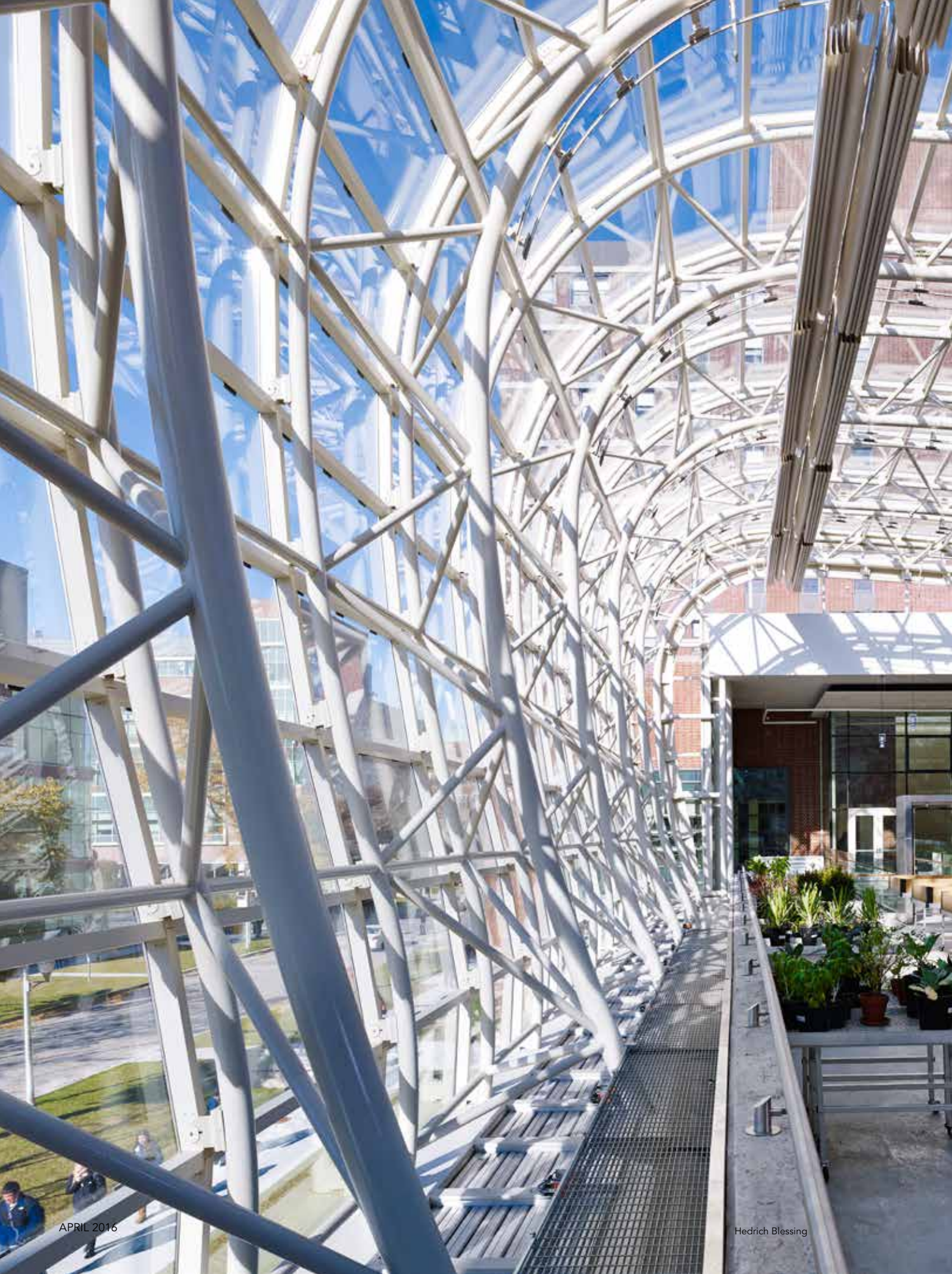

APRIL 2016

Hedrich Blessing

# GREEN Connection

BY RANDALL HERBSTMAN, S.E.

## A modern greenhouse links old and new construction on an urban college campus.

**STARTING IN 2007,** Loyola University Chicago embarked on a seven-year, multi-building expansion to its North Shore Campus.

The growth spurt kicked off with a new electronic library, the Information Commons, then continued with the Norville Center, an addition to the basketball arena; Cuneo Hall, a new academic building; the Damen Student Center; a new permanent seating bowl inside the school's basketball arena; and a new dormitory. The latest addition is the Institute of Environmental Sustainability (IES).

A living/learning building, the IES combines academic and residential functions to create a unique and transformative educational experience. The academic portion of the 215,000-sq.-ft building is a multi-disciplinary, research-based facility that includes classrooms, research and teaching labs, a clean energy lab, an aquaponic farming display and a greenhouse. The residential portion of the program—San Francisco Hall—provides freshman and sophomore student housing along with a café and recreation areas. The existing Wright Hall and Chapel have been renovated and expanded into academic and administrative offices and form the northern end of the IES. San Francisco Hall forms the southern end of the facility and the Winter Garden links the two buildings.

The 20,000-sq.-ft expansion of Wright Hall and the 16,000-sq.-ft Winter Garden, the centerpiece of the project, both use structural steel framing; the Wright Hall expansion used ASTM A992 wide-flange columns and floor framing with composite metal deck slabs. W27×84 shapes were used to span the 30 ft between columns in the expansion because they allowed for smaller foundations in the new building, which wouldn't interfere with the foundations of the adjacent existing buildings. Some of these were spread footings next to the existing structure and some were micropiles that were placed from inside the existing basement. Unreinforced web penetrations were provided in many floor beams, allowing the MEP systems to easily route above the ceiling, which was set just below the steel framing.

The Winter Garden link between San Francisco Residences and the Wright Hall expansion is a two-story structure that includes a curving steel framed glass roof. The second floor of the structure (steel framing with a composite metal deck slab) forms the floor of the greenhouse and an aquaponics farming display. Since the greenhouse is a naturally ventilated space, PEX tubing was run throughout the composite slab to provide supplemental radiant heat during the colder months of the year.

Several roof forms were considered during the design process; all were steel frames because a high level of transparency was required for the greenhouse. The final system chosen comprised trusses with a triangular cross section: two top chords,


The two-story Winter Garden includes a curved steel-framed glass roof. The second floor forms the floor of the greenhouse and an aquaponics farming display.

**Randall Herbstman** (**rherbstman@hpse.com**) is a project engineer with Halvorson and Partners in Chicago.


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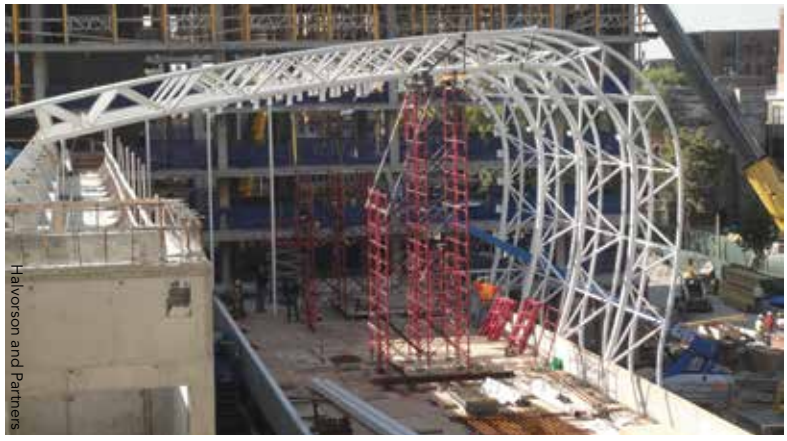
Erecting the HSS framing for the Winter Garden.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Halvorson and Partners

Winter Garden trusses are each supported by a single pinned connection on the concrete roof of the north section of San Francisco Hall.

Using steel instead of concrete (like the neighboring structures) allowed the design team to incorporate smaller foundations.

The Institute of Environmental Sustainability is meant to serve as a living/learning building that combines academic and residential functions.

**Worldwide Solutions**

The Institute of Environmental Sustainability strives to create solutions to stresses on the planet's natural resources, expanding knowledge through teaching, research and sponsoring outreach activities on pressing environmental issues such as global climate change, food production and distribution, conserving and recovering biodiversity, restoring ecosystem function, identifying emerging environmental contaminants and privatizing natural resources. The facility includes:

- The largest geothermal complex in Chicago—90 geothermal wells, 500 ft deep—providing over 700 tons of cooling energy
- Rainwater collection and reuse for greenhouse irrigation
- A three-story high vertical farming element
- Sustainable food systems and urban agriculture research projects and production labs
- A clean energy lab that will allow the biodiesel program to increase fuel production by up to 100,000 gallons per year

each HSS3.500×0.258, and a single bottom chord a HSS8.625×0.500; all diagonals that connect the chords are also HSS3.500×0.258.

Bender-Roller Chicago Metal Rolled Products used a three-roll, pyramid bending process to curve the 36 tons of HSS to various radiuses from 250 ft to 12 ft. The structure is made up of 27 pieces of 8-in. HSS (bottom chords) equaling roughly 840 ft of curved steel. Running parallel to this are 54 pieces of 5-in. HSS (top chords) that help make the triangular truss shape. To ensure that the structure met erection tolerances, the round HSS were curved to very tight tolerances. In addition to the radius

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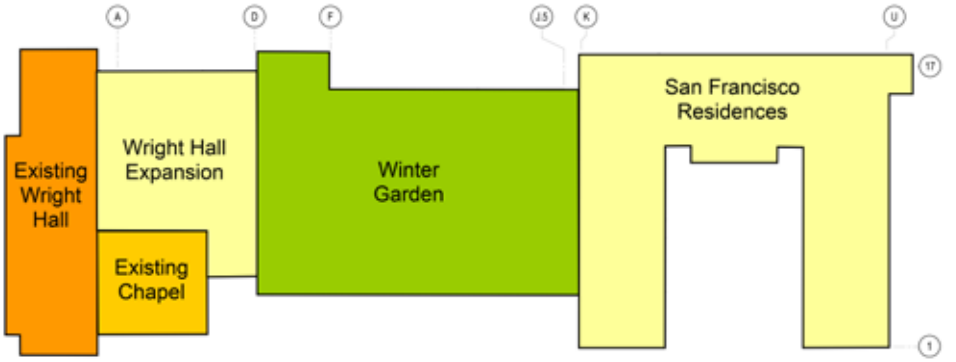


▲ A layout of the expansion/addition project.

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▲ ▼ Bender-Roller Chicago Metal Rolled Products used a three-roll, pyramid bending process to curve the 36 tons of HSS to various radiuses from 250 ft to 12 ft.

Chicago Metal Rolled Products

tolerances the architect also required a strict ovality and distortion tolerance since the trusses would be exposed to view. (For more on the bending-rolling process, see "There's More than One Way to Bend a Beam" in the January 2016 issue, available at **www.modernsteel.com**.)

The nine trusses are spaced at 16-ft, 3-in. centers, with 8-ft, ½-in. spacing between top chord members, and are supported at each end at the bottom chord. To stabilize the individual trusses, each truss is connected to the adjacent trusses with a grid of HSS3.500×0.258 at the top


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chords. The roof is supported by built-up plate connections cantilevering off the second framing floor of the greenhouse structure. The trusses are each supported by a single pinned connection on the concrete roof of the north section of San Francisco Hall. The staging of this erection had to be carefully managed to ensure each truss would fit into the provided connection points. The design team worked closely with the contractor and fabricator to develop the most visually appealing and cost-effective solution that would allow for the greenhouse glazing system to stay within the project budget. ■


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- Unreinforced web penetrations were provided in many floor beams to route MEP systems.
- The roof trusses are spaced at 16-ft, 3-in. centers.

**Owner**
Loyola University Chicago

**General Contractor**
Power Construction

**Architect**
Solomon Cordwell Buenz

**Structural Engineer**
Halvorson and Partners, a WSP|Parsons Brinckerhoff Company

**Steel Bender-Roller**
Chicago Metal Rolled Products AISC ASSOCIATE