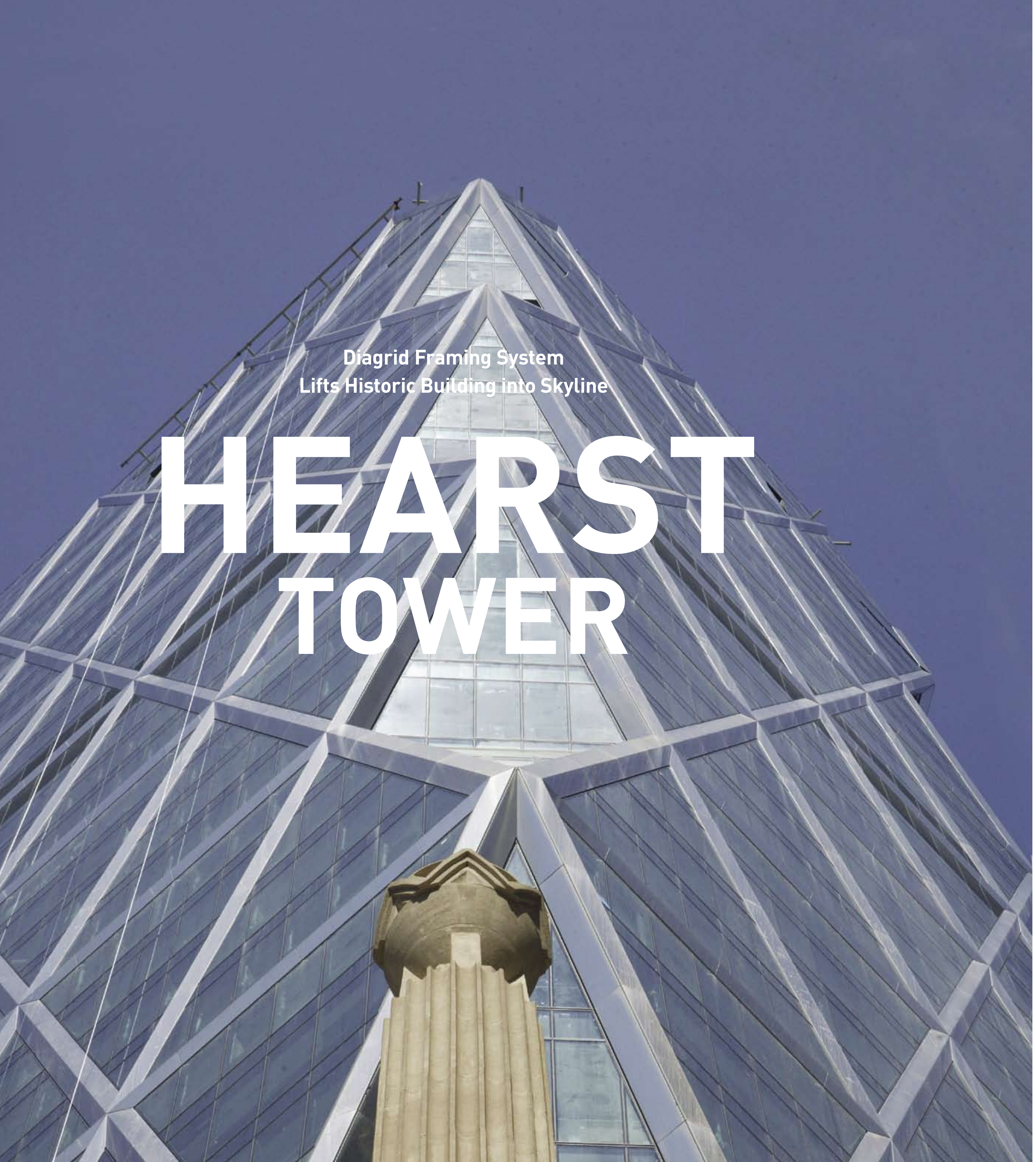

Diagrid Framing System
Lifts Historic Building into Skyline

HEARST TOWER

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At their morning meeting some five years ago, longtime Hearst CEO Frank A. Bennack Jr. and Pritzker Prize-winning architect Sir Norman Foster already had a lot to discuss: how to add 40 new stories to Hearst's historic low-rise headquarters in midtown Manhattan, while preserving its landmark art deco facade; how to achieve inside that facade the vast clear spans required by an indoor piazza planned for the new tower's base; how to build all of this on an unusually variable piece of Manhattan geology, around one of the city's busiest subway lines; and how to seamlessly integrate old and new. But that morning also turned out to be the morning of September 11, 2001. Foster was able to explain in real time what was happening to the structure of the World Trade Center towers downtown. It was a moment that not only inspired a boldness that would make the Hearst Tower the first major construction project inaugurated in New York in the months that followed, but one that added to the project even higher standards for structural strength. The solution was an innovative "diagrid" framing system, whose reliability and precision its structural engineer, WSP Cantor Seinuk president Ahmad Rahimian, compares to, "a swiss watch." That diagrid system directs and integrates both continual and exceptional loads back to a backbone of steel.

Slated to open in June of 2006, the 46-story, 856,000-square-foot, $500 million tower consolidates the corporate and editorial offices of Hearst's many publications and media ventures, from *Town and Country* to the History Channel, which had been scattered throughout the city. The base of the tower remains Hearst's historical home, the landmark 6-story, 40,000-square-foot International Magazine Building designed in 1926 by Joseph Urban and George P. Post. Original plans to add to that structure another seven stories, and potentially a skyscraper to rival the Chrysler and Empire State, were cancelled by the stock market crash of 1929—a setback to which Foster's tower is the comeback.

Preserving the richly decorated art deco statuary and facade of the original structure, as required by a New York City Landmarks Preservation Commission designation, while simultaneously reinforcing an existing subway line tube and driving a new foundation presented enormous challenges for the contractors. Turner Construction developed innovative techniques to handle the delicate business of heavy demolition and construction on a site a portion of which had to be scrupulously restored. While the old building was gutted, the original masonry facade and perimeter steel columns and spandrel beams were retained and reinforced by a complementary framing grid. The existing foundation was supplemented by new spread footings and bored caissons that accommodate an unusual 30-foot drop in bedrock across the site. Says Turner operations manager Mark Pulsfort, "We were able to use the exterior of the existing structure as a working platform for the new one." Behind that old exterior is one of the city's most remarkable new spaces: a 7-story-high, sky-lit, column-free atrium that is almost the size of the new tower's footprint.

The atrium features a dramatic angled "ice-fall" waterfall at its base, (featuring a cascade of water over cast glass supported by overlapping galvanized steel pans), through the center of which escalators ascend three stories to a vast entrance level, company cafeteria,

OPPOSITE The striking diagrid frame compliments the Hearst building's richly decorated art deco facade.

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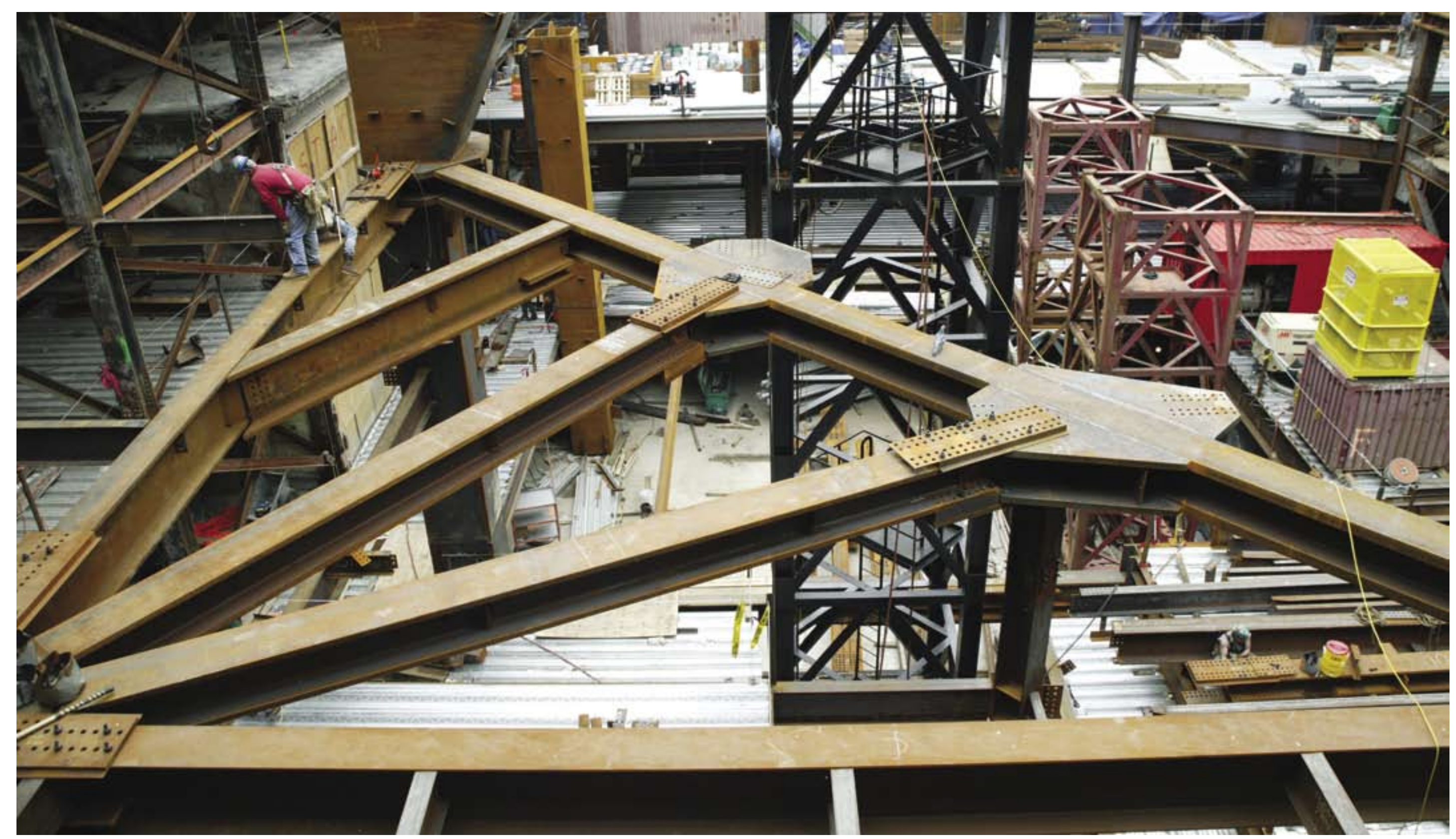
OPPOSITE TOP The 30-ton, 44-inch-square "mega-columns" were assembled from 4-inch rolled steel plates.

OPPOSITE BOTTOM Moment connection at node joining primary members of the diagrid framing system

event space, auditorium, and lobby. All of this is enabled by what engineer Rahimian calls, "the mega-columns"—twelve 30-ton, 44-inch-square box columns, assembled from 4-inch rolled steel plates, along with two 90-foot "mega-diagonals" of similar configuration. Grade 50 steel members were used throughout, with 65 ksi elements in what Pulsfort calls, "the jumbo pieces." A system of 40-ton beams at the tenth floor, integrated with skylights, forms a diaphragm that braces the structure laterally and ties the old building to the new. But what sounds like a massive structural system achieves a surprising lightness, thanks to a shimmering pewter-like linen finish, 5-millimeter stainless steel cladding from Swedish fabricators Ovako, which also wraps the exterior structural system, adding that same subtle shimmer to the streetscape and skyline.

If the spatial drama ends at ten stories up, that's where the structural drama begins. Explains Rahimian, "Three sides of the building face streets and views, but the west side is against another building; so the decision was made to shift the core to the western edge," like the spine at the back of a torso. While this enabled the spectacular atrium and clear 20,000-square-foot floor plates above, it also meant that a central service core couldn't be used to symmetrically reinforce the eastern edge of the building. The solution was the diagonal grid, or diagrid system. Although typical steel moment-frame skyscrapers have long used supplemental diagonal bracing systems to accommodate shear and distribute gravitational loads, Rahimian explains that there is a difference between diagrid and normal bracing: "The diagrid doesn't have a vertical element. The bracing accommodates gravitational load as well as lateral, wind, and seismic loading. By virtue of its stiffness and strength, it combines brace and column in one single element." A system of 40-foot,

BELOW Web framing beneath the atrium floor laterally braces the "mega-columns."



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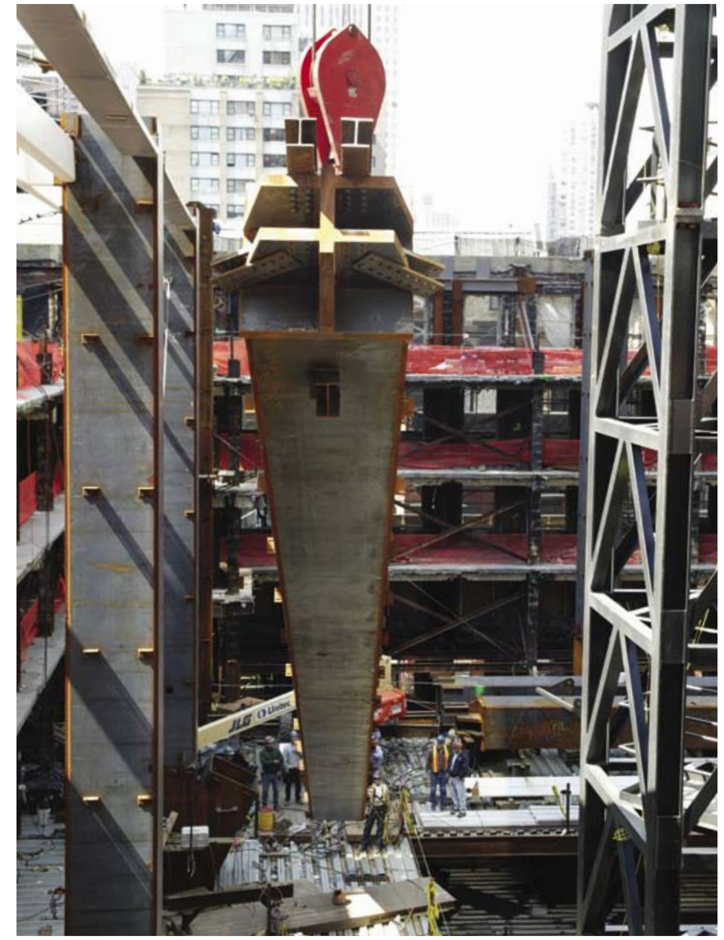

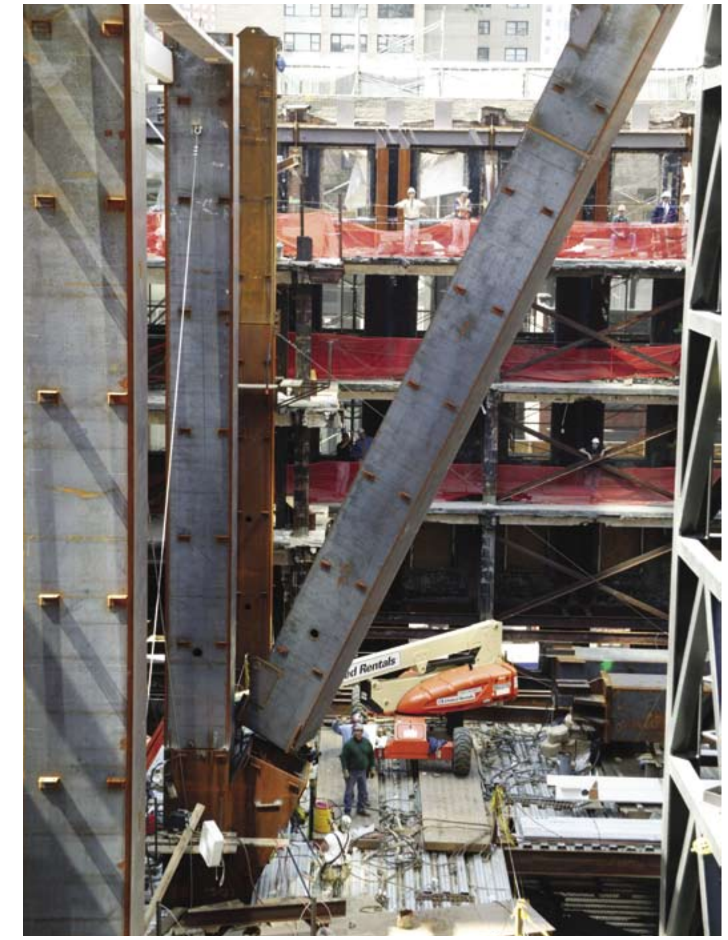

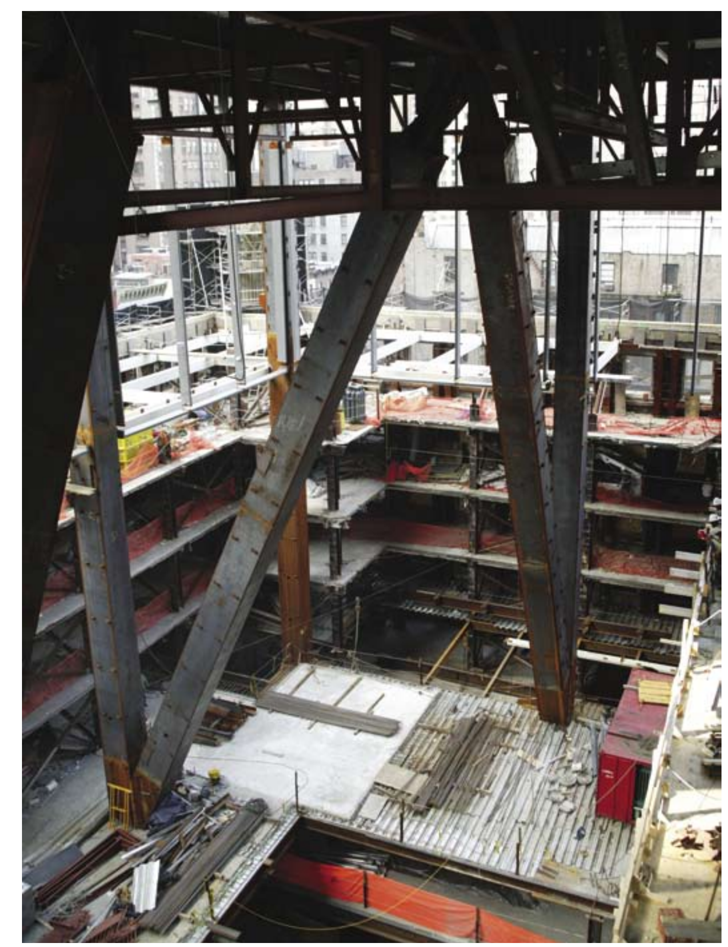

OPPOSITE The diagrid system is highly redundant, providing multiple load paths and a higher standard of performance under extreme stress conditions.

ALL THIS PAGE The "mega-columns" and similar "mega-diagonals" support the tower above a 7-story-high atrium.

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TOP Ironworkers connect the initial bolts of a 6-ton node connector

ABOVE Broad spans within the interior reach to 40 feet or more.

four-story triangular elements wraps around the building's perimeter, turning the facade, Rahimian explains, "into basically a giant truss, formed as a tube into a very strong shell."

Above the tenth floor, the hardened-steel core ties into the facade structure: The system allows broad interior spans of more than 40 feet between columns, as well as enabling a total steel tonnage of only 12,000 tons, 20 percent less that what a conventional structural system would have required. Most importantly, it's a system with unusual resiliency relative to its mass and scale. In Rahimian's words, "The diagrid system is inherently highly redundant by providing a structural network allowing multiple load paths. This provides a higher standard of performance under extreme stress conditions that national and international codes are striving to achieve." Indeed, Foster in collaboration with Rahimian proposed a similar diagrid system for his acclaimed "Kissing Towers" entry in the 2002 World Trade Center reconstruction competition, suggesting a similar geometry at precisely three times the scale.

The diagrid required exceptional exactitude in the construction process. The required stiffness of the structure reduced allowable tolerances from a typical 5/8-inch range down, in some cases, to 1/8-inch—a range equaled in Manhattan perhaps only by Yoshio Taniguchi's famously precise 2004 addition to the Museum of Modern Art. "You can't pull and rack it like a conventional structure," says Pulsfort of the construction process he managed. "The node had to be right on the money." Explains Rahimian, "We built a 3-D computer model to determine how we expected the structure to flex and deflect under gravity load at different stages of construction. It was a 3-D structural map over time." The elements were assembled by an innovative two-point crane pick that, explains Pulfort, "enabled each element to be hooked, carried, and placed already at the right [75 degree or 105 degree] slope." Cives Steel prefabricated wide-flange rolled steel sections into intricate 6-ton node connectors. In what the engineers called a "bird's mouth" geometry at the building's corners, these complex nodes bolted into six different 12-inch, H-column-type diagrid elements. To achieve additional fine tolerances within the gutters and ridges of the stainless steel cladding at the nodes, ironworkers had to flip the heads and shafts of bolts on a case-by-case basis. "The guys were happy," Pulsfort recalls, "when the first one worked."

In 1926, William Randolph Hearst demanded that his building be, "something with architectural character, with public character." And though the original 6-story structure went a long way in fulfilling that imperative, it hasn't been until now, 80 years later, that Hearst's wish has been realized. Thanks to a designer's vision, the precision of a construction team, and the pragmatic efficiencies and material strength of steel, the new Hearst Tower is a vibrant addition to the Manhattan skyline, one that will surely work it's way into the iconography of the city in the century ahead. ■

HEARST TOWER

Owner **Hearst Corp.** *New York, NY*
Developer **Tishman Speyer** *New York, NY*
Architect **Foster and Partners** *London, UK*
Associate Architect **Adamson Associates** *New York, NY*
Structural Engineer **WSP Cantor Seinuk** *New York, NY*
General Contractor **Turner Construction** *New York, NY*
Structural Steel Fabricator **Cives Steel Company** *Gouvernor, NY*
Structural Steel Erector **Cornell and Company** *Westfield, NJ*
Miscellaneous Metal Fabricators and Erectors
Empire City Iron Works *Long Island City, NY*
Ornamental Metal Fabricator and Erector
Allied Bronze LLC *Long Island City, NY*
Coordinated Metals, Inc. *Carlstadt, NJ*
Curtain Wall Fabricator **Permasteelisa Cladding Technologies LTD** *Windsor, CT*
Curtain Wall Erectors **Tower Installation LLC** *Windsor, CT*