

METALS IN CONSTRUCTION

THE STEEL INSTITUTE OF NEW YORK
THE ORNAMENTAL METAL INSTITUTE OF NEW YORK
211 EAST 43RD STREET, SUITE 804
NEW YORK NY 10017

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

METALS IN CONSTRUCTION

PUBLISHED BY THE STEEL INSTITUTE OF NEW YORK AND THE ORNAMENTAL METAL INSTITUTE OF NEW YORK
FALL 10

ROCKEFELLER UNIVERSITY COLLABORATIVE RESEARCH CENTER /
200 FIFTH AVENUE / RESCUE COMPANY 3 /
COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING FACADE /
COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING STRUCTURE/
MILSTEIN FAMILY HEART CENTER / GATEWAY CENTER AT BRONX
TERMINAL MARKET / MEDGAR EVERS COLLEGE ACADEMIC BUILDING 1



CONTENTS
FALL 10

1	EDITOR'S NOTE
2	ROCKEFELLER UNIVERSITY COLLABORATIVE RESEARCH CENTER
10	200 FIFTH AVENUE
16	RESCUE COMPANY 3
22	COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING FACADE
26	COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING STRUCTURE
32	MILSTEIN FAMILY HEART CENTER
38	GATEWAY CENTER AT BRONX TERMINAL MARKET
42	MEDGAR EVERS COLLEGE ACADEMIC BUILDING 1



Copyright ©2010 by The Steel Institute of New York
and The Ornamental Metal Institute of New York

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

The information contained in this magazine is merely general and illustrative in nature. The Institutes assume no responsibility for either the design or actual cost of any structure resulting from the use of the information contained herein, nor should anything herein be construed as either an endorsement or disapproval of any systems or designs indicated. Anyone relying upon or making use of this information does so at his or her own risk and assumes any and all liability or consequences resulting therefrom.

Above The Milstein Family Heart Center's double-skin curtain wall, designed by Pei Cobb Freed & Partners.

Paul Warchol; cover: Adam Friedberg

Adam Friedberg

EDITOR'S NOTE
Transparency by design

FOR A NUMBER OF YEARS now, the ads we place in industry publications have featured the slogan ***Transforming design into reality.*** It is meant as an expression distinguishing the role our industry plays from that of the designer in creating the built environment. Design aspirations need applicable building technologies for successful realization, and new concepts must foster even newer technologies in order to be realized. The innovations arising from this collaboration are what inspire the next era of designs, marking an evolutionary cycle that has long been important to the advancement of architecture. Nowhere has this collaboration been more influential than in the development of curtain wall systems. In this issue those influences are apparent as four of the articles document the technical aspects of curtain wall projects where building technology was instrumental in achieving the designer's goals. While the goals differ, in each transparency is the dominant theme. At Rockefeller University Collaborative Research Center transparency was desired for the visual experience, not only from within but from without, an experience enhanced by complex geometry and the museum-like encasing of an existing neoclassical facade. At 200 Fifth Avenue, transparency is used to provide dramatic views of a newly configured courtyard, views that helped create a desirable office environment out of uninspiring tenant space. At Columbia University's Northwest Corner Building, where the scheme of the curtain wall is integrally linked to the building's steel structural system, glass and louvered aluminum panels alternating in a rational

but painterly fashion achieve a transparency that reveals the structure, enticing people to look at, not through, the wall system. Developments in coatings, light modulating treatments on glass, as well as sun screening devices, lead to an energy responsive climate wall concept in the Milstein Family Heart Center. There the designer's goal was to bring the outdoors in, to aid in instilling hope in those facing life-threatening illnesses. In embracing the idea of transparency, these projects' design teams explored not only the possibilities of glass but of systems to support it, wanting the elements to be as minimal as possible without compromising strength. Designing systems such as this requires a high degree of knowledge on the part of the engineers and enclosure consultants, knowledge of both the forces and of the fittings and fixtures appropriate to resist them. With this knowledge, and with advances in engineering, material and glass technology, architects continue to aspire to new designs, aspirations that industry is able to transform into reality.



Gary Higbee

Gary Higbee, AIA, Editor
higbee@ominy.org /
higbee@siny.org

The Rockefeller University Collaborative Research Center

Renovations to two laboratories create a bridge between an academic institution's past and future scientific accomplishments.

WHEN THE ROCKEFELLER University began thinking about its future in the next millennium, it turned to two buildings that had helped foster more than 20 Nobel Prize-winning scientists during the past century. The buildings, Theobald Smith Hall, built in 1930, and Flexner Hall, built in 1917, form the historic northeast corner of the 14-acre Manhattan campus. To continue the university's outstanding legacy of achievement, both buildings needed updating of their facilities, as well as of their institutional model.

The university hired New York-based Mitchell/Giurgola Architects to undertake a gut renovation of the obsolete research buildings. Both infrastructure and laboratory spaces were in need of total replacement, but the new labs boast more than high-tech research facilities; bridging the open space between the two buildings—literally and figuratively—is a seven-story atrium designed to facilitate interaction between Rockefeller's scientists. As a symbol of the collaboration that will take place there, this dramatic elliptical atrium, enclosed by a metal and glass curtain wall and, on the interior, by a wooden lattice structure, offers a glimpse of the university's forward-thinking vision while respecting its past accomplishments.

The architects' goal of creating a light-filled space in which scientists can meet and share ideas involved several key design considerations, both practical

and creative. Maintaining a line of sight through the bridge building was important yet complicated because the buildings' longitudinal axes are at right angles to one another. The designers decided the new curtain wall would appear as an extension of Smith, whose original steel framing made removal of its southern face easier, while Flexner still reads as one building, its distinctive masonry bearing walls visible through the new glass facade. "We are very happy with the transparency of the curtain wall," says Jillian Sheedy, senior associate at Mitchell/Giurgola. "From the outdoors one can still experience the elegance of the entire neoclassical facade of the Flexner building."

Working with curtain wall consultant R.A. Heintges & Associates, Mitchell/Giurgola designed the curtain wall with large horizontal spans that create dramatic views toward the entry plaza to the west and the river to the east. The dramatic 17,000-square-foot western portion consists of two different panel systems in order to create the conical wall and the flat portions on either side. To support the conical portion, custom steel framing members were built up by welding together steel plates and finishing the exposed surface before painting. Each member had an access pocket that allowed fastening it to an adjacent mullion or transom. Steel infill plates were added to cover the access pockets and then steel glazing adaptors were welded to

each profile. A gasket system was installed over the glazing adaptors prior to installation of low iron insulating glass with Interpane Ipasol Neutral 73/39 low-e coating.

The adjacent flat walls consist of a unitized aluminum curtain wall system containing the same glass and hung from each floor slab with aluminum anchors. To minimize the appearance of the edge of the floor slab the designers used a painted steel plate instead of concealed spandrel zones.

While the flat panels are supported at each floor, the conical portion is hung from above. Because framing it entirely in concrete would have made it too heavy, much of the rooftop structure from which the curtain wall hangs is framed in steel. This hybrid component supporting the curved facade consists of a horseshoe-shaped concrete ring beam that is cantilevered past the setback exterior columns to the face of the flat wall. There, the ends support a W24x306 steel beam with a depth of 24 inches and a length of 48 feet, the beam being pocketed into each end of the horseshoe. This beam in turn supports a series of 24-inch steel beams cantilevering up to 18 feet to support the outer arc of the curve—a series of W8x35 beams each roll bended to create the curved shape—from which the curtain wall hangs. The back span of each cantilever is supported on the east side of the building by a much lighter W24x62 long-span beam, which frames into a deep concrete beam below.

Mike Lynch, senior associate and project manager with the

The Collaborative Research Center connects Smith (left) and Flexner halls with a seven-story glass enclosed bridge building.

Adam Friedberg



project's structural engineering firm, Severud Associates, says that the primary challenge was to calculate the deflection of each beam individually and collectively in order to minimize movement of glass in the curtain wall. Because snow loads on the roof could put weight on either end of the cantilevered beams, causing them to act like a seesaw, the engineers designed a slotted anchor to attach the curtain wall panels to the slab at each level. Embedded in the floor plate, the architecturally exposed stainless steel connections support the horizontal load and allow bolts to be tightened as the structure inevitably settles during installation, ensuring a watertight facade. "There's nothing special about the materials," says Severud chairman Ed Messina, "just the technique."

Turner, the project's construction manager, worked to avoid

Above Recessed glass handrail shoes hidden by painted aluminum fascias and custom stainless steel railings and stand-offs maintain the stair's weightless appearance.

deflection with another special technique. Using a Link Belt 40-ton rough terrain RTC 8040 II crane bearing on footings below the plaza, the team loaded the ellipse panels in a pyramid configuration from the bottom up, ensuring that the steel cantilevers would lower evenly and simultaneously.

Differential movement between the sloped and vertical walls is taken at their interfaces. On the north side of the cone, where balconies interrupt the glass on the second through fifth floors, a slotted double mullion marks the transition between steel curtain wall systems. At the south side, the juncture between the steel and aluminum curtain

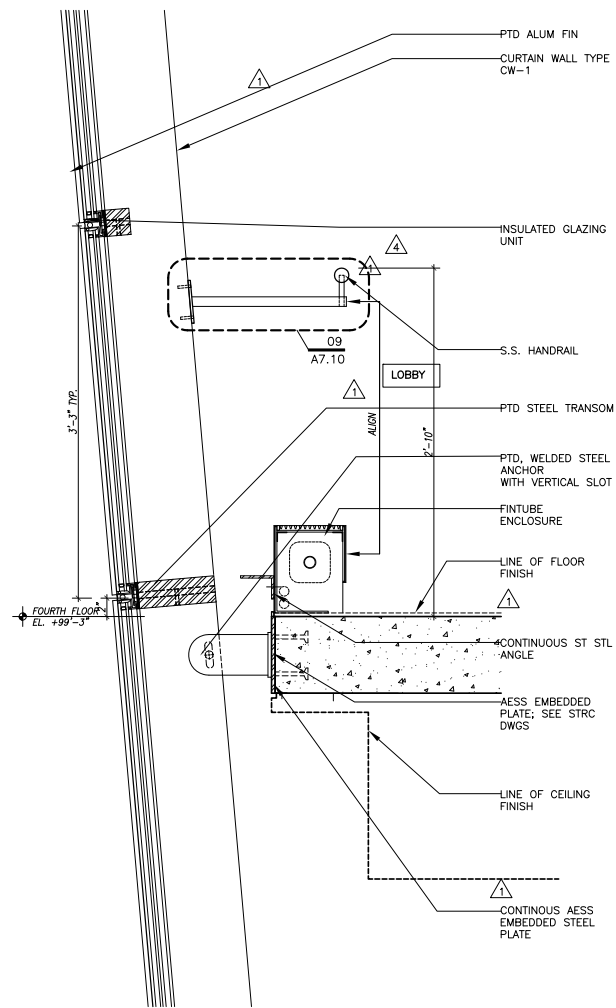
Facing The curved curtain wall completes the building's elliptical shape and creates a visual connection to the campus.

wall systems is marked with two separate mullions, which are linked while accommodating differential movement. Mitchell/Giurgola partner Paul Broches notes "the collaborative design of the hardware components to allow the movement between structure and envelope resulted in elegant details that we were happy to expose." In addition to the engineering team and Heintges, the architects worked with curtain wall consultant Allied Development Corp., curtain wall fabricator Frener & Reifer, and curtain wall erector Gamma USA to realize the complex design.

On the interior, the curtain wall's structure is no less stunning, mirrored by the wooden



Jeff Goldberg/Esto; facing: Adam Friedberg



Above A section detail of the west curtain wall's curved portion.
Below The structurally exposed slotted stainless steel connection allowed bolts to be tightened as the structure settled, ensuring a watertight facade.



Mitchell/Giurgola

Turner Construction

Facing top The eastern projecting conference rooms are glazed with highly transparent insulating glass with low-e coating.
Facing bottom A laboratory mockup of the atrium curtain wall was tested for air and water penetration and structural performance.

“The collaborative design of the hardware components to allow movement between the structure and the envelope resulted in elegant details that we were happy to expose.”
 Paul Broches, Mitchell/Giurgola Architects

latticework that completes the atrium's dynamic form. “The bridge building, of which the atrium is a part, performs two functions,” says Broches. “The square footprint of the new structure joins the historical lab buildings. The conical ellipse creates visual connections between floors and horizontal views from meeting spaces and casual gathering spaces through the latticework and, finally, beyond the curtain wall to the landscape beyond.”

Inside the atrium scientists have a number of open lounge and meeting spaces and glass-enclosed conference rooms, five of which are all-glass circular enclosures equipped with audio-visual technology. The atrium has an enhanced smoke control system that exceeds the requirements of the NYC Building Code. In the event of a fire, motorized Schuco windows open, allowing rooftop fans to exhaust smoke while drawing fresh air into the building.

Connecting the atrium and the bridge floor levels is a monumental stair, which appears weightless by the incorporation of all-glass guardrails set in metal shoes. Ornamental metal fabricator and erector Champion Metal and Glass had to set each shoe precisely at a 90-degree angle to the stair, ensuring that glass panels lined up perfectly. Recessing the rigid shoes behind the painted aluminum fascias contributed to the stair's weightless appearance. Stainless steel handrails are attached to the ½-inch-thick glass with custom stainless steel stand-offs that not only highlight the staircase's form, but also ensure its safety.

Rockefeller's new Collaborative Research Center has already become the highlight of campus tours, a hidden gem in the dense urban landscape thanks to a design and construction process analogous to the collaborative scientific work to be carried out within it. “It is very special to work with a team where all aspects of the construction process come together as well as we experienced at Rockefeller,” says Turner project executive Joe O'Connor. “The owners, the architects, the engineers, the subcontractors, and Turner developed a synergy between our operations and that is the main reason for the project's success.” ■





Left A slotted double mullion marks the interface between the cone and its north side, where balconies interrupt the glass.

Above The building will connect scientists from a range of disciplines.

THE ROCKEFELLER UNIVERSITY

Location: **504 East 63rd Street, New York, NY**
Owner: **The Rockefeller University, New York, NY**
Architect: **Mitchell/Giurgola Architects, LLP, New York, NY**
Structural Engineer: **Severud Associates, New York, NY**
Mechanical Engineer: **Bard, Rao + Athanas Consulting Engineers, LLC, New York, NY**
Construction Manager: **Turner Construction Company, New York, NY**
Curtain Wall Consultants: **Allied Development Corp., College Point, NY;**
R. A. Heintges & Associates, New York, NY
Miscellaneous Iron Erector: **HDG Consulting, Douglaston, NY;**
Post Road Iron Works, Greenwich, CT
Ornamental Metal Fabricator and Erector: **Champion Metal and Glass, Deer Park, NY**
Curtain Wall Fabricator: **Frener & Reifer America, Long Island City, NY**
Curtain Wall Erector: **Gamma USA, New York, NY; JEM Architecturals, Bronx, NY**



This page Architects designed a terraced addition to join the second through fourth floors, creating connectivity between floors and a landscaped courtyard for new tenants.

200 Fifth Avenue



From the inside out, renovation of the Toy Center building gives new life to the landmarked icon.

SOMETIMES AN ICON OF THE PAST MUST UNDERGO A FACELIFT to become an icon of the future. This was the case for 200 Fifth Avenue, the landmarked former International Toy Center built in 1909 that for decades was the home to toy manufacturers and suppliers before becoming largely vacant in recent years. Owner L&L Holding Company knew that finding tenants for the upper floors of the building, with majestic views overlooking Madison Square Park at the corner of 23rd Street and Broadway, wouldn't be a challenge after some interior modernization. However, finding tenants to take the lower floors facing an interior court full of mechanical equipment would be much more difficult. Responding to this challenge, the firm hired Studios Architecture to undertake an ambitious renovation of the entire building, opening up its circulation and adding a 14-story curtain wall with dramatic views overlooking a newly configured courtyard in the building's center.

Studios, working with structural engineering firm Thornton Tomasetti, identified three improvements that would create Class A office space for the entire building. The first was to create larger and more functional elevator lobbies by renovating the building entrance and adding a 14-story lobby extension onto the eastern courtyard wall. The second was to create additional floor space on the second through fourth floors by filling in the western end of the courtyard with a terraced structure that would increase circulation, making a rectangle out of the U-shaped floors. The third objective was to flood both the eastern elevator lobbies and the western infill floors with natural light by building glass and aluminum curtain walls facing the newly infilled courtyard, transforming the new terrace into a tranquil, landscaped gathering space. All the improvements were carried out in structural steel because of its versatility.

Engineers had the advantage of working with the existing structure's robust steel columns. "As we began to analyze the building's structure, we found that the columns had a great deal of reserve capacity, which helped minimize the reinforcement necessary to accommodate the additional loads," says Gary Mancini, senior principal at Thornton Tomasetti. Although many of the building's original structural framing drawings were uncovered, they did not contain essential information on the connection details. Because the beam connections were encased in 18-inch terra cotta flat arch floor slabs, engineers performed nearly 100 probes throughout the undersides of the floors to measure and evaluate the connections.



This spread: Studios Architecture



Top left Steel frames the new 14-story elevator lobby extension on the eastern courtyard wall.
Above left Column brackets at the north and south sides of the courtyard infill floors receive long-span W18 girders.



Top right The building's mechanical court before the renovation.
Above right The stepped west courtyard infill floors under construction.

“From a leasing standpoint, an attractive, exciting space on the second floor of a building isn’t always apparent.”

David Burns, Studios Architecture

Right The 14-story curtain wall extends to the lobby, bringing in natural light.



They found that the connections consisted of numerous variations of riveted seat configurations, stiffened and un-stiffened. Limitations in floor load capacity were driven primarily the beam connections, many of which required field-welded reinforcement or stiffening to strengthen the capacity in several areas where loads were increased.

“On the second, third, and fourth floors, the structure provided the connectivity that the tenants were going to be wanting,” says Studios principal David Burns. With a 40-by-60-foot courtyard as the focal point, architects were able to take advantage of larger existing floor-to-floor heights of 10 feet, 4 inches to create the hub of the building on the second and third floors. “From a leasing standpoint, an attractive, exciting space on the second floor of a building isn’t always apparent,” says Burns. “To really lease the building from the bottom up, we got clearspans across the courtyard so we didn’t have any columns.” Leased to advertising and marketing powerhouse Grey Group, the design gave the tenant the ability to accommodate the maximum number of people in its offices. “To have that big space at the center of their creative department, and the entire arrival sequence for the potential client in the event of a pitch, was important,” says Burns.

The 40-foot-wide, column-free courtyard infill was achieved with relatively shallow W18 girders, but because existing spandrel beams prevented access to the columns for conventional connections, the team designed custom seat connections that fit right beneath the spandrel beams. The new seats directly engage both sides of the column flanges and extend beyond the spandrel beams to support the new girders. “Our primary concern with this solution was the bending moments induced on the columns due to the large eccentricity of the seat connections and the major girder reactions,” says Mancini. “We worked closely with the steel detailer to develop a connection that was not only feasible for transferring the loads with minimal bending moment, but could also be readily implemented in the field.”

Structural support of the 14-story elevator lobby extension at the east side of courtyard, posed another challenge. The objective was to minimize the structural profile to achieve the architect’s vision of maximum clarity through the transparent new curtain wall. Because the second floor of the elevator lobby is open to the ground level, the vertical supports would need to span un-braced for nearly 30 feet, supporting the entire elevator lobby extension above. Ultimately, the aesthetic and structural goals were met with a pair of HSS20x8 A500

Clockwise from top: Studios Architecture; Studios Architecture; Thornton Tomasetti; Studios Architecture

Studios Architecture



Terra cotta louvers mark the separation between the landmark structure and the new 176-foot-tall curtain wall.

This spread: Studios Architecture

Grade B, Fy 46 ksi columns that transferred out to massive W18 girders at the ground level.

Concerns about the cost of installing a 14-story curtain wall system initially led the team to consider installing a window wall system. “Minimal differential in costs for this scale project and the improved visual appearance, enhanced performance and faster installation of unitized systems moved the project toward pre-tested, pre-engineered curtain wall systems,” Mancini says.

The courtyard’s new 178-foot, 14-story curtain wall on the east end is a four-sided structurally glazed aluminum mullion and glass unitized system, with 66-by-144-inch-high units anchored to the top of the structure at each floor. The exception is the lower two stories where the increased story heights required a stick-built system with reinforced vertical mullions. The clear 1-inch insulating glass has a PPG Solarban 60 low-e coating on the No. 2 face of the assembly, and spandrel areas are covered by clear 1-inch insulating glass with an insulated metal panel shadow box. Because of the higher story heights on the north and south courtyard walls, and on the “wedding cake” setbacks on the west side, a stick-built system using the same four-sided structurally glazed curtain wall panels was used at these locations.

The courtyard’s north and south setbacks, planted with sedum at the 8th and 12th floors, created a unique opportunity for the architects to juxtapose the old and new wall structures with 2-inch-square horizontal terra cotta louvers over the two vertical bays that infill the set-back areas, and over the 8-foot-high screen wall that juts above the roofline. “We’ve tried throughout the project to separate some of the old pieces from the new to create buffers, so it felt like a clear distinction and a respect for the existing structure,” says Burns. The use of multiple wall systems and green roof assemblies required the designers to pay particularly close attention to maintaining continuity of the thermal insulation, air and moisture barrier and transitions between new and existing wall systems.

While 200 Fifth Avenue’s internal changes are dramatic, L&L Holding knew that most who passed by would never see them, so they decided to update the ornate bronze entry to better reflect the sleek redesign of the building’s main lobby and interiors. Though the existing entry was not original to the building—it had been built with an open-air ground floor, like an arcade—any changes to the exterior still had to pass landmark approval. Studios collaborated with Thornton Tomasetti’s Building Skin experts to design an ultra-clear structure to complement the historic facade: three grand panels of anti-reflective, low-iron glass that span the width of the 16-foot arched doorway. The panels appear to float above the entrance, held in place at one-third points with bronze clamp supports, each a mere 3-by-3-inch square, attached to steel cables that are pre-stressed to a tension force of over 30,000 pounds in order to minimize deflection of the long-span glass panels under wind loads. To accommodate these huge forces, the building framing was reinforced at the cable support points behind historic limestone columns. Now, the ornate stonework of the vestibule and the newly sunlit lobby beyond are clearly visible, ensuring the building’s future will be just as bright as its past. ■



Glass supported by barely visible cables spans 200 Fifth Avenue’s new entrance.

200 FIFTH AVENUE

Location: **200 Fifth Avenue, New York, NY**
Owner and Developer: **L&L Holding Company, New York, NY**
Architect: **Studios Architecture, New York, NY**
Structural Engineer: **Thornton Tomasetti, New York, NY**
Mechanical Engineer: **FMC Associates, New York, NY**
Project Manager: **Gardner & Theobald, New York, NY**
Construction Manager: **Structure Tone Inc., New York, NY**
Curtain Wall Consultant: **Thornton Tomasetti, New York, NY**
Structural Steel Fabricator and Erector: **Empire City Iron Works, Long Island City, NY**
Miscellaneous Iron Fabricator and Erector: **Transcontinental Contracting, Newark, NJ**
Architectural and Ornamental Metal Fabricator and Erector: **A-Val Architectural Metal Corp., Mount Vernon, NY**
Curtain Wall Erector: **Genetech Building Systems Inc., Staten Island, NY**



The firehouse's upper floor is framed with a row of Y-shaped columns, which provide clear spans for a variety of spaces.

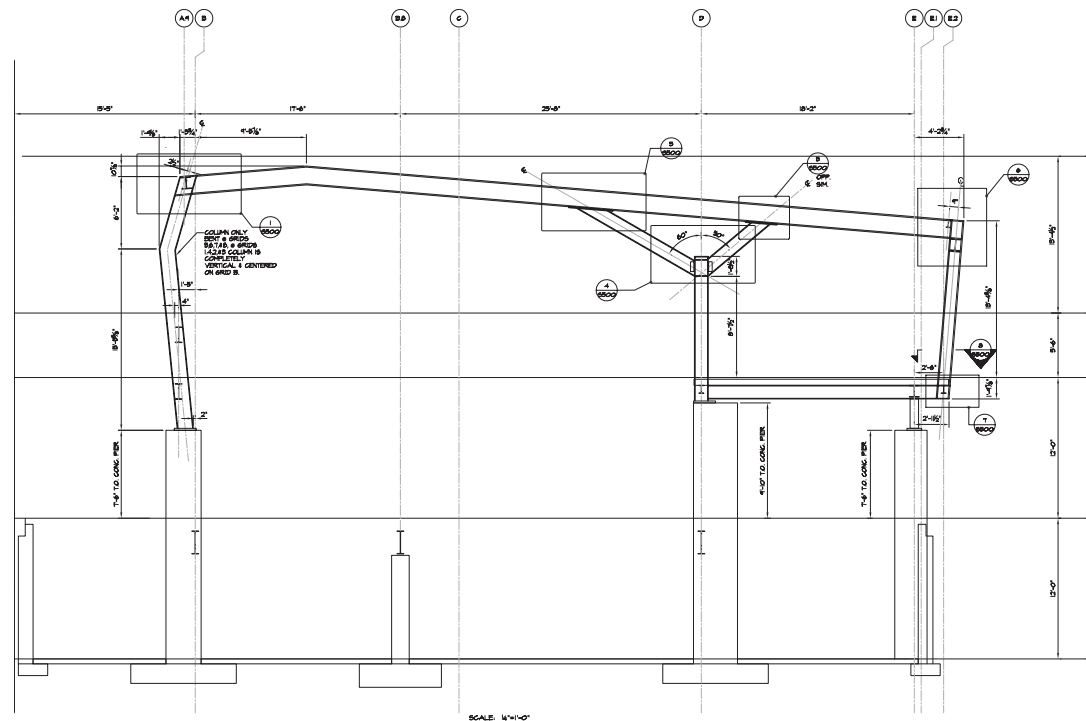
Rescue Company 3

Structural steel frames a new home for FDNY's Bronx-based Rescue 3.

IN 2005, COMMISSIONER DAVID BURNEY AT The New York City Department of Design & Construction responded to the city's call for a higher caliber of architecture by establishing the Design Excellence Program, issuing standing short lists for significant city projects. Among the eight firms selected to compete for the design of Rescue Station 3, Ennead Architects (formerly Polshek Partnership) emerged the winner and embarked on what principal Guy Maxwell classifies as, "A dream job so small you can wrap your arms around it!" The FDNY hadn't built a new rescue company in some time, and most were housed in existing firehouses, which in New York are narrow masonry structures. New York's Bronx-based Rescue Company 3, also known as Big Blue, eagerly anticipated a facility whose architecture would adapt to their needs, rather than the other way around.

Rescue companies handle tasks not commonly associated with a fireman's duties. Maxwell defines their breed as "the firefighters who rescue firefighters." High-angle rope work, water or confined rescue, and search for victims in structural collapse are among their unique capabilities. The tool kit they use is as eclectic as their work, including gear that can "slice and dice anything": Jaws of Life, pneumatic jacks, climbing rigs and all manners of cutting implement. "We focused on giving Rescue 3 a design tailored specifically around what they do," explains Maxwell. "We had to understand, for instance, where to place the equipment to be carried to and from the trucks, their maintenance, and what it would take to restock the trucks with whatever they'd need on call." In addition to spaces to accommodate this tool kit, the 20,000-square-foot stationhouse had to include a kitchen, dining hall, gymnasium, and sleeping quarters on a dauntingly tight site. So Ennead separated the station's "dirty" and "clean" functional spaces—tool storage and vehicles on the ground level, living quarters and gym upstairs—framing it with structural steel to provide the clear span spaces many of these functions required.

Ennead arranged the firemen's implements on the first floor around the company's fire truck—known within the profession as an apparatus. "If a fireman had his druthers, everything would be an arm's distance from the trucks," Maxwell reflects. The specially outfitted vehicles live in a double-height apparatus bay, the station's programmatic



Above A longitudinal section of the lateral steel frame.

Facing top In addition to tool and vehicle storage, the 20,000-square-foot stationhouse includes dining and living spaces, offices, and a gym on a small site.

Facing bottom Steel framing allowed for the addition of skylights, which let in sunlight while maintaining privacy.

crux. The minimum span that could accommodate these functions was approximately 44 feet, too much for concrete.

Workshops, house watch, and tool storage rooms surround the apparatus rigs, keeping all necessary amenities close at hand. The captain's office, bunkrooms, and communal area were placed upstairs along with a dining area and kitchen. Given the constant come-and-go of the fireman's schedule, off-call time becomes a valuable opportunity for training. A 30-foot-high wall topped by a hatch in the station makes itself useful for rigging and tying-off practice scenarios.

The division of dirty and clean programs called for an architectural expression that became the guiding principal of the structural system. Columns from the basement up to the second floor are cast-in-place concrete since vehicles and equipment could damage the fireproofing and cladding around steel columns. From the second v floor up, structural steel was used. "The way we looked at it architecturally, the first floor and basement were hard, but upstairs we wanted a more delicate expression with exposed steel coated with intumescent paint," says Ennead project architect Anthony Guaraldo.

The primary steel framing system consists of a single row of eight Y-shaped columns fabricated from W14x74 wide-flange sections. The Y shapes were assembled onsite with bolted connections. The row runs right of center along the length of the plan, connecting to W18x130 wide flange beams

that frame the shape of a distinctive zinc-clad roof. These beams connect to W12x120 columns at the perimeter, which bolt to steel plates imbedded in the concrete piers. All of the stationhouse's floors are framed with wide-flange steel sections in a variety of sizes ranging from W12x53 to W16x40 and topped with concrete poured on metal deck. A single crawler crane lifted the Grade 50 A992 steel members into place, where ironworkers bolted them together with high-strength bolts ranging in size from 3/4-inch to 1 1/4-inch diameter.

The exposed steel members in the station's interior are a fitting architectural expression, complementing exterior doors and curtain wall in FDNY's iconic red chrome, a color heralding the storied past of one of New York's most celebrated occupations. Skylights flood the apparatus bay with natural light although, "The team still needs to retreat when they come in and feel like they're in a bunker of sorts," asserts Maxwell. "We gave them privacy and uncompromised security." The robust assembly is tied together visually by its folded zinc roof. "We wanted a big wrapper to give the building an interesting massing and profile," says Maxwell. The overall effect is at once heartening and elegant. With both its physical and symbolic presence, Rescue Company 3 makes a silent promise to passers by that New York is in good hands. ■

Previous spread: Aislinn Weidele/Ennead Architects; top: Jeff Goldberg/Esto; left: Aislinn Weidele/Ennead Architects

Robert Silman



“Upstairs, we wanted a more delicate expression with exposed steel coated with intumescent paint.”

Anthony Guaraldo, Ennead Architects

Left: Studios Architecture; Top: Aislinn Waidele/Ennead Architects

Above left Workshops and storage rooms surround the apparatus rigs, separate from residential space upstairs.
Above right An exploded axon diagram shows how the firehouse is designed like a toolbox.



RESCUE COMPANY 3

Location: 1655 Washington Avenue, Bronx, NY
Owners: Fire Department of the City of New York, New York, NY:
The City of New York Department of Design and Construction, New York, NY:
Rescue Company 3, Bronx, NY
Architect: Ennead Architects LLP; New York, NY
Structural Engineer: Robert Silman Associates, New York, NY
Mechanical Engineer: WSP Flack + Kurtz, New York, NY
Construction Manager: The LiRo Group, Syosset, NY
Structural Steel Erector: Piermount Ironworks, Wayne, NJ
Ornamental Metal Erector: Piermount Ironworks, Wayne, NJ

Columbia University Northwest Corner Building Facade

A glass and aluminum curtain wall system creates a fitting expression of structure on a 21st-century laboratory building.

FAMED SPANISH ARCHITECT José Rafael Moneo is known for his elegantly conservative stone-clad institutional buildings. So his design for Columbia University's Northwest Corner Building—an interdisciplinary sciences facility containing a library, faculty offices, student breakout space, and 70,000 square feet of state-of-the-art laboratories—may come as a surprise to some. Nestled among the beaux-arts grandeur of the McKim, Meade, and White campus, between Chandler and Pupin halls to be exact, the 14-story, 188,000-gross-square-foot structure is clad entirely in a unitized curtain wall system of glass and louvered aluminum panels. “Moneo’s design expresses that it’s a modern building, capable of looking to the future, an appropriate place for the sciences of the 21st century,” says Joseph Mannino, Associate Vice President of Columbia University Facilities.

Moneo’s cladding concept is integrally linked to the building’s steel structural system. The entire elevation of the structure is designed as one giant truss with both internal and external bracing elements. The perimeter diagonals occupy select bays in a rational load pattern that the architect developed with structural engineering firm Arup. Moneo then expressed the diagonals on the exterior with opaque diagonally louvered aluminum panels. The panels, and diagonals themselves, were applied somewhat randomly and in painterly fashion. They alternate with panels of pure glazing, and panels with vision strips sandwiched between horizontal aluminum louvers, in a composition that speaks both to the artist and the structural engineer.

The placement of these cladding elements also relates to the building’s program, which is divided in plan between east and west. The east, or campus-facing elevation houses faculty offices



Left The facade expresses the building's truss diagonals.
Below left Four 18-foot-8-inch-high by 5-foot-wide panels make up each bay of the double-height lab floors.
Previous spread A glass-enclosed lounge looks north to upper Manhattan.



and student breakout spaces, whereas the west face, which looks out on Broadway, houses the laboratory functions. While the labs boast generous 18-foot floor-to-floor heights, the offices are subdivided in mezzanines, two per lab floor, creating an interesting tension between the two sides of the building. Moneo clad the east face entirely in glass, with the exception of its connection with Pupin Hall, where the louvered aluminum panels are used. This arrangement puts the indoor activity on view to the campus, an effect that the architect likens to a beehive. The lab side of the building, where more concentration is called on from the occupants, features the majority of the diagonally louvered opaque panels and the horizontally louvered vision strip panels. Again there is an exception, at the upper left hand corner of the elevation, where the all-glass system takes over.

Executive architect Davis Brody Bond Aedas and facade consultant R.A. Heintges Associates honed this cladding concept into a unitized curtain wall system. In the unitized system, four 18-foot-8-inch-high-by-5-foot-wide panels make up a single bay of the double-height lab floors. On the office floors, the all-glass modules are of the same dimensions, though they are made up of two glass lites placed one atop the other, so they read as half as high. The 1-inch-thick insulated glass units are a standard product, VE12M from Viracon. In the metal system they have 1/4-inch outer and inner lites, though in the all-glazed condition they come with a 3/8-inch outer lite, and a 1/4-inch inner lite. The extra thickness on the outer lite helps to prevent wave distortion and pillowing. The IGUs also feature thermally broken, warm-edge spacers—stainless steel spacers between the glass lites that offer higher thermal performance than

Right The east elevation is clad with glass, exposing activity in offices and student spaces to the campus.

the typical aluminum spacers.

The system was fabricated in a collaborative effort between curtain wall contractor W&W Glass Systems, Inc., Canadian firm Sota Glazing Inc., and Kansas City-based metal experts A. Zahner Company. Zahner provided the aluminum panels and louvers, which snap into the Sota-built the curtain wall system. W&W erected the completed system on site. “It’s very hard to get decent color control with anodized aluminum,” explains Heintges. “You can’t just start mixing up batches as any slight variation in the alloying constituents will cause a different color. We had to keep a tight control on the source of aluminum and keep in close contact with Zahner and Sota.

The cladding system includes more than 1,000 panels and construction manager Turner was pressed to keep the site orderly and moving smoothly. Because of the building’s configuration there was not a lot of room to store panels onsite before they were put in place. Turner had to carefully coordinate trucking and installation in an intricate three-day cycle with two rigs on the roof chasing each other around and around the building while W&W’s ornamental ironworkers clipped the system into place. All in all, it took six months to erect the facade, no shabby figure. Maninno is excited. “We’re ready to occupy this building in the fall,” he says, “and cap off three and a half years of construction.” ■



COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING FACADE

Location: **Broadway and West 120th Street, New York, NY**
 Owner: **Columbia University, New York, NY**
 Design Architect: **Rafael Moneo Valles Arquitecto, Moneo Brock Studio, Madrid, Spain**
 Architect of Record: **Davis Brody Bond Aedas, New York, NY**
 Structural Engineer: **Ove Arup & Partners Consulting Engineers, PC, New York, NY**
 Mechanical Engineer: **Ove Arup & Partners Consulting Engineers, PC, New York, NY**
 Construction Manager: **Turner Construction Company, New York, NY**
 Curtain Wall Consultant: **R.A. Heintges & Associates, New York, NY**
 Structural Steel Erector: **DCM Erectors, Inc., New York, NY**
 Miscellaneous Iron Fabricator and Erector: **Post Road Iron Works, Inc., Greenwich, CT**
 Ornamental Metal Fabricator and Erector: **Empire City Iron Works, Long Island City, NY**
 Curtain Wall Fabricator: **Sota Glazing Inc., Brampton, ON**
 Curtain Wall Erector: **W&W Glass, LLC, Nanuet, NY**
 Metal Deck Erector: **Solera/DCM, New York, NY**

Columbia University Northwest Corner Building Structure

A building built as a bridge, framed with structural steel, spans 120 feet to straddle an existing gymnasium.

WHEN IT COMES TO THE IVY LEAGUE, NEW YORK CITY HAS A major feather in its cap: Columbia University. As with any top-of-the-heap institution, Columbia is always using peer schools as measuring sticks to make sure it continues to make the grade. Back in 2002, that watermark showed the university in danger of falling behind in one key area—it had no cutting-edge, 21st-century laboratory facility that could match what the Harvards and Princetons of the world were erecting. To close the gap, Columbia hired famous Spanish architect José Rafael Moneo to design a contemporary laboratory building on the last remaining major unbuilt plot of the original McKim, Meade, and White campus—the northwest corner. The site, however, came at a price. Whatever was to be built there would have to share its footprint with the existing Dodge Physical Fitness Center—notably its basketball facility, home to Columbia’s Division One Lions. “The basic challenge was to come up with a structure that would span 120 feet over the existing gym, and to facilitate construction while the gym was closed,” explains Dan Brodtkin of Arup, whose firm collaborated with Moneo on the design. “We experimented with many possibilities, and decided to create a building like a bridge.” The New York City Department of Buildings requires that two floors be completed before a space below can be occupied. Columbia wanted the gym to be open in time for the Lions to begin daily practices so construction had to move at a rapid pace. With long spans and narrow timeline the choice of structural material came easily: The building would be framed out of structural steel to cover the long span and keep the building light.

At 14 stories and 188,000 gross square feet, the Northwest Corner Building, as it is now known, packs a lot onto its 65-foot-wide site. To keep all of this space stable and immune to live loading—lab buildings are adverse to vibration and sway—Arup decided to use the whole height of the building as the truss. In other words, the engineers filled each of the perimeter framing bays with diagonal bracing elements, and put one giant chevron—a big V—through the center of the elevation. “There’s a pay off to this approach,” continues Brodtkin. “There are more bits and pieces, but it’s deeper and stronger.” The internal system runs longitudinally north-south through the building, sandwiched between the corridor and offices of the east side and the laboratories of the west side. Framed with mid-range W14 wide flange sections fabricated from Grade 50 A992 steel, the big V cuts the span of the truss in half, while its easily understood, rational load pattern makes it simpler to thread mechanical systems through the building.

The expected loads did not call for bracing elements in every perim-

Above The building acts as one large truss in order to bridge the gymnasium below.

Right The 14-story building sits on a 65-foot-wide site and includes seven research lab floors, a column-free science library, a lecture hall, and a café.

eter bay, so the engineers had the freedom to decide which would be braced and which wouldn’t. Arup came up with a computerized force-weighted random structure generator that began by assuming mathematically that every space between column and beams would have an X brace. This model was then analyzed and the engineers deleted every bracing element in compression while maintaining every element in tension. Then they analyzed it again, grouping the diagonal members based on their force level—600 to 900 kips were grouped as high force, 300 to 600 kips as medium force, and 50 to 300 kips as low force. With these groupings in place, the team set up an algorithm that they applied to each group, allowing the computer to randomly delete 70 percent of low tension members, 40 percent of moderate tension members, and 10 percent of high tension members.

Arup then began to play with its numbers, sometimes deleting more



Turner Construction; facing: Arup



Davis Brody Bond Aedas

Turner Construction



Facing The building was constructed using Building Information Modeling (BIM). Lab floors are framed with 5-foot-deep castellated beams to allow 18-foot floor-to-ceiling heights that make room for office mezzanine levels. A unique tower crane design with a bumped-out base made room for truss assembly atop a heavy construction shed.

Above Because jumbo trusses were too large to be brought to the site on trucks and lift into place by cranes, the building team assembles them on a heavy shed above the sidewalk, then slid them into place with hydraulic rams.



hard working members, sometimes more non-hard working members. Each time, a different load pattern emerged. When hard working members were deleted the pattern became weird and unexpected, but when non-hard working members were deleted the pattern was more rational. This process became an integral part of the final look of the exterior and Moneo was a willing collaborator. He gravitated more toward the rational expressions generated by deleting the low force members, and Arup ran the program playing with the numbers until they found one that he liked. In the final assembly, the bays and diagonals are framed with a variety of mid-range W14 wide flange sections fabricated from Grade 50 structural steel.

While mathematically this building-as-truss system functioned fine as a means to carry the structure over the 120-foot span of the gymnasium without bearing on it, the design assumed that the entire assembly appeared magically in place and did not take into account the step-by-step, bottom-up nature of the construction process. To manage this essential procedure a system would have to be developed to shoulder the building's massive dead loads while it was being built. In answer, Arup devised a system of three, full-floor-height jumbo trusses that would span across the gym and serve as a launch pad for the rest of the structure. It would handle dead loads during construction, and help to manage live loads once the erection was complete. These trusses, approximately 400 to 500 tons each, were constructed from massive W14x730 wide flange sections reinforced with 4-inch-thick steel plates welded across the webs. The trusses tie into eight similarly hefty columns—W14x730 wide flange sections reinforced with 4-inch-thick steel plates—five on the north side of the building, three on the south,



that transfer the gravity load down to bedrock.

However, these jumbo trusses were too large to fabricate off site and then truck in. They were also too heavy to lift into place with a crane, or to assemble while bearing on the roof of the gym. Working out a plan with erector DCM, Turner Construction assembled the components on a heavy construction shed above the sidewalk on Broadway, connecting them with complete joint penetration welds. Because the location of the tower crane would have interfered with the area needed for this work, its base was bumped out from the building to provide room for assembly of the trusses. Once assembled, they set up temporary steel beams spanning the roof of the gym, greased them liberally with lubricant, and slid the trusses into place with hydraulic rams.

The remainder of the steel structure is relatively straightforward, excepting the laboratory bays with their 40-foot clear spans and 18-foot floor-to-floor heights. Moneo and executive architect Davis Brody Bond Aedas set up these wide-open spaces to create greater flexibility within the facility, allowing for different scientific disciplines to augment any floor to its needs, a move that will keep the building relevant well into the future. Castellated beams frame these bays, allowing mechanical systems to be run through the web openings. The double height floors allowed mezzanine levels to be set up on the east side of the building, a literal beehive of faculty offices and student breakout space. But without structural steel, some 4,000 tons of which were used in the project, few if any of these innovative design decisions would have been possible. ■

Above top Trusses weighing between 400 and 500 tons each are slid into place.
Above bottom Each perimeter framing bay is filled with diagonal bracing elements, creating giant chevrons through the center of the elevation.



Above The campus-facing east side exposes the building's open spaces, which create greater flexibility for students and faculty.

COLUMBIA UNIVERSITY NORTHWEST CORNER BUILDING STRUCTURE

Location: **Broadway and West 120th Street, New York, NY**
 Owner: **Columbia University, New York, NY**
 Design Architect: **Rafael Moneo Valles Arquitecto, Moneo Brock Studio, Madrid, Spain**
 Architect of Record: **Davis Brody Bond Aedas, New York, NY**
 Structural Engineer: **Ove Arup & Partners Consulting Engineers, PC, New York, NY**
 Mechanical Engineer: **Ove Arup & Partners Consulting Engineers, PC, New York, NY**
 Construction Manager: **Turner Construction Company, New York, NY**
 Curtain Wall Consultant: **R.A. Heintges & Associates, New York, NY**
 Structural Steel Erector: **DCM Erectors, Inc., New York, NY**
 Miscellaneous Iron Fabricator and Erector: **Post Road Iron Works, Inc., Greenwich, CT**
 Ornamental Metal Fabricator and Erector: **Empire City Iron Works, Long Island City, NY**
 Curtain Wall Fabricator: **Sota Glazing Inc., Brampton, ON**
 Curtain Wall Erector: **W&W Glass, LLC, Nanuet, NY**
 Metal Deck Erector: **Solera/DCM, New York, NY**



**Milstein Family
Heart Center**



A dynamic double curtain wall delivers energy performance and optimism for this cutting-edge medical community.

THE VIVIAN AND SEYMOUR Milstein Family Heart Center at NewYork Presbyterian Hospital is one of the world's leading pioneers of cardiac treatment. In order to maintain this edge, the institution recently built a \$240 million, 125,000-square-foot addition to its 165th Street hospital complex. Seeking to provide more than just room for the latest in medical advances, the hospital leadership and key donors, including the Milsteins, wanted a building that would buoy its patients' morale—giving the gift of hope to those facing life-threatening illness. Ian Bader, the project's lead designer for architects Pei Cobb Freed & Partners, knew immediately how to deliver this kind of reassurance in the form of architecture: The site, a cramped plot at the southern edge of the hospital's upper West Side campus, overlooked a breathtaking panorama of the Hudson River and Palisades. Bader intended to bring this view to the interior, opening up the

facility to the soothing effects of unfiltered daylight in the process. The problem was how to do so without also causing wild swings in temperature. His solution was to enclose the building in a four-story-high glass climate wall—a dynamic double curtain wall that tracks the diurnal course of the sun, controlling incoming daylight while keeping the hospital's occupants in immediate touch with the glory of the natural world. “Looking outwards becomes an event of hope,” explains Bader. Thanks to superb thermal performance and unrivaled craftsmanship, the facade system also helped the project to earn a LEED Gold rating.

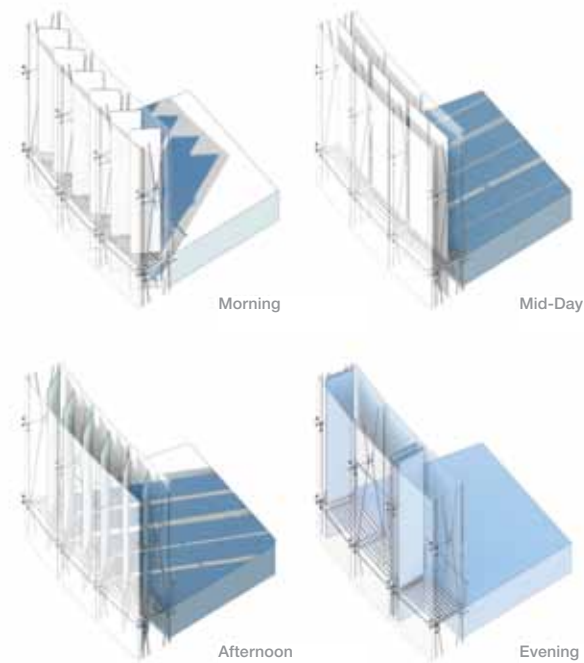
More than just an expansion of the hospital's facilities, the addition creates a new entry sequence to the Milstein Heart Center, ushering visitors in from Fort Washington Avenue along a curving passageway that opens into a naturally illuminated four-story atrium. Glass-floored bridges cross the atrium, span-

ning between the addition and the existing Irving Pavilion and linking directly to corridor waiting areas that abut the curving climate wall. Constructed of custom steel box beams, the bridges support a structural glazing floor system that allows daylight to pass freely through the space's water white glass curtain wall and skylight. A single, mid-span vertical cable suspended from the atrium roof above is used only to control deflections and vibrations. The bridges connect the neighboring Irving Cancer Center with the floors of the new building, facilitating continuity between medical departments.

The four-story atrium is constructed with both a glass ceiling and an approximately 45-by-70-foot glass facade. The paramount aesthetic goal was that the structural support of the atrium facade be as willowy as possible in order to leave views of the Hudson River and beyond unobstructed. An efficient single-plate steel girder system spanning

This page and opening spread: Paul Warchol

Top left: Pei Cobb Freed & Partners; top right: Thornton Tomasetti



Above Computer-controlled louvers track sunlight throughout the day, optimizing the amount of light entering the building.
Above right Prestressed Vierendeel trusses provide the atrium's lateral support.
Facing In warm weather, the building's exhaust air is drawn through custom grating at each floor to a rooftop vent.
Opening spread The climate wall and atrium give a new face to the hospital's cutting-edge facilities.



between the new addition and the existing Irving Pavilion supports the atrium roof. The gravity load of the atrium wall is supported by small diameter Bright drawn stainless steel 316 S 1x19 strand cables hung from the atrium trusses above. The lateral support of the vertical wall is provided by prestressed, Vierendeel horizontal trusses, constructed of a thin plate and prestressed horizontal cable. The glazing is supported from these systems with Pilkington stainless steel glass point-support hardware.

Rising to the west of the atrium, the addition's climate wall is composed of a 22 millimeter-thick laminated glass outer wall and a 44-millimeter-thick insulated glass inner wall separated by a 3-foot cavity. The layer of air in the cavity mediates solar heat gain in warm months and acts as insulation during the winter. When outdoor temperatures rise, the building's exhaust air is drawn into the lowest level of the wall by convection currents, allow-

ing built-up heat to rise naturally to the top elevation where it is expelled through a rooftop vent. In winter, this vent is closed off, holding in the air and creating a thermal blanket for the building.

As with the atrium, the climate wall's glass panels are composed of Pilkington Optiwhite insulated glass units, meaning that the light that comes through is unadulterated by high-performance coatings, which tend to taint the sun's full-spectrum rays. “We live in a filtered world,” muses Bader. “I tried to avoid that here.” The trade-off, of course, is that the glazing offers little in the way of shading. To make up for this, Bader and his team designed a system of computer-controlled fabric louvers, essentially motorized vertical blinds that track the trajectory of the sun. In the evening, the system is completely open, at midday it is closed, and between these two extremes the panels adjust accordingly, optimizing the amount of light passing through at any given time. “Typically, a



high performance glass would have a shading coefficient of .6 to .45,” says Bader. “The shading coefficient of this system is very low—.1 or .05. You would have to have a virtually opaque wall to get that.” In addition to the blinds, the airspace features a stainless steel catwalk system, a custom grating supported by small-diameter pipe members integrated into the climate wall support structure, that allows easy access for maintenance.

The wall’s double laminated glass panels are a variety of sizes, though they are generally 5 feet wide and 16 or 17 feet high depending on floor-to-floor heights. The wall does not rely on a mullioned framing system, but upon structural glazing and custom-designed point supports. The point supports attach to a system of crisscrossing post-tensioned fine ground brush drawn 304 stainless steel rods that hang from the ceiling and are drawn down by coil springs at the wall’s base. This system kept the 3/8-inch diameter rods as slim as possible, as the structures in tension require significantly less

material to handle the applicable loads. Rods also tie the tensioned system back to the floor plates to absorb lateral forces, primarily wind loads. W&W Glass erected the wall with stainless steel components milled by TriPyramid Structures.

Behind its sophisticated steel and glass corset, The Milstein Family Heart Center now stands as a hopeful refuge for patients and their families, with enlarged details of Hudson River School painters’ landscapes on the walls of the waiting areas and lobby imbuing a natural vibrancy and depth to the center’s interior and reiterating the addition’s strong ties with the natural world. Luminous between NewYork Presbyterian’s older masonry structures, “All the elements of the center were carefully engineered like pieces of jewelry—each item has its own special identity and purpose,” says Bader. “And while the existing buildings are not architecturally distinguished, they are of archaeological value, allowing a layering of stories to happen. The dialogue is alive and well here.” ■



Pei Cobb Freed & Partners

Paul Warchol

Right Because the climate wall structure is in tension, less material was required to handle applicable loads and steel rods could be a slender 3/8-inch diameter, making them nearly invisible from the exterior.
Facing page Glass point supports attached to crossed post-tensioned steel rods drawn by coil springs in the wall’s base.



Milstein Family Heart Center

Location: **165th Street and Fort Washington Avenue, New York, NY**
Owner: **NewYork-Presbyterian Hospital, New York, NY**
Architect: **Pei Cobb Freed & Partners Architects, New York, NY**
Associate Architect: **daSILVA Architects, New York, NY**
Structural Engineer: **Thornton-Tomasetti, New York, NY**
Mechanical Engineer: **Syska Hennessy Group, New York, NY**
General Contractor: **Bovis Lend Lease, New York, NY**
Curtain Wall Consultant: **R.A. Heintges & Associates, New York, NY**
Structural Steel Erector: **Empire City Iron Works, Long Island City, NY**
Miscellaneous Iron Fabricator and Erector: **Post Road Iron Works, Greenwich, CT**
Architectural Metal Fabricator and Erector: **Post Road Iron Works, Greenwich, CT**
Ornamental Metal Fabricator and Erector: **Precision Glass and Metal Works Co., Inc., Maspeth, NY**
Curtain Wall Erector: **W&W Glass, Nanuet, NY**

Gateway Center at Bronx Terminal Market

This spread Structural steel supports outdoor balconies while providing clear span floor space for the north and south volumes.



Structural steel allows the newest mixed-use development in the Bronx to accommodate a range of tenants and architectural expressions.

SITUATED ON 17 ACRES WEDGED BETWEEN River Avenue and the Major Deegan Expressway, the new Gateway Center at Bronx Terminal Market has more of a history than most big-box store developments. The market dates to the 1920s, when Mayor John Hylan proposed building it to reduce crowded conditions among the fruit and vegetable vendors in Tribeca's Washington Market. In 2004, Related Companies acquired the Bronx Terminal Market lease and entered into an agreement with the City of New York and the New York City Economic Development Corporation to redevelop the long-neglected site, as well as the adjacent Bronx Mens House of Detention (BMHD), as a major shopping center. To create a linkage between the site's old and new structures, architects GreenbergFarrow and BBG-BBGM conceived a design in structural steel that would yield the long spans and design flexibility that tenants desire, while supporting balconies and other elements that create a welcoming pedestrian environment for the new buildings and their historic neighbors, including the BMHD and pieces of the original market buildings.

The design called for a pair of three-story big-box structures flanking a six-level parking garage for 2,600 cars, each occupied by a range of big-name retailers. While so called big-box structures may seem simple enough, creating a structural steel design that could satisfy the different requirements of tenants like Home Depot versus Target was key to realizing the project, particularly one of this scale. Totalling approximately 1 million square feet, the \$500 million project needed to be constructed in phases. Related first retained GreenbergFarrow as retail planners, who divided the bulk of the retail program into north and south volumes serviced by centralized parking. The architects also conceived of staggering the buildings so that each store could have a dedicated parking field (each garage floor is 12 feet high). BBG-BBGM then shouldered the job of design architect, and acted as overall architect for the project.

Complicating the planning was each retailer's floor loading requirements. In the north retail building, occupied by Home Depot, Staples, and Target,

Home Depot is located at grade where the slab is able to handle its 650-pounds-psf live load requirement. In the south retail building, whose tenants include Babies and Toys "R" Us, Bed Bath & Beyond, Best Buy, BJ's, Marshalls, and Raymour & Flanagan, BJ's required a 250-pounds-psf live load capacity, while the floor load required by other retailers is 150 pounds psf and floor-to-ceiling heights are 24 to 26 feet. Only structural steel could stand up to the demands of suspended slabs without sacrificing clear span floor space. Structural steel also made certain architectural expression possible—in particular the series of expansive balconies that cantilever from the parking-facing sides of the two main retail volumes. Smaller stores line the garage, which is constructed of precast concrete, and occupy the Prow Building, a 20,500-square-foot, two-story holdover from the original Bronx Terminal Market.

"We explored a number of different ways to express this building," says BBG-BBGM principal Gregory Cranford. "Ultimately, we opted for a less industrial look in order to make a linkage between the neighborhood and the riverfront. There are a lot of scaling elements that create a pedestrian environment." Those include the two sets of balconies, which also contain vertical circulation cores, the restored Prow Building, and bas-reliefs that were reclaimed from the Bronx House of Detention and mounted at pedestrian level along River Avenue.

Gateway Center's structure was made possible partly by salvage, too. According to Narendra Shah, principal of one of the project's structural engineers, Axis Design Group International, the foundation of the old six-story wholesale market was designed for a heavy load, so it was reused for a majority of the north retail building's footprint. "We utilized those pile caps, putting a new concrete pier and base plate on top of each pile cap and then erecting the steel columns for the new building," Shah explains, adding that those piles have a capacity of between 15 tons and 20 tons. To provide retail tenants with more unfettered interior spaces, the project team eliminated many of those columns and drove 100-ton-capacity piles for the new building's expanded footprint to achieve an average 30-by-50-foot column grid. "It was not far off from the grid originally established by the retail planners," says BBG-BBGM partner Marc Gross. The average column grid in the south retail building, where there were no preexisting constraints, is 36 by 40 feet.

The south building's tighter column grid is just one indication that it is heavier, comprising 4,000 tons of steel compared to its sister's 3,000 tons. Charlie Weir, owner of structural-steel fabricator Weir Welding, cites the BJ's live load for that difference. In another example, floor construction is concrete fill on composite 18-gauge metal deck; where most decking is 6 1/4 inches deep, the BJ's decking is 8 inches deep.

In the north building, retail bays are framed mostly with W24x68 or W27x84 beams spaced at 10 feet and W30x99 girders. Its heftier counterpart to the south has W24x76 and W24x55 beams spaced at 9 feet and W33x118 girders, with W36x210 and W30x211 girders at the BJ's level. Columns are W14, and all the material is ASTM A992. The Grade 36 steel connection clips were attached at the shop, and the steel was field-bolted using A325 bolts



typically measuring 7/8 inches in diameter. Separate crawler cranes were deployed to erect the buildings, with the north building beginning first and erected in two vertical runs working from south to north. The south building was erected in a U sequence, starting in its southwest corner and proceeding northward.

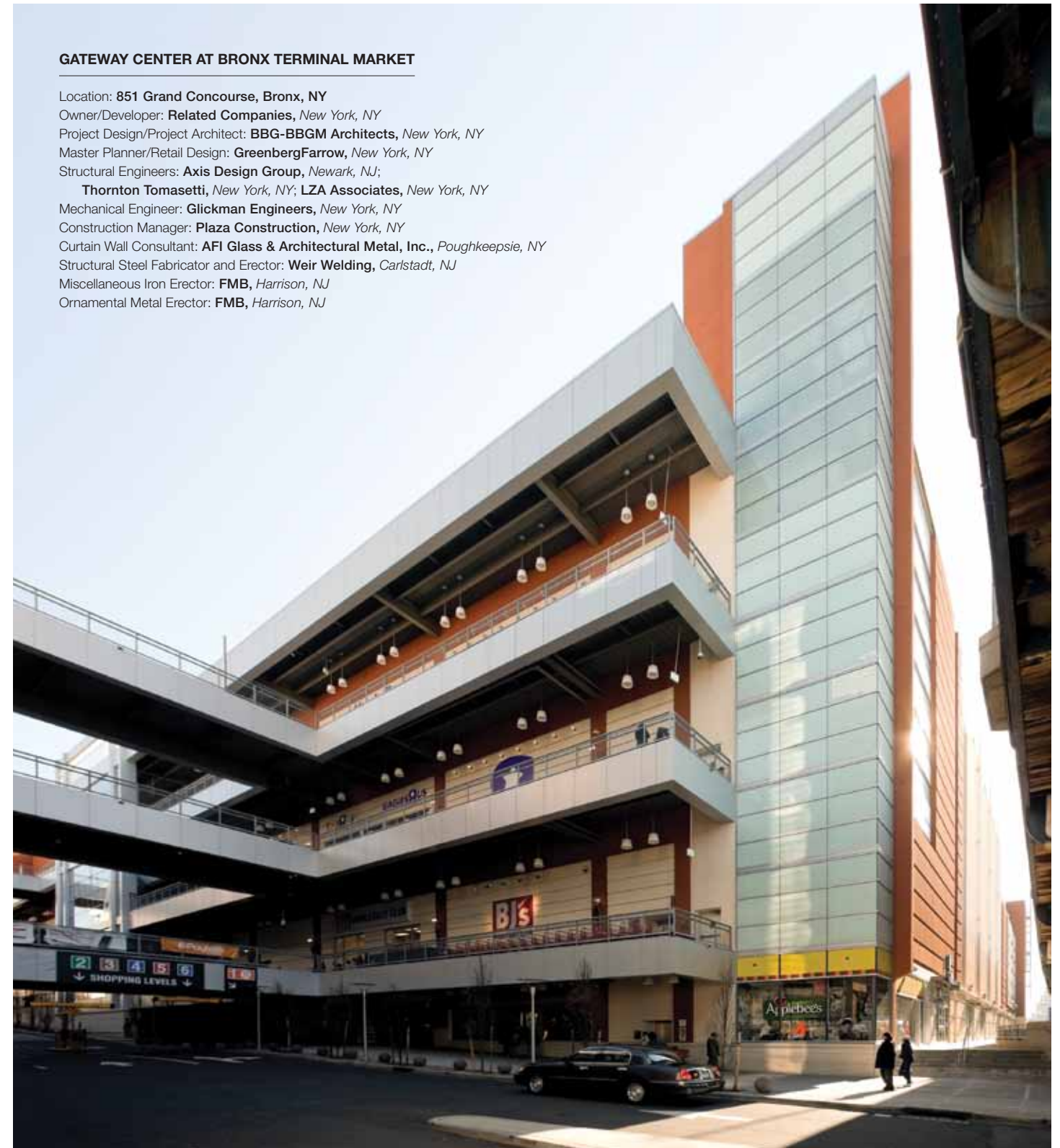
Although pedestrian bridges link the cantilevered faces of the retail buildings to the parking structure, the precast concrete building remains independent of its steel-framed bookends. The bridges—the northern and southern spans comprising W40x199 and W40x297 beams, respectively—frame into the retail buildings and rest on independent columns at the garage side, with expansion joints and seismic gaps.

“Ultimately cost advantage led us to a lightweight exterior material,” Cranford says of the precast concrete and Dryvit panels that are mounted to galvanized steel studs. That skin, like Gateway Center’s open-web joist roof, bears the only resemblance between Gateway Center and a run-of-the-mill big box. The project’s pedestrian-friendly articulation and its mighty structure, however, couldn’t be farther from the ‘burbs. ■

Above left United Iron fabricated and installed new canopies and railings on the restored Prow Building, unifying the center’s pedestrian space.
Above and facing Steel bridges link the cantilevered face of the retail buildings to the parking structure. The bridges frame into the retail building and remain independent of the precast concrete garage.

GATEWAY CENTER AT BRONX TERMINAL MARKET

Location: **851 Grand Concourse, Bronx, NY**
Owner/Developer: **Related Companies, New York, NY**
Project Design/Project Architect: **BBG-BBGM Architects, New York, NY**
Master Planner/Retail Design: **GreenbergFarrow, New York, NY**
Structural Engineers: **Axis Design Group, Newark, NJ;**
Thornton Tomasetti, New York, NY; LZA Associates, New York, NY
Mechanical Engineer: **Glickman Engineers, New York, NY**
Construction Manager: **Plaza Construction, New York, NY**
Curtain Wall Consultant: **AFI Glass & Architectural Metal, Inc., Poughkeepsie, NY**
Structural Steel Fabricator and Erector: **Weir Welding, Carlstadt, NJ**
Miscellaneous Iron Erector: **FMB, Harrison, NJ**
Ornamental Metal Erector: **FMB, Harrison, NJ**



Previous spread: left: Dbox; right: GreenbergFarrow Left column: United Iron Inc.; right: Dbox

Dbox



Medgar Evers College Academic Building 1

At CUNY's new Brooklyn science building, structural steel expands the core curriculum.

FAR FROM YOUR AVERAGE brick-block campus building, the new Academic Science Building 1 of Medgar Evers College, City University of New York in Brooklyn is an elegant glass and steel centerpiece for a campus poised to become a neighborhood hub. A joint undertaking between the City University of New York/Dormitory Authority of the State of New York, Ennead Architects (formerly Polshek Partnership), and Leslie E. Roberts Associates, the new six-story academic facility features four teaching laboratories, a hospital simulation room, and five laboratories for molecular biology, anatomy, physiology, microbiology and general biology—flanked by a pair of feature stair cases on its eastern and western facades and capped at the north end by a crystalline floor-to-ceiling glass curtain wall pavilion.

Tasked with opening campus activities up to the community at large, while still fulfilling the exacting functional requirements demanded by the lab facilities, the architects at Ennead turned to structural steel to achieve a bal-

ance between form and function. “These days academic buildings have shifted away from fixed spaces,” says Todd Schliemann, lead architect for Ennead. “They’re a little more flexible and there’s a desire to expose the faculty to the students more, so that there’s more interaction.”

While steel’s inherent light weight and malleability are prominent factors in the building’s stunning exterior, its long-span properties were key to creating column-free spaces required for teaching labs presented a challenge not only for the present, but for the future as well.

“Laboratories are perhaps best constructed with steel because of changes that may come up down the road,” says Schliemann. “Laboratories are very mechanically intensive; there’s a lot of services that have to run and supply them. With steel, if in the future you need to run new mechanical services, you can drill anywhere you want. Whereas with concrete you have to avoid the column capitals and all the rebar, which is a much more difficult operation.”

“The span of the typical teaching lab member is 37 feet—well above the average 28-foot members used in the framing for ordinary classrooms,” says Rick Zotola, structural engineer for LERA. “In this case, they couldn’t tolerate having more columns in the space, which made it even more challenging to limit vibrations—something anathema to laboratory work.” With long-spanning members of W21x68 ASTM A992, Grade 50 steel, and a floor system of 3 ¼-inch lightweight concrete on a 3-inch metal deck, totaling a 6 ¼-inch slab, the teaching labs on the third floor are designed to limit vibration velocities to 2000 micro inches per second, in accordance with the AISI Steel Design Guide 1.

Steel also played a pivotal role in showcasing the feature stairs on the building’s eastern and western facades, the stairs respectively three and four stories. Commonly relegated to secondary structural roles and confined to enclosures, the science building’s open feature stairs appear to float like bridges between the floors, further emphasizing



This page The Science Building's crystalline shaped floor-to-ceiling glass curtain wall pavilion opens the campus up the community. The eastern and western floating feature stairs are framed with a single HSS 24 x 22 x 1/2, resulting in a 36-foot free span between flights.

the project's goal of transparency and community inclusion. "Often times in a multi-storied building you just live in a slice on a floor, unaware that you're part of a larger community," says Schliemann. "These stairs link the whole building together in such a way that you can see people moving through this big volume all the way up the building. It's part psychological and part circulation, but you're aware that you're a part of this bigger academic community."

To achieve the long vertical spans between floor levels without adding too much bulk, the designers framed each flight with a single 36-foot-long HSS 24x2x1/2 spanning member, bent in plane and elevation, and spliced together at the kink points via full penetration butt welds made in the shop. The stair structure is also used in resisting the effects of wind load on the glass and aluminum curtain wall, which is braced back to the stair by a series of 2 1/2-by-10-inch split aluminum tubes that bear on the top of the foundation wall at ground level and laterally brace at the floor slabs and stair stringers. While the floor slab connections are hidden, the curtain wall and stair connections engage the tube mullions via a series of tuning fork-shaped aluminum extrusions with bolted connections that allow for thermal expansion and contraction.

The custom design and fabrication required for the complex glass enclosure of the two-story mixed-used pavilion at the building's northern end hinged on the deft application of a series of structural steel tubes in place of aluminum mullions. "With the



Above The pavilion's folded glass planes are supported by stainless steel gravity and wind load patch fittings projected from a series of HSS members connected to the second-floor building framing and to the roof above.

pavilion curtain wall we wanted to have as open and as transparent space as we could; we needed to handle a bit of tricky geometry," says Daniel Stube, Senior Associate with Ennead. "We used a steel support in each place where you would typically have a mullion. Rather than drilling the glass we had fittings go through the joints in the glass to take gravity and lateral loads back to the steel tubes." The pavilion's folded low-e water white glass panes and sloping skylights are supported by stainless steel gravity and wind load patch fittings that project from a series of 29 shop-painted HSS 3x6x1/2 members, spaced at

5 feet on center, with fixed welded connections to the second floor framing and vertically slotted connections at the roof above.

"By using the steel structure for the curtain wall and holding the glass off of that steel structure, all the geometry, all the trickiness, suddenly became easier," says Stube. "Rather than having the aluminum intersecting on the pane of the glass and creating very complicated joints, the geometry came together in just the thinness of the glass, and that was all reconciled with the sealant joints."

Whether bracing glass, spanning labs, or floating stairs, the

choice of steel not only met the designer's needs, but also those of deadline and budget, helping to ensure that Medgar Evers will be a beacon in the community for years to come. "Steel is much more of a carpentry material," says William Clark, associate with Ennead. "You can cut it, bend it, shape it, drill into it—you can work it to meet conditions much more easily than you can concrete." ■

This spread: Leslie E. Robertson Associates



Left Integrated into the curtain wall mullions, an aluminum louver sunscreen system reduces heat gain without requiring the architects to frit the glass, providing the feature stairs with a dynamic play of light and shadow.

Facing The pavilion is framed by six structural columns, which slope through the two-story structure.



“Laboratories are perhaps best constructed with steel because of changes that may come up down the road.”

Todd Schliemann, Ennead Architects

Ennead Architects

MEDGAR EVERS COLLEGE ACADEMIC BUILDING 1

Location: **1150 Carroll Street, Brooklyn, NY**
 Owner: **City University of New York, New York, NY**
 Agency: **Dormitory Authority of the State of New York, New York, NY**
 Architect: **Ennead Architects, New York, NY**
 Structural Engineer: **Leslie E. Robertson Associates R.L.L.P., New York, NY**
 Mechanical Engineer: **Lakhani & Jordan Engineers P.C., New York, NY**
 General Contractor or Construction Manager: **The McKissack Group, New York, NY;**
Turner Construction, New York, NY
 Curtain Wall Consultant: **R.A. Heintges & Associates, New York, NY**
 Structural Steel Fabricator: **SteelCo, Roselle, NJ**
 Structural Steel Erector: **Midlantic Erectors Inc., Roselle, NJ**
 Miscellaneous Iron Erector: **RISA Management Corp., Westbury, NY**
 Ornamental Metal Fabricator and Erector: **RISA Management Corp., Westbury, NY**
 Curtain Wall Erector: **Metro-Tech Erectors Corp., Glendale, NY**
 Metal Deck Erector: **AC Associates, Lyndhurst, NJ**

ARCHITECTURE

LECTURES BY ARCHITECTS
 IN SUPPORT OF ARCHITECTS' ELEMENTS
 FUNDRAISING

Presented by
Architects' Elements

Pratt Manhattan
 Lecture Series

THURSDAY, SEPTEMBER 10, 7:00 PM
STABLES
 by **BRUCE FORTNEY**
 Director, Stable Hands
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

THURSDAY, SEPTEMBER 17, 7:00 PM
CRANE
 by **JOHN CRANE**
 President, Crane
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

THURSDAY, SEPTEMBER 24, 7:00 PM
FELDMAN
 by **JOHN FELDMAN**
 President, Feldman
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

THURSDAY, SEPTEMBER 30, 7:00 PM
RATNER
 by **JOHN RATNER**
 President, Ratner
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

Pratt Brooklyn
 Lecture Series

FRIDAY, SEPTEMBER 11, 7:00 PM
LE CORBUSIER
MIRACLE BOXES
 by **LE CORBUSIER**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 18, 7:00 PM
SHUMWAY
 by **JOHN SHUMWAY**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 25, 7:00 PM
MONEY & BROCK
 by **JOHN MONEY & BROCK**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 29, 7:00 PM
VOYAGE THROUGH
LE CORBUSIER
 by **LE CORBUSIER**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 30, 7:00 PM
CRANE
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

EVOLUTIVE MEANS
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 30, 7:00 PM
CRANE
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FOREIGN ARCHITECTS
IN ROME
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 30, 7:00 PM
GERNY
 by **JOHN GERNY**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FRIDAY, SEPTEMBER 30, 7:00 PM
ALSOR
 by **JOHN ALSOR**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

ARCHITECTURE AND BEAUTY
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

FACTORY CITIES
 by **JOHN CRANE**
 100 West 25th Street, 10th Floor
 New York, NY 10001
 Tickets: \$100 (includes dinner and drinks)
 \$200 (includes dinner, drinks, and a book)

Pratt

FALL 2010

Pratt

Wednesday, November 10, 2010, 3 p.m.: The world-renowned architect will take an unusual break from his busy schedule to discuss his work in a conversation sponsored by the Ornamental Metal Institute of New York. On stage with him will be Julie Iovine, editor of *The Architect's Newspaper*, and Yael Reisner, author of *Architecture and Beauty*. The event

On November 9, 2010, leading architectural metal expert Catherine Houska will return for the fourth year in a row to lead an all-day seminar on planning, specification, and execution of innovative stainless steel designs. The event will take place at the AIA New York Chapter Center for Architecture, 536 LaGuardia Place, New York, NY 10012. For more information, visit www.omying.org/events.

The Steel and Ornamental Metal Institutes of New York are sponsoring a student design competition that encourages students to explore innovative ways of creating an original design for loft-style residential living conceived entirely in structural steel, that utilizes innovative systems allowing column-free clear spans with reduced floor thicknesses, and integrated with an energy efficient curtain wall.

The Steel Institute of New York sponsored the featured Friday luncheon at NCSEA 2010 – NEW YORK, the national engineering organization's eighteenth annual conference, held October 1, 2010, in Jersey City, NJ. The Institute engaged David I. Ruby, PE, SE, SECB, founding principal and chairman of Ruby + Associates, Inc., as guest speaker for the luncheon to talk about sustainable design and how the concept of constructability can be the thread that enhances the delivered project. His presentation on the value of introducing collaborative design during early planning and concept development was well received by the 200 engineers in attendance, a tribute to both Ruby and host chapter SEAO NY, the organizers of the conference. The Institute congratulates SEAO NY on its success.

James Callahan
President and Business Manager

Arthur Rubinstein
Skyline Steel Corp.
Brooklyn, NY

Dennis Milton
Business Agent

SPANNING GENERATIONS

William Shuzman
Executive Director
Gary Higbee AIA
Director of Industry Development

