EDITOR’S NOTE

Learning from those who build

Last October, facade industry professionals gathered at the Princeton Club of New York to hear panels of experts discuss managing the risks inherent in delivering high-performance facade systems. The event—Facade Tectonics Institute’s New York City Forum hosted by the Ornamental Metal Institute of New York—highlighted many projects completed by the Institute’s contributing contractors, most of which were featured in past issues of the magazine. In exploring how risks were managed on these projects, one of the panelists emphasized that success was not just choosing the right delivery strategy, managing the supply chain efficiently, or coordinating the critical path of envelope closure for the following trades. It resulted from an ability to obtain highly skilled installers when they were needed, eliminating the risk of having too few at critical stages in the project or too many when the level of work did not demand it. This flexibility and scalability, he pointed out, was afforded by employing union ironworkers to install the complex facade systems. Thanks to a union hall having a pool of highly trained installers who contractors could engage as needs arise, a skilled workforce could be tailored to meet owner deadlines in the most cost-effective manner. This was just

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Above A detail of perforated aluminum facade panels at Cornell Tech’s Bloomberg Campus, designed by Morphosis.

Cover The facade of the Nassau Veterans Memorial Coliseum designed by Skift.
3 World Trade Center

For one of Lower Manhattan's newest office towers, exterior steel K-bracing not only provides structural stability, it also grants tenants column-free views from every corner of the building.

ALONG WITH THE RECONSTRUCTION of the World Trade Center complex has come renewed attention to restoring the street grid that was blasted out by the original World Trade Center superblock. In the time since 2001, Greenwich Street has been reconnected to the east of the site and Fulton Street extended west. With the completion of 3 World Trade Center, Lower Manhattan has added another piece of pedestrian connectivity with two new non-vehicular areas, Cortlandt Way, to the south of 3 WTC, adds a block of Cortlandt Street that was "de-mapped" in the original WTC scheme; on the north side, a new plaza allows pedestrians to travel between 3 WTC and the Calatrava-designed transportation hub. But the building's relationship with its neighborhood doesn't end with improving pedestrian permeability. From the onset, architects Rogers Stirk Harbour + Partners envisioned a structural steel design that would complement and acknowledge the WTC Memorial and present a series of human-scaled elements to those who see and use the building on a daily basis.

The design brief for the tower by Silverstein Properties included development of 2.8 million square feet of commercial space, with 2.5 million square feet above grade. Commercial office space comprises approximately 2.1 million square feet of this, accommodated in large trading floors within the podium section, as well as in typical office floors in the tower. The tower's stepped design is meant to offer a variety of floor-plate sizes to tenants, ranging from 30,000 to 70,000 square feet.

*The main core of the building is pushed further to the back, so the relationship of the tower passes straight away down to the ground and reinforces the Church Street frontage, and the Dey and Court Street frontage," says RSHP project partner Richard Paul. The tower's slightly offset positioning accounts for its neighbor to the south, Tower 4 designed by Fumihiko Maki, whose face stands only 41 feet from Tower 3. "The Maki tower is further forward and Tower 3 is pushed to the back, and that's purely to gain aspect—something that came out of the overall master plan," says Paul.

Tower 3’s most noticeable feature is a stainless-steel clad exterior frame and unique load-sharing system of K-shaped steel bracing that climbs the corners of the structure on the north and south facades and allows the building’s corners to cantilever. "It was one of the main objectives to keep the corners of the building completely column-free so every corner of the building allows you panoramic views out both sides," says Paul. "In doing that we have also expressed the relationship of the structure with this perimeter load-bearing structure, where
effectively the facade edges have been pushed in to keep the main expression external to the skin.”

The K-bracing acts as part of the building’s redundancy system. “In the event we lost a column in a catastrophic event, the load is transferred to the diagonal bracing system, which we’ve used as an expressive element.” Owen Steel Company fabricated the tower’s 27,000 tons of steel, which was erected by NYC Constructors, a company of Banker Steel.

On a four-story module, the K braces—constructed of a pair of columns with a diagonal element bolted between them—accentuate the central volume of the tower and its east-west configuration while also providing the architect points out, the human scale of grain and texture to the external facade. Clad in a linen-finish stainless steel, the expressive elements do change the building’s appearance depending on how light hits them. When you see the sun hitting it, it turns the color of the building into an almost orange glow,” says Paul, lamenting on the day of a cloudy site visit. “It’s a shame you can’t experience it today in the rain!” Changing weather changes the view for those inside as well.

Positioned opposite the WTC Memorial, the building’s triple-height office entrance lobby presents an expansive cable net facade to Greenwich Street and the Memorial beyond. 3 WTC purports to be the first building in the world with a three-sided cable net facade. Designed to withstand high loads like the impact of a blast, the walls are composed of laminated glass units 5 feet wide by 10 feet high that will not shatter into shards if broken. A true element goes around the perimeter floor above the lobby and cantilevers to take the load of the facade. “We have a gradually descending scale inside the lobby to try to bring in as much natural light as possible,” says Paul. The lobby steps from 62 feet at its highest to 42 and then 22 feet. Three sides of the space have three levels of retail; there are nine entrances, including two each from the retail area and the Transportation Hub and five from the street. With completely pedestrianized space on Cortlandt and Dey, the building is a new gateway between the east side of Lower Manhattan and the Memorial area.

Above, the tower also offers outdoor respite for tenants, who include GroupM, JDX, and McKinsey, with three outdoor...
terraces on levels 17, 60, and 78. Located 936 feet above street level, the 76th floor terrace is the tallest outdoor office terrace in Manhattan (the 60th- and 17th-floor terraces are positioned 718 feet and 335 feet above street level, respectively).

More than a symbol of continued growth at the WTC site, Tower 3 represents the leaps and bounds being made by the city’s building developers in responding to Governor Cuomo’s Minority and Women Owned Business Enterprises campaign. Silverstein Properties’ MWBE commitment for 3 WTC was estimated at $402 million, or 40 percent of all contracts awarded, with minority and female workers making up 36 percent of skilled labor during the tower’s construction.

“I couldn’t be more proud of the 2,300 union construction workers who have already put in over 5 million hours to build this tower from bedrock to 1,079 feet,” said Gary LaBarbera-President, Building and Construction Trades Council of Greater New York, at the building’s topping out in 2016. Nearly three years later, the tower stands as another testament to the city’s ability to move forward.

Three World Trade’s west elevation as seen from the 9/11 Memorial.

Facing A 1,079 feet tall, 3 WTC’s tower is the third building to be completed on the World Trade Center masterplan site developed by Silverstein Properties.
Joan Weill Center for Dance

Large expanses of high-performance glass fill out the newly erected curtain wall designed for the existing Alvin Alley American Dance Theater and its new three-story expansion in midtown Manhattan.

Known around the world for its vibrant fusion of dance styles, the Alvin Alley American Dance Theater’s performances, training programs and educational activities can look forward to an even brighter future at the Joan Weill Center for Dance. Now, the huge expanses of glass that form the center’s newly erected facade showcase the vibrancy and movement inside its studios. Choosing the right product and installing for the glass, and a close-knit project process, were key to seamlessly integrating the old with the new at the Midtown Manhattan facility.

The attention-grabbing project involved removing 2,400 square feet of the original 2004 curtain wall and installing 1,600 square-feet of new curtain wall on the existing facade and on a new three-story addition. The addition accommodates four new dance studios, two classrooms and administrative offices inside approximately 10,227 square feet of added space at the corner West 55th Street and Ninth Avenue.

“The addition’s new, less articulated, more transparent curtain wall exposes the dancers to the streetscape, further fulfilling Mr. Alley’s vision of bringing dance to the people,” explains Natan Biblowitz, partner at l+b + Biblowitz Architects, New York, which designed the renovation as well as the original 2004 building.

The building’s core spaces are encased by red brick masonry to help blend into the tenement brick buildings in Manhattan’s Clinton District. The curtain wall is accented by a silk-screened “wave pattern” of fit. “The undulating fit on the transparent, less articulated curtain wall of the newly expanded West building reinforces the concept of the ‘Teflon forms of the entry marquee and the roof vents referencing the ‘Wave in the Water’ segment from Alley’s signature dance, ‘Revelations,’” which uses flowing blue fabric that stretches across the stage as dancers glide through it,” says Carolyn Lu, partner at l+b + Biblowitz.

In its quest to design a high-performance facade, the design team chose Eire Architectural Products’ Enviro Facade unitized curtain wall fitted with Interpane Isopac low-e coated insulating glass units. With panel sizes running as large as 100 inches by 292 inches, the Enviro Facade was unique in its ability to meet the design requirements of this site and scope.

The project’s tight timeline also placed constraints on the materials used. “The Interpane Isopac low-e coated IGUs were procured for this project due to the sourcing at the time not allowing for any domestic glass fabricators to be able to produce the largest coated insulating glass size required on the project, which was 96-inches wide by 174-inches tall,” says Bruce Heimsdorf, senior project manager at W&B Glass.

Beyond the unique size requirements, the Enviro Facade curtain wall offered a high level of thermal, air, water, and structural performance. Moreover, the project team benefited from the expertise of Eire’s highly sophisticated engineering team when it came to addressing the many challenging detail, interface, and anchorage issues presented by the facade’s complex design.
“The addition’s new, less articulated, more transparent curtain wall exposes the dancers to the streetscape, further fulfilling Mr. Aliley’s vision.”

Natan Bibliowicz, Iu + Bibliowicz Architects

“The utilized facade allowed for faster installation on site at a very tight project site with little to no layout space,” adds Hermadot.

While the work on the 55th Street side was able to be crane set, the theater’s interior courtyard presented more of a challenge. Here a custom monorail had to be built on top of the expansion to hold panels that were loaded onto the roof by the 55th Street side crane. “The monorail was only way to lower the panels down to the courtyard area for distribution and setting as there was no other accessibility into that space, otherwise,” Hermadot explains.

The anchoring conditions on the three-story existing portion of the building posed another installation challenge for the team. Once the old curtain wall was stripped off and the anchors were exposed, a full X-ray scan and analysis of the existing reinforcement in the concrete slabs revealed that they were insufficient to support the new curtain wall system.

To resolve this issue, WBW and Erie worked together to design, engineer, and fabricate new anchors on the fly since the structure had already been exposed to the elements.

The X-ray analysis also revealed that some of the existing columns required reinforcement and therefore some additional lateral bracing was needed. At the same time, the existing footings, columns, and lateral system in the existing building had reserve capacity, so did not require structural changes.

Offering some more details on the curtain wall’s structural system, Phil Murray, partner at Gilsanz Murray Stelick, explains, “The curtain wall is supported by connectors that are embedded into the concrete topping slab and the slab provides gravity and lateral support for the Mullions and glazing. The anchors have reinforcing bars around them to provide a ductile connection.”

While the facade components themselves are not fire protected, because this is not required by the building code, all of the structural steel beams, columns, and girders are fireproofed with a two-hour fire rating. The majority of the steel was treated with a spray-on cementitious material and where the structural steel is exposed, intumescent paint was applied. Otherwise, the thickness of the concrete topping was sufficient to achieve the desired fire.
rating for the concrete and metal deck floor slabs, according to Bibiowski.

Unique to this particular project was the fact that the space had to actively function as a dance studio during construction. This meant that vibration and acoustic considerations had to be built into the long span design.

"The steel beams were proportioned so that their natural frequency of vibration exceeded 10 Hertz, i.e., cycles per second," relates Murray. "This frequency helps to ensure that the structure is not excited by the rhythm of the dancers."

In addition, the architects specified the thickness of concrete on metal deck for the dance floors at 6 inches to provide additional mass. "Then the dance floor itself was supported on vibration isolation pads that help with acoustical separation and provide a cushioned surface that does not impact that dancer’s knees and joints as would be the case if the floor was supported directly on the concrete slab," says Bibiowski.

Another acoustic design step involved filling the mullions, which interconnect from floor to floor, with sand in order to dampen sound or vibration that would otherwise telegraph up or down the mullions.

Now, with a new high-performance skin as their backdrop, rehearsals and performances at Alvin Alley have new brightness. This would not have been possible without the properties of the materials used and the close-knit team that worked in tandem to deliver the building’s new high-performance skin. "Our project management team was involved every step of the way to ensure a successful installation to achieve the architectural intent and system performance criteria," says Herrndorf. "And, just as in a dance performance, this coordination made all the difference."

**JOAN WELL CENTER FOR DANCE**

**Location:** 485 West 55th St., New York

**Owner:** Alvin Alley Dance Foundation, New York, NY

**Architects:** Bibiowskis Architects, New York, NY

**Structural Engineer:** Gidanz Murray Stefick Engineers and Architects, New York, NY

**Construction Manager:** Structure Tone, New York, NY

**Curtain Wall Consultant:** Gidanz Murray Stefick, New York, NY

**Structural Steel Fabricator and Erector:** United Structural Works, Congers, NY

**Curtain Wall Fabricator and Erector:** W&N Glass, Nanuet, NY

Along with a three-story addition, the entire facade of the Alvin Alley American Dance Theater in Midtown Manhattan will be refined with a high-performance Curtain Wall System.
Milstein Center at Barnard

A terraced design avoids casting shadows on the campus lawn while opening the building to the surrounding community and creating a variety of interdisciplinary spaces within.

A NEW HUB FOR ACADEMIC and intellectual life on the Barnard College campus opened last fall and features its soaring library and structural steel to its steel frame. Designed by Skidmore, Owings & Merrill (SOM) and built on the former site of Barnard’s former library, Lehman Hall, the distinctive 128,000-square-foot building has a terraced, five story base anchored by a 11 story tower on the west side. Its rain screen system of shingled, patinated zinc panels breaks down the building’s scale and blends in with its historic surroundings.

SOM and structural engineer Robert Stilman Associates explored both concrete and steel structures early in the design process for Milstein, but ultimately found that the regular column layout played to the strengths of structural steel. In addition to the double-height library, the Milstein Center includes over 270 meeting student spaces for individual study or collaborative group work large, light-filled classrooms, a conference center on the lower level: offices for departments and programs that were previously dispersed throughout the campus, such as computer science, economics, and political science; and a home for programs such as the Vagelos Computational Science Center and the Athena Center for Leadership Studies.

“One of the reasons why we really wanted to pursue this project was its location—how many opportunities do you get to create an intervention at the center of a campus?” says Meredith Bechick–Lorenzo Eirre, SOM Project Manager.

Indeed, Milstein is located at the heart of Barnard’s campus, facing Broadway and Columbia University, and in front of an open green space often occupied by students and events. Because Milstein is twice as big as Lehman was, “a big part of our responsibility was to make sure the building didn’t become a deterrent to the pavilion of the lawn,” says Bechick–Lorenzo Eirre. SOM determined the building’s massing
Clockwise from top: Mithen’s double-height library is framed by U-braces and accentuated by a cantilevered, switch-back feature wall. The fitness achieved by using braced frames, repositioned on the ground floor of the library, allowed for an overall more efficient structural frame and supported Mithen’s height. The steel structure of the U-braces and rebar visible during construction.

Based on sun studies and added glass rails to the terraces, which feature seats and pavers, to allow unobstructed views to the lawn below. They also appear to extend the lawn vertically.

Mithen’s central location on campus also influenced SOM’s facade choice. The pre-weathered zinc panels match the terra cotta and brick on campus, as well as Weiser-Matten’s adjacent Diana Center, with its clear and color-integrated glass panels. Fabricated by Zahner and erected as part of a unibond curtain wall by Island Exterior Fabricators, each of Mithen’s metal shingles is unique, shifting in tone with the changing light and modulating the building to its context. The pre-weathered finish also means the facade requires minimal cleaning and maintenance.

Bostwick-Lorenzo Siroa notes that the exterior wall was completed through a design assist process with Zahner, Island, and construction manager Turner Construction. This fast-tracked process relied on collaborative sessions with the team, and meant that design drawings could be speedily turned into shop drawings with troubleshooting along the way. The wall system was procured early, while Lehman was still being demolished, and ultimately allowed the project to come in on budget and on schedule. “It afforded us a better quality wall than we would have been able to get otherwise, if it was a traditional process,” says Bostwick-Lorenzo Siroa. “Design assist is becoming the status quo in the industry, especially in New York, and we encourage a lot of our clients to pursue it.”

Stepping inside, Mithen welcomes the Barnard community with a grand library clad in warm wood. The structure’s lateral bracing is expressed in two mirrored, W150 x 72 wide-flange U-braces that define the library’s central bay, as well as the book stacks on the second floor. At about 31 feet long, they weigh around 2,200 pounds each, or 4,400 pounds per “U.” The stiffness achieved by using braced frames for a building of Mithen’s height allowed for a more efficient structural frame. (While moment frames would have kept all of the bays of the library open, they are significantly more expensive and heavier.)

The elegant trusses are upholstered at their curved bases on the ground floor, creating coved seats. “We went through many iterations of hiding or expressing the bracing and ultimately thought it was a great way to integrate it into the design,” says Julia Grabaza, SOM designer. Adding to the drama, a monolithic, switch-back four-story glass panel is inserted into the roof.
stair clad in wood connects the library floors. It cantilevers from the second story, anchored to the north by the two 16-inch-deep columns hidden in the wall. Two W12 beams, which are aligned with each landing, cantilever out to provide a platform, and the stair continues downspan between the cantilevers. The moment connections of the landing cantilever beams were field-welded to the 16-inch columns. “Simple details, like reveals in handrails, really make the space and add human to the design,” says Grabas. She adds that active design was an important part of Milstein’s architecture, and the stair means that students can forgo the elevator for at least four floors.

The open and flowing library experience prioritizes fire safety in several ways. The main entrance connects to Level 1 below via a grand straight-run communicating stair flanked by continuous fire-rated glass walls and a large pair of fire-rated wood saving doors, which have hold-open devices that connect to the building’s fire alarm system. As the library moves into Level 4 from the switch-back feature stair, there is a large fire-shutter concealed in the ceiling. On the fifth floor, the design team chose to connect Milstein’s tower with its neighboring tower, the 1969 Atchson Hall. This skybridge connects the Vagelos Computational Science Center at Milstein with the science-focused spaces inside Atchson Hall. Because the floor plates of the two buildings don’t match up, SOM created a gradually sloping ramp that allows students to easily travel from the classrooms in Atchson to the collaborative spaces in Milstein. “The computational sciences—all of that brain power—is in the Ivory Tower next door. How do we invite the sciences to participate here?” asks Bootzin-Lorenzo Elsso. The bridge was the obvious answer.

It was built with one W36x116 cantilever and one W30x90 cantilever on the 5th floor. The roof of the bridge is framed with one W36x135 cantilever and one W36x170 cantilever.

Further up Milstein’s tower, a window-walled faculty room cantilevers 18 feet over the base building with sweeping views of the Hudson River, Columbia’s campus, and Midtown Manhattan. It was achieved with W24 cantilevers on both the 9th and 10th floor. The upper 10 floors of the tower itself also cantilever to the north, over the Atchson Hall garage. Four parallel full-story trusses cantilever 19 feet to support those upper floors.

Another structurally challenging space was the large-span lecture hall on the lower level. Transferring a column over the room required a non-traditional approach. Due to the beam depth restrictions aimed at preserving sightlines, two side-by-side W40x397 beams were needed to span the 50 feet.

While not as visible as its muscular steel structure, Bootzin-Lorenzo Elsso adds that the project was also noteworthy for its team of female architects and engineers, including Principals Victoria Ponce de Leon and Sarah Stahle from Robert Gilman Associates. “This being a women’s college, it was important for Barnard that there were women who really contributed and thought innovatively about how we brace this building.”
NYU Langone Kimmel Pavilion

An expansive curtain wall and unique long-span bridge support New York City’s first single-occupancy hospital tower.

In addition to the complex structural design, the striking new structure features an expansive curtain wall facade with low-iron vision glass, contrasting white ceramic frit, and an innovative cast shadow box design.

The Kimmel Pavilion maintains the same planes and terracotta cladding as the adjacent Energy Building, creating a unified campus appearance. “A continuous lightwell feature provided at the top of the Energy Building and the Kimmel Pavilion podium also unifies the two buildings,” adds Nicki Match Sana, senior vice president and vice dean for real estate development for NYU Langone Health.

The new tower, overlooking the East River on 34th Street, features a thermally broken aluminum utilized curtain wall with triple-glazed insulated glass at the north, south, and east facades, while the west facade incorporates a double-glazed insulated glass unit. "With expansive views of the city and access to an abundance of natural daylight, the upper half of the building is clad with vision glass and spandrel panels, and the lower half, on the other hand, is designed with vision glass and ultra-high performance concrete panels that serve as a rainscreen," explains Kevin Krudel, senior associate at Ennead.

With a six-lane highway and heliport bordering the east facade, controlling interior noise levels factored in significantly to the facade design. Early design iterations included a combination of window wall, precast concrete
In addition, stainless-steel struts carry the lateral loads acting on the wall to the interior horizontal steel ring beams. In order to accommodate thermal expansion, contraction, and deflection coming from the 6th floor, the struts run in slots that allow them to freely move up and down with the building. During curtain wall installation units were delivered to each floor using construction hoists and installed using mobile cranes and monorails positioned on floors above. The procedure involved a pair of support cables that were hung from outriggers at the top of the building, and lowered to pick the units at the floor needing to be enclosed, says Kudo. At the podium level, the UHPC cladding panels were installed onto the appropriate curtain wall panels on-site before the entire units were hoisted and installed.

In order to ensure a tight enclosure, the architect specified a pressure-equalized system with multi-line of defense against water and air infiltration. "This system utilizes a rainscreen gasket to resist bulk water, a weather seal to limit impact of water further into the system, and an air seal that frames the pressure equalized cavity and prevents indoor air from entering the system where it could condense," explains Pachuta. This approach ensures redundant protection against water infiltration and reliably limits how much air can circulate through the system's joints.

Prior to fabricating the curtain wall units, the performance of the system was extensively tested using full-scale mockups to ensure that the specified air, water and thermal targets were being met. Further field tests were conducted to ensure that the system was being properly installed.

As carefully considered as its highly visible facade, the building's hidden structure is supported by a uniquely designed, long-span bridge comprised of steel trusses between 104 feet to 140 feet long and 34 feet deep, which are integrated into the mechanical floor placed at the top of the podium.

The choice of steel framing minimized the weight that needed to be transferred and allowed for maximum strength and stiffness for the bridge. "Without these bridging trusses, a third of the site would be unusable, rendering the building impossible to construct," explains Doug Gonzalez, associate partner and project director at LEVA Consulting Structural Engineers.

The trusses primarily span to columns and frames located on each side of the rail tunnels with their deep caisson foundations, positioned clear of all tunnels, extending down to bedrock. The buildings's services core, which contains the majority of the lateral load resisting system, had to be located off-center of the tower and podium in order to avoid the southern tunnel zone.

In addition to avoiding the Amtrak tunnels, the engineers were challenged to deliver the required tolerance and deflection. "Trusses supporting the podium only consist typically of heavy W14 shapes in the 400 and 500 weight series, but trusses bearing the weight of the tower also needed to have built-up box sections weighing over 1,000 pounds per linear foot consisting of plate 4 inches to 6 inches thick," explains Gonzales.

"While the trusses are fairly stiff, with small deflections and vibrations relative to the significant transfer loads, satisfying tolerances in order to successfully cast the flat floor slabs for clinical spaces was incredibly challenging," he adds.

Putting their heads together, the building team developed and coordinated a system of adjusting the elevations of steelwork after erection. In particular, all of the hanger columns supporting the steel-framed operating room floors below the trusses were detailed to allow for their up- and down-elevation adjustment prior to the casting of floor slabs, according to Gonzalez. By utilizing high strength threaded bars that could be jacked, this allowed for adjustments as much as 1½ inches, which greatly smoothed out the podium floors' levensness.

When the team evaluated vibration concerns, the rails running through nearby tunnels weren't an issue. There was some concern about the vehicular traffic driving down Franklin D. Roosevelt East River Drive, but analysis concluded that there were negli-
A long-span, structural steel bridge—made from steel tubes between 104-foot to 108-foot long and up to 24-foot deep—provide the required structural support for this challenging site.

NYU LANGONE KIMMEL, PAWILION
Location: 434 East 35th St., New York, NY
Owner: NYU Langone Health, New York, NY
Architect: Ennead + NBBJ, New York, NY
Structural Engineer: LEFPA Consulting Structural Engineers, New York, NY
Mechanical Engineer: ECOA, New York, NY
General Contractor: Fasano Construction Company, New York, NY
Curtain-Wall Consultant: Henspaw, New York, NY
Structural Steel Fabricator and Erector: Canam/Stonebridge, South Plainfield, NJ
Miscellaneous Iron Fabricator and Erector: Empire City Iron Works, Long Island City, NY
Architectural/Structural Steel Fabricator and Erector: Jonathan Metals & Glass, Queens, NY
Curtain Wall Fabricator and Erector: Enclaves, New York, NY

gible effects on the building from traffic vibration. Consequently, no structural enhancements were required to meet the Kimmel Pavilion’s second-floor operating room needs.

Because resiliency became a top priority after Langone’s experience with Hurricane Sandy, the building was designed for flood-level waters with an allowance for sea-level rise by providing a building-wide, resilient “bathub/boat” system to keep flood waters out of the building. In addition, critical MEP services and hospital functions were located above the ground floor.

At the ground level, “a building-wide spanning pressure slab with additional mini-caissons resist uplift from hydrostatic pressure and flood walls were designed for lateral hydrostatic and dynamic wave loads,” says Gonzalez. “At the building perimeter, multiple types of deployable flood barrier are used at entrances and openings, while long segments of cantilevering concrete flood walls, supported by the pressure slab, are integrated behind facade elements.”

In order to accommodate the 114-foot long perimeter at the main canopy and storefront entrance, the team designed a self-rising flood barrier. Essentially, this is an above-grade passive wall made from fiberglass-en- cased foam, which is less dense than water and will rise with water levels.

As a result of these efforts, in addition to other campus resiliency upgrades including an 11 MW capacity combined heat and power plant, NYU Langone received Platinum certification under U.S. Green Building Council’s Performance Excellence in Electricity Renewal (PEER) v2.0 standard, and has been recognized as the first medical campus in the world to achieve this accreditation.

“As the first certification program that measures and improves power system performance, PEER recognizes industry leaders for improving efficiency, day-to-day reliability and overall resiliency when it comes to severe events, such as flooding and hurricanes,” explains Match Suna.

As for meeting LEED Platinum sustainability criteria, the facade’s triple-silver- low-E glass coating played a key role in reducing solar heat gain and the number of air changes required to condition the facility’s interior spaces.

“The curtain wall also permits large areas of vision glass, allowing visitors and staff of the Pavilion ample views outside, and reducing artificial lighting requirements at the building perimeter,” says Pachuta.

With a high percentage of post-consumer recycled material, these structural steel design also helped to garner crucial points within the materials category.

“The infrastructure and efficient operations we’ve implemented on the Main Campus will help us meet our 50 percent carbon reduction goal by 2025,” adds Match Suna. With an eye on the future, NYU Langone believes that sustainability and resiliency go hand in hand.
Kosciuszko Bridge: Phase I

Replacing an outdated truss bridge with two elegant cable-stayed bridges, an all-star design/construction team overcame demanding site conditions and introduced innovative features to minimize maintenance and smooth traffic flow.

THE EXPERIENCE of daily life in a city depends on the attributes of its infrastructure—functional practicality and aesthetic inspiration alike—no less than the design of its buildings. Among the indignities associated with driving in New York City, the Kosciuszko Bridge has long ranked high on the aggravation scale. Built in 1939, the original Kosciuszko was a through-truss design supporting six vehicular lanes, a 1.1-mile viaduct connecting the Greenpoint and Maspeth segments of Interstate 278 (the Brooklyn-Queens Expressway) above Newtown Creek. It was named for Polish military engineer Tadeusz Kosciuszko, whose contributions to the American Revolution included destroying bridges to impede British troops. More than a few drivers—whether or not they knew what he’d achieved, or how to pronounce his name (koosh-chush-ko)—cheered on October 1, 2017, when a controlled implosion brought his namesake bridge down as well.

The “K Bridge,” the busiest of the four Brooklyn-Queens bridges, was a notorious congestion pinch point. With its steep grade, poor sightlines, narrow lanes, and lack of shoulders or a drainage system, it was not up to Interstate specs; originally designed for 10,000 vehicles per day, it couldn’t handle the 160,000 to 180,000 a day it eventually carried. Replacing it was a high priority when Gov. Andrew Cuomo announced the $1.2 billion New York Works program in 2012. When work began in 2014 on a two-part cable-stayed bridge (CSB), says Walt Alber, chief engineer for the state’s Department of Transportation (DOT), the Kosciuszko became “the largest single contract in the history of New York State DOT” Phase I, which opened in April 2017 and initially holds three lanes in each direction (converting to all eastbound service to Queens once the partner bridge opens), cost $550 million; the winning bid for Phase II, the westbound bridge to Brooklyn that will occupy the old bridge’s footprint, was $318 million. Considering the risks, not just nuisances, associated with tearing infrastructure—as well as the new bridge’s functional upgrades, elegant aesthetics, and 50 percent increase in lane capacity when completed—this is a well-timed investment.

The new Kosciuszko is New York City’s first major bridge in over half a century, the last being the Verrazano-Narrows in 1964. It is also the first pure CSB to grace the skyline, reflecting a preference by both state officials and community members for CSBs’ graceful profile and low-maintenance requirements. The directive to build a CSB was built into the RFP chosen over box girder, deck-arch, and through-arch options. Hans Hutten, engineer of record for architects HNTB, notes that while cable-stayed and arch designs are both economical, “cable-stayed bridges can be built using a balanced cost/character style of construct-
tion, which minimized temporary fastenings. Phase I construction proceeded one lane at a time, a replace-in-place strategy, without closing I-278 or requiring a tem- porary bridge, the computationally intensive but materially efficient design was realized seven months ahead of schedule.

When Phase II is complete, the eastbound bridge will hold five ve- hicular lanes, and the westbound will include four plus a 20-ft protected pedestrian and cycling path on the Manhattan-facing side. Increasing motor-vehicle capacity from six total lanes to nine while offer- ing a popular feature for citizens who favor self-powered travel. If the 1939 Kosciusko reflected the earth-gritting endurance of 20th- century New York’s uneasy accom- modation to motorism, today’s version adds a 1 1/4-th-century city upgrading its quality of life.

The Kosciusko’s cost is high, yet several decisions kept it from being higher both up-front and long-term, particularly the cable-supported design and the structuring of Phase I as a single lump-sum design-build contract. Led by a joint venture combining Skanska, Italcementi, and ECCO III (SKB) and HNTB, the Phase I partnership “looked in project costs and avoided major overruns,” Albert notes. “We estimated at the time the contract announcement that we would save three to four years on the completion of both phases of the K Bridge.” Phase I, the city’s first major design-build project, was completed in April 2017, paving design and construction (including most connectors for both bridges) into 36 months. With a similar design for Phase II on a “design-build-bid-last” plan and a shorter construction period (about 22 months), he adds, “that will definitely be a record of building a cable-stayed bridge with this much approach to it in the country.”

“Design-build usually achieves some innovations,” Albert contin- ues, “and typically you don’t see that in design-build-bid as much.”

The new Kosciusko features nu- merous details intended to control maintenance costs. There are no expansion joints on the approach spans, he reports. “Every joint leaks eventually, and deteriorated substructures are mostly attrib- uted to leaky joints with [a] high self-salting concentration of water. Over time it just eats up the concrete and then gets into the steel, and that’s how we lose substructure prematurely. … No joint is a good joint,” he continues, “no matter how expensive and modern it becomes.” Thermal expansion in the approach superstructure (which sits on steel multi-rotation or disk bearings installed at both abutments and anchor pier) is handled by the tall concrete piers: “You can accommodate some of this expansion by flexibility, designing the piers as flexible as possible, and still get the strength you require.” Talon Tusola, project manager at Skanska USA Civil, adds that CSSB generally need less maintenance than suspen- sion bridges, having fewer anchor points and moving parts, and that the Kosciusko’s slender columns “allow the structure to move as a whole, as opposed to the individual parts of the structure with provide much sturdier columns, as you might see on other bridges.”

Durable materials are an essen- tial priority here. “On a bridge that carries 180,000 cars a day, we do not want to be going out there and doing maintenance work,” Albert comments. The reinforced-con- crete pylon towers are anchored in drill shafts extending 170 feet into ground and 13 feet socketed into rock. The roadway deck has high-performance, low-perme- ability concrete with stainless steel reinforcement; "on top of that," he adds, “we put a 1-inch-thick polyester polymer concrete overlay on the main span roadways to reduce life-cycle costs and provide a more robust corrosion barrier.” Hutton describes the roadway in detail: “The superstructure is com- posed of a 10-inch precast, post- tensioned concrete deck, made composite with the edge girder and floorbeams by cast-in-place closure strip. The deck is pro- tected by the use of stainless steel reinforcing. … The post-tensioning runs longitudinally throughout a majority of the deck, with the tendons spaced at 10 to 20 inches.”

The edge girders are 7 feet deep, built of primarily of grade 50 steel, with grade 70 steel used in a few strategic locations. The floorbeams were also 7 feet deep, constructed of grade 50 steel.”

The bridge’s upper superstruc- ture consists of 66 steel cables, 28 on either side of a single vertical 287-foot concrete pylon tower (near the height of the Statue of Liberty on the Brooklyn side, solid from the footing up to an elevation 201 feet above Newtown Creek and hallow above that point. Cables vary in length from 128 feet closest to the pylon to 812 feet for the last post crossing the creek; their upper ends are secured in- side steel anchor boxes embedded in the towers, and their lower ends are secured in anchorages attached to "S" girders connecting at roadway level. The cables range from 18 to 92 strands of 0.65-inch diameter 270 grade ASTM A416 steel, with seven-wire strands. Hutton says, individually gressed and sheathed, each cable has a viscous damper to mitigate vibrations and instability. All in all, the eastbound Kosciusko includes “approximately 1 million linear feet of steel strands.” Albert reports. “That’s more than 188 miles...enough to circle the pi- meter of Manhattan six times.”

Steel components are metal- lized to protect against corrosion, a new technology for DOT at the outset of the project and one that Albert finds superior to either painting or weathering steel. Metalizing, as a thermal spraying process rather than dipping in a tank (as in galvanizing), can be done either in a shop or in the field for touchup work, with no limit on piece sizes. Among the technolo- gies used here and applicable to future projects, “the biggest bang for your buck,” Albert summarizes, “is metallizing the steel structures and stainless steel reinforcements in the deck,” followed by the poly- eater polymer concrete overlay. “In my opinion, steel is the best type of superstructure for longer spans,” Albert says, noting that the team envisions a service life of 100 years for the bridge’s non- replaceable components.

The cleverest improvement from motorists’ perspective is the roadbed’s lower vertical profile, 80 feet above mean high water rather than the old bridge’s 125. The 1939 bridge’s height, says Tusola, was initially designed to allow passage of tall vessels in air are when the city had good reason to suspect Nazi U-boats lurking in its waters, presumably no longer a pressing concern. On the old Kosciusko, Albert recalls, “trucks had trouble getting to the crest of it, especially if they were loaded.” The sharp in- cline reduced sight distances, and drivers’ tendency to slow down in narrow shouldless lanes exacerbated congestion, particularly when a collision or breakdown blocked a lane. The new Kosciusko is not a magic bullet against five-pa- volume remained dense after it opened, and induced traffic phe- nomena may kick in when six total
KOSCIUSZKO BRIDGE: PHASE I

Location: Brooklyn/Queens
Owner/Developer: New York State Department of Transportation (Region 11)
Lead Design Firm: WSP New York Engineering and Architecture PC
New York, NY

Structural Engineer: WSP USA, New York, NY
General Contractor: Skanska-Kieret-Ecco III (SKE) Construction Joint Venture,
New York, NY

Construction Manager: The Lillo Group, Syosset, NY

Structural Steel Erection: Skanska-Kieret-Ecco III (SKE) Construction Joint
Venture, New York, NY

Miscellaneous Iron Fabricator: Glenside Fabricators, Glenside, PA

Ornamental Iron Fabricator and Erector: Glenside Fabricators, Glenside, PA

The Queens-bound Kosciuszko Bridge lit up at night with clouds moving. (Photo by Mark Cates via the authors.)

lanes become nine. SIRL’s gentler incline and interstate-standard 10-foot shoulders are conducive to fewer crashes and calmer nerves.
“Trucks love us,” Albert says, “because they don’t have to hit the gas as hard to go up that hill.” The design accommodates traffic projections for 30 years past the construction year.

Nearby flight paths to LaGuardia Airport required coordination with the Federal Aviation Administration and limited pylon-tower height to avoid interfering with cockpit-to-control-tower communications. Erection of the asymmetrical spans, 624 feet on the main span and 577 feet on the back span, proceeded in segments allowing for the weight disparity, Hutton says, “alternating between the main span and the back span to keep the dead load balanced about the pylon. No temporary stay was required other than a single temporary bent in the back span to keep the bridge stable during the possible high-wind event until it was fully erected.” Demolition of the old bridge combined lowering the main span onto a barge for flotation to a New Jersey steel-recycle facility, then controlled implosion (“energetic felling”) of the rest of the structure: another first for the city, Tulgu reports, performed after extensive environmental-impact studies.

The new bridge includes aesthetic flourish. “We felt the high towers and the cable-stays are a fantastic, dramatic visual experience for the community,” Albert comments. “It has a sophisticated lighting system; we can change the color from our office on a daily basis. On either side of the pylons, the top five cables are colored burnt umber, an orange tone-contrasting with the natural metallic gray of the nine cables below; the mastically inclined will read the five parallel orange lines as a staff, and when viewed against a blue sky, they also allude to the Dutch-derived orange and blue scheme of the city flag. (Resemblance to the colors of the Mets, Knicks, and NYGCC: Tulgu notes, was unintended but a welcome afterthought.) At least in this part of the regional transportation complex, however, after decades of making New Yorkers swear, the Kosciuszko just might make some of them want to sing.
The first academic building to open on Cornell Tech’s Roosevelt Island campus aims for net-zero energy performance, a mission that drives its advanced aesthetics. Its facade of pixelated perforated aluminum and curved glass provides both thermal protection and inspiration.

A stroll through Cornell Tech’s new campus, which opened in the fall of 2017, reveals surprises practically everywhere the eye lands. One is a ping-pong table. Beside a walkway near The House (the residential tower by Handel Architects) and The Bridge (the Weiss/Manfredi academic/corporate co-location building, now renamed the Tata Innovation Center; see details in Construction Winter 2018, p. 14), with a direct view of the Bloomberg Center, stands a futuristic German outdoor table with a metal net. It’s not just sturdier than fabric nets; it’s a hint that this campus values quality-of-life details and puts materials to unexpected uses.

The Bloomberg Center, the four-story, 160,000-square-foot academic and research facility named for the former Mayor’s daughter and designed by Morphosites, is the most visually adventurous of Cornell Tech’s buildings, thanks largely to an alumi-

num-and-glass facade that combines complex digital patterns with distinctive, ever-changing coloration. Like all buildings erected here to date, Bloomberg meets rigorous standards for energy performance (not just LEED Platinum here but Net Zero, generating as much power as it uses). “We were given not so much of a cost budget,” says Ung-Joo Scott Lee, Morphosites’s project principal, as “an energy budget, so we kind of had to work backwards from a restrictive amount of energy consumption.”

Beginning with that core mission, the design and construction team devised strategies that went beyond the familiar: Photovoltaics were always part of the sustainability plan, Lee recalls (along with an 80-well closed-loop geothermal system providing all heating and most cooling, a rainwater harvesting system to reduce potable water usage, low-energy workstations and LED lighting, a facade designed to minimize solar heat gain, and an all-electric power system avoiding fossil fuels altogether)—yet the architects, he says, rejected “the original concept, which was to put all of these solar panels down on the field and cover the greenscape of the campus. We wanted to do a little bit better than that, and we actually wanted everything that talks about sustainability to be integrated into the identity of the building.” The PVs form a roof canopy instead; “it’s a build-

ing that actually begins from the top down,” Lee comments. Observers may read its profile, at first glance, as a building wearing a scholar’s mortarboard: the 1,450-panel PV canopy, a companion to the one topping the Tata, proudly proclaims both the Bloomberg’s cerebrality and its commitment to renewables.

With exceptional coordination among the architects, engineers, fabricators, general contractor, and others to align decisions with energy goals, Lee says, the Bloomberg Center embodies a broad definition of resilience. Along with the rigorous metrics, he observes, “there’s a lot of hype about the Net Zero thing,” but “we wanted to prove that a Net Zero building is actually a healthier build-

ing”, better-fit, more livable, and more productive than ordinary facilities. “If you have a building that is wonderful, it spends no energy, but it’s awful to [be in] because it’s dark, there’s no lights, or it’s just kind of unpleasant, there is really no point.” Intangibles like views, artwork, program-tailored rooms, elegant structural members, and smoothly curved volumes all contribute to its performance. The Bloomberg is sustainable not in an eat-your-vegetables sense of constraints, but in the heady atmosphere of a clean green future.

The facade, 60 percent opaque and 40 percent transparent, controls energy demand through shading and achieves a form of dynamism without...
moving parts. On a gateless campus that emphasizes “porosity and access and public space,” Lee says, circular perforations in the aluminum panels made conceptual sense; the tracery simultaneously breathes, functions as a rainscreen, and suggests streaming bits of information. It also shimmers: iridescent PPG polymer coating on the aluminum shifts color along a green/brown/cooper continuum as lighting conditions and viewing angles vary.

The aluminum came pre-finished in huge rolls resembling paper products, Lee recalls. The design team had the idea of "imprinting the facade with some kind of pixelation ... we wanted to perforate it, but keep the remains of the hole as a little tab." Though the multi-angled tab patterns were created robotically with fabricator A. Zahner’s Louvered ZIPA (Zahner Integrated Pivoting Angular system), Lee likes to "debunk the myth a little bit." Zahner had a "very old welding arm that wasn’t even being used in their shop ... collecting dust in the corner, and one of the fabricators guys said ... we could probably program it ... and we can 3-D print a little nozzle that we could attach to the arm," turning it gently to shape the tabs. Staffers with Cornell and MIT tech backgrounds connected the device to an old laptop and wrote some quick scripts.

Volk: a repurposed welding robot. "All the advancement was only on this programming and scripting command," Lee recalls. "The infrastructure to execute the fabrication was all there." The patterns on the west and east facades, respectively, are derived from landscape photographs of the Manhattan elevation as viewed from the site, "a reflection of the exterior imprinted back to the building," and, facing Tech Walk on the campus interior, an image of an Ithaca gorge near Cornell’s main campus. Overall, the facade has 337,500 tabs; pores in the skin of an organism, pixels composing images that hover between familiarity and abstraction.

Another distinct feature is an arresting clinging curved-staircase hovering to the southeast, using the most complex of the building’s three categories of Guardian low-emissivity, low-iron glass fabricated by Crotacea, a specialist in glass bending. The strip windows, curtain walls, and skylights are 60N 62/27 insulated glass units (IGUs) with argon fill and warm-edge spacers (double SentryGuard Plus [SGP] laminated makeup on inboard and outboard lites for strip windows and curtain walls; SGP laminated makeup on inboard lites for skylights). The "Star 5 structure was treated almost as its own job by itself," notes Corey Weekley, project manager for MW2 Glass, that area used custom-bent 6N 69 IGUs.

The shapes involved compound bends, Weekley says, with a regular radius at the nose of the stair and "trapezoidal shapes that are also curved" at its bottom skirt. "We had a very challenging thing engineering the substructure to that glass, and then actually the thickness of the glass and the strengthening processes to be able to withstand the loads to be imposed by Roosevelt Island’s winds. I’ve never seen a building like that. It’s almost shaped like the Millennium Falcon from ‘Star Wars.’"

"When they engineered the building," Weekley continues, "It’s like a gigantic frus, and it’s designed so that when there’s six stories of glass hanging on it, it’ll drop ... two inches here, an inch and a half there." The team installed the panels out of level, anticipating the drop when all panels were stacked. The steel diagrid structure at the second and fourth levels "cantilevered as it came up to the nose of the structure; we had to pre-tension that 732 pounds per cable, the engineered weight of the glass, using tension cables and jersey barriers on the ground as dead weight, slowly releasing tension as glass was set. If we didn’t simulate the weight of the glass, the tabs would have been off. I mean, those things moved over 1/8 inch from the weight of the glass." Further complications included the lack of a floor carrying through the structure, as in a conventional stairwell (Weekley and his surveyor devised a waterjet-cut template attached to the parapet wall to hold control lines) and keeping inhumane paint on custom steel members watertight before installing the glass.

Every aspect of the project, Lee reports, involved high awareness of sustainability and constructability in all their forms. At the schematic design stage, he recalls, Superstorm Sandy struck. The architects re-evaluated program/space relations, moving most mission-critical equipment to the penthouse, elevating pumps and other basement gear onto pads, and specifying some items as submersible. Other measures tailored to the conditions of Roosevelt Island included офис construction of "utilized or modulated" facade systems to be transported via temporary barge—
Every aspect of the project involved high awareness of sustainability and constructibility in all their forms.

not trucked, since the island has only one access road. These measures offered other advantages:
"You can quality-control, you can build them inside a heated warehouse, you're not trying to stick-build this thing over the wintertime. You load it up as efficiently as you can, and then you start just clipping the thing; once they start clipping the facade, it goes very quickly." The facade's support system is "a unified stud panel with continuous insulation outboard of the studs, so we could get a really good continuous-envelope perimeter insulating line," with a Faberex pad providing a thermal break at the tricky transition point where a structural column emerges through the roof to support the PV canopy.

Cornell Tech prioritizes collaborative project work-over disciplinary boundaries and top-down information delivery, Lee says, having Dean Daniel Huttenlocher as the architect of this curriculum. The interiors correspondingly downplay "sage on the stage" unidirectional lecture halls for "guide on the side" communal spaces, scaled and proportioned appropriately. Public amenities on the ground floor include a lecture hall, a "galleria" running the length of the building for impromptu meetings, and a large café offering wide views to Manhattan and Queens. Embracing the quirks and vulnerabilities of its midriver site, the Bloomberg Center expresses openness on multiple levels, with an edgy design that fuses today's technology with tomorrow's purpose.

Above: The center's lobby and circulating stairs. Right: The Bloomberg Center was the first academic building to open on Cornell Tech's new Roosevelt Island.
At the new home of Local Union 3, design and engineering (not to mention a little historic research) combine to transform a former factory building into a high-tech educational center for electricians-in-training.

A city’s lights don’t run on their own—neither do its power supplies, train signals, and high-speed internet connections. Behind New York’s humminng streets and brightly lit buildings (and even the New Year’s Eve ball drop in Times Square) is a legion of electrical engineers, many of whom have trained at the home of Local Union 3, the Electrical Industry Training Center (EITC) in Long Island City. “The center’s new home evokes the energy of its mission to train the best in the field thanks to a renovation, led by the Educational and Cultural Trust Fund of the Electrical Industry and designed by Gensler, that added a new event space level to a former T-shirt screening factory’s concrete structure and allowed the building open at its northeast corner to create a double-height atrium and glass-enclosed climbing staircase. Now, the training center has an outward face that represents the forward-thinking culture of the union and the innovative profession it represents. It also stands as an example of the ways in which existing concrete buildings, notoriously difficult to retrofit, can be updated with structural steel architecture. Built in the 1970s, the original 30,000-square-foot structure was essentially two stories with a cellar that was partially below-grade. “One of the things we address right away was the fact that they wanted to add onto the building, but there wasn’t a lot of additional FAR,” says Peter Wang, the project’s design director for Gensler. In order to achieve the client’s wish of adding a third story event space for large meetings and galas, they were able to discount the portion of the building that was partially below-grade, as well as a portion that was reallocated for parking, which allowed for the addition of a third level over more than 50 percent of the building footprint—a strategy that was verified and approved through the help of a land-use attorney. The rooftop addition is framed in structural steel. “We always consider steel because it’s lightweight and it’s flexible, so later on if you needed to do any reconfiguration it would be much easier to deal with,” says Wang. But before plans could be finalized, structural engineers at Shmyrykovsky Consulting Engineers had to determine whether the existing structure could withstand the load of an additional floor.

With a new building, “The design team can relatively easily move things around to make the collective result work,” says Marco Shmyrykovsky. “With an existing building, which has limited or no existing drawings, the challenge is deeper and greater. Not only do you have the typical new-construction challenges, but you must adapt the solutions to mesh with something that already physically exists. Existing elements cannot always be moved to make way for new elements. Everything has to fit, live, and work together. Also, before you can modify the existing, you must understand how the object was originally designed and constructed. You must be a historian, an archaeologist, and an engineer.”

Because a comprehensive set of original drawings was unavailable, Shmyrykovsky put on his historian-archaeologist hat and consulted the building’s original column schedule and certificate of occupancy, which indicated that all levels, including the roof, had been constructed to handle live loads of up to 200 pounds per square.
to terminate above the existing concrete columns so that their vertical reactions would be transmitted into the columns below; this configuration avoided having to reinforce the existing waffle-slab structure. Due to the layout of new mechanical equipment on the remaining roof area, an alternative bracing system was required: W8 steel members connect horizontally from the screen wall to an intermediate W10 column and then to another W10 column that is part of the new level's framing system, thus bridging over the equipment.

A steel beacon tower at the building’s southwest corner is clad in photovoltaics, giving a glimpse at the energy-conscious electrical education being presented within. The 60-foot-tall tower posed a structural challenge, however, because of a staircase bulkhead at its base. The tower is composed of three vertical X-braced frames running north-south, spaced 12 feet, 6 inches apart, and two vertical steel chevron frames running east-west, spaced 12 feet apart. While X-braced framing would have also been an ideal lateral-support solution for the short-spanning direction of the tower as well, the X-braced framing for the westernmost side of the structure is the only north-south frame which is not interrupted by the bulkhead and which extend to the main roof level. For the other two braces, an alternative system was required. The engineers designed what they call an “external superbrace” made of a diagonal W10 brace running down from the southwestern W12 tower column to one of the W12 columns that supports the decorative screen wall. At that point, another W10 brace connects to the existing roof slab above one of the building’s existing columns. Shmaryukovsky describes the overall effect as an unobtrusive structural support system that maximizes the architectural impact of the beacon tower on the rooftop.

While the rooftop interventions perhaps had the most impact on the building’s presence in the neighborhood, another structural update at the building’s northeastern corner has drastically changed the
“The entire building has become a tremendous recruiting tool.”

Peter Wang, Gensler

experience of those entering the school. Where a nondescript door once led into the facility, a two-story glass atrium now invites apprentices and instructors inside. A brick-ridged volume represents a new core for the building; the architects replaced an oversized cargo elevator with two passenger elevators and four bathrooms and repurposed an existing fire stair as a light-filled circulation staircase with views to the street. The double-height glass wall that separates the staircase from the atrium is made possible, from a code-compliance standpoint, by fire-rated glass, which allows the stair to do double-duty as a fire exit. “It’s not the cheapest thing,” says Wang, “but it was fantastic to be able to open up the stair like this.

To create the atrium space, the structural team removed a rectangular portion of the existing waffle slab on the second floor and the roof level and shored the remaining slab. The resulting openings were refinished with W14 steel beams framed into new steel columns. To accommodate the new stair, existing openings were widened and repaired with heavy W14 and Hollow Structural Section (HSS) members designed to open between supports without the benefits of a braced top flange (HSS sections were used in locations where torsional rigidity was required),” says Shewchuck. These members frame into new steel columns that were installed along the perimeter of the stairway opening. Elements of this framing system also function as support for the stair’s stringers. Underneath the stringers at the second and third floors, north-south-spanning W12 beams frame into the foundation wall.

The stair’s exposed structure hints at the openness and high-tech aesthetic the renovation brought to the rest of the training center, where classroom and workshop space was also fully renovated. In some hallways, overhead ductwork and electrical conduit are exposed behind mesh ceilings, allowing them to become real-world examples for apprentices. “The entire building has become a tremendous recruiting tool,” says Wang. Because the existing brick facade was deteriorating and uninsulated, the architects elected to use two-ton aluminum composite panels (ACM) to replace most of the facade. “Using ACM panel on the facades was not only cost-effective and provided a visual contrast to the surrounding context, using it on insulated stud wall framing was a lightweight facade solution that also allowed us to make the building energy efficient,” he says. As reducing energy consumption becomes more of a priority across all professions, it’s an important lesson for any training program to impart on its students.
A new folded-ribbon facade of composite aluminum fins connects to the original structure with a minimum of intervention, ensuring thoughtful reuse of a venue that still has a lot of wins in its future.

THE NASSAU VETERANS MEMORIAL COLISEUM is a beloved fixture of Long Island life. So treasured is it, the Uniondale, New York, multipurpose arena even has pet names—most famously Fort Neverlose, which hockey fans coined in the early 1980s in the midst of the New York Islanders’ four consecutive Stanley Cup victories. Yet emotional attachment never spared the Walton Glocke-designed concrete bowl from criticism. Sportscaster Marc Albert reportedly called Nassau Coliseum “a dump” at its 1972 ribbon cutting, and property owner Nassau County had battled around redevelopment plans for the facility and its 77-acre site since at least 2000.

With a renovation by Forest City Ratner Companies completed in April 2017, Nassau Coliseum now boasts an architectural identity as bright as its reputation. Thanks to an over-cladding designed by New York-based SHoP Architects, the 416,000-square-foot venue shines literally as well. The new exterior is a folded ribbon comprising 4,700 individually unique Alubond fins. SHoP coated the bowl’s original concrete siding and 32 perimeter girders in black paint to bring out the composite’s brushed aluminum shimmer.

When Nassau County issued this project’s underlying redevelopment RFP in March 2013, Forest City had its own winning streak in mind. The Brooklyn-based developer behind the soaring Barclays Center (see Metals in Construction Winter 2013, p. 16) recommended SHoP’s construction manager Hunt Construction, and other key players from the then-year-old arena project to respond to the suburban opportunity.

While the RFP team initially considered replicating their previous success by erecting an arena from the ground up, it instead felt drawn to consuming fewer resources and modernizing the vintage building. “Studies proved the economic viability of incorporating certain minimally invasive techniques of connecting to the existing structure, and quickly we realized that something very compelling could be done to transform it,” says SHoP director of virtual design and construction John Cerone. He adds that the group still planned to emulate the Barclays Center in its digital fabrication method. As with the Brooklyn arena before it, SHoP would create the Nassau Coliseum geometry in Rhinoceros software and then plug it into a CATIA model to reconcile the new facade’s mass-customization concept with performance and constructability parameters. Forest City first presented the coining over-cladding as part of a schematic design in May 2013 and won the redevelopment in September.

Post-contract bidding changed the project’s structural presumptions. While the original schematic design envisioned that Nassau Coliseum’s over-cladding would be highly penalized and
clipped into the concrete structure at regular intervals—taking another page from the Barclays Center—subcontractor Crown Con concluded for the job with greater simplicity in mind. As Cerone puts it, “They came in and said, ‘You set up a structural ring form from which smaller units are hung; we’d use the arena’s concrete piers and span the entire system in 32 bays.’ We were looking at four [pier sets] per bay, and they said, ‘We think we can do it in one.’

Crown Con founded its proposal on space-frame construction. As the Gary, Indiana-based subcontractor’s operations manager Kirt Opres says, “Nassau Coliseum’s schematic design used steel structural channels, which would have encompassed going behind the existing concrete siding, and everyone was uncertain about what was back there and where it was.” The company had just employed a space-frame to clad a transit facility in San Francisco, and the concept seemed suited to this case, as well. “That would allow us to attach a structural lug to the concrete piers and attach the space frame to those lugs already pre-assembled with the fins,” Opres says.

A space frame not only avoided the risk and cost of penetrating the arena, but also improved upon SHoP’s vision for a reinvigorated skin. “Instead of channels and angles installed behind the fins, now there would be round tubes and space-frame nodes, and we wanted to understand the aesthetic implications of that,” Cerone says. “It was relatively effortless to model that change, and we were happy with the results.” New York-based Thornton Tomasetti, which joined the project team around the same time to provide structural engineering and façade consulting services, further checked the tensile stability of Crown Con’s idea. As associate Elle Karanci recalls, “The first questions that came to my mind were, ‘How many attachment points, and what loads do they impose on the building?’”

Thorton Tomasetti conducted studies in which the space frame endured wind loads beyond 100 percent to confirm the capacity of the 8-foot-wide concrete piers. It also drew 16 cores from the perimeter at different heights to make sure that the concrete could handle the attachments’ point loads. To attach the space frame to two points of each pier, the engineers decided to exploit one of the signatures of the Weldon Beckett scheme. As Thornton Tomasetti principal Jeffrey Callow explains, “Nassau Coliseum’s 32 perimeter concrete piers are U-shaped in plan, with the opening of the U facing the outside of the arena, and the U-shape transitions to a solid rectangular concrete column below the main concourse level and rests on a 241-square-foot footing. We thought the space frame contractor could create a wide-flange horizontal beam spanning the inner faces of the U-shaped pier to [hold] the outrigger supports.”

Crown Con’s structural lug comprises a W14x132 flange spanning 4-foot-wide welded endplates, which are bolted and epoxied to the concrete. Welded to the face of the W-flange are two matchplates, from which 10-inch-diameter HSS tube frames provide welded “hull-rods” for attaching adjacent space-frame panels. The attachment points are separated by approximately nine and a half feet of elevation.

The overall form of the space frame was revised and updated as SHoP® incorporated design connections and fabrication criteria into the CATIA model. Because Alucobond manufactures the over-cladding’s aluminum composite in coiled sheets of a standard dimension, Cerone cites as an example, “we adapted the design so that when you unfold the sheet and fold the fins, it fits exactly on that width. You have to make minimal cuts and there’s zero waste.” Once the fin scheme was finalized, the frame’s tubes were cut to length and sized per load path. The space frame is assembled from HSS in diameters that vary from 2.375 to 3.5 inches according to tuned-to-contextual loads and load paths. The chords are threaded into spherical nodes ranging from 3.5 to 7 inches diameter. The overall project’s steel types also range in specification, in response to conditions, and include ASTM A668 and ASTM A693.

Cerone says the space frame is inherently efficient and did not impact design criteria as the Alucobond had. He also notes that the interaction of Nassau Coliseum’s new façade and its existing structure serves as a proof of concept for automating the design process. “What’s exciting is that it realignates time,” he observes. “You can spend more time making decisions and understanding the why of those decisions—you can explore aesthetic intent, performance, and other implications when you can compress the execution.” Callow believes the project bodes well for responsibly reusing mid-20th-century buildings that are approaching obsolescence. “The lesson is that you can marry a new shape and a new form to what was existing, without forcing that design upon the structure.”

For sports fans and concertgoers, the result may not be so handy, but it’s no less momentous. Long Islanders finally have a gathering place they can root for.
NASSAU VETERANS MEMORIAL COLISEUM FACADE RENEWAL

Location: 3255 Hempstead Turnpike, Uniondale, NY
Developer: Forest City Ratner, New York, NY
Prime Architect: Gensler, New York, NY
Facilities Designer: Studio Architect, New York, NY
Structural Engineer: Thornton Torreсадa, New York, NY
Construction Manager: Hunt Construction Group, New York, NY
Facade Consultant: Thornton Tomasetti, New York, NY
Structural Steel Erection: MCLO Structural Steel Corp., Farmingdale, NY
Metalwork in Steel Fabrication and Erector: C&G Steel Corp., West Hemp, NY
Freedom Ironworks Inc., Rockville Centre, NY
Curtain Wall Fabricator and Erector: Crown Corp., Inc., Cary, NY

The coliseum shortly before its completion in 2017.
WINNER AND FINALISTS ANNOUNCED FOR METALS IN CONSTRUCTION MAGAZINE 2019 DESIGN CHALLENGE TO CREATE A NEW URBAN PATHWAY

On February 25, Metals in Construction magazine and the Steel Institute of New York named the winner and five finalists for its 2019 Design Challenge at the TimesCenter in New York City. The "Create A New Urban Pathway" competition challenged architects and engineers to design a pedestrian bridge that connects the transportation hub of the newly adapted Moynihan Train Hall with New York’s largest development since Rockefeller Center, Hudson Yards, which is estimated to see 100,000 workers traveling from the rail station to offices there each day.

The Metals in Construction magazine 2019 Design Challenge was conceived to generate ideas for making foot travel a more attractive, engaging component of living and working in a city. With urban environments overly reliant on automobiles, creating elevated, landscaped thoroughfares that encourage foot traffic can help alleviate congestion and improve the overall experience of urban life. One testament to this is the popularity of the High Line’s transformation of an abandoned railroad spur into a pedestrian walkway, stimulating development in adjacent neighborhoods along the way. The High Line captivates New Yorkers in a way that few projects do. It also demonstrates the potential such projects have to revolutionize urban landscapes by serving not just as places for public recreation, but also, when properly designed, as preferred modes of travel for commuters to use on a daily basis.

The magazine awarded a $15,000 grand prize to the design judged best at delivering this connectivity while becoming an iconic urban pathway unto itself. Titled “The Midtown Viaduct,” the winning proposal “employs forward-thinking approaches to form, fabrication, assembly, and urban solutions that mitigate/synthesize the complex forces of contemporary cities,” writes the team from DXA Studio (see full team information below). The jury praised the design for its structural and fabrication feasibility as well as for presenting a compelling idea for streamlined pedestrian transit that still offered opportunities for a unique urban experience.

This year’s winner was chosen from a field of 45 qualifying entries. The panel of four jurors who awarded the prize come from architecture and engineering fields and include experts in urban design and infrastructure: Benjamin Poskey, Assc. AIA, Executive Director AIA New York Chapter; Claire Walz, FAIA, Founding Principal, WXY architecture + urban design; Enrica Oliva, M.Sc. Struct. Eng., Partner and COO, Werner Sobek NY; Paul Bauer, AIA, LEED AP Principal, Dahlin Architects. Jack Robbins, AIA, LEED AP Principal and Director of Urban Design, FXCollaborative Architects, served as moderator for jury deliberations.

The grand prize was awarded at a half-day conference at the TimesCenter in New York City on February 25, 2019. The competition was sponsored by the Steel Institute of New York.

The Metals in Construction magazine 2020 Design Challenge, themed “Create A New Urban Identity,” will be sponsored by the Ornamental Metal Institute of New York with the goal of reimagining the skin of an existing building in New York City. The full competition brief will be announced in September 2019.

For more information about upcoming Institute-sponsored events, visit www.siny.org and www.ominy.org.
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Terry Flynn
Tutor Perkins Corporation
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Stephen Laseacon
SPI Consultants LLC
Carlin, NJ

William Mathe
Ivanhoe Inc.
Claremont, NJ

Rich Lucato
F.J. Lucas Consulting Inc.
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Manhattan, NJ

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Mont Brothers, S.W. Co., Inc.
New York, NY

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Director of Industry Development

Metal in Construction Summer 2013