with a building envelope that practically disappears. The residential component, structured as mirror-image towers linked by a central glass atrium, opened in 2019 on what the firm calls "the last developable site of its size in SoHo." If 565 Broome marks the culmination of SoHo's evolution from hardscrabble industrial district through edgy bohemia to a privileged enclave, it does so with close attention to the simplest, most universal elements of the quality of life: light and air.

The site, observes RPBW partner and project architect Elisabetta Trezzani, sits adjacent to the Holland Tunnel's Freeman Plaza entrance ramps, which funnel more than 15 million cars a year under the Hudson River, according to Port Authority metrics. Noise, vibration, and exhaust may be inescapable there, but the tunnel ensures that the building will never have something built in front of it. To take full advantage of views in all directions, the architects designed a facade with ultra-transparent low-iron glass, slim mullions, and a regular rhythm of two-foot-wide modules.

One of the project's challenges was "the typical Renzo wish to have as little visible surface of the mullions and transoms of the unitized facade as possible to allow as much glass surface as possible and thus natural light into the building," says a spokesperson from the German office of curtain-wall fabricator/erector Josef Gartner, a division of Permasteelisa. "Implementing this in such a way as to meet the structural and building physics requirements is always a balancing act between what is feasible and what the architect wants."

"We stayed away from the idea of a flat glass facade, where you don't really see inside," Trezzani says. "We wanted to play with the light as a material." Minimizing shadows and obstructions, with columns set in from the facade and curved glazing allowing a full bi-directional view at each corner, the building maximizes occupants' sense of connection to the neighborhood. "This curved corner [is] completely transparent," says Trezzani. "You have almost the feeling of flying in the city." Apartment floors have a unitized aluminum-and-glass facade, while the double-height ground floor spaces (including the retail component) and central atrium use point-fixed cable-net glazing, offering exceptional transparency at grade as well.

Like RPBW's Jerome L. Greene Science Center (2016) in Manhattanville, 565 Broome does an exceptional job of muting exterior noise near transport infrastructure. But it accomplishes that without Greene's double-wall facade, instead using tight, double-glazed units with solar-protective coating (Guardian SN 62/34) on the interior lite and a more transparent exterior lite, minimizing tint. Acoustic testing guided the glazing selection, Trezzani says, initially for the Watts Street facade where ambient sound was loudest, and eventually for the full facade, outperforming code in noise reduction. The Gartner spokesperson notes that the requirements ranged from Outdoor-Indoor Transmission Class (OITC) 28 to OITC 37, depending on the facade's orientation to noise sources. Operable window segments feature Gretsch-Unitas projecting top-hung hardware, positionally stable at any angle up to the opening restrictor's fall-safe point, allowing occupants considerable airflow control. With 11-foot floor-to-floor heights, 10-foot internal ceiling heights, and floor-to-ceiling windows flush with the floorboards, the 115 apartments have a more spacious ambience than one normally finds in Manhattan residences.

When the client bought the site, it was L-shaped due to a youth center/charter school annex building on the northeast corner of the block. To assemble a rectangular site and allow construction of a driveway and private *porte-cochère*, the client bought the dilapidated annex used by the youth

Evan Joseph, © Bizzi & Partners

This page, Top The double-story lobby is accessible by a private vehicular entry court tucked behind the building. **Center** The main indoor pool is part of an amenities-rich package that includes a library, gym, social spaces, and a 92-foot-tall glazed atrium between the two towers. **Bottom** Apartments, which range from studios to four-bedroom suites, feature floor-to-ceiling windows and many get views of the Hudson River. **Facing, clockwise from top:** Facade detailing at 565 Broome shows the minimalist aesthetic associated with Renzo Piano's work; Metal-and-glass curtain wall was attached to the concrete slab-and-column structure during construction; Glazing units fabricated for 565 Broome have high ratios of glass to aluminum mullions.

center as its primary entrance and agreed to build a new entrance for the center on the corner of Broome and Varick Street. As part of the deal, the developer included a basketball court underneath the new residential building that is accessible from the youth center/school. Since basketball courts must be column-free, "We built the slab on grade as a transfer beam," dedicating the outdoor area as an entry court for the apartment building and part of the interior for storage and MEP, says Trezzani. Because the property lies in a flood zone, important MEP equipment cannot be placed underground. A greater structural challenge, she says, involved the setback creating the 11th-story terrace, which RPBW solved by using a big transfer beam to move out the columns on the lower portion of the building and to bring in the columns on the upper part of the tower.

The building's volumes are organized in quadrants: the two symmetrical north and south towers are divided at the 11th floor into lower and upper segments. The glazed atrium between the two towers developed as a result of zoning regulations and negotiations with city officials, says Trezzani. The architects' initial design called for "one building until the setback" and two separate towers above that point, connected by a small bridge at roof level. When the team submitted documents for approval, however, officials told them that the 20-foot-long bridge was too small as a connecting element and insisted on a continuous facade. The solution was to enclose the space between the towers' inner concrete structural walls almost completely, leaving gaps for air and wind at the top. The resulting 92-foot-tall glazed volume ("the conservatory")

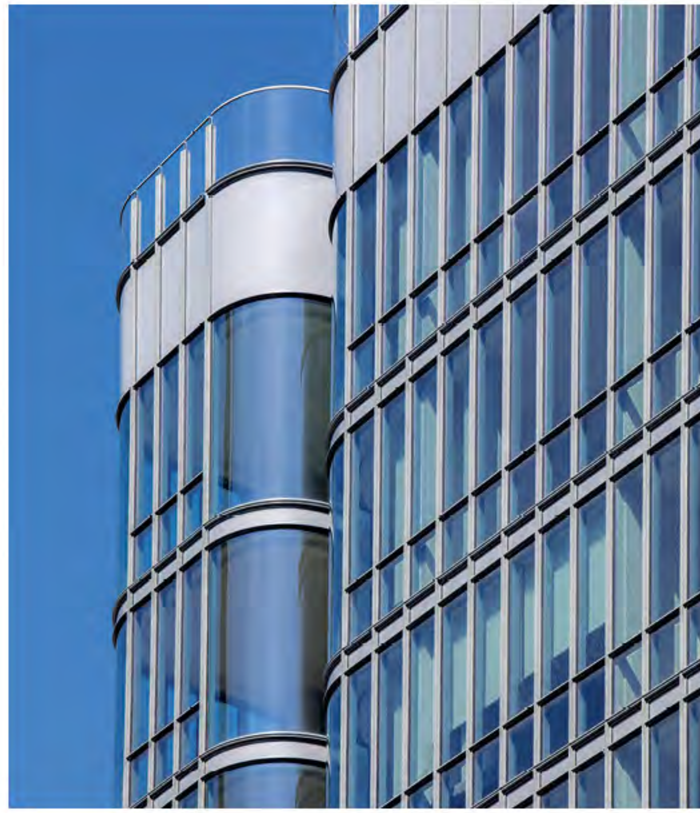
Top and center: Adrian Gaut; bottom: Evan Joseph, © Bizzi & Partners.

has the feel of a placid liminal zone, neither entirely indoors nor entirely outside, with indoor furniture at home among olive trees. Taking advantage of air currents in the atrium, RPBW suspended a kinetic sculpture, *Rainbow Leaves*, by longtime Piano collaborator Susumu Shingu, which features tri-colored stainless-steel petals that dance when activated by breezes.

Another Shingu sculpture, *Birth of a Rainbow*, adorns 565 Broome's landscaped entry court , a rare feature in Manhattan. A robotic parking system carries cars to a 42-space garage on the third floor, so residents with automobiles need never grapple with street parking. The garage space, says Trezzani, was unusable as apartments because it would have exceeded the zoning limit for floor-area ratio.

Like many upscale Manhattan buildings, 565 Broome offers amenities—such as a library, wet bar, social spaces, pools, and gym—but here, the main pool and gym are located in naturally lit, generously proportioned double-height spaces. The 11th-floor terrace includes four swimming pools, two per tower, and the north and south penthouse suites each include a private rooftop pool.

In the apartments, which range from studios to four-bedroom suites, floor plans emphasize views. Some of the larger units position bathrooms at corners along the eastern facade, with tubs facing the curved windows at oblique angles, so a bather can gaze out above the roofs of SoHo and Greenwich Village.



Top: Anna Morgowicz, courtesy of Renzo Piano Building Workshop; bottom left and right: © RPBW – Renzo Piano Building Workshop Architects

Left When seen from between the two towers, 565 Broome's glazing appears to vanish against the sky.
Facing Viewed from the west, the building stands as a new landmark on the edge of SoHo and injects a sophisticated touch of modernism to a formerly industrial district.

A different type of amenity requested by the client is the property's status as a zero-waste building, thanks to the expertise of environmental consultant firm Think Zero in coordinating waste-reduction, recycling, and donation programs so that 90 percent of the building's waste materials are diverted from landfills and incinerators. Although the building did not seek LEED status, Trezzani describes its facade-wide thermal-control metrics as meeting the city's 2015 code standards in effect during design, roughly equivalent to LEED Gold-level performance. Details such as electric charging stations, composting facilities, electronic-waste recycling, water-bottle refillers, and on-site car sharing indicate the importance of light-footprint living to the building's management, which aims for it to become Manhattan's first residential building certified as Zero Waste by Green Building Certification, Inc.

SoHo was industrial, longtime New Yorkers recall, before it was posh. Threatened by Robert Moses's Lower Manhattan Expressway plan until Jane Jacobs and other activists blocked that form of automotive urbicide, the neighborhood of cast iron and cobblestones attracted artists in the 1960s and '70s, then the deeper-pocketed residents who inevitably followed and displaced the "creative class." It's still possible to walk these streets at night and hear the ghosts of George Maciunas, Jonas Mekas, Holly Solomon, Keith Haring, and Ornette Coleman lamenting the tides of gentrification.

What 565 Broome brings to this environment is subtler than simple upscaling. "We use materials in a very honest way," Piano has said of this building, eschewing elaborate finishes in favor of a material palette of steel, aluminum, crystal-clear glass, limestone, ultra-high-performance concrete, and white-oak flooring—embracing restraint over garish display. Trezzani, who also worked on the earlier Whitney project, finds that the newer building's essential material isn't really a material at all: "Steel is the material of the Whitney; light is the material of the SoHo building." Guiding that light into these dignified spaces called for a blend of craftsmanship and integrity that makes RPBW and its collaborators credible inheritors of this neighborhood's pioneer tradition.

565 BROOME

Location: **565 Broome Street, New York, NY**
Owner and Developer: **Bizzi & Partners**, *New York, NY*
Architect: **Renzo Piano Building Workshop**, *Genoa, Italy*
Architect of Record: **SLCE Architects**, *New York, NY*
Structural Engineer: **DeSimone Consulting Engineering**, *New York, NY*
Mechanical Engineer: **Ettinger Engineering Associates**, *New York, NY*
Construction Manager: Joint venture: **Triton Construction** and **Plaza Construction**, *New York, NY*
Curtain Wall Consultant: **ICS**, **Mark Pasveer**, *Los Angeles, CA*
Curtain Wall Fabricator: **Gartner / Permasteelisa**, *Bloomfield, CT*
Curtain Wall Erector: **Tower Installation**, *New York, NY*
Structural Steel Fabricator and Erector: **Maspeth Welding**, *Maspeth, NY*
Miscellaneous Iron Erector: **Integrity Iron**, *Glen Cove, NY*

This spread: Evan Joseph, © Bizzi & Partners

A new feature, called the Bustle, runs 430 feet along Seventh Avenue and hovers 45 feet above the entry plaza to PENN 2.

PENN 2

A dull 1969 office building is transformed as part of a larger effort to upgrade the district around Penn Station.

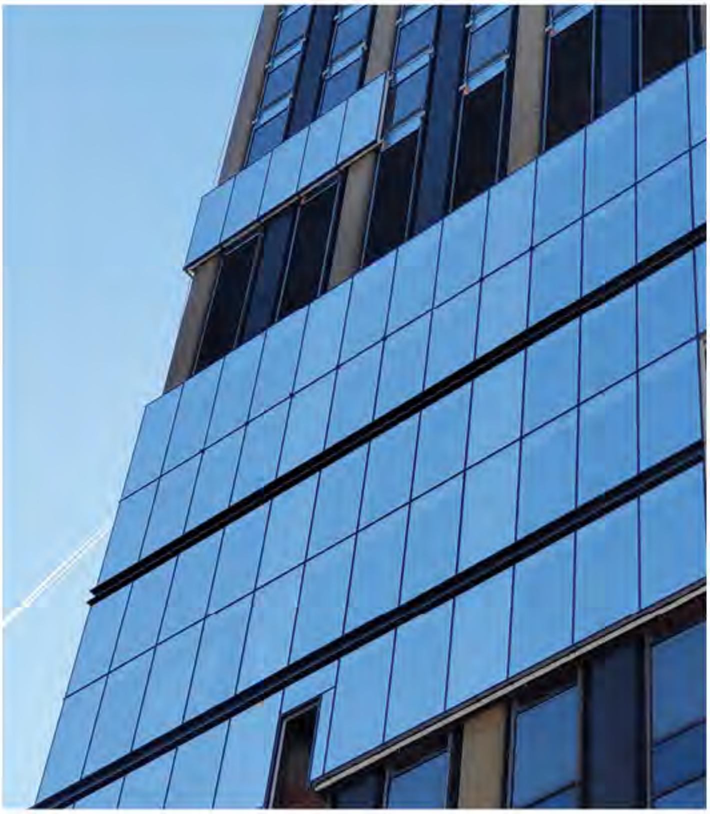
AFTER DECADES AS A WALLFLOWER, 2 Penn Plaza, a 31-story office tower adjacent to Madison Square Garden, has undergone a dramatic makeover and been rebranded as PENN 2. Its original 1969 facade, featuring alternating bands of precast concrete panels, tinted glass and aluminum panels, has been replaced by an all-glass facade, with dramatic new extensions facing east and north.

Replacing the curtain wall while tenants remained in place was a major challenge. "MdeAS and GMS, the curtain wall consultant, developed an over-cladding technique that allowed the curtain wall to attach to the existing mullions with reinforced anchor connections all from the exterior," explains Mike Zaborski, a principal at MdeAS Architects. "The old curtain wall was then removed from the inside when floors became available, either at night or on the weekend."

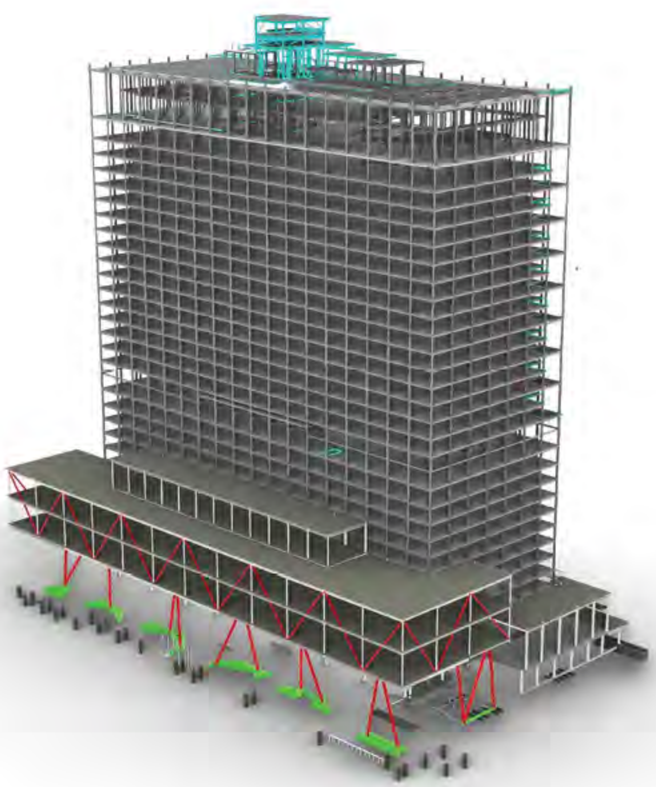
The building has always stood out from its neighbors for its position on a double-block site on top of Penn Station, North America's busiest transportation hub, and its setback from Seventh Avenue. The design team took advantage of the setback by adding a showy new feature, named the Bustle, which is 430 feet long, 70 feet wide, and hovers 45 feet above the entry plaza level. With 23-foot-tall double height floors, the Bustle adds 101,000 square feet of office space, as well as a 20,000 square foot outdoor terrace on the eighth floor and a 9,000 square foot terrace on the 10th floor.

The Bustle features an unconventional framing system, due to the need to avoid doing any construction work within the Penn Station train shed directly below the office building. "We managed to support the entire Bustle with only one new foundation placed outside of passenger egress, Penn Station infrastructure, and Penn Station retail," said Matthew Peitz, a principal at Severud Associates, the structural engineer. All other supports for the Bustle start at the plaza level and use the depth between the plaza and sidewalk to fit a transfer system.

"The existing plaza had to be demolished architecturally and reinforced structurally," says Craig J. Zegler, a construction executive at Turner Construction Co., the general contractor. "Steel-plate diaphragm reinforcement was placed on the structural slab, major dunnage groups of beams were placed on top of the new steel diaphragm, and new



Replacing the curtain wall while tenants remained in place was a major challenge, so the consultant developed an over-cladding technique that attached the new skin from the exterior.



Above Replacing the curtain wall while tenants remained in place was a major challenge, so the consultant developed an over-cladding technique that attached the new skin from the exterior.

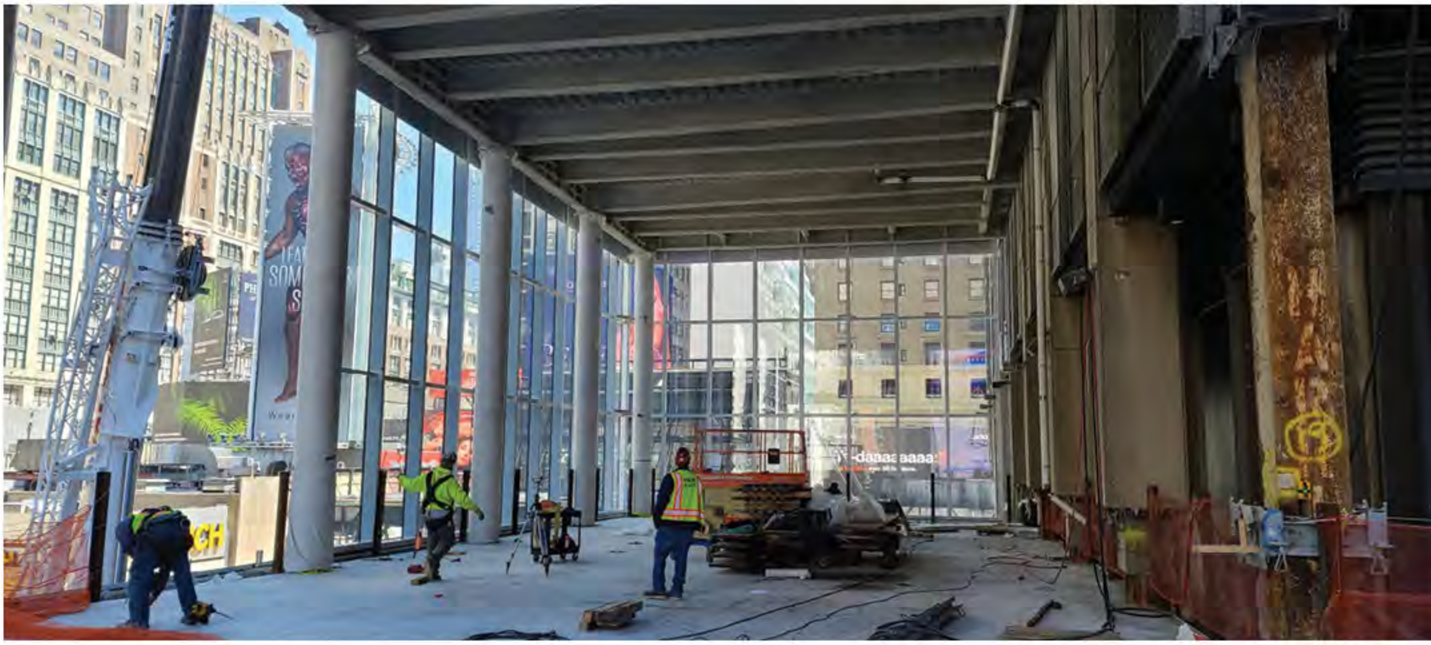
structural slabs were poured to create the foundation for the Bustle." In addition to using the existing Penn Station foundation columns below, Turner had to construct an additional foundation column 60 feet below the plaza level, reaching bedrock below the track level—work that was done during the course of five 55-hour continuous Amtrak outage weekends. Coordination with Amtrak, the Long Island Rail Road, the Metropolitan Transit Authority, the New York City Department of Transportation, and the NYC Department of Buildings was also "a challenge that resulted in cultivating strong relationships between Turner and these agencies," says Zegler.

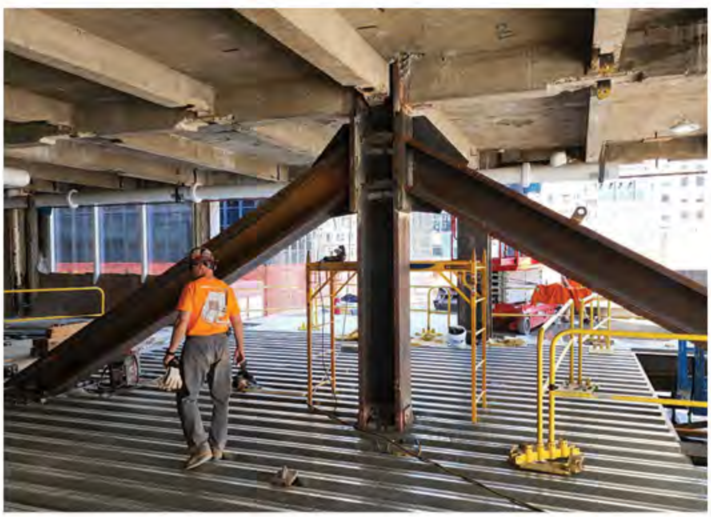
The sidewalk-level transfer system consists of ASTM 572, Gr. 50 plate girders and heavy ASTM A992 wide flange channel sections divided into seven individual platforms that bear directly on the train shed roof, which simplified installation and precluded disturbing the tracks below. The seven platforms are supported by original Penn Station building columns and foundations. "The framing is integrated into the elevated plaza—constraining their depth and arrangement—and encased in concrete for stability and weather protection," says Peitz.

"Fourteen dramatically sloped ASTM A572, Gr. 50 columns, bearing on the existing train-shed framing below support the east and north sides of the Bustle; one sloped and six vertical columns support its west edge, adjacent to the tower," explains Peitz. At the center of the building, brackets field-welded to existing steel columns support the Bustle; field-welded steel plates increased their load capacity.

The lowest level of the Bustle—the 4th floor—is framed as a cantilevered "tabletop." Steel plate girders span east-west from the face of the tower and over the top of the sloped columns to the facade on Seventh Avenue. North-south, a

Previous spread: Ivane Katamashvili; This page: Courtesy of Severud





Above, clockwise from top: The interior of the Bustle under construction; a cast steel-pin connector; new steel framing and metal decking.

Courtesy of Severud

line of plate girders across the tops of the sloped columns, cantilevering at the ends overlooking 33rd and 31st Streets. The undersides of the plate girders are tapered to create a faceted, triangular-patterned soffit.

"The exterior of the Bustle is diagonalized between the 4th and 8th floors to form a multi-span truss to collect vertical loads tributary to the plate girders and their supporting columns," says Peitz. The diagonal members are 14-inch diameter HSS with cast steel pin connectors. "Laterally, the Bustle is self-supporting." All column-to-beam joints incorporate moment connections with the sloped columns acting as diagonal braces, according to Peitz. Connections at the 6th, 8th, and 10th floors ensure stability without transferring significant lateral load. At the 4th floor, an isolation joint uncouples the existing building from the addition and prevents lateral load from flowing to the sloped columns, he explains. The brackets that vertically support the Bustle allow horizontal slip for expected deflections.

Lateral loads are resisted by existing north-south concrete retaining walls in the train shed below the building and existing east-west moment-resisting frames in PENN 2. The concrete slab on the plaza level and the girder encasement are reinforced for the additional shear forces. At sidewalk level, steel plates are anchored to the train shed roof and spliced together to form a load path from the plaza framing to the resisting elements.

The sloped column connections as well as the pipe-truss element connections consist of castings with a single pin connection at each end. Bolted moment connections were used at each column-to-beam point and standard bolted shear connections were used at secondary framing and filler beams. The pipe connections and round HSS sections had castings with a single pin connection at each end, which were universal pin connectors provided by structural steel fabricator CastConnex.

The building is designed to accommodate a heavy volume of foot traffic: commuters entering and exiting Penn Station and patrons going to events at Madison Square Garden. The two MSG passageways that pierce the ground floor of the building have been enhanced with new white granite portals, as well as new metal wall and ceiling panels and paving to match the public plaza beneath the Bustle.

The makeover produced significant energy improvements. "The over-cladding approach repurposes as much of the existing building as possible, minimizing waste and preserving 54.1 million kgCO2e of embodied carbon," states Zaborski. "The thermal insulation gained by the new triple-glazed curtain wall allows MEP systems to downsize, increases vision glass on a typical floor by 43% and reduces thermal transmission by 32%—significantly improving tenant comfort on every floor." A full perimeter MEP upgrade and other tenant improvement packages will reduce total building energy consumption by 28%, he adds. A full building energy model has verified that these upgrades will result in no fees under Local Law 97, which requires buildings larger than 25,000 square feet to meet new greenhouse gas emissions and fines those that don't.

A "Mini Bustle" at the northeast corner of the site faces Plaza 33, a large outdoor space that was created by closing 33rd Street to vehicular traffic and a snazzy new entrance to Penn Station designed by SOM and AECOM that features a curving glass canopy. This Mini Bustle contains a 280-seat Town Hall that can be booked for tenant use or outside events and offers a 4,000-square-foot terrace on its roof.

Another Mini-Bustle cantilevers out toward 31st Street on the building's south side, a 100 foot-by-40-foot column-free span, with a 4,000-square-foot exterior terrace.

Additionally, a 17,000 square foot terrace was created on the building's main roof, which is accessed from a 3,000 square foot enclosed glass roof pavilion lounge called The Perch.

Begun in January 2020 and completed in February 2024, the PENN 2 makeover cost $750 million. It is a major component of Vornado's 10-million-square-foot portfolio in the neighborhood. "We have built The Penn District as the gateway to the new west side of Manhattan—a place that now offers a top-quality experience for people coming to work, commuting to and from the city, socializing with friends or colleagues, or simply walking around," says Vornado in a statement.

Above The seventh floor of the Bustle offers expansive views to the east and north.

Facing PENN 2 stands just east of Madison Square Garden and engages with a new pedestrian plaza on its north side and a new entrance to the subway below Penn Station.

PENN 2

Location: **2 Pennsylvania Plaza, New York, NY**
Owner and Developer: **Vornado Realty Trust**, *New York, NY*
Architect: **MdeAS Architects**, *New York, NY*
Structural Engineer: **Severud Associates**, *New York, NY*
Mechanical Engineer: **AMA Group Consulting Engineers**, *New York, NY*
Construction Manager and GC: **Turner Construction Company**, *New York, NY*
Curtain Wall Consultant: **Gilsanz Murray Steficek LLP**, *New York, NY*
Structural Steel Erector: **Skanska USA Northeast, Inc.**, *New York, NY*
Miscellaneous Iron Fabricator and Erector: **Empire City Iron Works**, *Long Island City, NY*
Architectural Metal Erector: **W&W Glass LLC**, *Nanuet, NY*
Ornamental Metal Fabricator and Erector: **JEM Architecturals, Inc.**, *New Rochelle, NY*
Curtain Wall Erector: **W&W Glass LLC**, *Nanuet, NY*

This page: Magda Biernat; facing: Frame Photographics LLC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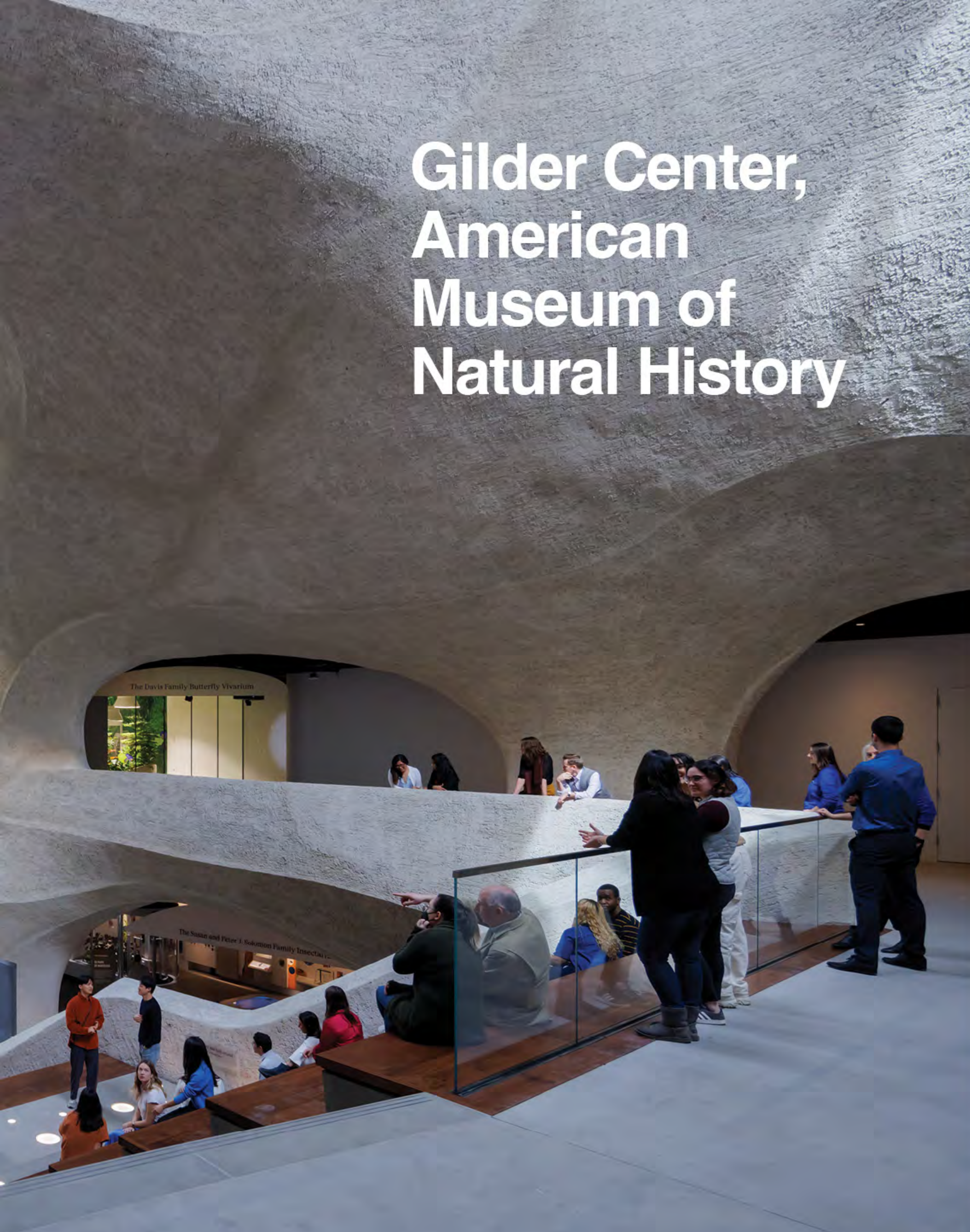
Looking toward Columbus Avenue, the Gilder Center atrium alludes to natural stone formations and geological forces, thanks to its textured shotcrete.

Gilder Center, American Museum of Natural History



This page Cut-outs at each level offer views into and through the Canyon. **Facing, from top** During construction, contractors erected the galvanized-steel subframe that would support the facade's Milford pink granite panels; The new building's *Invisible Worlds* theater (seen here under construction) uses structural steel for the long column-free spans needed for an immersive experience.

Previous spread and this page: © Iwan Baan

Beneath its signature forms of shotcrete and granite, a complex system of rebar and steelwork are the unsung heroes of the museum's striking new "canyon" and facades.

ON THE CAMPUS OF THE American Museum of Natural History (AMNH) between Central Park West and Columbus Avenue on Manhattan's Upper West Side, the new Richard Gilder Center executes a series of ambitious maneuvers through time and space. Alluding to the processes by which water and wind gradually shape rock, the building by Chicago-based architects Studio Gang invites its visitors to contemplate geological history, along with the biological and ecological sciences explained in its exhibits. Opening its central spaces to ample daylight, and its chambers and corridors (once full of frustrating dead ends) to improved circulation, the project enlivens an essential civic and national institution.

The Gilder encompasses 190,000 square feet of new construction plus 40,000 square feet of renovated space and connects at 33 points to 10 existing AMNH buildings that had adhered to an orderly cross-and-square design by Calvert Vaux and Jacob Wrey Mould from the 1870s. Its completion took nine years between the initial announcement in 2014 and the opening in 2023, intermittently delayed by budgetary factors, challenges from neighbors, changes in leadership, and the pandemic: perhaps long for a single midrise building, but hardly an eon for an institution that has been developing and adding component buildings in a succession of styles for a century and a half. Atavistic in form, pale enough to recall the cetological passages of *Moby-Dick*, the Gilder dares to stand in dramatic contrast to its sister buildings, a product seemingly not of human hands but of patient, uncanny Nature.

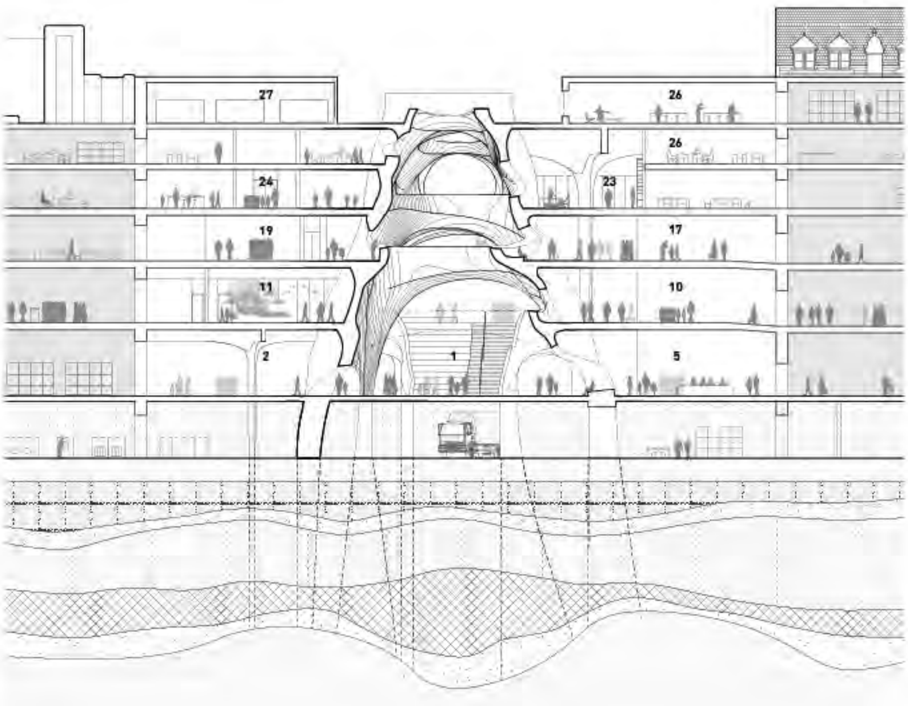
The Gilder's five-story, 80-foot-tall Kenneth C. Griffin Exploration Atrium (the "canyon,") draws on a footnote from the AMNH's own history: Carl Akeley (1864-1926), a pioneering taxidermist/naturalist whose work underlies the life-like animal exhibitions throughout the museum, was also the inventor of shotcrete. This pneumatically sprayed material, first used in 1907, is commonly employed in excavations and tunnels but less often in architectural applications. Though the shotcrete and the stone exterior are the building's visible stars, the supporting players deserve a share of the limelight. Inside the building, the seamless walls, arches, bridges, and caverns of shotcrete rest on combinations of 3D-modeled steel rebar and shoring. With internal metalwork enabling the geomorphic shapes, there is no need for the customary wooden formwork used for concrete buildings and then discarded_or for the form marks that dot the surfaces of famous structures such as Frank Lloyd Wright's Guggenheim or Eero Saarinen's TWA Terminal at JFK Airport.

One of the Gilder design team's insights was that materials customarily serving as a building's workhorses could also become its show ponies. "We used very standard products in unusual ways, especially when it comes to rebar," says structural engineer Matt Jackson, associate principal at Arup. "Shotcrete is used in below-grade structures very commonly as a structural element. It's used in above-grade structures as a more sculptural element, and we put the two together." The shotcrete and the stone facade both perform essential structural work and create the rock-formation effect; steel is essential to both. "The glazing systems are all aluminum. All the stone, though, is supported by galvanized steel," says John Ivanoff, facades principal at Buro Happold, the project's facade/MEP/fire-protection engineer. "No one sees this, but behind all that stone is an extensive amount of steel."

"What is controlling and determining the geometry of the shotcrete is all steel," says Jackson, describing how the rebar rests on a geometrically complex pipe-form system, with the shotcrete sprayed onto a metal lath stay form. The metals there enabled the geometry of the shotcrete to be created, as well as acting as reinforcing.... A lot of times, when you see complicated-geometry buildings, it's cladding that defines the geometry," Jackson comments. "In this case, it's the structure defining the geometry."

"The canyon wall is actually the structure that's supporting the floors of the building," adds Michelle Roelofs, another Arup associate principal. "It is a large architectural feature of the building, but it is also the load-bearing structure.... I've had people ask me about the plaster," and she invariably replies, "'It's not plaster.'" With the form of the wall determined by points where it could touch down and avoid below-grade utilities, the design evolved to ensure efficient load paths. This is why "it really does feel very natural, because it's following real structural load paths that would be logical in nature as well."

Shotcrete contractor COST of Wisconsin developed 2D shop drawings from the 3D models, with slices every two feet guiding pipe-form systems holding the pre-bent rebar. Every bar had a specific ID, and no forms were repeated. The collaborative BIM tool Revizto aided quality control during installation, Roelofs says.: "We wanted to have the full 3D



model with us on site, so we used this tool to do those inspections [as well as] log issues, take photos, click on any individual bar and understand what the size and spacing [were] supposed to be, and generate inspection reports."

Construction was staged, with aluminum and steel shoring posts and tubes temporarily holding the edges of floor slabs built prior to the erection of the canyon walls that would later support them. One important component of the Gilder was built of structural steel rather than concrete, Roelofs notes: an egg-shaped, open-concept theater on level 3 for the *Invisible Worlds* immersive experience, employing long-span steel beams to support catwalks and audiovisual equipment above the column-free space. The concentric rings of catwalks are hung from steel. All structural steel was standard ASTM A992, Jackson reports, produced domestically from electric-arc-furnace mills with high recycled content. Roelofs points out that the Gilder project involved adaptive reuse of some existing buildings at the museum, mostly older steel construction, and it conserved embodied carbon by retaining more of those structures, using long-span steel and lighter-weight steel framing.

Additional major steel components, Roelofs says, include canyon bridges supported by steel beams and slab on metal deck; a feature stair "floating through some openings in the slab near the Collections Core" with a primary stringer and side tubes; and "steel embeds that lived in the shotcrete wall to receive the stone panels" on the building's facade. The sculptural stone facade, like the elements of the canyon, owes its natural appearance to an extensive internal framework of galvanized steel.

The facade of Milford pink granite, the same stone used on the museum's main entrance on Central Park West, is composed of 156 angled panel frames. "Each panel is entirely unique; each stone is entirely unique," notes Kyle Birchall, director of business development and preconstruction at Island Exterior Fabricators of Calverton, N.Y., the producer of the stone mega-panels and steel framework. The outer stone surface is connected to the shotcrete wall with embeds that reach out to the two steel frames, a hot-dip galvanized subframe that "does the heavy lifting from different depths and geometries that support the stone," he says, and "a series of laser-cut plate channels and small HSS profiles that translate attachment points for the panels themselves to the superstructure and provide attachment points and brackets." This assemblage resembles "an accordion of galvanized steel and aluminum components," says Birchall. The "network of plates and tubes and channels of primary components" is only half the story, he adds: "The framing jigs that allow for the setting of those primary components are actually just as complex, if not more complex than the framing of the panels."

"We were able to perform a scan of the larger subframe," Birchall continues, "to understand, during galvanizing, where tolerances were warped in and out. These things move when you're galvanizing them. So that allowed us to dial in individual clips for the stone, so that when they were set in sequence on the shop floor, you could recreate [the connections] and be comfortable that you're meeting the surface that needed to be hit. The entire shop floor was basically leveled and set up as a dance floor: we scanned the entire factory floor, creating a virtual assembly space, and then every single time we were touching these units, we were able to verify at key control points on the galvanized steel frame that then translated to the cladding itself. All the metalwork was one long dance of assembly to galvanization to clips and confirming tolerances, so that the stone, once set, was where it belonged."

"A good bit of the work we're doing today," Birchall

© Studio Gang

© Iwan Baan

adds, "was driven by the need to develop processes on this project.... Where we grew a lot was increasing how much we were leveraging a digital model, letting that model talk better from us to the architect, confirming how we were understanding the geometry, and then leveraging that model for output of parts, components, brackets, and the stones themselves." For those who built it, no less than for those who visit its vivarium, insectarium, theater, and displays, the Gilder is a potent generator of knowledge.

Facing page A transverse section of the Gilder Center shows the relation of the atrium and surrounding spaces to adjacent museum buildings and underlying geologic features.
Above An expansive glass-and-metal entry facade reveals the dramatic interior of the Gilder Center's atrium.

GILDER CENTER, AMERICAN MUSEUM OF NATURAL HISTORY

Location: **415 Columbus Avenue, New York, NY**
Owner: **American Museum of Natural History**, *New York, NY*
Architect: **Studio Gang**, *New York, NY*
Executive Architect: **Davis Brody Bond**, *New York, NY*
Structural Engineer: **Arup**, *New York, NY*
Mechanical Engineer: **Buro Happold**, *New York, NY*
General Contractor: **AECOM Tishman Construction Corp**, *New York, NY*
Facades Consultant: **Buro Happold**, *New York, NY*
Structural Steel Erector: **Gabriel Steel Erectors**, *Montgomery, NY*
Curtain Wall Erector: **W&W Glass**, *Nanuet, NY*

The building's steel exoskeleton solves many of the project's design challenges and gives it a distinctive but classic appearance on Park Avenue.

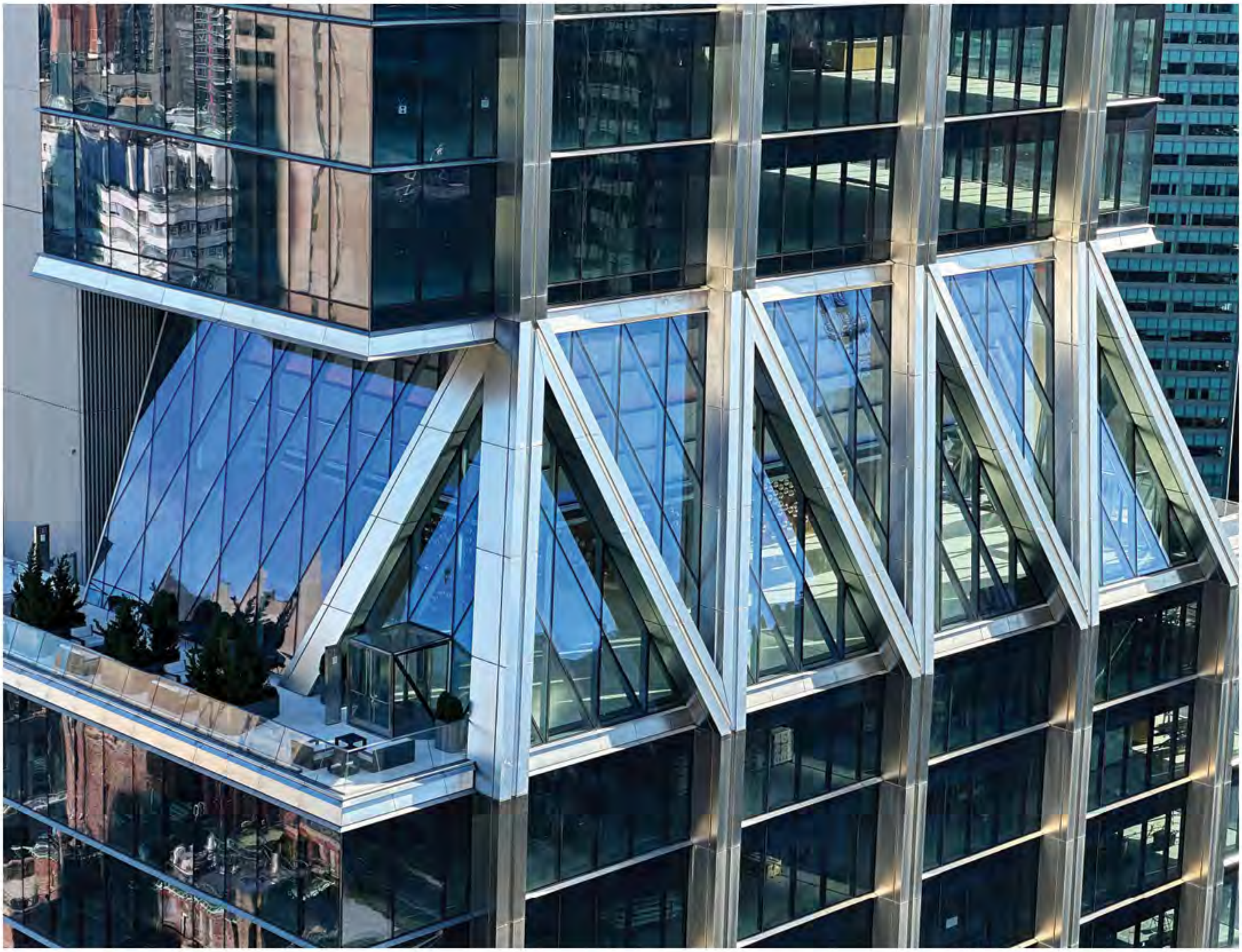
425 Park

A new addition to Park Avenue uses steel to reinterpret the classic New York high-rise.

THE "WEDDING CAKE" SETBACKS CHARACTERISTIC of early 20th-century Midtown Manhattan towers are rethought in a contemporary style at 425 Park Avenue, a 681-foot-high office skyscraper designed by the London-based architecture firm Foster + Partners (with Adamson Associates). The building rises from a base that occupies almost the entire site—stepping back on the front and sides at the 12th floor and then again at the 26th floor. The design emphasizes verticality with brawny external columns, clad in stainless steel, rising outside the glass curtain walls. Soaring 136-foot steel-framed fins, surmounting the rear elevator core, extend that esthetic, and shape a distinctive silhouette on the skyline.

Sloping glass, divided into diamond patterns by a diagrid framework, spans the two setbacks, wrapping the Park Avenue side as well as those on the north and south. At the lower setback, this greenhouse-like space encloses a double-height work area that opens to outdoor terraces facing north toward Central Park and south toward the towers that cluster around Grand Central Station. At the upper setback on the 26th floor an amenities area called the Diagrid Club includes a luxe dining area, lounge, meditation rooms, and planted terraces for use by all the tenants.

The building's distinctive appearance and high-end features were the brainchild of L&L Holdings, a boutique real-estate company that saw an opportunity to build on a site with a rare block-long frontage on the most desirable stretch of Park Avenue. "We felt an immense responsibility to create a tower that would stand proudly among the architectural masterpieces that surround it," said L&L Holding Company Chairman and CEO David Levinson. Those mid-century landmarks include



SOM's Lever House and the Seagram Building by Mies van der Rohe.

James Barnes, senior partner at Foster + Partners described Levinson as "wanting to reset what the office building could be."

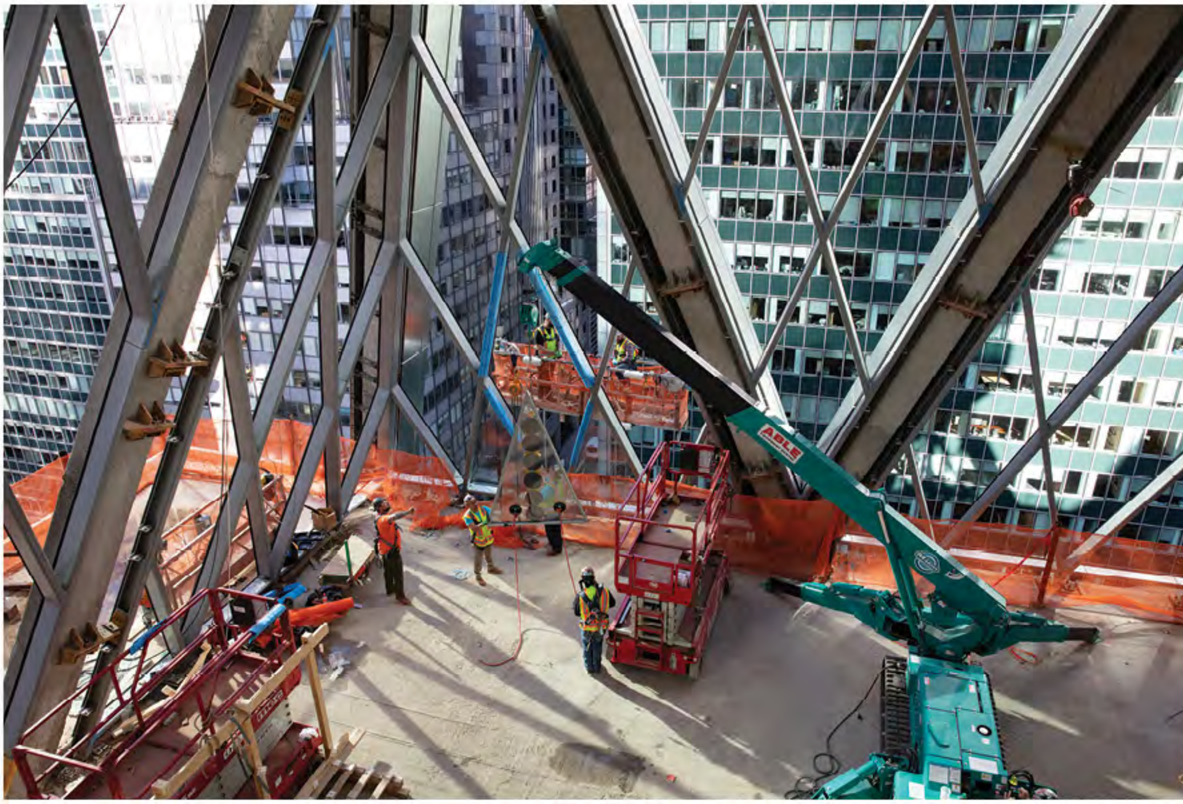
There was one imposing site impediment: an obsolete 32-story office building from 1957. With its low ceilings, dense column grid, and large, dark floors, the existing building was regarded by L&L as irredeemable in a district capable of commanding among the highest rents in the city. The site had been downzoned after construction of the original building, but a new project could offer the same amount of space—675,000 square feet—if it retained 25 percent of the previous building's fabric. Foster took on that challenge, which helped shape some uniquely appealing qualities of the design. That decision demanded some engineering acrobatics from structural consultant WSP as well as posing extraordinary construction challenges.

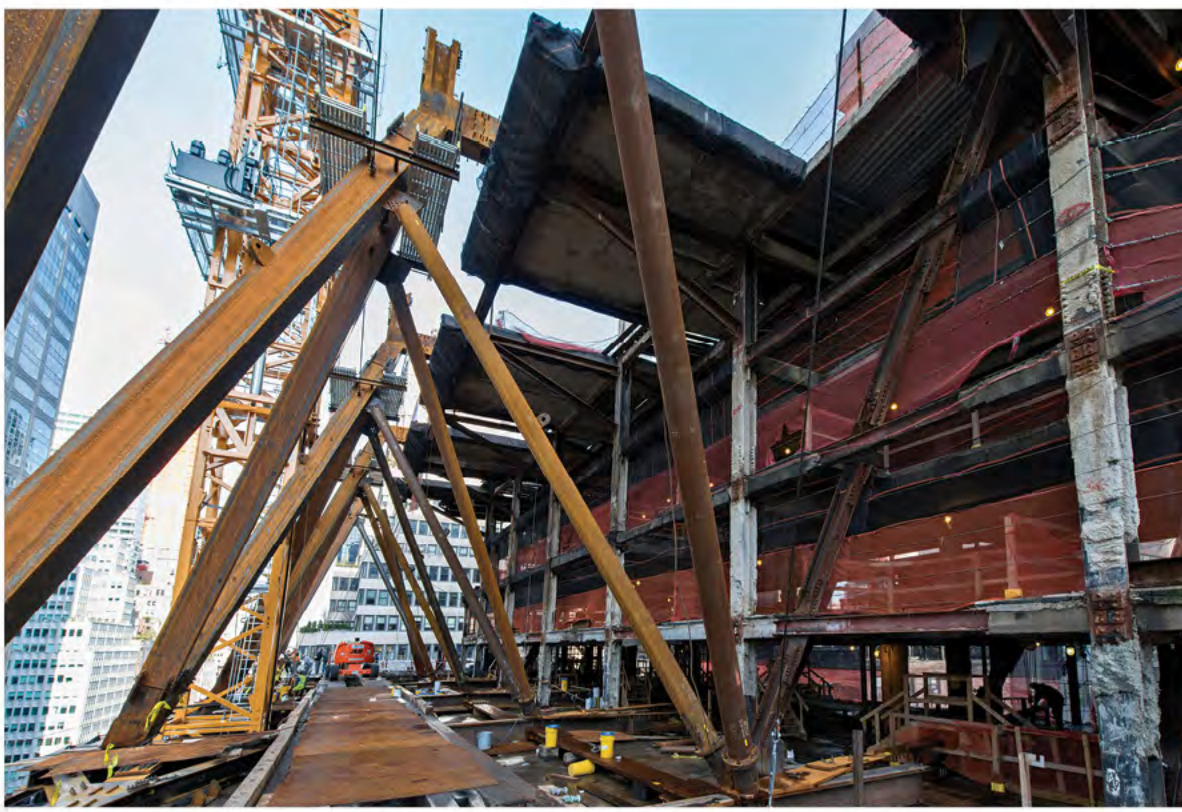
Contractor AECOM Tishman demolished the top 15 stories of the 1957 structure but retained the 17 lower floors in the base of the new building. It then removed every other floor slab from the building's base to create 22.5-foot floor-to-floor heights. Six new columns made of ASTM A913 steel now rise through the tower, in one of the first building uses of Grade 70 material. To minimize columns, beams span as far as 54 feet and provide a flexibility of layout unattainable in high rises with conventional column spacing. Once the new framing was bolted into place, 28 old interior columns were removed.

By placing the cast-concrete core on the east side of the structure instead of the center, Foster provided greater flexibility in terms of floor plans and backed the tower's services up against an adjacent building that blocked views in that direction. Setting columns that rise along Park Avenue outside the floor plates claimed additional space for tenants. At the base of the building, the heaviest available shapes were used, W14 X873 (flange thickness 5.5 inches), with 3-inch-thick cover plates. Unitized column covers finished in an embossed linen stainless steel form a rainscreen protecting the structural

Above Sloping glass divided into a diamond pattern by a diagrid framework wraps around three sides of the setback on the 26th floor. The same approach was taken to the setback at the 12th floor.

Previous spread: Nigel Young / Foster + Partners; this page: Alan Schindler

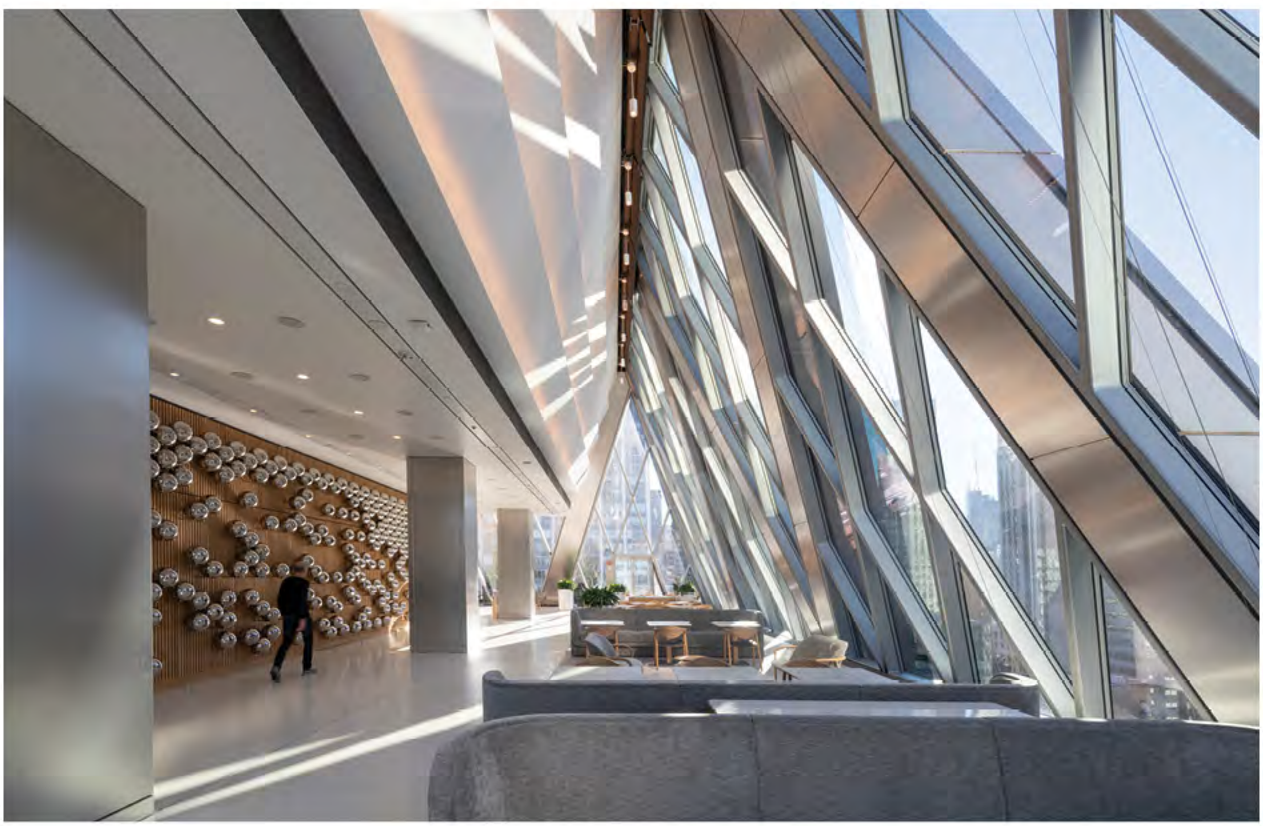




Courtesy of L&L Holding Company

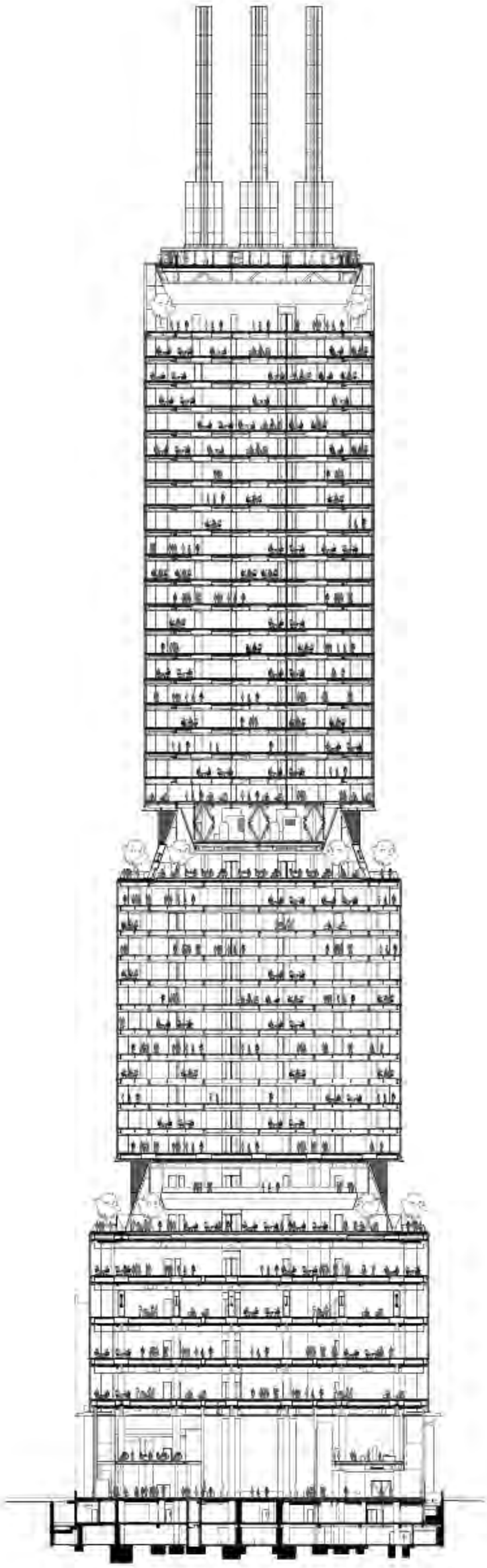
Above The steel diagrid structure (under construction here) creates double-height spaces at the two setback floors.

The setback floors were conceived as "magnets where people come together," says the developer.



Top Each of the setback floors offers a pair of outdoor terraces, one on the north and one on the south.
Bottom The Diagrid Club on the 26th floor offers amenities such as a lounge, dining, meditation rooms, and access to two terraces.

Nigel Young / Foster + Partners



Above North-south section of the tower.

steel columns within, which are also insulated and supplied with tempered air to reduce expansion and contraction. (The curtain walls were fabricated and erected by Permasteelisa North America and its subsidiary Josef H. Gartner of Germany.)
The glinting, finlike columns elegantly express the gravitational forces acting on the building. They cascade along the sloped glass of the setbacks, dividing into inverted Vs to carry the loads to the greater number of columns below each setback. There are no visible columns along the north and south sides, because the floor slabs are cantilevered 17 feet beyond the outermost columns. "Pulling the columns away from the corners of the building opened all sides of the office space to views as far as the Hudson and East Rivers," said Barnes.

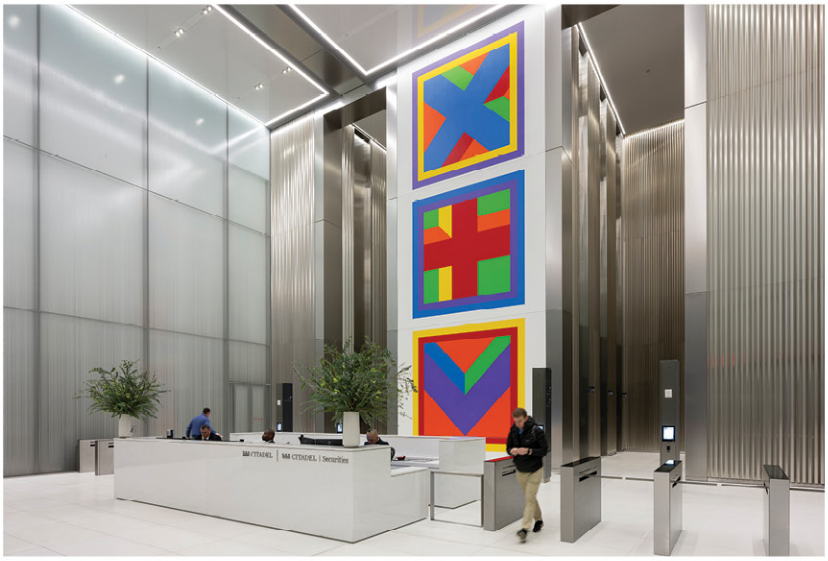
Those cantilevers impose high loads on the outermost columns on the Park Avenue side and rest on nodes at the top of the setback floors which also convey gravity loads from the floors above. Each node divides loads and sends them across the sloping glass via inverted Vs to be distributed to pairs of columns below. A tieback member at the node resists the thrust from the outward slope of the columns. It is visible as it runs diagonally on the north and south and continues inside the building to anchor at an internal column. Given these multi-directional loads, the starfish-like node was cast as a single piece 18 inches thick and 42 inches deep. Five-foot lengths of the column descending to the sloped glass from above and the inverted-V columns below were pre-welded to the node. These massive elements were fabricated by the Owen Steel Company.

The 425 glass panels of the sloping diagrid curtain wall at each of the two setbacks sit flush with the backs of the diagonal columns. From two to four 15-foot-high diamond-shaped frames were prefabricated then bolted together on site. They were patched and painted to match the column covers, after which unitized glass units were hung outside the framing with a "hook and pin" ladder system, according to Justin Boyer, a Foster partner who managed the project.

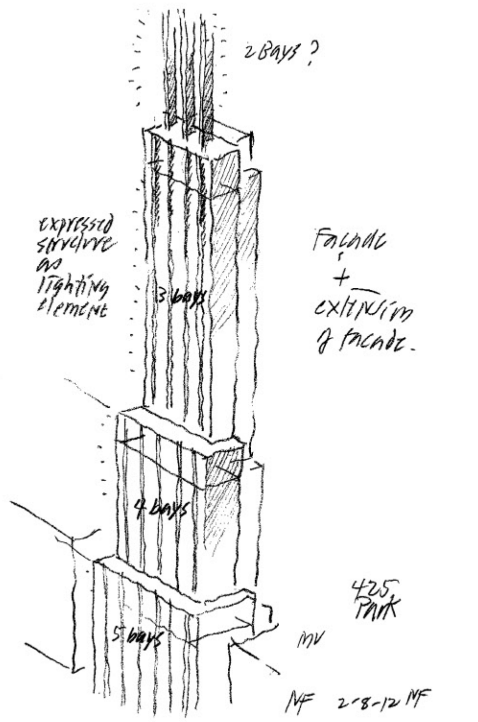
At the base of the building, the contractor created a soaring 45-foot-high lobby by removing an existing second level. The corners of the gleaming elevator lobbies are wrapped in stainless-steel—an elegant frame for a monumental painting by Sol Lewitt rising above the reception desk. The corrugated infill is aluminum. Translucent glass walls separate the lobby from retail space on the south and a restaurant on the north. Slender sections of carbon-steel bars wrapped with sheets of stainless steel frame glass entrance vestibules. .

Operated by Jean-Georges Vongerichten, the upscale restaurant offers a swank bar on the ground floor and dining on a mezzanine, which sits on a slab retained from the original building. Clad in dark-stained wood and set back from the building's facade, the dining level appears to float within the tall glass walls of the ground level.

Underlying Levinson's $1-billion bet on the project was his contention that "ultra-premium space would command leading rents in an upmarket," he said, "but would also benefit from a flight-to-quality should New York encounter challenging times." The bet seems to have paid off, given the developer's



Left, top The 45-foot-tall lobby features stainless steel details, corrugated-aluminum wall panels, and a colorful Sol Lewitt painting above the reception desk.
Left, bottom In the building's restaurant, Four Twenty Five, a 24-foot-long painting by Larry Poons runs above the bar on the ground floor, while dining occupies a mezzanine space above.
Below An early sketch by Norman Foster expresses the organization and key elements of the tower.



success in leasing all the office space. Only the retail space on the ground floor is vacant.

Achieving the spatial drama, the spectacular views, and the fine-dining amenity of the setback floors took an extraordinary commitment by L&L and the design team, as well as the fabricators and erectors of the structure and curtainwall—even as it now looks effortless. The setback floors were conceived as "magnets where people come together," Levinson has said. They were a response to his perception that people "need to collaborate differently." He is proud that all tenants have access to the upper amenity floor, "the most valuable space in the tower."

Integrating spaces for greenery and gathering in skyscrapers has long been an interest of Foster's firm, most famously seen in the Commerzbank tower in Frankfurt, Germany. which opened in 1997. The firm's design for 425 Park Avenue brings this commitment to ecological towers to midtown Manhattan, perhaps setting a precedent for other projects to follow.

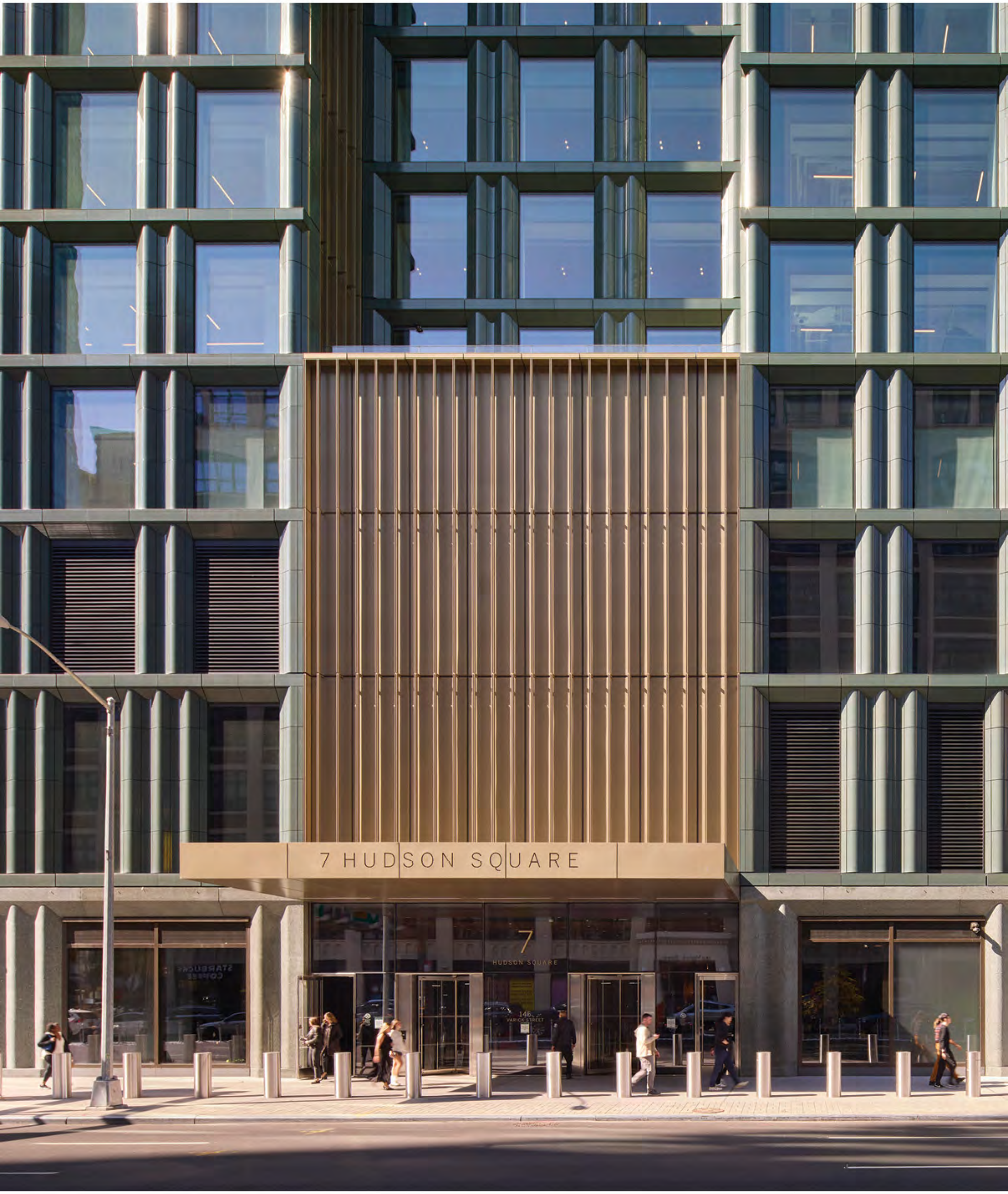
425 PARK

Location: **425 Park Avenue, New York, NY**
Owner: **L+L Holding Company LLC**, *New York, NY*
Developer: **L+L Holding/BentallGreenOak/Tokyu Land Corporation**, *New York, NY*
Architect: **Foster + Partners**, *London, United Kingdom*
Architect of Record: **Adamson Associates**, *New York, NY*
Structural Engineer: **WSP Cantor Seinuk & Zieman Engineering**, *New York, NY*
Mechanical Engineer: **WSP**, *New York, NY*
Construction Manager: **AECOM Tishman**, *New York, NY*
Curtain Wall Consultant: **Socotec, Israel Berger & Associates**, *New York, NY*
Structural Steel Erector: **AJ McNulty & Co. Inc.**, *Maspeth, NY*
Curtain Wall Fabricator: **Permasteelisa North America**, *Bloomfield, CT*;
Scheldebouw & Josef H. Gartner, *Gundelfingen, Germany*
Curtain Wall Erector: **Tower Installation**, *New York, NY*
Miscellaneous Metal Fabricator and Erector: **Skyline Steel Corp.**, *Brooklyn, NY*

Photos: Nigel Young / Foster + Partners; diagram: Courtesy of Foster + Partners

The architects at Foster + Partners tried to create a high-rise that would clearly express its structure and work with iconic neighbors such as the Seagram Building and Lever House.

Alan Schindler


7 HUDSON SQUARE
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VARICK STREET

Disney Headquarters

Attached to a steel-frame structure, fluted terra-cotta panels give depth and character to the media company's New York headquarters.

The predominant colors of the building's envelope—green and bronze—allude to the patinated copper and metal detailing found on the neighborhood's older structures.

ONCE KNOWN AS THE PRINTING DISTRICT and now called Hudson Square, the area running along Hudson and Varick streets below Houston still looks at first glance like a roll-up-your-sleeves kind of place with loft buildings hefty enough to support printing presses and die-cutting machines. Although it lacks the corporate pedigree of Midtown or the Financial District, the area is now attracting companies like Google and Disney that control the post-print media—lured by a refreshing lack of glitz and a few sites that offer very large building opportunities. In 2018, the Walt Disney Company was able to assemble an entire city block with a footprint of 85,600 square feet to erect a 1.2 million-square-foot headquarters where it could consolidate all its New York offices into one "vertical campus." The company decided to "stand out by fitting in," says Michael Gordon, a project executive at Disney. In response, the architects at Skidmore, Owings & Merrill designed a building with texture and color that nods to the area's legacy of early 20th-century industrial architecture, instead of producing yet another thin-skin, glass tower. SOM focused on the building's envelope, rather than its form, wrapping its steel frame with fluted, green terra-cotta, an old material updated for a 21st-century information and entertainment company.

The 320-foot-tall building—named after long-time Disney CEO Robert A. Iger—stands 10 stories at its base, then rises another 9 stories as a pair of towers on the east and west sides of the property with landscaped terraces at various levels as you go up. Between the towers, SOM designed a skylit "Great Room" on the 10th floor that serves as the social hub for the entire complex. The building also burrows several floors below grade to accommodate three studios for producing television shows such as *The View* and *Good Morning America*.

Driving the design was a desire to create "a gracious, confident, and stylish neighbor" for a part of town tucked between Greenwich Village to the north, SoHo to the east, and the Hudson River waterfront to the west, says Colin Koop, a design partner at SOM. "When you look at this part of the city, you see

Above The Great Room on the 10th floor acts as a social hub for the entire complex.
Left An internal stair connects the Great Room to shared spaces on the 9th floor.

brick and stone, cast iron, and inlays of terra-cotta," adds Koop. "There's a real kind of integrity to the material palette here." At the start of the project, the SOM design team noticed that green appeared in the area's buildings on copper roofs and terra-cotta inlay. "If green was the accent color of the surrounding buildings, we decided to be the accent of the neighborhood," explains Koop.

The new headquarters brings together a broad range of functions—entertainment and news production for brands such as ABC and ESPN, streaming operations, and corporate activities including sales and accounting—that had been spread out among facilities on West 66th Street (many designed by Kohn Pedersen Fox starting in the 1970s), Times Square, and South Street Seaport. "The goal was to unite all these different parts of the Disney organization under one roof and build an integrated culture," explains Koop. Reflecting the character of the brands in New York, the architecture expresses an ethos of tech savviness and low-carbon sustainability. It's neither a Silicon Valley start-up with bean bag chairs and ping-pong tables nor a knock-off or update of Disney's headquarters in Burbank, California where Post-Modern buildings by Michael Graves and Robert A.M. Stern house operations for the company's animation, entertainment, and theme park divisions.

The need for long-span, column-free spaces for television studios drove the design and engineering of the building's below-grade and podium areas. The 50-foot-deep basement sits on a concrete mat foundation on metal decking with 36-to-42-inch-thick

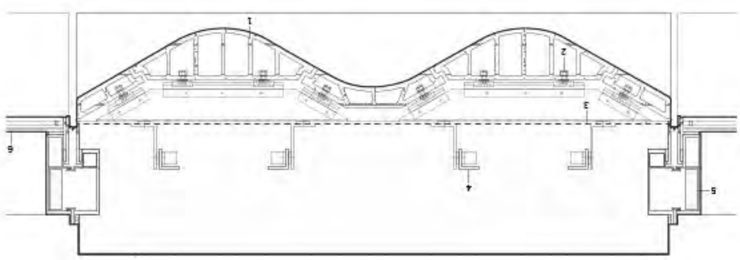
Previous spread and this page, top: Dave Burk – SOM © 2024 Disney; this page, bottom: Garrett Rowland – Gensler

Below, clockwise from diagram
Plan view of a terra-cotta panel; terra-cotta panels being attached to the unitized curtain-wall system and steel structural frame; one of the towers rising above the 10-story podium.

concrete retaining walls creating a "bathtub" around the 210-by-400-foot site, says Stephen Szycher, a managing principal at Thornton Tomasetti, the structural engineers for the project. Anchors tie the concrete mat to rock below it and resist hydrostatic uplift. Other than the concrete foundation and circulation cores on the east and west parts of the property, the building employs a steel-braced-frame structure with concrete composite deck floors and lateral bracing in the two cores.

Columns are typically spaced 25 feet at the perimeter of the building, though this varies within the footprint, while infill beams are typically 10 feet apart. On podium floors, beams and columns are W14, and girders are W33. In the basement, spans for the TV studios can be as long as 110 feet. To handle noise and vibration from subway trains and surface traffic, each studio is essentially built as a box within a box with high ceilings that accommodate all kinds of video technology, including up to 12 camera positions. Stacked vertically, rather than side-by-side, these large open volumes posed complex engineering challenges. Giant trusses occupy the full height of the building's second floor, transferring column loads from above and suspending the ground floor and loading dock below. In addition to the large studios below street level, smaller studios for television production occupy spaces above the giant second-floor truss—so significant loads needed to be transferred throughout the podium's structural system via built-up plate girders and transfer beams. Steel offered the speed and flexibility of construction that was needed for these kinds of spaces, says Stephen Newbold, a senior technical architect with Gensler, the firm that designed the project's interiors. "Steel was the only way to go," states Newbold.

In the podium, floor heights are mostly 13.5 feet, while in the two towers, they are 14 feet. Both the ground-floor lobby and 10th floor Great Room are double-height spaces, reflecting the importance of their social functions. Above the giant second-floor truss, technology and support operations occupy the third floor, while studios for the ABC network and local WABC news fill out the fourth and fifth floors. Newsrooms for the network and local station reside on the sixth and seventh floors and Disney streaming services are on the eighth floor. The ninth floor combines workspaces, conference facilities, and some



Photos: Jonathan Morefield © Field Condition; diagram: Courtesy SOM

shared amenities and is connected to the 10th-floor Great Room by a large internal stair. An impressive set of north-facing, saw-tooth skylights tops the Great Room, while a terrace on this level offers a welcome connection to the outdoors. The two towers provide 14,000-square-foot floors for executive and administrative offices. One of the goals of this project was to break down silos between production, broadcast, and general business units to create a more unified workplace, says Newbold. This was done architecturally—by creating flowing spaces and internal connections—but also technologically, by allowing content creators to work almost anywhere and feed broadcast, streaming, and online platforms.

For people in the neighborhood, it's the project's undulating facade with its striking hunter-green-glazed terracotta panels that grabs the most attention. Vertical fluting gives depth and animation to the four elevations with the lowest floors featuring three flutes per panel, mid-rise floors clad with two flutes, and upper floors with one flute. The terracotta acts as a rainscreen attached to a high-performance, unitized curtain-wall system that achieves an overall ratio of opaque-to-transparent of 65% to 35%. The typical panel height is 13.5 feet with the terracotta portions ranging in width from 7.5 feet (three flutes) to 5 feet (two flutes) and 2.5 feet (one flute).

At the start of the project, SOM and Heintges, the building envelope consultant, explored different options for the material—quickly narrowing it down to precast concrete and terracotta. Ultimately, they selected terracotta because it is lighter and would require fewer crane settings, explains Daniel Vos, a principal at Heintges. Taking advantage of the increased insulation depth of the rainscreen panels and using thermal breaks and thermal shielding materials within the curtainwall detailing, the building was able to achieve Zone Green status without having to use insulated interior knee walls, which can generate condensation problems. The typical IGU is 1 7/16 inches thick with two lites separated by a half-inch argon-filled air space.

The terracotta was fabricated and glazed in Germany by NBK and assembled with aluminum framing and bird-friendly glass in Pennsylvania by New Hudson Facades, which also installed the panels on site. With its combination of terracotta and glass, the building alludes to the punched-window facades of the older buildings around it. Above the main entries and at building insets, bronze-colored aluminum panels with vertical fins serve as visual accents within the overall elevations. For the ground floor, the architects specified precast-concrete panels instead of terracotta, because they're studier and won't chip. The precast, installed by W&W Glass, has the same color and fluted profile as the terracotta above it.

Targeting LEED Platinum and aiming to cut carbon emissions to 50% of New York City's strict Local Law 97 emissions limits, the all-electric building combines its high-performance envelope with solar panels, waste-heat recovery, and electric heat pumps. Roof terraces landscaped by SCAPE Studio also help reduce solar loads.

Disney is in the business of storytelling and its New York headquarters weaves a tale of quiet power that doesn't need to scream to get noticed. Rather than flaunting radical forms or architectural

This spread: Dave Burk – SOM © 2024 Disney

DISNEY HEADQUARTERS

Location: **7 Hudson Square, New York, NY**
Owner: **The Walt Disney Company**, *New York, NY*
Developer: **Silverstein Properties**, *New York, NY*
Architect: **Skidmore, Owings & Merrill**, *New York, NY*
Structural Engineer: **Thornton Tomasetti**, *New York, NY*
General Contractor: **Lendlease**, *New York, NY*
Facade Consultant/Commissioning: **Heintges**, *New York, NY*
Structural Steel Erector: **Stonebridge**, *South Plainfield, NJ*
Miscellaneous Iron Fabricators and Erectors: **Skyline Steel Corp.**, *Brooklyn, NY*, **FMB Steel**, *Harrison, NJ*; and **Transcontinental Steel**, *Piscataway, NJ*
Architectural and Ornamental Metal Erectors: **Eastern Millwork**, *Jersey City, NJ*; **Jerome Metals**, *Westbury, NY*
Miscellaneous Metal Fabricator and Erector: **Skyline Steel Corp.**, *Brooklyn, NY*
Storefront Curtain Wall Erector: **W&W Glass**, *Nanuet, NY*
Curtain Wall Erector: **New Hudson Facade**, *New York, NY*

This spread SCAPE Studio designed outdoor spaces at various levels for the project (above), including a terrace (facing page) adjacent to each of the two towers.

Rather than flaunting radical forms or architectural gymnastics, the building wraps itself in a rich green coat that expresses confidence in values such as craft and elegance.

The Spiral

Simple in visual concept yet complex in structure, The Spiral uses high-strength steel to bring trees to the sky and rethink old rules for high-rise buildings.

IN *YES IS MORE*, A MANIFESTO in "archicomic" form produced by Bjarke Ingels Group (BIG), the Danish architecture firm explains its impulse to "incorporate and integrate differences, not through compromise or by choosing sides, but by tying conflicting interests into a Gordian knot of new ideas." The firm coins counterintuitive catchphrases—"hedonistic sustainability," "utopian pragmatism"—and presents projects that joyfully break the rules: structures flipped upside down, superimposed typologies, rejected and repurposed designs shifted to unrelated programs. As BIG has subsequently gone on to complete The Spiral, its first supertall in Manhattan, its habit of both/and thinking now challenges the mother of all dialectics: nature vs. human intervention. The building puts active ecosystems on display while also saluting that most industrial of materials, steel.

"New York defines itself, architecturally, as a city of steel," says project architect Dominyka Voelkle, an associate at BIG. "It's fitting that this material should be celebrated," states Voelkle. "It was fascinating to ask, 'What does steel want?'" The answer to this Louis Kahn-style question, like so many proposed by BIG, fuses opposites: here, steel wants to do the heavy lifting *and* to shine in the spotlight.

The lobby of The Spiral, the 66-story, 2,800,000-square-foot tower that opened in Manhattan's Hudson Yards district in 2023, includes panels of seven types of steel, both an homage to the neighborhood's industrial past and a proclamation of the centrality of metals in BIG's vision for the building. The exterior's visual signature is exuberantly biophilic, a series of verdant terraces that slices through all four facades as it rises from the seventh floor to the roof, in the process encircling the tower and offering observers of any elevation two, three, or four sharp green slashes on its path upward. The ascent of trees and foliage is in turn possible because of structural steel, bearing the building's unconventional stresses through a composite structure of steel around a concrete core. Inside the building, steel paneling gives each elevator bank a distinct look and continues inside the elevators themselves. The Spiral wears its natural/industrial contrast proudly on its surfaces.

"There are seven ways we chose to exhibit steel in the lobby," Voelkle says. Mirrored stainless steel, clear chromate on steel, yellow chromate on steel, zinc oxide on carbon steel, blackened steel, browned stainless steel, and weathered steel are the

Previous spread Terraces set in stairstep fashion provide verdant outdoor space for tenants of The Spiral.
Above, top The building's publicly accessible lobby includes art installations and makes decorative use of steel paneling.
Above, bottom Elevator banks at The Spiral feature steel paneling with seven different finishes.

Previous spread: © Laurian Ghinitoiu, courtesy of Bjarke Ingels Group. This page, top: © Tommy Agriodimas, courtesy of Bjarke Ingels Group; this page, bottom: © Laurian Ghinitoiu, courtesy of Bjarke Ingels Group

players in a characteristic BIG game that treats basic materials and their finishes as artwork. The steel is right at home alongside the paintings and sculptures from Tishman Speyer CEO Rob Speyer's personal collection, one of multiple features giving The Spiral an ambience closer to a hotel than an office building.

"Steel is not a material necessarily made to be a finished product," Voelkle explains. "Steel is either a component of something or is treated, painted, sprayed on, encased, so you rarely experience it in a finished form,says Voelkle. "We took an industrial-grade material and elevated it to become an architectural finished material." They did this by remediating surface defects, dipping and baking the steel, protecting it from fingerprints, letting the iridescence of chromated steel shine, and manually infusing patina development on zinc-oxide-treated steel to resemble what Ingels calls "rhino skin" (a proprietary finish developed for The Spiral). (Realizing that tenants' and visitors' white shirts would come in contact with weathering steel, she adds, "we went through an incredibly interesting process" of retarding the material's controlled corrosion, "getting the steel to its core by basically shedding all the layers that react with acid application. It's the first instance – at least to my knowledge – [of using weathering steel in its] fully retarded stage, so it no longer rubs off on fabric.") A maintenance worker reportedly dedicates his time to constant daily steel-polishing.

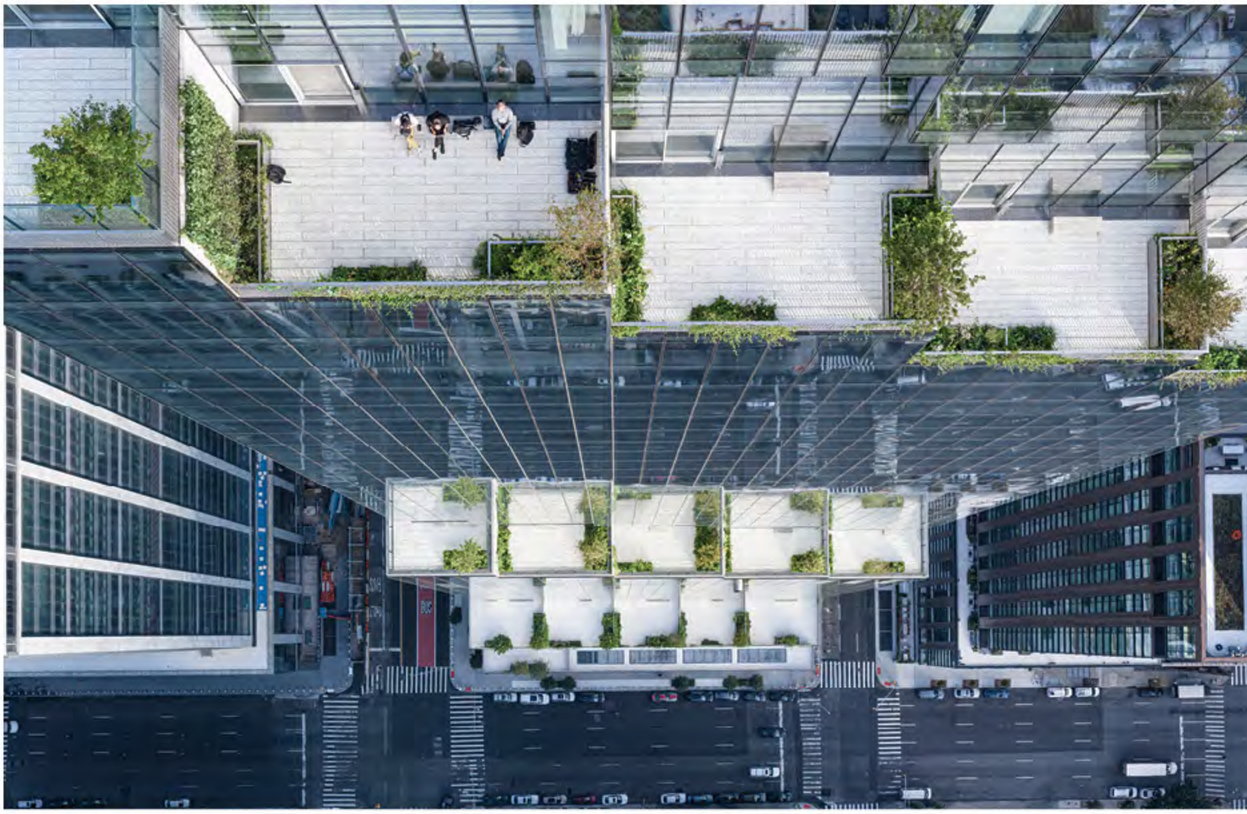
The Spiral's functional steel elements are at least as distinctive. The framework of the ziggurat-like building must contend with highly irregular loading patterns. "It's the character of our firm that we like to understand in depth the rules that we are subject to in any environment that we work in," Voelkle says, "and then see if we can outsmart those [rules]." In this case, the rules are New York's zoning requiring setbacks for tall buildings. "We found ourselves thinking, 'What would be the next logical evolutionary step for such a prescriptive zoning ordinance? We found a loophole: you can interpret the setback as the distance [a building] needs to be at a certain height; it doesn't prescribe how you get there."

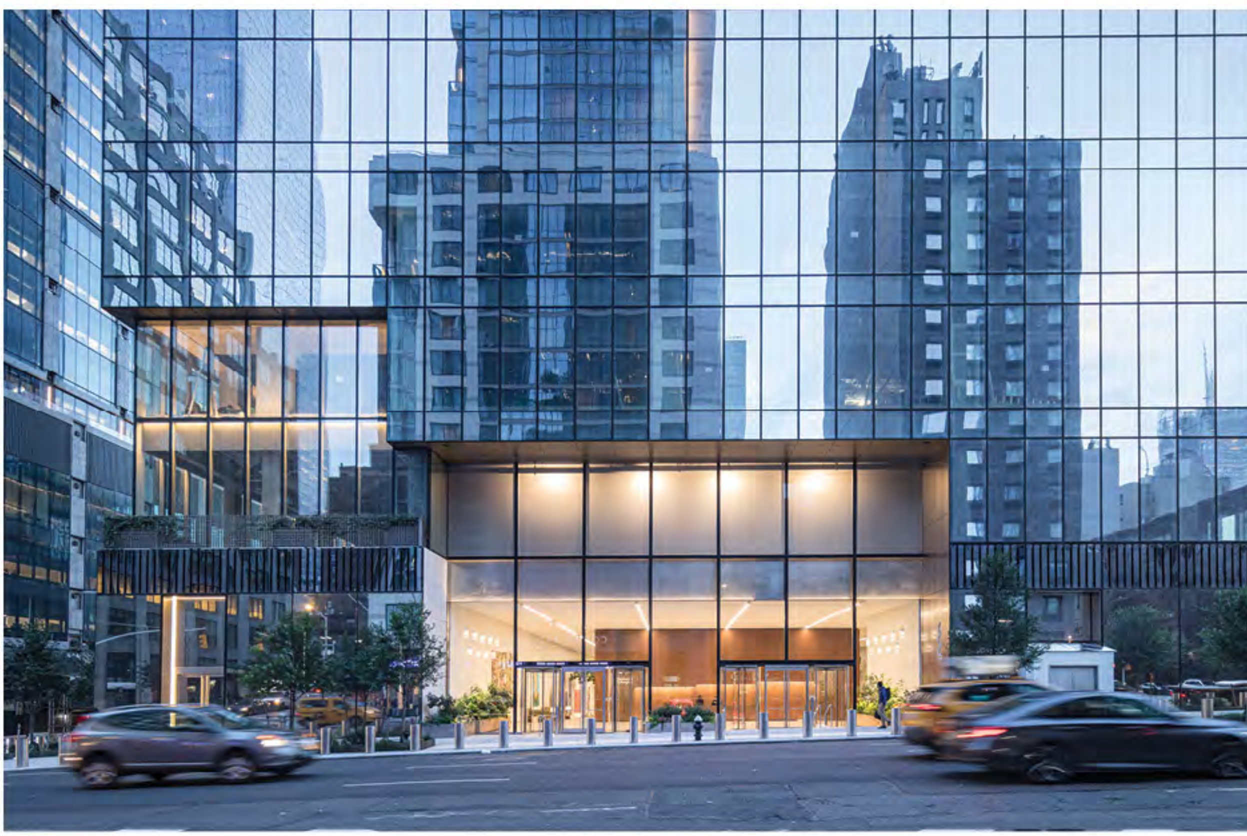
The Spiral gets there with continuous 7.5-foot setbacks at every floor, instead of the periodic setbacks that create a wedding-cake form. Voelkle describes the design as still "native to the New York skyline, because that stepping language is very much within the DNA of the city." No two floors have the same plan or structure. Terraces are staggered, with double-height zones and optional stairs between interconnected levels, achieved with "knockout" framed areas inboard of the terraces and removable for tenants choosing such spaces after construction. Exterior columns and the facade are shifted 5 feet inward in building sections containing terraces, with no columns visible on the exterior.

"This condition that we call the knockout slab moves alongside the terrace as it steps at every single floor plate," she notes. "From a structural standpoint, it is outside of the main framework; therefore, it doesn't affect the performance of the structural membrane. So we give tenants the chance to connect their floors vertically without having to undergo any structural gymnastics." In fact, one tenant, law firm Debevoise Plimpton, has done this on the 12 consecutive floors it occupies, creating a continuous atrium.. The law firm has noted that the internal stair is not only keeping its staff fit, but bringing them together as an organization.

Structural engineer WSP specified a combination of ASTM A992 perimeter columns and high-strength Nucor Aeos ASTM A913 grade 65 steel to handle The Spiral's geometric complexities. "The building is asymmetric from a structural standpoint," Voelkle says, with a "desire to pull away from its core." Contending with vertical, axial, and diagonal loads including high wind-shear forces from the nearby Hudson River, the steel frame transfers large perimeter-column axial forces (as high as 11,000 kips in chord members of outrigger trusses, according to WSP's Jeffrey Smilow and Patrick Chan) to the "extremely stiff concrete-steel core," while multiple two-story, 10-degree sloping columns continue load paths to the foundation. Voelkle credits a collaboration between Turner Construction and the design team with determining that lightweight horizontal trusses at every floor were a better solution than conventional vertical ones, since they conserved steel.

Steel members include custom built-up box sections, I-beam sections, and wide-flange beams, with a combination of built-up columns of grade 65 and standard rolled column shapes. A floor-by-floor "walking column" condition, where "none of the perimeter columns at the building base are continuous to the top of it," Voekle notes, helps accommodate





Above, top Terraces (viewed from above) use "knockout slabs" exterior to the main structural framework and snake up the tower.
Above, bottom Clear glass at the entrance provides views inside and helps connect the sidewalk to activity in the lobby.

© Laurian Ghinitoiu, courtesy of Bjarke Ingels Group

the irregular structural moments. The strength and lightness of A913 steel in both standard and custom shapes economize on material (in the central bracing core as well as the framework), while reducing the overall weight of the building (by minimizing concrete mass), and allowing for large column spans, tall ceiling heights, and tenant-friendly interiors with ample rentable area.

WSP's Smilow says that The Spiral, with its substantial angled stresses, is a structural innovator, thanks largely to the high-strength steel. "Sloped columns we've been doing for a long time," he says, "but of course the buildings are getting taller now, the loads are more significant, and all of this contributes to larger welds [and] thicker plates." With stronger, lighter steel, "there's a significant change in thickness, and at the top end, it means you could use the rolled shape versus building up box-shape outer plates."

The Spiral occupies a brownfield site, a former hat factory where toxic adhesives in the soil required remediation. This was just the first of many moves toward sustainability, broadly defined, beyond the LEED Gold certification the building seeks. Aware that any glass-and-steel building can be critiqued over embodied energy, Voelkle defines the building's longevity as "the highest sustainability aspiration that we should all have.... If it lasts 100 years, I think it offsets the carbon footprint that it carries with it." Opaque surfaces constitute 11 percent of the enclosure, she reports, and "8 percent of that is covered in greenery," well below proportions mandated in Singapore but impressively green for Manhattan.

With, tenants today expecting floor-to-ceiling glazing for unobstructed views, and with high wind forces varying widely along the enclosure, the curtain walls—which contain 788,000 square feet of glazing—received special attention for consistent appearance and energy performance. The building has two distinctive types of glass: super-high-reflectivity tower glass and clearer low-iron glass in the recessed areas. "We're trying to limit the areas of sin, if you will," Voelkle says, "from an energy standpoint, to the areas that are in shade, set back and avoiding that direct solar exposure."

Bird strikes were another concern, since the site is on a migratory route. The team considered bird-deterrent fritting, but ornithologists advised against it, recommending the terraces themselves as a deterrent. "There were a lot of bird strikes upon construction of the tower," Voelkle says, "but once the landscape went in, it all stopped. Before they see the glass, they see the trees." The root ball of each tree is tied to a planter, and each planter is tied back to the structural slab by means of stainless steel plates. Then the slabs cut back into the core, so the steel works all the way up to the top of the tree canopy. The canopy configuration of multi-stem trees helps with reducing the uplift moment, says Voelkle.

Amenities at The Spiral include a 66th-floor common area—called the ZO Clubhouse—which affords all occupants a lounge/restaurant/event space with a panoramic skyline view, another feature reminiscent of a multi-star hotel. Tishman Speyer even provides gardening among the standard services for tenants. For people working in the building, The Spiral operates as a vertical extension of the nearby High Line: a highly engineered structure that opens part of the city to nature's unexpected inhabitants and activities. "Nature always finds a way," Voelkle infers, "if you're not in its way."

THE SPIRAL

Location: **66 Hudson Blvd E, New York, NY**
Architect: **Bjarke Ingels Group (BIG)**, *Copenhagen, Denmark*
Architect of Record: **Adamson Associates**, *New York, NY*
Structural Engineer: **WSP Cantor Seinuk**, *New York, NY*
Construction Manager and GC: **Turner Construction**, *New York, NY*
Mechanical Engineer: **Cosentini Associates**, *New York, NY*
Curtain Wall Consultant: **Heintges**, *New York, NY*
Curtainwall Fabricator: **Permasteelisa North America**, *Bloomfield, CT*
Curtainwall Erector: **Tower Installation**, *New York, NY*
Glass Screens: **W&W Glass**, *Nanuet, NY*
Lobby Metal Panels: **Bamco**, *Middlesex, NJ*

This spread: © Laurian Ghinitoiu, courtesy of Bjarke Ingels Group

Right Terraces include tree planters tied to the structural slab with stainless steel plates. **Facing** Viewed from the west, The Spiral contributes its distinct form to the midtown skyline.

The cantilevered State Street entrance to the elementary school, Elizabeth Jennings School for Bold Explorers, has a protected, residential feel, buffered by flowering planters.

Passive House Public Schools PS 456 / KGIA

WEDGED BETWEEN TWO LARGE RESIDENTIAL towers and two historic buildings on a constrained triangular lot between low-rise Boerum Hill and rapidly growing downtown Brooklyn, a pair of public schools meeting strict Passive House standards used 1,315 tons of steel and employed smart design, engineering, and construction phasing to create enough space for 850 students. The decision to aim for the highest zero-energy environmental standards added unusual complexity to combining two visually distinct schools in one 146,000-square-foot structure meant to last at least 100 years.

When the project at 80 Flatbush Avenue was announced by Alloy Development in 2017, local residents denounced the scale of the 74- and 38-story mixed-use towers, the tallest originally set to top out at 986 feet. At the center of the block, Alloy planned to partner with the city's Education Construction Fund, which works with private developers to build public schools accommodating the city's ever-growing school-age population, issuing bonds to finance construction. But citing the development's scale, bulk, and proximity to a residential district, the local community board's land-use committee voted unanimously against the necessary rezoning. Without it, the towers could only reach a maximum of 400 feet.

Four months later, however, the City Planning Commission approved the rezoning anyway. Then, spurred by elected officials mediating between local opponents and the developers, Alloy agreed to reduce the height of the tallest structure by 146 feet, still more than twice as tall as the zoning otherwise permitted. The rezoning quickly cleared the rest of the public review process. Six years later, in the fall of 2024, two new public schools built to Passive House standards and a 44-story all-electric apartment tower with 440 rental units opened their doors. (The 860-foot-tall tower has yet to be started.)

Architect and Alloy co-founder Jared Della Valle led the design of the towers but brought in Architectural Research Office (ARO) to design the school building, having previously collaborated with the firm on a single-family house for Syracuse University's Near Westside green-home initiative. "We're good at making complex things not seem complex," said Stephen Cassell, an ARO principal and the lead designer for the project.

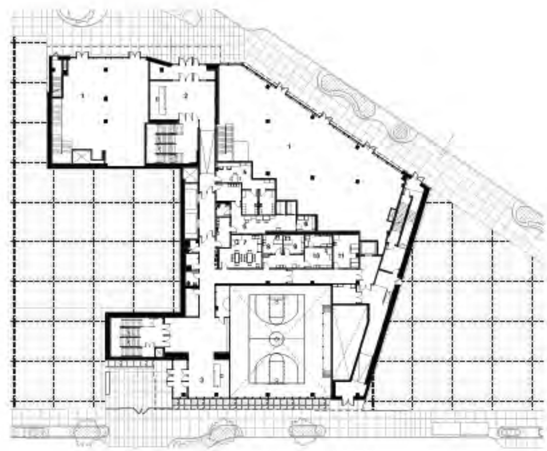
The architectural strategy centered on two principles. First, the educational buildings would have their own distinct presence instead of being hidden within the towers. Second, they would meet a Passive House standard for energy conservation, anticipating Local Law 31 requiring more stringent energy-use reduction coming into effect in 2020. The law mandates that public buildings in New York City reduce energy use by 40 percent by 2030 and achieve a net-zero threshold by 2050, putting the schools 25 years ahead of regulations.

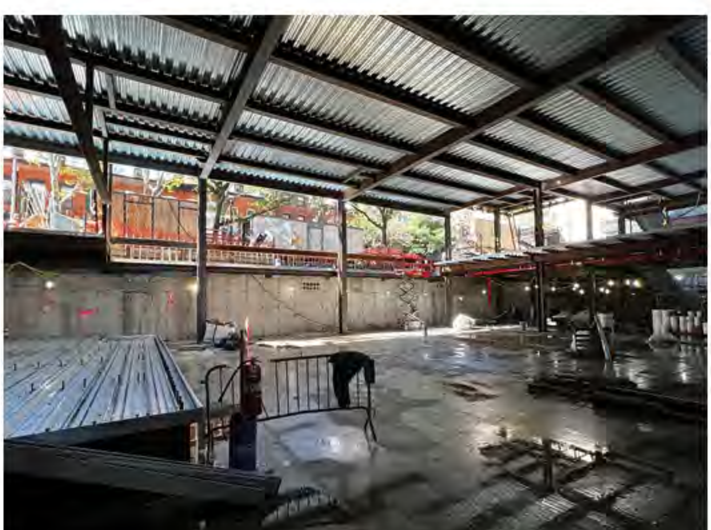
To give each component its own identity, ARO designed the high school so it would appear as a floating cube appropriate for a broad thoroughfare like Flatbush Avenue, while crafting the entrance to the elementary school to step down to a brownstone block on State Street. A cocoa-colored brick rain screen facade, syncopated with recessed and projected planes and high-performing punched windows, gives an expressiveness to the exterior facing Flatbush, while employing a neutral surface material that doesn't stand out extravagantly in the neighborhood. A mesh trellis will eventually be overgrown with plants, providing a visual buffer for the terrace outside a third-floor cafeteria. "We tried to make something that felt like a civic building and told high school students it's their building in the city," Cassell said.

The cantilevered entry to the 350-student progressive elementary school, Elizabeth Jennings School for Bold Explorers, has a more residential feel to it, buffered by flowering planters, and its lobby has a lower ceiling. Meanwhile, the front doors of the high school—the 500-student Khalil Gibran International Academy, which provides Arabic language classes—has a more cosmopolitan, urbane sensibility. Its lobby opens onto a public plaza facing busy Flatbush Avenue, and its terrace and ground-level retail spaces add urban activity and continuity to the nearby commercial corridor on Flatbush. "We wanted the high school students to be integrated into the liveliness of the city," said ARO project director Dominic Griffin.

Inside, most of the elementary school classrooms are on the fourth and fifth floors, with the high school on the sixth and seventh, and the third floor split between the two schools, separated by a pair of doors. Kitchen services are shared, but the cafeterias and gyms for each school are autonomous, and the terrace outside the cafeteria gives the high school students a private outdoor social area.

Structurally, the steel framing of the combined building is relatively standard: slab on metal deck, with steel and concrete slabs acting compositely to make a stronger steel section. Girders that are 21 to 24 inches wide and steel beams 14 inches wide span distances ranging from 132 to 190 feet, supported by steel columns set 24 to 28 inches apart. Most





Previous spread: James Ewing/JBSA; this page: Courtesy of Architecture Research Office

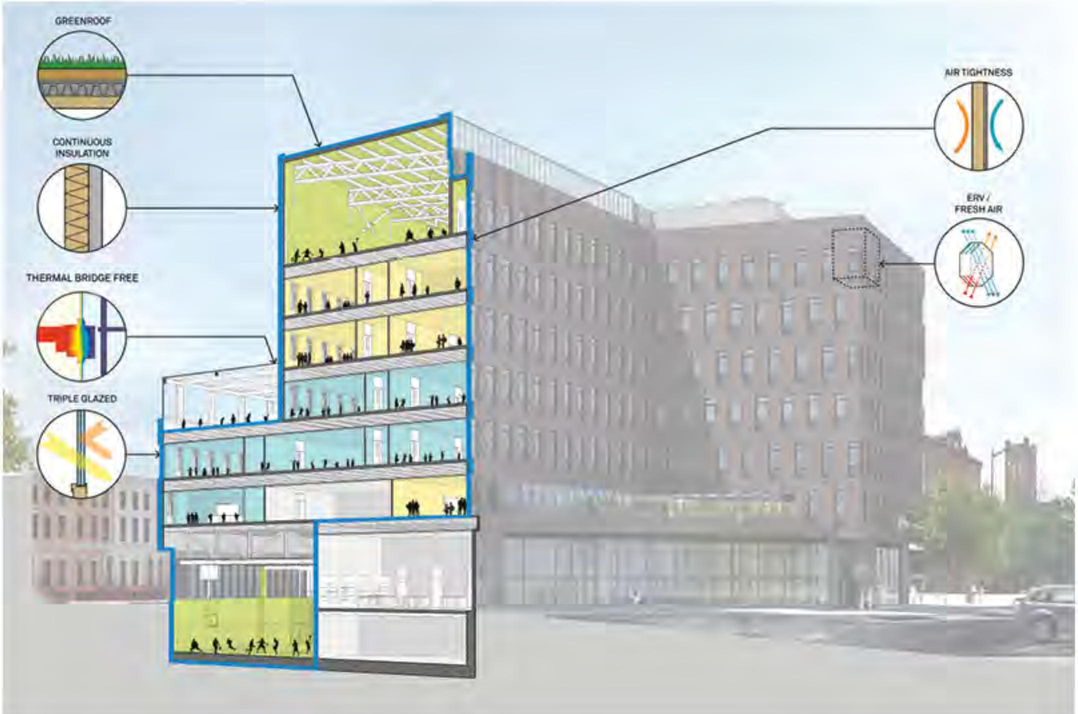
Facing, clockwise from top Seen from Flatbush Avenue, the project's steel frame rises during construction; The ground-floor plan shows the high school entrance on Flatbush, two retail spaces, a gymnatorium, and the State Street elementary school entrance; Structural steel cross-bracing handles lateral loads in the building; The gymnatorium uses steel trusses fabricated in Orange County to secure its 24.5-foot-high ceiling spanning 60 feet.
This page, top to bottom A rooftop veranda outside the high school cafeteria serves as a welcome social space; The elementary school's gymnatorium includes fold-out seating for performances and community events; The schools have separate cafeteria but share a kitchen.

of the foundations are concrete spread footings bearing on four-ton-per-square-foot soil. Select areas with high concentrated loads or lateral uplift use steel micropiles drilled into the soil.

To achieve Passive House standards, the structure employs thick insulation, high-performing windows, a tight envelope, and thermal breaks between the columns and the foundation, using high-density polyurethane pads to prevent thermal bridging and interrupt the transfer of energy through the structure. "We're starting to see such energy-conserving strategies even in projects that don't aim for Passive House standards," said Jason Tipold, structural engineer and principal of TYLin.

Engineering the complex geometry of the site demanded some delicate balancing of lateral structural loads and strategic cross-bracing set back from the facade to prevent daylight from being blocked. But the trickiest aspect of the project came from the constrained building site. Traffic on Flatbush Avenue could not be blocked during construction, and a subway tunnel runs directly adjacent to the site beneath Schermerhorn Street. That meant there was nowhere for the crane to sit except on top of the base of the building as it was being erected. Crane engineers had to reinforce the first floor of the building with extra thick beams to absorb the weight of the crane and materials being lifted, practi-

James Ewing/JBSA; following spread, diagram: Courtesy of Architecture Research Office; photo: James Ewing/JBSA



cally making the building a part of the construction machinery. Simultaneous construction of the 44-story tower also required the careful staging of work.

The other distinctively reinforced parts of the structure are a customized gymnatorium—a combined gym and auditorium—lit from clerestory windows facing State Street, a top-floor gymnasium, and a recycled-rubber-floored rooftop play terrace framed with AESS stainless steel tubes and tensioned wire mesh to prevent balls from flying off the roof. Because of the 60 to 63 foot spans of open space, the ceilings of the gyms are supported by long steel trusses with wide flange members, welded together by Orange County Ironworks in their Montgomery, New York shop and delivered to the site on trucks with extended trailers. Many of the mechanical building systems were hidden in the trusses to save ceiling space for the gymnatorium. The stainless steel and mesh cage of the play terrace also had to be specified as architecturally exposed structural steel to withstand exposure to the elements.

Ultimately, these highly specific, customized elements that negotiate the constraints of the site give the schools a strong civic presence. "It was a lot more work but it makes it a better building," said Cassell, "and creates a school where students have a sense of belonging, engagement, and pride."

With the development's yet-to-be-started tower anticipated to be the second tallest in all of Brooklyn, there's little doubt the complex will remain abhorrent to some residents of Boerum Hill, despite the appeasement of public schools, exceptional environmental standards, and the 45 low-income rentals so far included. But the project has already provided dozens of rentals far below the market rate and a pair of public schools whose design and construction met demanding environmental standards, pointing to a bright future for high-performing city institutions.

Above A rendering of the facade calls out the sustainable strategies used toachieve Passive House standards, including a green roof, thick insulation, padding to prevent thermal bridging of the structure, triple-glazed windows, an air tight building envelope, and energy-recovery ventilation to prevent heat loss through air circulation.
Facing At the intersection of Flatbush and Lafayette avenues, the combined school building negotiates a complex site that includes an adjacent 44-story apartment tower. Triple-glazed windows punched into a brick facade and ground-level retail help the project engage with its lively urban context.

PASSIVE HOUSE PUBLIC SCHOOLS PS 456 / KGIA

Location: **489 State Street** and **362 Schermerhorn Street, Brooklyn, NY**
Client: **Educational Construction Fund (ECF)**, *New York, NY*
Developer: **Alloy Development**, *Brooklyn, NY*
Architect: **Architecture Research Office (ARO)**, *Brooklyn, NY*
Architect of Record: **Ismael Leyva Architects**, *New York, NY*
Structural Engineer: **Silman Structural Solutions (TYLin)**, *New York, NY*
Mechanical Engineer: **Cosentini**, *New York, NY*
Construction Manager: **Hunter Roberts Construction Group**, *New York, NY*
Curtain Wall Consultant: **Front**, *New York, NY*
Structural Steel Fabricator: **Orange County Ironworks**, *Montgomery, NY*
Structural Steel Erector: **Gabriel Steel Erectors**, *Montgomery, NY*
Miscellaneous Iron Fabricator: **Orange County Ironworks**, *Montgomery, NY*
Miscellaneous Iron Erector: **Gabriel Steel Erectors**, *Montgomery, NY*
Architectural Metal Fabricator and Erector: **FMB**, *Harrison, NJ*
Ornamental Metal Fabricator and Erector: **FMB**, *Harrison, NJ*
Curtain Wall Erector: **Utopia Construction**, *Queens Village, NY*

One Madison Avenue

A sophisticated new steel structure rises through and sits atop an existing 1950s podium.

WHEN SL GREEN REALTY INVITED Kohn Pedersen Fox (KPF), with structural engineer Severud Associates and contractor AECOM Tishman, to compete for the modernization of One Madison Avenue, the RFP could not have been clearer. New York's largest office landlord aimed to reduce the 14-story, cast-in-place-concrete annex to its 9-story podium and stack a set-back tower atop it. Working with a preconstruction advisor, SL Green had even planned how the 1950s-era annex could be structurally transformed into contemporary Class A workspace. "They handed us a solution of reinforcing hundreds of columns and beams in the base volume and extruding the core upward," recalls KPF senior associate principal Andrew Werner, "but we threw it out the window."

Explaining why they risked defying the potential new client, Severud's president and CEO Ed DePaola says of the existing structure, "It's a 24-by-18-foot grid, and reinforcing that forest of columns and all those footings would have been staggering, so we thought, Why don't we go with the power solution?" The collaborators proposed erecting a new 27-story core on the eastern side of the square-block property and threading 13 mega-columns as large as 60 by 68 inches through the podium. Steel trusses tracing the southern and eastern edges at the bottom of the new, 18-story tower would transfer its gravity load to those variably sized columns, while the cast-in-place-concrete side core would provide lateral stability.

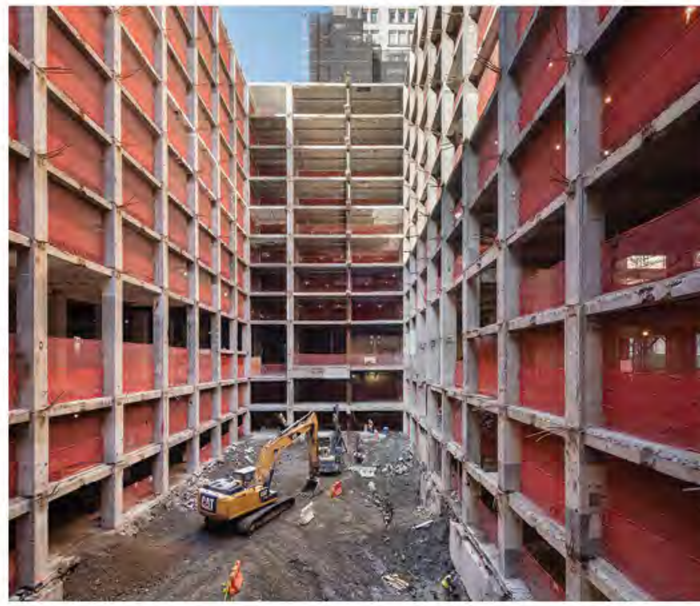
This "power solution" offered some important advantages, says Werner. "By optimizing load paths, we could develop a more efficient structure that could hold additional floors and maximize the floor area." It also avoided problems like smaller interior spans in the base volume and unforeseen field costs. Severud principal Daniel Surrett further notes that, in the new tower, "a column-free, 60-foot lease span between the core and the facade was a goal that could only be achieved practically with steel. It would take a significant post-tensioning operation to match that in concrete and the weight of the system would've increased the size of the mega-columns."

Previous spread Fiberglass-wrapped steel trusses stretch along the south side of the building at the 10th floor, transferring loads from the new tower to the original podium's reinforced matstructure.
Above The new structure steps back from the historic Metropolitan Tower.
Left The architects carved out a new three-bay entrance facing Madison Square.

A 22-foot-high steel truss transfers loads from the new office tower to the existing podium and serves as a dramatic design element.

Previous spread and this page: Raimund Koch, courtesy KPF

From top: The 10th-floor transfer zone under construction; Crews hollowed out the podium's extant 9 floors to make room for a new 27-story core; The rooftop tower seen from the east just prior to topping out.



After demolishing the original building's mechanical floor as well as its top five stories, construction crews hollowed out a 180-by-65-foot portion of the podium to its foundation, to make room for the new side core. At the same time, they fortified the footings of nine existing concrete columns and expanded them using rebar cages to create the mega-columns. Four new mega-columns were also added to the existing mat, to the east of the side core.

During the erection of the concrete core, ironworkers bolted plates to the shear wall to accept steel floor beams—mostly W30 x 116 and W14 x 34 members in the north–south and east-west axes, respectively. It's "very simple floor framing with a lot of repetition," as DePaola puts it, and he adds that typical floor beams are W 24 x 68 spanning 58.5 feet at 10 feet on center. The tower's typical column specification is W14 x 90 at 50ksi, and floors feature a 14-foot slab-to-slab height on a 30-foot column grid. For the portion of the tower that sits to the south side of the new core, tenants enjoy the desired 60-foot spans from north to south and a spectacular 280 feet of open space from east to west.

The transfer zone at which the new tower rises above the existing base is equally stunning. A 22-foot-high truss made of W14 steel members wraps around the south and east sides of the new 10th story, which is set back 85 feet from the west edge of the old podium to create a landscaped terrace overlooking Madison Square Park. The configuration transfers gravity load to the foundation via base plates that are mounted to the mega-columns using ASTM F1554 anchor rods. Surrett explains that, because the engineers used the southern perimeter of the truss to mount an exterior climbing crane, they installed moment connections with web plates. (Regarding the crane, Surrett says the "platform was snaked through and supported by the south truss' bottom cord, and the platform's back-span was connected to the shear wall.") On the east and west they used simple shear connections.

Because the truss is the signature feature of what is otherwise a background building, Werner and his KPF colleagues encased the zigzagging steel elements in fiberglass and placed the entire floor behind glass that the team aimed to make clearer than even the impressive glazing of Apple stores. They ultimately arrived at quadruple-glazed, low-iron laminated glass from Germany and installed it in 10-by-18-foot panes. The steel beams on the 10th floor are W14 x 665 at 50ksi, while the typical new steel grid begins one floor above. The 11th floor bears some similarity to the transfer zone directly beneath it thanks to its wrapper of mullion-less laminated glass and a slab height that also measures 22 feet.

The tower frame was assembled with pre-welded tabs, into which the remaining curtain wall could be mounted. "The tower features a pretty standardized system of aluminum and double glazing with projecting fins," Werner says. Of the 5-foot-wide glass units, Werner notes, "The sheets are 14 feet 3 inches tall, so there's no break at the spandrel .There's [just]

Top and bottom: Max Touhey, courtesy SL Green; Center: Raimund Koch, courtesy KPF

a kiss mullion behind it, which keeps a very clean read and reduces the tack joints." Meanwhile, the fins are dark gray fileted frames that run vertically every 15 feet on the exterior of the curtain wall.

The tower also possesses its own summit: a 6,800-square-foot rooftop pavilion designed by Rockwell Group and 5,000 square feet of adjacent landscaped terrace. The pavilion is fabricated of 10-foot-diameter hollow-structural-section (HSS) columns laid out on a square grid and of trusses made from 6-by-4-inch HSS oriented on 45-degree Xs to pinned joints at the roof. "The crown joint is a 3-inch pipe with shear tabs in four directions [that connect] to T-shaped 'paddles' on the ends of the tubes," Surrett says. "The truss tubes are welded together for minimum profile and were then clad." A Daniel Boulud restaurant occupies the pavilion, and another Boulud venture can be found on the ground floor. Additional building amenities are located in the lobby and below grade.

While upgrading the podium, KPF and Severud rehabilitated the midcentury envelope with a similar eye to unitization. The team cleaned and repaired the existing 4-inch-thick Alabama limestone or replaced it using material from the annex's original quarry. To spirit more daylight into the base volume and raise the interior ceiling height, original punched windows and crenellated steel spandrels were replaced with so-called zippers: a new unitized curtain-wall system that features much larger apertures. In the zippers, aluminum panels replace the spandrels, resting behind the kiss-mullioned double glazing, so the glass breaks only at stack points. To highlight the Madison Avenue entrance within the podium, KPF removed three bays from the facade and finished it in clear glass.

One Madison's curtain wall weighs more than the stick-built system it replaces, and the 1950s design was geared to a different code with different wind loads, "so we needed to figure out a way to support it off the existing building," Werner says, "There was a lot of discussion around the anchors and the terminus points." So at the top and bottom of each zipper, the team paired HSS and C-channel members to the existing concrete. The exterior framing of the zippers echoes the filleting of the fins that project from the new tower, and all this detailing alludes to the crenellated steel spandrel panels that were characteristic of the original annex building.

However respectful of the past, One Madison Avenue is blazing a path for the industry. "I think that overbuild using mega-columns and the big transfer system is definitely the to go on these older buildings," DePaola states. Werner adds, "People are realizing what a great return on investment this is. They see how smoothly this process went which has helped whet the appetite of other developers and clients."

Above KPF layered gunmetal-colored fins on the tower's glass curtain wall to make the overall volume appear less monolithic, spacing them every 15 feet vertically and every third floor horizontally.

Facing page The podium of One Madison was originally constructed as an annex to the Metropolitan Life Insurance Company Tower, which Napoleon LeBrun designed in 1909. The new building defers to the neoclassical landmark by sitting back from it and using different materials.

This spread: Raimund Koch, courtesy KPF

ONE MADISON AVENUE

Location: **One Madison Avenue, New York, NY**
Owner: **SL Green Realty Corp.**, *New York, NY*; **Hines**, *New York, NY*;
National Pension Service of Korea, *Jeonju-si, South Korea*
Developer: **SL Green Realty Corp.**, *New York, NY*; **Hines**, *New York, NY*
Architect: **KPF**, *New York, NY*
Structural Engineer: **Severud Associates**, *New York, NY*
Mechanical Engineer: **JB&B**, *New York, NY*
Construction Manager: **AECOM Tishman Inc**, *New York, NY*
Curtain Wall Consultant: **Gilsanz Murray Steficek**, *New York, NY*
Structural Steel Erector: **NYC Constructors**, *New York, NY*
Miscellaneous Iron Fabricator and Erector:
Empire City Iron Works, *Long Island City, NY*
Architectural Metal Fabricator and Erector:
Champion Metal & Glass, Inc., *Hauppauge, NY*
Ornamental Metal Fabricator and Erector:
Mistral Architectural Metal & Glass, Inc., *Woodside, NY*
Curtain Wall Erector: **Force Installations**, *New York, NY*

Steel Institute of New York

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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
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