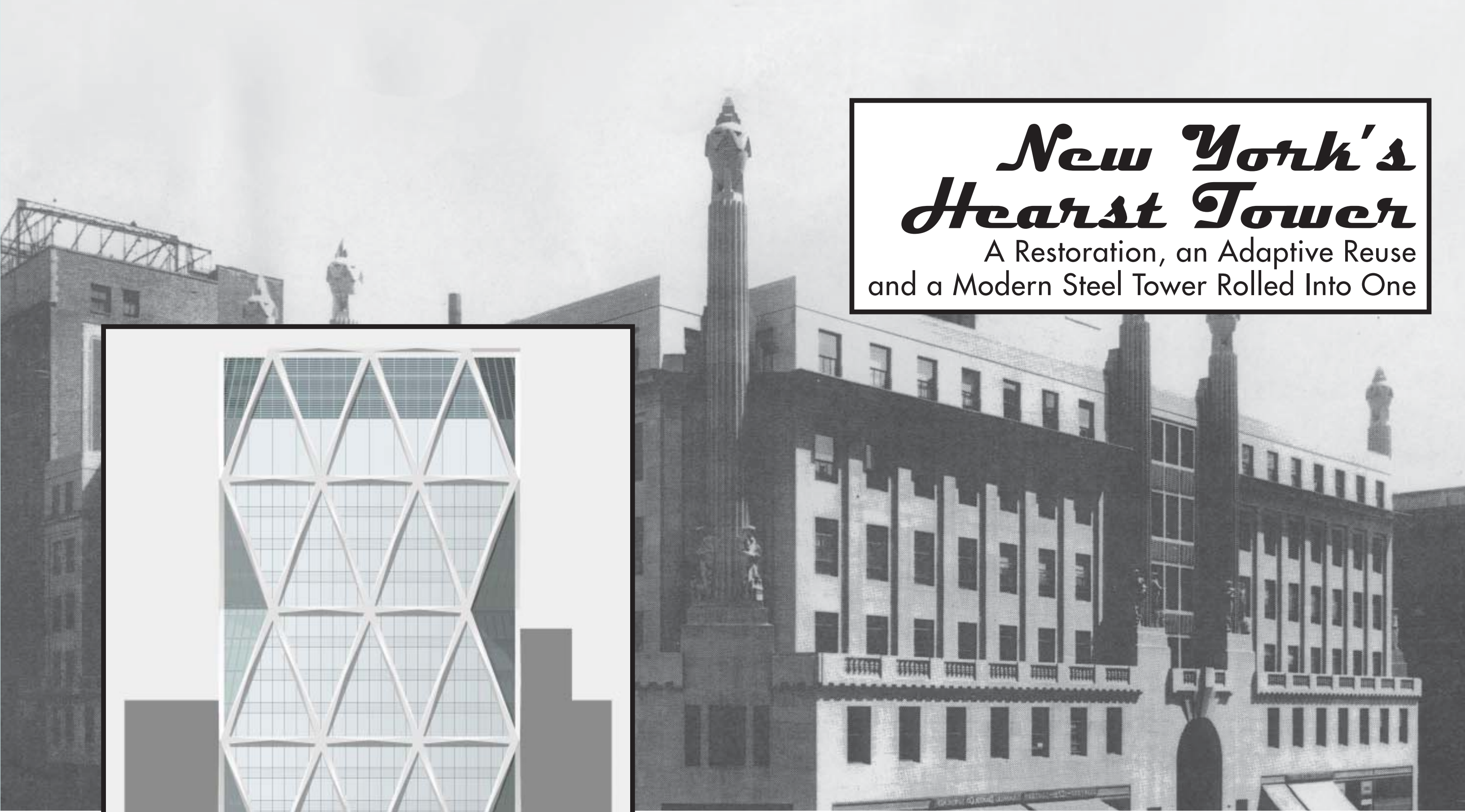


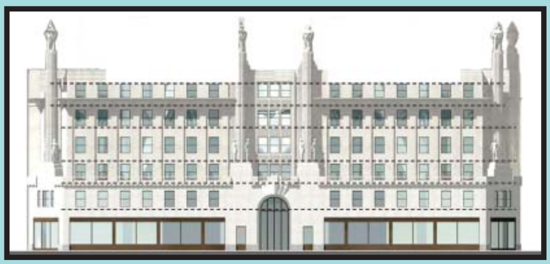
New York's Hearst Tower

A Restoration, an Adaptive Reuse and a Modern Steel Tower Rolled Into One

By Ahmad Rahimian, Ph.D., P.E., S.E., and Yoram Eilon

In the late 19th century, William Randolph Hearst envisioned a headquarters building for his newspaper empire and began acquiring real estate in and around 57th Street and Eighth Avenue. The site was originally intended to hold a two-story, mixed-use structure with stores, offices and a 2,500 seat auditorium.

In the 1920's, a six-story structure was commissioned to house offices for the Hearst Corporation's twelve magazines. Located between 56th and 57th Streets, the horseshoe shaped structure contains 40,000 square feet and was originally named the International Magazine Building. The building was designed in 1926 by Joseph Urban and George P. Post & Sons to accommodate seven additional floors which were never built.



The building included an auditorium and features six sculptural groups executed at the building's corners, main entrance on Eighth Avenue and the 57th Street entrance — which was later altered for commercial use. The precast limestone façade is comprised of a four-story setback above a two-story base. Its design consists of columns and allegorical figures representing music, art, commerce and industry. The main entrance is flanked by "Comedy and Tragedy" on the left and "Music and Art" on the right. "Sport and Industry" are above the corner at 56th Street and "Printing and the Sciences" are located on the building's major corner at 57th Street. Construction began in 1927 and was completed in 1928 at a cost of $2 million.

The building was designated as a Landmark Site by the Landmarks Preservation Commission in 1988 and was considered to be an "important monument in the architectural heritage of New York".

In early 2001, the Hearst organization commissioned Foster and Partners, Architect and Cantor Seinuk, Structural Engineer, for the design of its new headquarters at the site of its existing building. The new headquarters is a 44-story office tower, approximately 600 feet tall with 856,000 square-feet of area, and two underground levels.

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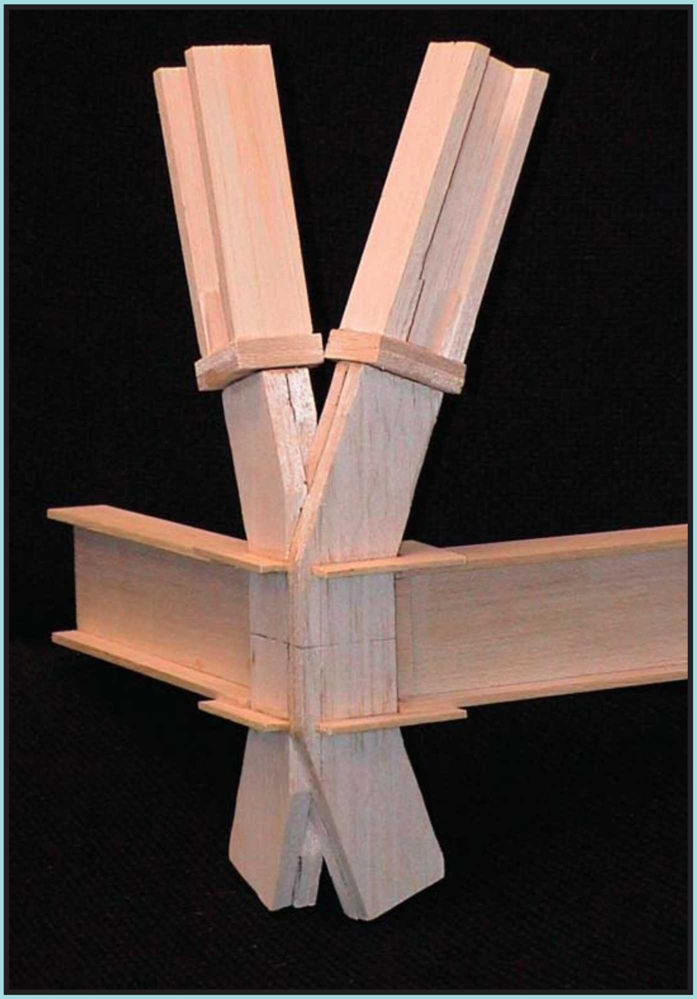


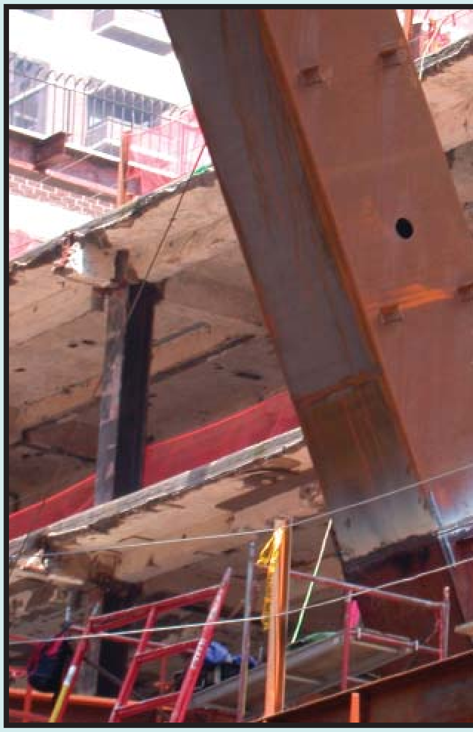
Landmark Façade

One of the major design requirements was the preservation of the six-story landmark façade and its incorporation into the new tower design. The existing six-story building had a horseshoe-shaped floor plan with a footprint of approximately 200 by 200 feet. The new design was based on removing all the existing construction, except the landmark façade wrapped around the three exterior faces of the building at 56th, 57th Street and Eighth Avenue.

> *"A diagrid system wrapping around all four faces of the tower was proposed..."*

The design called for a new tower, 44 stories above ground level and with a footprint of 160 by 120 feet. This was to be situated on new foundation rises behind the existing six story landmark façade. The new design also required a seven story high interior atrium, formed by the existing façade and the tower above.

Maintaining the existing façade without the existing supporting structure meant a larger unbraced height, a feature not originally designed for. This necessitated a new framing approach for the structural stability of the existing wall, addressing the new design condition as well as construction phase issues. In addition, the existing façade is reinforced and upgraded for new seismic requirements contained in the current New York City Building Code.



Along with the masonry façade, the supporting perimeter steel columns and spandrel beams were also maintained. The spandrel beams and columns provided full vertical support for the façade system. The lateral stability and seismic requirements for the façade construction were studied, and as a result an additional grid of vertical and horizontal framing was provided behind the existing façade. The new and existing framing are in turn laterally supported by the new tower's 3rd floor framing system, as well as skylight framing system at the top of the seventh level which coincides with the top of the existing façade.

Foundation

The boring tests indicated a sharp drop in the elevation of the rock at the site. The rock elevation varied from a few feet to 30 feet below the basement level. Therefore, almost half of the tower is supported on spread footing on rock and the other half on caissons of equivalent strength embedded into rock below.

> *"The nodes are all prefabricated and installed at the site using all bolted connections."*

Structure

The building utilizes a composite steel and concrete floor with 40-foot interior column free span for open office planning. The tower has two distinct zones. The office zone starts 110 feet above street level at the 10th floor rising to the 44th level. Below the 10th floor, the building houses the entrance at street level and lobby, cafeteria and auditorium at the 3rd floor with an approximately 80-foot high interior open space. At the seventh floor elevation, the tower is connected to the existing landmark façade by a horizontal skylight system spanning approximately 40 feet from the tower columns to the existing façade.

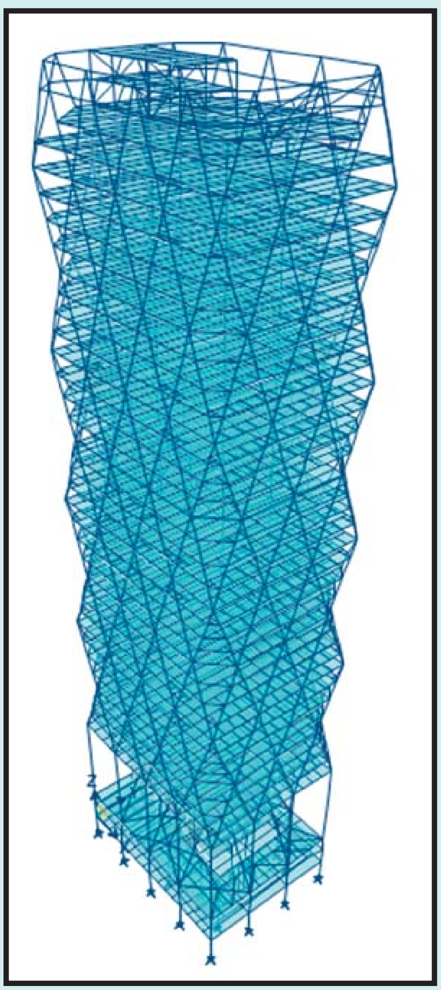
Lateral system

On three sides, the building is open to streets; however, on the west side it has a common lot line with an existing high rise building. Therefore, from the standpoint of interior layout efficiency, the

service core zone is placed asymmetrically toward the west side of the tower. However, this reduces the structural benefit of utilizing the core as the main spine of the tower due to the eccentricities inherent in the location. To address the general stability of the tower, the design team decided to focus on the opportunities that the perimeter structure could provide. This resulted in the conceptual design going through an evolutionary process by evaluating the effectiveness and benefits of various systems. A diagrid system wrapping around all four faces of the tower was proposed and selected for its multitude of merits.

Diagrid

The diagrids form a network of a triangulated truss system interconnecting all four faces of the tower, thus creating a highly efficient tube structure. The diagrid nodes are formed by the intersection of the diagonal and horizontal elements. These nodes are one of the key design elements both structurally and architecturally. Structurally, they act as hubs for redirecting the member forces. Architecturally, they were required to not be larger than the cross dimension of the diagrid elements in order to maintain the pure appearance.



The nodes in this project are on a 40-foot module and placed at four floors apart creating the diagrid system. The chamfered corner conditions, which are called "Bird's mouth," were the natural evolution of the refinement of the structural and architectural options. This not only accentuates the aesthetic character of the diagrid but also solves an otherwise structural vibration concern of having 20-foot cantilever conditions at each corner every eight floors.

The diagrid members are typically wide flange rolled steel sections. The nodes are all prefabricated and installed at the site using all bolted connections. Typically there are two types of nodes; the interior and corner nodes. The interior nodes are planar and transfer the loads in two dimensional space, whereas the corner nodes transfer the loads in three dimensional space and thus form a more complicated arrangement. The nodes were designed during the Conceptual Design phase since the actual dimension of the nodes, although maybe an issue for Detail Design phase, could have significantly impacted the viability of the overall concept in addressing issues such as cladding, aesthetics, and ultimately the structural system.

"…an important monument in the architectural heritage of New York."

Nodes

The alternate study of the corner nodes was an interesting process. Even with all the available computer software, it was much more rewarding when we switched to a time tested method of model making. The key to the design of the node was to have a less labor intensive design, even at the cost of marginally increased material.

The outcome satisfied not only the structural and architectural requirement, but also the fabrication requirement in such a way that the design concept was wholly accepted by the steel contractor.

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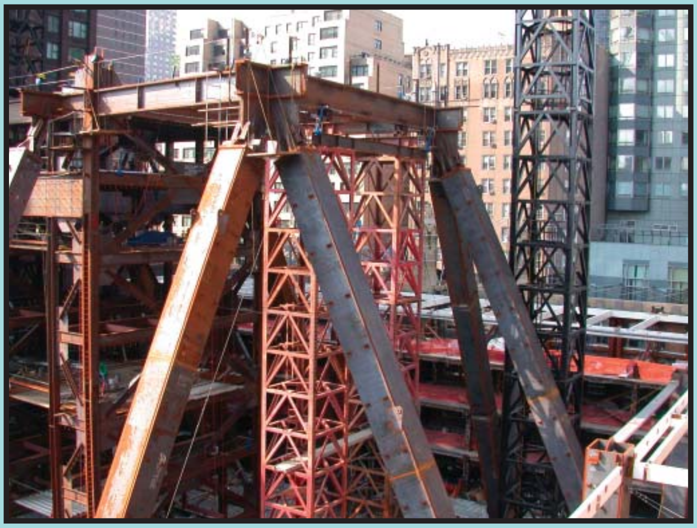

The inherent lateral stiffness and strength of the diagrid provided a significant advantage for the general stability requirement for the tower under gravity, wind and seismic loading. This resulted in a highly efficient structural system that consumed 20% less steel material in comparison to conventional moment frame structures.

"...the need for a secondary lateral system connected to the common diaphragm floors."

While diagrid systems have inherent strength and stiffness comparable to a triangulated structure, the diagonal elements are required to be braced at the floor levels between the nodal levels. This necessitates the need for a secondary lateral system connected to the common diaphragm floors. The secondary lateral system should account for the stabilizing requirements, considering the total gravitational loads at each level and the customary inter-story construction tolerances. The secondary lateral system in this project is defined by a braced frame at the service core area.

"...a new framing approach for the structural stability of the existing wall..."

The highly redundant diagrid system provides a structural network with multiple load paths that provides resistance to progressive collapse. This structure provides a higher standard of performance under extreme stress conditions that national and international codes are striving to achieve. At the 10^{th} floor, the diagrids are supported by a series of mega columns around the perimeter. The lateral system below the 10^{th} floor is achieved by a robust composite core shear wall comprised of steel braced frames encased in reinforced concrete walls. The core wall lateral stiffness is enhanced by the two sets of super-diagonals.

Mega Columns

The typical office tower starts at 110 feet above ground, at the 10^{th} floor. The design calls for an interior open space between the 3^{rd} and 10^{th} floor with a height of approximately 80 feet.

The structure below the 10^{th} floor is designed to respond to the large unbraced height by using a mega column system around the perimeter of the tower footprint, supporting the tower perimeter structure. Mega columns are primarily made out of built-up steel tube sections and strategically filled with concrete. In order to create the interior open space, two of the tower interior columns are also transferred out to the perimeter of the tower via a series of super diagonals below the 10^{th} floor.

Additional interior super-diagonals are provided below the 10^{th} floor to assist the composite core wall system for general stability. Mega columns are continued down to the foundation.

Design

The structural software used was **ETABS, RAM** and **SAP2000**. The controlling lateral load was primarily wind. Seismic analysis was in accordance with the New York City Building Code, Seismic Zone 2A.

Construction

The existing façade was laterally reinforced and is supported at the 3rd and 7th level which is equivalent to the top of the wall by the new tower structure. However, to erect the new tower, the existing structure which provides stability for the existing façade needed to be removed. Therefore, the retained façade had to be stabilized 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 provides a working platform for existing façade wall reinforcing.

Nevertheless, the analysis of the one bay ring structure under the temporary loading condition showed that it also temporarily required to be laterally stiffened. This necessitated placing bracing members within the temporary remaining one bay ring structure prior to removal of the balance 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.

The structure is planned to open in June 2006.▪

Project Team

—Owner—
Hearst Corporation

—Development Manager—
Tishman Speyer Properties

—Architect—
Foster and Partners

—Associate Architect—
Adamson Associates

—Structural Engineer—
WSP Cantor Seinuk

—MEP—
Flack & Kurtz

—Construction Manager—
Turner Construction Co.

Ahmad Rahimian, PhD., P.E., S.E. is president of WSP Cantor Seinuk, Structural Engineers, New York division of WSP Group. He is an internationally recognized expert in tall buildings. Dr. Rahimian is the recipient of numerous awards from engineering societies for various exemplary projects that he has engineered, including the ENR Excellence Award as one of the Top 25 Newsmakers of 2003 and 2005 ASCE-CERF Charles Pankow award for innovation. Dr Rahimian holds a US patent for seismic protective design, has authored numerous articles and lectured widely on the design of tall buildings in professional societies and universities. Yoram Eilon is an Associate with WSP Cantor Seinuk Structural Engineers, New York division of WSP Group. He has designed office, residential, stadium, industrial and parking structures in United States and overseas. Mr. Eilon is currently completing work on the Hearst Building and working on the design of the Freedom Tower in New York City.