Something Old, Something New

BY AHMAD RAHIMIAN, PH.D., P.E., S.E., AND YORAM EILON, P.E.

A vintage Manhattan office building expands upward with an innovative glass and steel office tower, while maintaining its historic base façade.

Michael Ficeto, The Hearst Corp.

NEW YORK IS A CITY OF ICONIC SKYSCRAPERS. And as of last fall, there's a new kid on the block: Hearst Tower, the $500 million, 46-story headquarters for the Hearst Corporation.

Standing nearly 600 ft tall, this elegant new glass and steel tower rises from the six-story base of a landmark art deco building. This original masonry façade building, completed in 1928, was commissioned by magazine magnate William Randolph Hearst as the first stage of a corporate headquarters for his vast publishing empire. Designed in 1926, the building was intended to accommodate seven additional floors, which were never built. With its limestone façade featuring columns and allegorical figures representing music, art, commerce, and industry, the building was considered an "important monument in the architectural heritage of New York," and was designated as a Landmark Site by the Landmarks Preservation Commission in 1988.

In 2001, the team of Foster and Partners Architects and WSP Cantor Seinuk Structural Engineers was commissioned by the Hearst Organization to design its new headquarters at the site of this historic building. The resulting tower is 856,000 sq. ft, including two underground levels.

Preserving Architectural Heritage

Given the original building's Landmark status, a key design specification was preserving the vintage exterior and incorporating it into the new tower design. This necessitated retaining the façade on the three exterior faces at 56th and 57th Streets and Eighth Avenue while demolishing the building's interior to provide space for the new tower.

The original six-story building was horseshoe-shaped with an approximate footprint of 200 ft by 200 ft. The new tower, however, required a footprint of 160 ft by 120 ft, and was to be situated on new foundations behind the original façade. Furthermore, the design envisioned a new, 95-ft interior atrium within the existing building and new tower.

Removing the existing lateral support structure for the façade necessitated a new design requirement, thanks to the larger unbraced height condition of the façade. Therefore, a new framing approach was incorporated for the structural stability of the existing wall, in order to address this new design condition as well as construction phase issues. The existing façade was also reinforced and upgraded for the new seismic requirements of the current New York City Building Code.

The supporting perimeter steel columns and spandrel beams of the original building were also maintained and provide full vertical support for the façade system. However, an additional grid of vertical and horizontal framing was provided behind the façade, following lateral stability and seismic requirement studies. The new and existing framing systems are in turn laterally supported by the new

The original Hearst headquarters (shown here circa 1930) was six stories tall with the capacity for seven more floors to be added.

Michael Ficeto, The Hearst Corp.

The prefabricated diagrid nodes were installed using field-bolted connections. The nodes are set on 40-ft modules spaced vertically every four floors.

tower's third-floor framing system, as well as by the new skylight framing system at the seventh level, which coincides with the top of the existing façade.

Structural Layout

The tower has two distinct zones. The lower zone, which rises to the 10th floor, contains the street-level entrance and at the third floor, a lobby, cafeteria, and auditorium, as well as approximately 80 vertical ft of interior open space. The upper office zone starts at the 10th floor, approximately 110 ft above street level, and goes to the top of the building. Composite steel beams and concrete floors with 40 ft interior column free spans were utilized for open office planning. The tower is connected to the façade at the seventh level by a horizontal skylight system spanning approximately 40 ft from the tower columns to the façade.

Efficient Structural Form

For interior layout efficiency, the service core zone was placed asymmetrically toward the west side of the tower, as this is the only side of the building that is not open to the surrounding streets, and in fact shares a common lot line with an adjacent high-rise building. Naturally, the eccentric core position reduces its structural benefit as the main spine of the tower. Therefore, the design team decided to focus on the opportunities that the perimeter structure could provide in order to address the tower's overall stability. This led to an evolutionary process in the conceptual design of the tower by evaluating the effectiveness and benefits of various structural systems. The outcome was a diagrid system, which would wrap around all four sides of the tower.

This diagrid is composed of a network of triangulated trusses that interconnect all four faces of the tower, creating a highly efficient tube structure. The system is an inherently highly redundant structural network that allows multiple load paths, providing a higher standard of performance under extreme stress conditions. The inherent lateral stiffness and strength result in a significant advantage for the general stability requirement of the tower under gravity, wind, and seismic loading. The efficiency of the diagrid system resulted in 20% less steel than if a conventional moment frame structure had been used for the project.

Although diagrid systems have exceptional strength and stiffness characteristics, it was necessary to brace the diagonal elements at the floor level between the nodal levels, as the vertical distance between nodes is four floors. This approach required a secondary lateral system connected to the common diaphragm floors. The design of this system addressed stabilizing requirements that considered the total gravitational loads at each level and inter-story construction tolerances. A braced frame at the service core area was incorporated to provide this secondary lateral system.

The main dimensions for the diagrid system were based on its nodes being set on a 40-ft module and placed at four floors apart. Refinement of the structural and architectural options led to chamfered corner conditions referred as "bird mouths." This not only accentuates the aesthetic character of the diagrid, it also resolves the structural vibration issue of having 20-ft cantilever conditions every eight floors at each corner of the tower.

Typically, wide-flange rolled steel sections were used for the diagrid members, with all nodes being prefabricated and installed on-site using bolted connections.

Innovative Detail

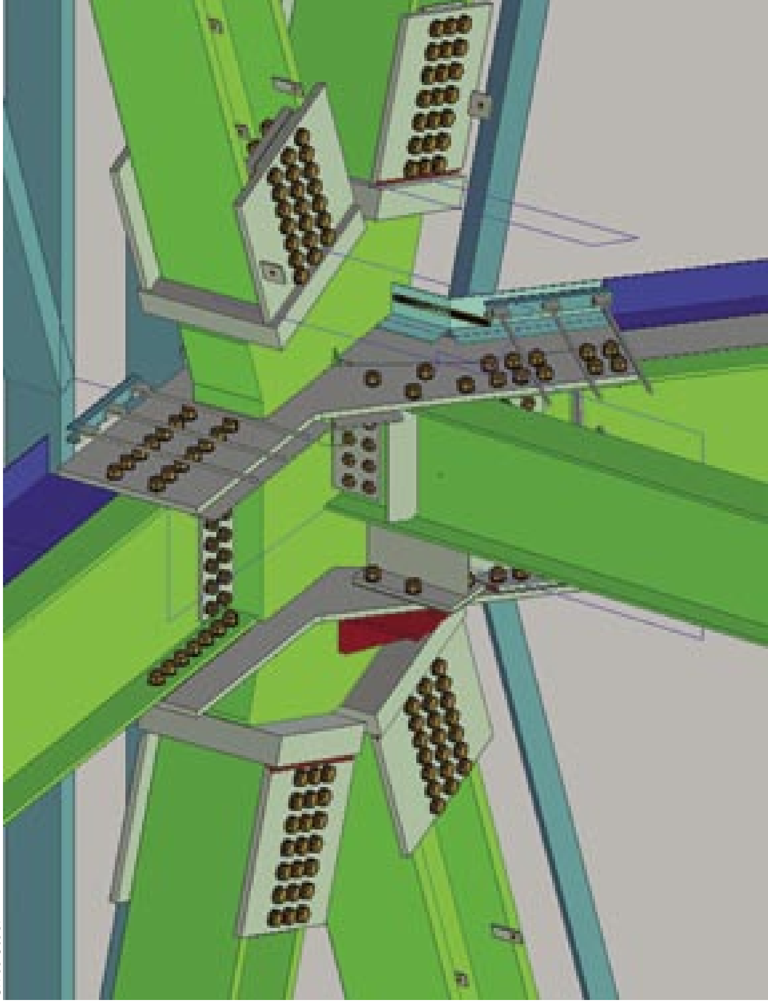
The diagrid nodes are formed by the intersection of the diagonal and horizontal elements and, from both a structural and architectural viewpoint, were one of the key design elements in the project. Structurally, they act as hubs for redirecting member forces. Architecturally, they were required to not be larger than the cross dimension of the diagrid elements in order to maintain the pure and crisp appearance of the intersecting elements at the façade.

There are two types of nodes at the perimeter: interior and corner nodes. Interior nodes are planar and transfer loads in two-dimensional space, while corner nodes transfer loads in three-dimensional space and thus form a more complicated arrangement. As the dimensions of the nodes could have a significant effect on the viability of the overall concept in respect to cladding, aesthetics, and ultimately the structural system, it was imperative that the geometry and details be designed—and the constructability confirmed—early in the conceptual design phase as opposed to the more typical detail design phase.

Mega-columns

A series of perimeter mega-columns support the diagrids at the 10th floor and continue down to the foundation. The lateral system below this level is provided by a robust composite core shear wall comprised of steel-braced frames encased in reinforced con-

In order to present a clean architectural appearance, the diagrid nodes could be no larger in dimension than the main members of the diagrid.



Cives Steel

crete walls. Two sets of super-diagonals further enhance the core wall's lateral stiffness.

Again, the office tower starts at the 10th floor, and a 95-ft interior atrium resides between this level and the ground floor. The mega-column system was positioned around the tower's perimeter and was utilized to give this portion of the building the appropriate stability for such a large, unbraced height.

Mega-columns are primarily made out of built-up steel tube sections filled with concrete. In order to create the interior open space for the lobby, two of the tower's interior columns are also transferred out to the perimeter mega-columns via a series of mega-diagonals below the 10th floor. The horizontal component of the load in the mega-diagonals intersecting with the mega-columns is resisted through in-plane ring beams and trusses that interconnect all thrust points and are part of the floor framing located around the third floor lobby.

Construction

The existing façade, in its final condition, was laterally reinforced and supported at its third and seventh levels—the latter correlating to the top of the wall by the new tower structure. However, the façade had to be temporarily stabilized, as its existing internal structure was removed in order to construct the new tower.

This was achieved by temporarily keeping the first bay of the structure all around the perimeter, including its columns and floor framing as a ring element. This also provided a working platform for existing façade wall reinforcement. However, analysis of the one-bay ring structure under the temporary loading condition showed that it also required temporary lateral stiffening, so bracing members were placed within the temporary remaining one-bay ring structure prior to removal of the rest of the existing building.

These temporary bracings remained in place until the major permanent structural work was completed up to the 10th floor and the final stability of the existing façade wall was restored.

A New Icon

Steel erection was completed in April 2005 and Hearst Tower opened last September, on time and on budget. Through the incorporation of innovative engineering techniques, a dazzling new iconic tower, in harmony with its historic base, provides a new gem on the 21st century Manhattan skyline. MSC

Ahmad Rahimian is the president of and Yoram Eilon is an associate with WSP Cantor Seinuk in New York.

Owner
The Hearst Corporation, New York

Developer
Tishman Speyer, New York

Architect
Foster and Partners, London, and Adamson Associates, Toronto

Structural Engineer
WSP Cantor Seinuk, New York

Mechanical Engineer
Flack + Kurtz, New York

Construction Manager
Turner Construction Corp., New York

Steel Fabricator
Cives Steel Company, Gouverneur, N.Y. (AISC member)

Steel Erector
Cornell & Company, Woodbury, N.J. (AISC member)

Read about the Hearst Tower from the steel fabricator's point of view in the article "A New Angle" (July 2006), available online at **www.modernsteel.com/backissues**. Hearst Tower is a Merit Award winner in AISC's 2007 IDEAS^2 awards. Read about AISC IDEAS^2 award winners in the May issue of *MSC*.