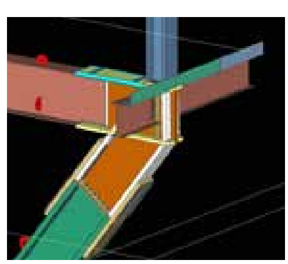
Above and BEYOND

BY GEOFF WEISENBERGER

One of Chicago's newest and most dynamic high-rises chose to go big with steel to make the most of a constrained but high-profile site.

THERE'S A LOT GOING ON around 150 N. Riverside. The new building, which opened this past spring in Chicago's West Loop, sits on a 0.7-acre site between active rail lines (below streel level) to the west, the Chicago River to the east, Lake Street and elevated CTA train tracks to the north and Randolph Street to the south. It's also directly above Metra commuter rail and Amtrak tracks that feed into Union Station to the south.

The transfer system consists of two similar but slightly different sets of trusses. The six type 1 trusses connect to the core and the two type 2 trusses are located at the far north and south column lines, outside of the core footprint. (The north type 2 truss is at the far left; the south truss isn't constructed yet in this photo.)



Fabrication started with the type 1 trusses. This model shows the connection of a plate girder to the node of a super-diagonal.

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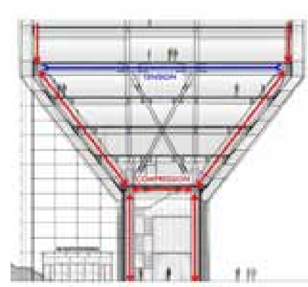
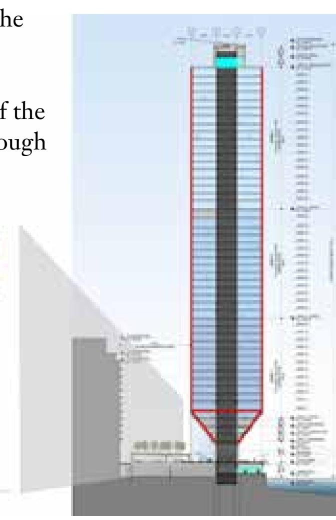
The base of the 747-ft-tall, 54-story building is eight stories. From levels 4 through 8, the building cantilevers diagonally out to the full floor size, with the first full office floor 104 ft above grade. In addition to providing a signature design element to the project, the cantilever solution was conceived to minimize the building's footprint on the tight riverfront site, a portion of which was required to be set aside for public space. The 1.2 million-sq.-ft building's footprint takes up only 25% of the site.

In an effort to reduce weight and material costs, the project ended up being the first use of ASTM A913 70-ksi steel in the United States.

The following pages will take you on an image tour of the project from fabrication through completion.





While there are many ways to transfer perimeter column forces into the core, the scheme used for 150 N. Riverside was to slope the columns inward to be supported by the structure at or near the core of the building. The lateral system employs a core wall only, but to provide acceptable lateral performance for building drift and occupant comfort, a 160,000-gallon tuned liquid damper was employed at the roof level.

The column transfer is accomplished via a sloping column transfer system spanning from levels 4 through 8. Compression on the diagonals and tension element take place at level 8. While the need to slope was only really needed on the west side of the building, the team saw great benefit in sloping both sides of the building. This way, the horizontal thrusts associated with the sloping columns are essentially balanced, and the building is not required to resist a significant unbalanced lateral force. In essence, the system is an inverse tied-arch.

▲ A 60-ft-long diagonal section of a type 1 truss , a 65-ksi W36×925, being heat-straightened in the shop (which was done for most sections).

▲ The 60-ft diagonal sections of the type 1 trusses projecting from the core.

◄ A type 1 truss plate girder and node, connected in the shop.

► The mega-columns are comprised of not one but two 65-ksi W36×925 columns—each one carrying 13,000 tons of force. The flanges are 4½ in. thick and 18 in. long, and the web is 3 in. thick and 43 in. deep.

► At the lower levels where the forces are significant, the goal was to minimize the number of erectable pieces in order to reduce construction cost and optimize the schedule. The lower levels (below the full-floor office levels) incorporate 54 major pieces weighing between 26.5 tons and 31 tons and up to 68 ft long. The main laydown area was located to the west of the building on the overbuild atop existing rail lines, as well as to the south in areas that would become public spaces.

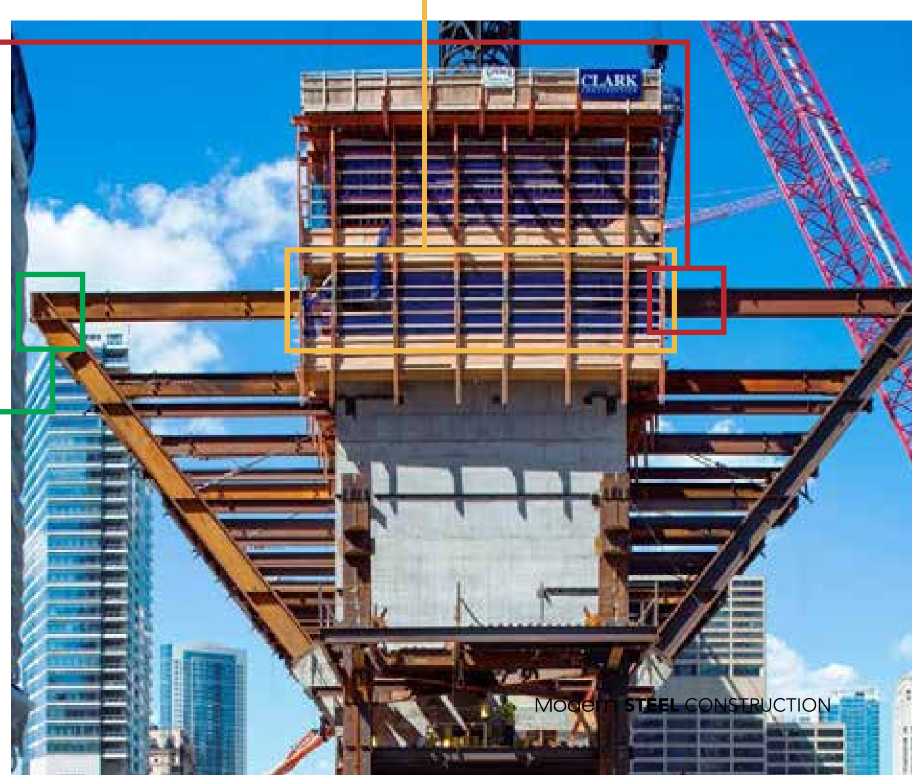
◄ Connecting a type 1 truss diagonal to a node, then a plate girder. All members were test fit on fabricator Zalk Josephs' shop floor.

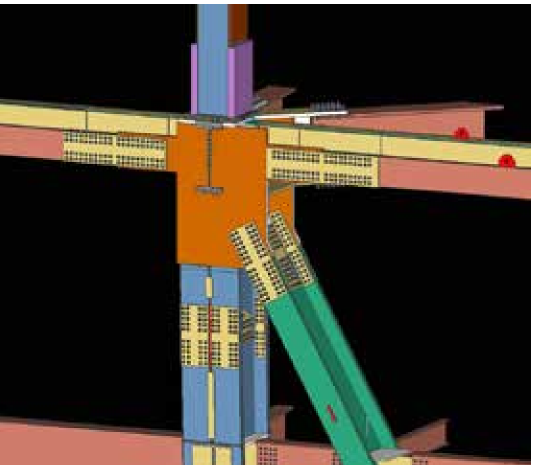
The resulting tension forces are resisted by a continuous tension tie extending from building edge to building edge. Outside of the core, the tension tie is a built-up plate girder with a 4-in. web plate acting as the tension member. Inside the core, a pair of plates are cast into the core and connected to the built-up transfer girder via a bolted splice connection just outside of the concrete core wall.

Each connection to the core uses 150 1⅛-in.-diameter, 15-in.-long A490 SC Class B bolts in double shear. Given the importance of this connection in terms of stability, side plates were added outside of the primary shear planes, effectively creating a quadruple-shear condition and providing a completely secondary load path for the tension forces.

At the outer nodes, the team worked to eliminate field welding entirely at the tie-to-sloping-column connection.

► The original truss design involved concrete-filled box columns in order to minimize pick weights, but it was changed to an all-steel option, which proved to be more cost-effective. **The W36×925 sloping columns are the largest rolled shapes in the world.** All truss connections were bolted.





All joints were bolted to accelerate work and reduce cost. This is the inner node of a type 2 truss at level 8. Most of the major bolts were 1-in.- and 1⅛-in.-diameter A490.

Riverside Investment & Development

A steel braced framed was used in the center bay of the type 2 trusses to resist any imbalanced loading on each side of the building. Each truss is supported by a pair of mega steel columns. Truss diagonals were temporarily supported with two cable systems: one low, used as the main support, and one high, used for adjustment and as a redundancy. Both used twin 1-in.-diameter cables.

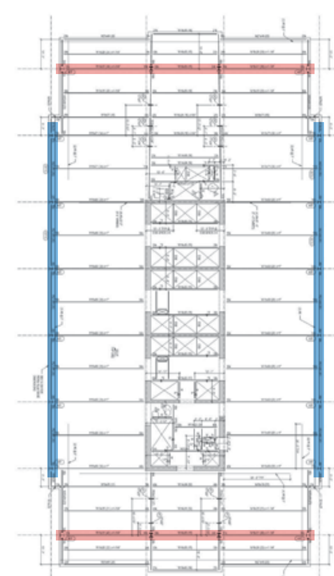
Preassembly of a type 2 truss node.

Shop fit-up of a type 2 truss for levels 4-8.

A solution resulting from collaboration between engineer and fabricator: For the type 2 trusses, using W36 members for not only the sloped columns but also the tension tie and the braced frame elements meant field-bolted sandwich-plate connections could be employed.

Connecting the outer top cord of a type 2 truss to the inner node.

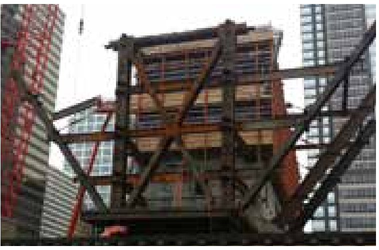
Above the level of the transfer truss, the building plan resembles a conventional steel-framed office building. Perimeter columns along the east and west sides of the building are 70-ksi steel (blue) while columns along the north and south ends are 65-ksi (red). Incorporating these higher grades of steel saved around 540 tons of total steel for the project. In all, the building's framing consists of 10,000 tons of structural steel, including 1,755 tons of 65-ksi and 665 tons of 70-ksi steel.



Chicago Steel Construction erected column line 8 from levels 6-8 as one 120-ton unit comprised of 11 pieces weighing between 0.6 tons and 30.5 tons.

A type 2 truss at the north end of the building bracing back to core at levels 4, 6 and 8.

Another view of the type 2 truss at the north end of the building.



A 125-ton bent frame being assembled at an additional laydown area at the northeast corner of the site.

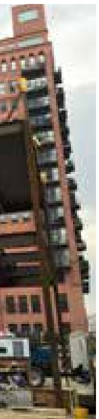
The 660-ton-capacity crane, which rotated on a 43-ft-diameter ring, was located on a barge on the Chicago River.

The building entrance at the southwest corner features a hanging glass curtain wall that extends from the ground to the bottom of the cantilevered section.

A view of the completed building from the northeast.

Under the cantilevered portion on the east side. The site is bordered by a residential building to the west, elevated train lines and a street to the north, the Chicago River to the east and another street to the south.

Green space on the building's west side.



A corner embed at level 8 consisting of a W14×398 with #11 bar couplers and three 1¼-in. to 2-in. plates for three in-plane bracing beams to connect to. All embeds were fabricated with connection materials attached in the shop. Only two connection plates were remade following field surveys.

Owner
Riverside Investment & Development, Chicago

General Contractor
Clark Construction, Chicago

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Goettsch Partners, Chicago

Structural Engineer
Magnusson Klemencic Associates, Seattle and Chicago

Connection Design
Computerized Structural Design, SC, Milwaukee

Steel Team

Fabricator
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Erector
Chicago Steel Constuction, LLC, Merrillville, Ind.

Detailer
Ken Boitz and Associates, Inc., Bloomingdale, Ill.