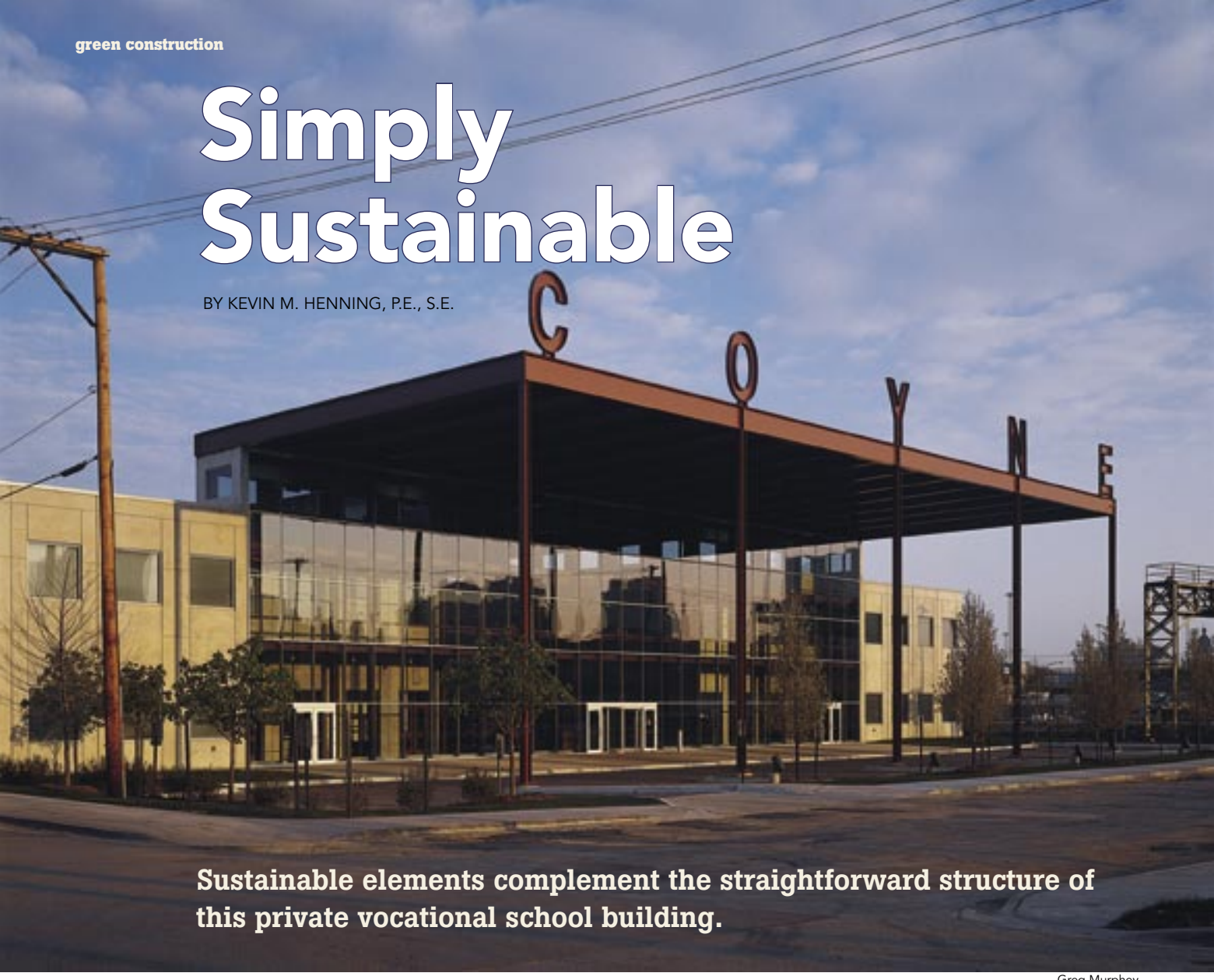
Simply Sustainable

BY KEVIN M. HENNING, P.E., S.E.



Sustainable elements complement the straightforward structure of this private vocational school building.

Greg Murphey

THE DESIGN FOR COYNE AMERICAN INSTITUTE'S NEW EDUCATIONAL BUILDING, LOCATED IN CHICAGO'S INDUSTRIAL WEST LOOP NEIGHBORHOOD, SATISFIED THE VOCATIONAL SCHOOL'S NEED TO EXPAND QUICKLY AND THE CITY'S GOAL TO INCORPORATE SUSTAINABLE PRACTICES INTO NEW CONSTRUCTION.

Booth Hansen architects, working with Thornton Tomasetti structural engineers, quickly designed a simple U-shaped facility that provides 76,000 sq. ft of classrooms, administrative offices, and laboratories.

The design team worked with the project's developer to incorporate a number of green features—such as a city-mandated green roof, light-reflecting exterior materials, and the maximized use of sunlight for interior lighting—with minimal impact to the budget.

Structural System

The two-story building is constructed of structural steel framing with precast bearing walls—a system selected for its speed of erection, long spans, and column-free spaces—with composite floor framing and steel joist roof framing. The building's north wall is oriented on a skew to reflect railroad and utility rights-of-way along the site's northern property line. This orientation also maximizes the amount of natural light allowed into the building's interior

Resistance to lateral loads is provided by the precast concrete wall panels. Thornton Tomasetti performed lateral analysis of the structure and indicated horizontal shears at each perimeter wall on the structural design drawings.

Foundations consist of continuous footings around the perimeter and isolated spread footings below the interior steel columns. The ground floor slab on grade was stained and polished to provide the finished floor in the atrium, corridors, and classrooms.

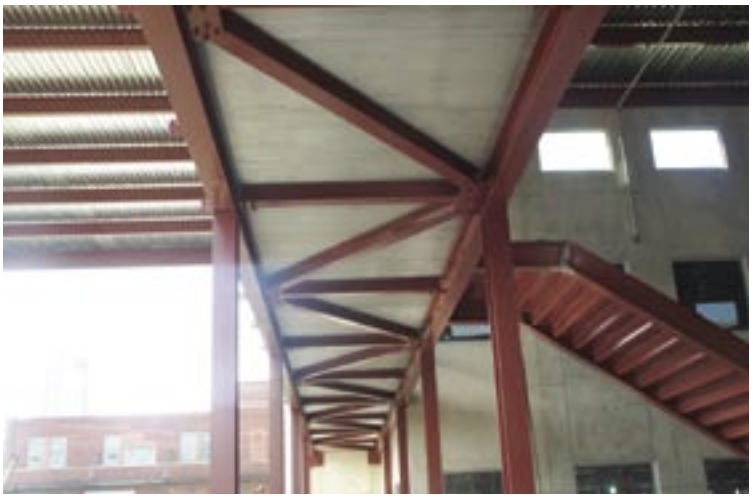
The second floor framing is conventional composite floor construction consisting of 5¾"-thick composite floor slab supported by W18 wide-flange beams at 10' on center. Girders are typically W24 wide-flange sections. The composite floor slab was used as the finished second floor, as well.

Roof Framing

An extensive green roof landscaping system was used

Booth Hansen

The roof beam connections at the queen post locations were detailed to provide moment resistance, allowing the posts to be designed as "fixed-free" compression members and eliminating the need for bottom chord bracing.



Booth Hansen

A horizontal truss that braces the glass curtain wall at the entry also provides support for aluminum grating, creating a walkway that links north and south classroom corridors.

on the main roof, with low growing sedums that do not require irrigation. The green roof system reduces the "heat island effect" and manages storm water run-off. Its weight is less than 15 psf, minimizing the economic impact on the structural framing.

The main roof framing consists of 1½"-deep wide rib metal deck supported on K-series open web steel joists and wide-flange steel girders. Steel girders were detailed with overhanging cantilevers and suspended spans, reducing both the required girder depth and weight by balancing positive and negative moments and reducing girder deflections.

Five large air handling units were to be placed on the main roof, but the precise size, location, and weight of the units were not known at the time the steel structure was put to bid. A "rooftop unit zone" framed with KCS joists and heavy girders was designated on the structural framing plan to facilitate the steel bid and construction schedule and allow flexibility in the purchase and installation of the mechanical equipment. This zone provided a 140' by 50' area where the rooftop units could be placed.

Atrium

Perimeter precast bearing walls return into the building along its east wall to form a 6,800 sq. ft light-filled atrium at the building's entrance. The atrium is enclosed by a 40'-tall steel-framed glass curtain wall that extends along nearly two-thirds of the eastern wall.

The atrium roof rises approximately 10' above the main roof, creat-

Simply Good Design

Some of Coyne American Institute's sustainable elements were incorporated, in part, to satisfy Chicago's requirements for new buildings constructed within Tax Increment Financing districts. However, according to David Mann, AIA, principal at Booth Hansen Associates architects, green elements are given regular consideration in the firm's design process.

"For us, it's become good design practice to incorporate sustainable design elements that provide value to the client, especially over the life of the building," Mann says.

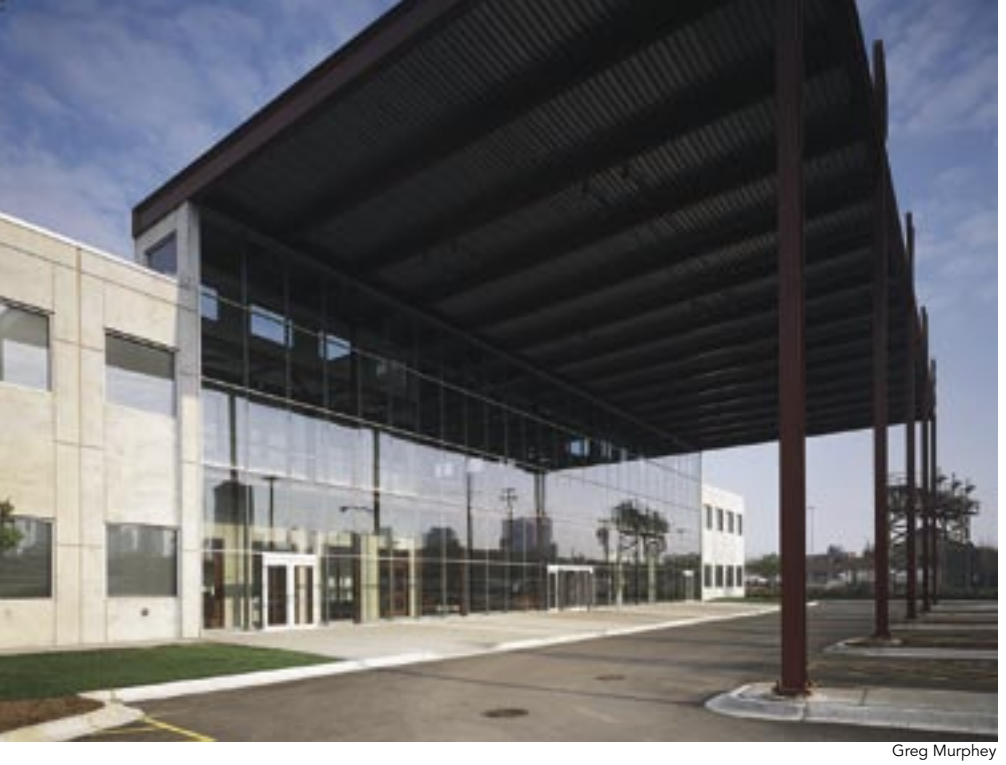
For Coyne American Institute, the project team worked together to include the following sustainable elements:

- A green roof with trays of low-growing plants to minimize storm water runoff and reduce the "heat island" effect.
- Reflective, high-emissivity coatings and ballast that manage the amount of heat emitted into the atmosphere from the areas of the roof not covered by plants.
- Exterior concrete surfaces that were left unpainted to maintain their naturally light-reflective quality.
- Exterior lighting that was shielded to reduce light pollution.
- Independent lighting control zones every 200 sq. ft in the building's interior to minimize wasted electricity.
- A building orientation that most efficiently uses the sun for interior lighting.

And the use of structural steel provided the opportunity to maximize the amount of natural light allowed in. A glass façade spans the eastern wall of the building to allow even more light to penetrate the interior spaces.

"The whole front of the building is a glass façade," Mann says. "Without a steel structure behind it, you couldn't do that. The light goes deep into the building to provide daylight to interior spaces that wouldn't normally get that amount of light."

—Lena Singer



Greg Murphey

The atrium roof extends 50' beyond the building line to create a canopy over the drive aisle and entry.

ing a clerestory to bring additional natural light into the atrium. This roof is framed with exposed wide-flange beams and a queen post truss that spans 60' across the center. The roof beam connections at the queen post locations were detailed to provide moment resistance, allowing the posts to be designed as "fixed-free" compression members and eliminating the need for bottom chord bracing.

The atrium roof extends 50' beyond the building line to create a canopy over the drive aisle and entry. This 7,000 sq. ft canopy is framed with wide-flange roof beams and is covered by 3"-deep galvanized roof deck. A colonnade of five steel columns supports the leading edge of the canopy, which provides a prominent location for steel signage letters that spell the school's name.

Curtain Wall and Walkway

Extending across the atrium, the 5,600 sq. ft entry curtain wall reaches 40' from the ground level to the atrium roof above. Bracing for the curtain wall is provided by two horizontal trusses, one located at the second floor level and the other located just below the main roof level. Horizontal trusses are constructed of W12 wide-flange chords and W6 wide-flange diagonals and struts. The horizontal truss at the second floor also provides support for aluminum grating, creating a walkway that links north and south classroom corridors.

Above the curtain wall, a 140'-long variable depth continuous plate girder supports the atrium roof and canopy framing and provides a weather closure for the atrium. The top flange of the plate girder slopes to follow the profile of the roof, ensuring proper roof drainage, while the bottom flange remains flat to receive the head of the curtain wall. The plate girder was fabricated and shipped in three pieces and spliced on site using bolted end plates. MSC

Kevin M. Henning is a project manager for Smithfield Construction Group. He was a senior project engineer for Thornton Tomasetti during the Coyne American Institute project.

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Coyne American Institute, Chicago

Architect
Booth Hansen, Chicago

Structural Engineer
Thornton Tomasetti, Chicago

Engineering Software
RAM Structural System
SAP2000

Detailer and Fabricator
Merrill Iron & Steel, Inc., Schofield, Wisc., AISC member

Detailing Software
SDS/2

Steel Joist Supplier
Canam Steel Corporation, Point of Rocks, Md., AISC member

General Contractor
Smithfield Construction Group, Chicago