Holding Court

BY FLORA CALABRESE, S.E.

A late 19th century warehouse provided the framework for this modern courthouse.

Mark Ballogg

COOK COUNTY ILLINOIS' DOMESTIC VIOLENCE COURTHOUSE WAS ILL-SUITED FOR THE PURPOSE AND PEOPLE IT WAS MEANT TO SERVE: Victims and their accused abusers were often made to ride in the same elevator and wait in the same area before their trials began.

The search in 2002 for a new courthouse led to a steel-framed warehouse, originally constructed in the late 1800s. The four-story building had stood empty in Chicago's South Loop neighborhood for many years until a project was undertaken in 2000 to convert it to a high-speed Internet center. Financial concerns associated with dot-com ventures disrupted these plans, however.

Cook County purchased the 170,000 sq. ft warehouse and initiated plans to convert it into the new courthouse. The alley and a parking lot to the north of the building were also purchased to provide space for an atrium, landscaped plaza, and parking area.

Original Structure

The structure of the original building consists of perimeter brick masonry walls, which carry their own weight but little of the floor and roof loads. A framework of structural steel beams, girders, and columns supports segmental clay tile arch floors. The foundations of the masonry walls and columns were constructed with stone blocks, with pyramid-shaped isolated footings for the columns.

The original steel members are typically built-up sections, with rolled sections present only at the roof structure. The built-up beams and girders consist of flange angles riveted to web plates. The existing columns are Phoenix columns, a historic, proprietary design consisting of flanged quarter-circles riveted together.

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Laboratory testing had been performed during the Internet center's design on samples taken from the flange angles of several beams and girders. The testing consisted of tensile testing and chemical analysis. The tensile tests indicated that the steel had yield strengths ranging from 45.4 ksi to 50.5 ksi, with an average yield strength of 47.2 ksi. The ultimate strengths of the samples varied between 64.8 ksi and 69.5 ksi, with an average ultimate stress of 66.9 ksi. Engineers for the courthouse project found these values to be well above the typical minimum strengths specified for steels at the time of the warehouse's construction.

In general, the chemical analysis found that the steel was comparable to the current specification for ASTM A36 steel. The exception was its relatively high amounts of phosphorous and sulfur, which would require the use of particular welding procedures. For welds required at the existing steel, engineers specified a low-heat input procedure. The welds and steel were then to be inspected after the welds had cooled, at least 48 hours after installation. If cracking was found in the weld or base metal, one of two options was necessary to concentrate the shrinkage strain in the weld metal: standard E7018 welding was to be used, but only with "Atom Arc" welding electrodes produced by ESAB; or stainless steel (309L) welding electrodes and procedures would be required.

Renovation

Several aspects of the renovation would have a major impact on the building's structure, the most prominent being the addition of a steel-framed atrium along the north wall of the building. The atrium would add to the serviceability of the building by providing public entrances at the center of

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the north elevation, as well as at the northeast and northwest corners of the building.

The architectural design required a new rain screen façade to vertically span 60' between supports to create the clear four-story atrium space. Steel trusses were selected to support the façade for architectural and structural reasons—the space-frame trusses are visually appealing and provide the needed stiffness to limit deflection under design wind loads. The deflection limit was imposed by the use of large windows that amount to 40% of the façade's area.

The trusses consist of A572 wide-flange members that are embedded in the façade and A500 pipe members that project into the atrium space. The connections at the pipe-to-pipe and pipe-to-wide-flange intersections are plates welded into the slotted ends of the pipes. The final configuration of the truss nodes resulted in relatively stiff connections. Originally, the trusses included conventional diagonal web members, consisting of solid steel rods, between the truss nodes.

During computer analysis of the trusses, performed using SAP 2000, engineers included a realistic representation of the truss connections with regard to their calculated stiffness. They found that the diagonal rods attracted very little load and therefore had little impact on the behavior of the truss structure, including the stresses in the pipe and wide-flange members and the lateral deflection of the façade structure under wind loads. Consequently, it was decided to omit the rods from the trusses, which resulted in a less congested, more elegant appearance.

The lateral support at the base of the trusses consists of a sloped floor that is supported on steel framing and concrete shear walls, thereby providing usable space under the atrium. At the top of the trusses, steel beams extend from the new façade to the existing structure. Curved steel beams are exposed to view at the atrium's ceiling. Blond wood panels are located between the curved steel beams and the flanges of the vertical wide-flange members, accenting the appearance of the silver-painted steel members.

In addition to the atrium façade, roof, and floor framing, steel was also used to frame the mechanical penthouse at the building's roof level. Steel at this level fit with the existing steel framing and was also the most efficient choice for the lintels needed to create large openings in the thick masonry walls.

A ramp structure is constructed along the northern edge of the building and provides access to an indoor parking area that was added to the building's basement level. A pedestrian bridge spans over the ramp to provide access between the atrium and the surface parking lot. Engineers designed the pedestrian bridge with steel beams acting compositely with a concrete slab to provide sufficient clearance under the pedestrian bridge while limiting the depth of the excavation and, therefore, the ramp slope.

Steel was also used as temporary shoring for the new construction. At the lowest portion of the ramp, it was necessary to undermine the stone foundation of the north masonry wall and the foundation of the steel columns located immediately adjacent to it. Steel framing was used to support the wall until concrete caissons and grade beams could be constructed. It was also used to support several interior columns whose foundations impacted the construction of a truck dock within the building.

The courthouse opened in October 2005 with ten new courtrooms and a care facility for children whose parents or guardians are attending court. The facility also has a dedicated, private, and secure "support area" to address the special needs of victims of domestic abuse. MSC

Owner
Cook County, Ill.

Architects
Design Architect: Booth Hansen, Chicago
Architect of Record: Campbell Tiu Campbell, Inc., Chicago
Associate Architect: Folgers Architects, Ltd., Chicago

Structural Engineer
Wiss, Janney, Elstner Associates, Inc., Northbrook, Ill.

Engineering Software
SAP 2000

Erector
Rigging Services, Inc., Rockford, Ill., NEA member

General Contractor
Sollitt/Oakley, Joint Venture, Chicago