

Harlem Hospital New Patient Pavilion



Above Vertis Hayes's *Pursuit of Happiness* is digitally printed on the building's six-story glass facade mounted on a concealed steel structure.

Dominick Pader/TDX Construction Corporation

Modernization of the more than 100-year-old teaching hospital's campus makes room for improved patient care and community outreach in Harlem.

HARLEM HOSPITAL CENTER'S NEW PATIENT pavilion project is proving that modernization need not be at the expense of historical significance. The project's design, undertaken by HOK's New York office in association with Bronx-based architect Jack Travis of Studio/JTA calls for constructing a new six-story, 150,000-square-foot pavilion to connect the existing Martin Luther King Pavilion at West 135th Street and Lenox Avenue. The MLK pavilion will be renovated with the existing Ron Brown Ambulatory Care Pavilion, which is set back from Lenox Avenue on 137th Street. Scheduled for completion in 2012, the project will house new emergency and surgery departments, diagnostic and treatment services, a critical care suite, and a modern radiology center, all centered around an expansive full-height atrium to create a unified health care complex out of seven disparate structures spread over two city blocks.

Though the plan is rooted in bringing the most up-to-date medical care and teaching facilities to Harlem, at its creative center is the restoration of the hospital's historic WPA-era murals painted by some of the most famous African American artists of the 1930s, including Charles Alston and Vertis Hayes. While the original artwork, depicting themes of medical science, life in Harlem, and experiences of black people in America, will be displayed in the new pavilion's lobby gallery, Hayes's work *Pursuit of Happiness* is replicated on the building's six-story curtain wall facade in the form of a 180-by-65-foot glass mural mounted on a concealed steel structure.

The unusual project posed several challenges to the design team, who worked with structural engineer Robert Silman & Associates to realize the new pavilion's structural design. Pavilion spaces needed to be organized to flow into existing portions of the hospital campus. Perhaps most importantly, the design had to anticipate plans to build two additional floors atop the new pavilion in the future. Using steel for the structural frame provided the necessary flexibility in both cases, but the team found that the unique mural curtain wall design prevented them from using more efficient cross-braced frames to address lateral loading. Therefore, the building's lateral system (with the exception of a double-height mechanical space) is designed as a series of moment frames. This required large W14x342 columns

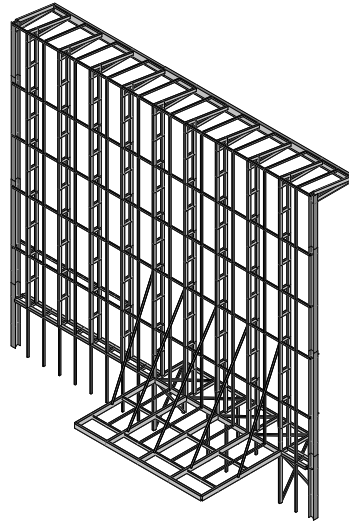
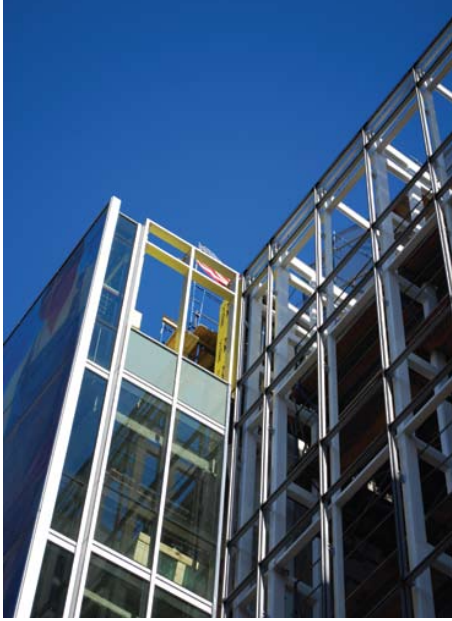
and W24x117 girders, both of Grade 50, A992 steel, to keep lateral drift to acceptable limits. The double-height mechanical space at the seventh floor created a "soft story" where moment frames were inefficient, so the design team instead used perimeter-braced framing for better lateral load resistance.

With the facility's expansion goals in mind, the structure is designed to carry two more floors in the future. To anticipate the additional stresses on the building the future floors presented, the team developed several structural models to determine appropriate seismic and wind requirements both before and after their addition. Because the hospital is set back one bay at the sixth floor, large W44x335 transfer girders support the new floors and potential floors above.

Column layout also presented a challenge to the design team. Because of the hospital's desire to create open, light-filled spaces in line with modern health care standards, the architects set column lines on the north and west sides of the building 9 feet 6 inches back from the building edge. The design team used cantilevered stub beams moment connected to the columns to create corridor areas free of vertical structural elements. The unique space, along with fluorescent backlighting, will help show off the hospital's new glass mural wall to Lenox Avenue.

The pavilion's five-story central atrium required another structural steel solution. "Early on in the design, the team made the decision to treat the main pavilion and the atrium as one whole building, rather than splitting the two with an additional row of columns to create a seismic joint," said Silman engineer Tom Reynolds. Because of this decision, the design team had to drag the lateral load from the frames in the main pavilion to the frames at the perimeter of the atrium using a horizontal roof truss. The roof truss was composed of 5x5 angles bolted to gusset plates that were field bolted to the wide flange members at the roof.

In total, the project comprises more than 2,000 tons of structural steel: Grade 50, A992 for all wide flange sections, ASTM A500, Grade B, for all hollow sections, and A36 for all channels, angles, plates and other miscellaneous metals. Typical infill beams are compositely designed W18x40, and typical girders are compositely designed W24x68. Most columns are W14x342 and smaller, with the largest, a W14x426 column, placed in the center of the basement level. At the foundation the design team used large W36 (328, 260 and 280) beams encased in concrete and embedded in the ground to support the atrium column line that was placed



Clockwise from top Atrium HSS framing; the horizontal roof truss takes lateral loads from the main pavilion frames and transfers them to frames at the atrium perimeter; web penetrations; the atrium truss meets the mural wall truss.

Right The 150,000-square-foot pavilion will connect to the existing Martin Luther King with steel bridges at each floor.



against the existing MLK building. Large, kinked, 60-foot-long W36 members created the bridges connecting each floor of the new pavilion to the MLK structure.

To accommodate the building's show-stopping curtain wall, bent plates of $\frac{3}{8}$ -inch-thick A36 steel form the edge of slab at the West facade. Three-quarter-inch diameter, embedded headed steel studs (attached to the inside face of the bent plates) provide the additional capacity necessary at the slab edges for the curtain wall attachment. Because the printed curtain wall was part of a separate design-build contract, Silman's engineers worked with curtain wall engineer Arup to develop connections to the bent plates that could accommodate the necessary vertical deflection at the slab edge, as well as the lateral movement of the building.

As with many design-build curtain wall systems, the hospital's steel sub-frame needed to be designed for maximum flexibility at the attachment points. Because the slab edge at the west mural wall was cantilevered out as much as 1 foot, 10½ inches, the spandrel beam design uses HSS members connected with full-height stiffeners to keep them from rotating.

The west-facing portion of the atrium is framed vertically with full-height HSS 9x5x5/8 Vierendeel trusses of ASTM A500, Grade B, HSS, placed at 9 feet 6 inches on-center, which are attached to W27x84 Grade 50, A992 wide-flange beams at the atrium roof. These HSS were specified as AESS and were erected and fabricated according to those strict tolerances.

Aside from visible horizontal mullions at each floor line, the atrium's west wall is structurally glazed, presenting an uninterrupted canvas for Hayes's work. Each of the curtain wall's 429 panels was printed with a new digital, direct-to-glass

printing technology called Alice, which works much like an inkjet printer. The pattern is printed on the #3 surface of the six-layer insulated glass units, directly under a PVB interlayer laminating it to the outer lite. Because interior corridors pass behind the glass, it will remain unobstructed by furniture. At night, the back-lit image comes alive thanks to the illuminated column-free space behind it, highlighting the historic scene from the past—the hospital's new face—for all who pass by.

HARLEM HOSPITAL NEW PATIENT PAVILION

Location: 506 Lenox Avenue, New York, NY
 Owner: NYC Health & Hospitals Corporation, New York, NY
 Developer: Dormitory Authority of the State of New York (DASNY), New York, NY
 Architect: HOK, New York, NY
 Associate Architect: Studio JTA, Bronx, NY
 Structural Engineers: Robert Silman & Associates, New York, NY;
 Trevor Salmon Associates, New York, NY
 Mechanical Engineers: Kallen & Lemelson, New York, NY;
 Lakhani & Jordan, New York, NY
 Construction Manager: TDX Construction Corporation, New York, NY
 Curtain Wall Consultant: Ove Arup & Partners, New York, NY
 Structural Steel Erector: Brooklyn Welding Corporation, Brooklyn, NY
 Miscellaneous Iron Erector: Capco Steel Co., Providence, RI
 Architectural Metal Erector: Brooklyn Welding Corporation, Brooklyn, NY
 Curtain Wall Erector: W&W Glass Systems/Metal Sales, Nanuet, NY
 Metal Deck Erector: AC Associates, Lyndhurst, NJ

Clockwise from top: Robert Silman Associates; Robert Silman Associates; Robert Silman Associates; Dominick Riello/TDX Construction Corporation

HOK