Innovations in cold-formed steel framing

Improved constructability, efficiency, and sustainability meet the demands of 21st century design.

By Steven H. Miller, CDT

Cold-formed steel framing (CFSF) has grown from a simple imitation of wood frame construction to an increasingly versatile system unto itself. Notable innovations include light weight concrete/steel hybrid wall systems that make more structurally efficient buildings; methods for producing precise, custom-curved framing members quickly and affordably to meet contemporary architectural demands; and a standardized, pre-engineered rough opening system to simplify engineering of door, window, and mechanical rough openings through framed walls and partitions.

Since the introduction of CFSF (sometimes known as light gauge steel framing), headers and jamb studs for doors, windows, and overhead mechanical openings have been fabricated onsite by building up combinations of standard studs and tracks into beefier, load-bearing members. Todd Brady, a framing contractor and the inventor of SLP-TRK slotted top track, observed the multiple problems caused by this method: high cost at the engineering phase because there are no standards and rough openings have to be individually designed and detailed; high cost in construction because they are labor-intensive assemblies; inconsistency of fabrication; wasted materials; uneven construction; and protruding screw heads resulting in bumps in the drywall finish.

"I knew there had to be a better way," Brady said. He devised a solution that has resulted in the ProX RO (Rough Opening) System (www.proxheader.com), manufactured by CEMCO Steel Framing, a standardized, pre-engineered RO system. ProX Headers replace site-fabricated headers with a single manufactured component, and ProX RO wide-flange single jamb studs (standard "C" shapes) eliminate built-up double- and triple-jamb studs. "This simplifies both design and construction," Brady said. "It brings speed, consistency, and standardization, and improves the appearance of finished wall surfaces."

Both the header and single jamb stud have ICC Evaluation Service reports (ICC-ESR-1765 and 4943P, respectively) verifying compliance with the International Building Code (IBC) 2006. Engineers can simply specify components according to load requirements, and avoid having to design and detail each individual opening, saving time and resources.

In the construction phase, the rewards are even greater. "This factory-manufactured RO system not only saves time and money, it ensures that the installed framing will actually be as designed," explained Mike Dolati, technical support representative for CEMCO. "With a field-fabricated piece, the structural soundness and quality is dependent on the competence and consistency of the installer, which is variable."

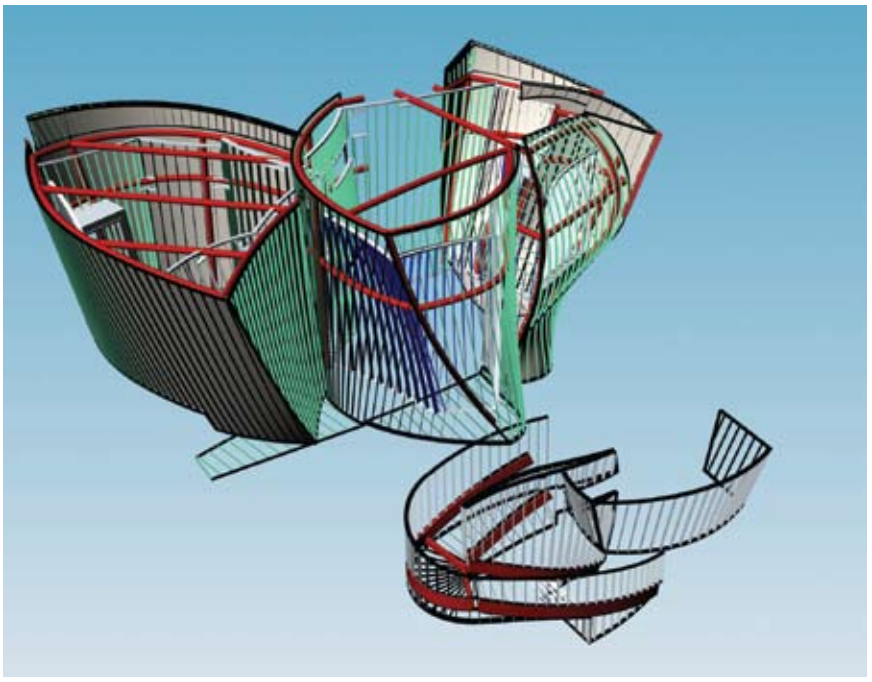
The ProX Header is a light-gauge steel roll-formed component with a modified "W" cross-section featuring special flush-mounted, internally installed ProX Clips. The system is

Installations made with the ProX RO System present flush surfaces for drywall mounting, eliminating bumps caused by protruding screw-heads and other surface blemishes that occur with uneven built-up assemblies. Inset at lower right shows the uneven surfaces and protruding screw heads presented by a built-up header and double jamb-stud. *Photo: CEMCO Steel*

completely assembled using industry standard screws. It comes in the full range of widths and gauges to satisfy all project requirements.

The system is an environmental plus. It lowers materials consumption, using approximately 40 percent less steel than built-up elements. It requires no welding and, therefore, eliminates toxic gas emissions associated with welding galvanized steel.

ProX Header and RO framing systems have been used in the market for the last five years, completing many Office of Statewide Health Planning and Development and Division of the State Architect projects in California, and various project types across the United States and Canada.



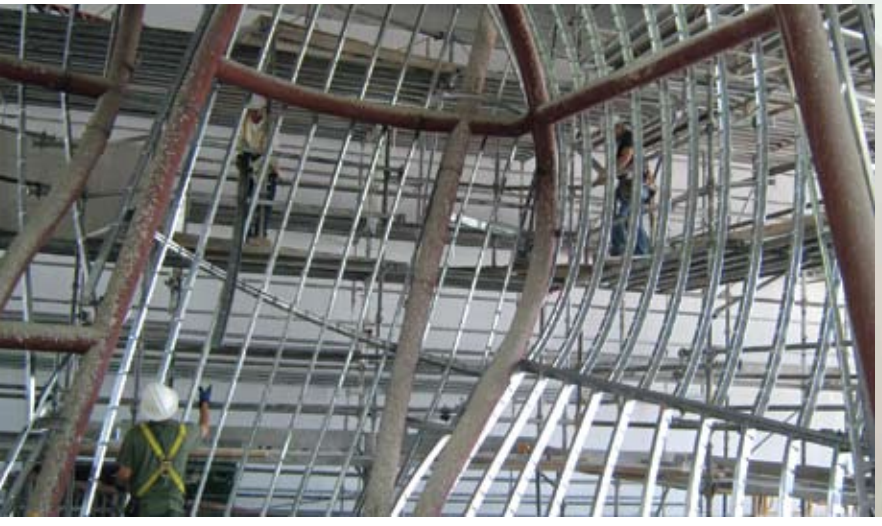
(above) A series of complex curvilinear shapes comprise the interior of the New World Symphony's Campus Expansion in Miami. Framing was rendered in 3D by Radius Track, using data from architect Frank Gehry's computer-based designs. *Photo: Radius Track Corp.*

Curve appeal

The biggest challenges in CFSF construction are curves. Using standard straight materials to approximate curves, even when done well, often results in finished surfaces that betray their polygonal skeletons.

A solution to this problem emerged with a flourish during construction of the Walt Disney Concert Hall in Los Angeles during the

(right) The finished objects seem sculpted from solid masses with clean, sweeping gestures because of the smooth curvature of the surfaces. *Photo: New World Symphony*



(below) Thousands of custom-fabricated CFS members were delivered by Radius Track to the New World Symphony Campus Expansion jobsite. *Photo: Radius Track Corp.*

EARN CONTINUING EDUCATION CREDIT FOR FREE

REGISTER TODAY!

*Certificates of attendance for 1 PDH will be provided to registered attendees that view the entire live presentation. However, it is the responsibility of the licensee to determine if this method of continuing education meets his or her governing board(s) of registration's requirements, including the fact that the sponsor is presenting.

CE NEWS WEBCAST SERIES

Delivering success: One year early and under budget

When: Thursday, April 28, 2011 / 2 pm ET, 1 pm CT, 11 am PT

Duration: 1 hour **Where:** Your computer

Cost: Free – Register today at www.cenews.com/webcast

Available credit: 1 PDH*

Presented By:

Bill Allard
Program Manager
Burns & McDonnell

Chris Stimpson
Project Controls Manager,
Burns & McDonnell

Brett Williams
Vice President
Burns & McDonnell

Bob Wolfe
New England Regional Project Controls Manager,
Burns & McDonnell

Garrett Harley
Industry Market Manager,
Oracle Primavera

Moderated By:

Christine Brack, PMP
Principal, Strategic Advisory Services,
ZweigWhite, LLC

Summary:

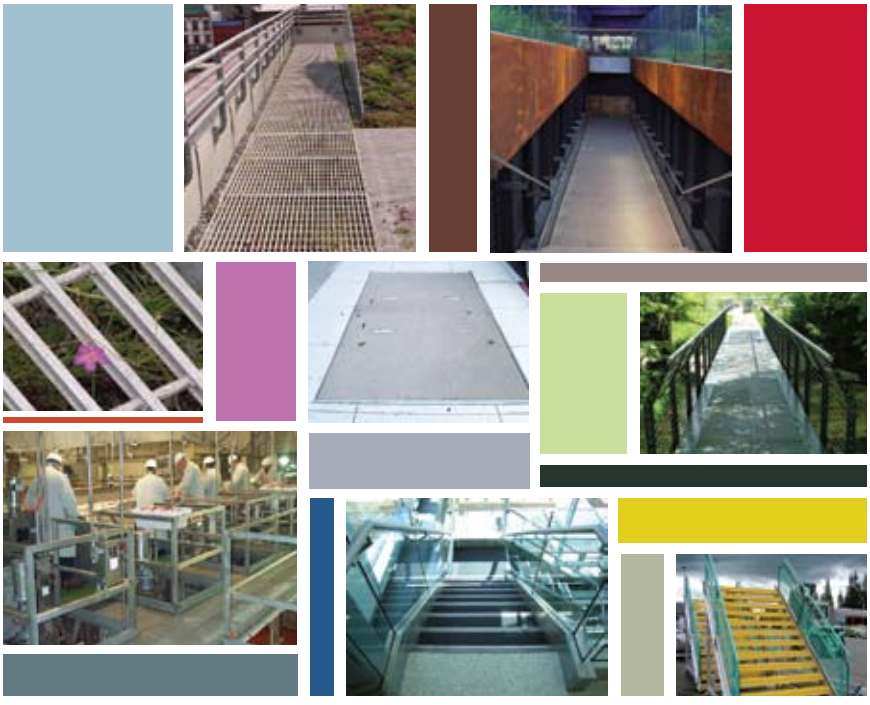
The Middletown-Norwalk Project was at one time the largest transmission capital project in the country and the first application of program management in the power delivery industry. Burns & McDonnell, a full-service engineering, architecture, construction, environmental, and consulting solutions firm, was tasked to help deliver this project one year ahead of schedule and significantly under budget. Learn how Oracle Primavera's Enterprise Project Management solutions — which Burns & McDonnell chose to assist with this challenging project — provided the tools to manage scheduling, document control, costs, and resources to achieve amazing project success.

Sponsored By:

ORACLE
PRIMAVERA
www.oracle.com/primavera

To register for this **CE News** webcast visit **www.cenews.com/webcast**

early 2000s. The Frank Gehry design was curvilinear in its DNA, with an exterior resembling billowing steel sails and interior spaces composed of sweeping curves throughout. The original exterior design called for thousands of uniquely shaped studs, curved by stretch-forming — the prevalent but expensive method of bending CFS elements. To facilitate construction, the surfaces were redesigned to reduce the requirements down to about 50 curvatures. For the interior walls, a precision bending system based on calibrated bends was brought in. Using it, workers were able to fabricate thousands of uniquely shaped steel members accurate to within 1/8 inch in 36 feet, so the interior construction was able to realize fully the architect's design intent. This system, the invention of Chuck Mears, AIA, was the foundation of Mears' company Radius Track Corp. (www.radiustrack.com).



"In the '90s, some architects were discouraging clients from putting curves in their buildings because quality control was such an issue," Mears said. "Radius Track technology solves that problem, allowing engineers to create affordable, constructable designs for any shape an architect can draw up."

The Radius Track process has evolved since then to include extensive fabrication and engineering services, as well as site-fabrication materials and tools. The company offers 3D design services and complete engineering solutions for all types of structural surfaces, including domes. They provide engineers with independent testing data on the structural properties of curved members to facilitate design.

Their custom shop-fabrication and panelization services integrate 3D modeling with production. By sending data directly from computer models to computer numerical controlled (CNC) hydraulic and pneumatic benders, the system produces heavy structural curved track and stud elements quickly and efficiently. Custom curved studs, track, angle (L-metal), furring (hat) channel, and channel sections (CRC) can all be shop-fabricated accurately and affordably and delivered to the jobsite ready to install.

Mears noted that this technology often has a positive sustainability aspect. "In domes, for example," he said, "we often reduce or eliminate the use of heavy red-iron members."

Radius Track also offers manually powered bending tools that enable contractors to site-fabricate curved track, studs, and angles up to 20 gauge quickly and with precision. They also have hand-bendable products available

through distribution that can be custom shaped quickly on the jobsite without specialized tools.

"The confluence of digital design and fabrication versatility offers affordability, precision, and design freedom," Mears said, "and we believe it's having a major impact on architecture."

Lighten up

The versatility of light-gauge steel framing can be extended by hybridizing it. One such system composites panelized framing with thin sections of concrete to make lightweight concrete curtain walls of a type sometimes referred to as "studcast." The SlenderWall system (www.slenderwall.com) typically marries panelized CFSF to a 2-inch thickness of precast concrete. The connection is formed by a headed stud anchor welded to the frame, which is embedded in the concrete during casting. It is available from precast producers throughout North America.

The resulting panels have numerous advantages compared with conventional 6- or 8-inch precast panels. Dead load reduction is dramatic — about 30 pounds per square foot (lb/sf), less than 50 percent of a conventional 6-inch panel at 75 lb/sf. This reduces dead load throughout the superstructure and right down into the foundation. In seismic zones, it lowers seismic resistance requirements because of the reduced mass.

"The thinness is made possible by re-envisioning the interaction between concrete and steel," explained Moffette Tharpe, managing director of Easi-Set Worldwide, licensor of SlenderWall. Conventional precast must be heavily reinforced, but reinforcing bars at the panel's center are not located efficiently to provide tensile forces to hold together a panel, requiring great concrete thickness.

"In a Slenderwall panel, the steel studs are efficiently designed to resist horizontal loads," Tharpe said. "The precast concrete requires only a modest amount of reinforcing (typically, welded wire mats) to strengthen short spans between steel studs. The two materials work together creating an efficient composite wall."

Integral framing eliminates the need for applying additional furring. The as-cast panel is ready to receive interior finishes, and provides built-in cavities for utilities and insulation. Closed cell foam insulation can be installed by the manufacturer. Panels mount outboard of the floor edge, gaining 6 inches or more of floor space around the entire perimeter of the building, sometimes a "free" office or more.

This lightweight SlenderWall curtainwall panel is a composite of panelized CFSF and a 2-inch thickness of concrete. It reduces dead load versus conventional concrete panels by more than 50 percent and can be handled with lighter-duty cranes. *Photo: SlenderWall*

Panels can be cast with any architectural options possible in conventional precast panels. Installation is considerably faster than with conventional precast, allowing the structure to be enclosed more quickly, speeding up access for other trades to work inside the building.

The system provides sustainability advantages, too. The significant reduction in concrete volume translates into reduced CO^2 emissions by about 9 lb/sf. (Production of portland cement, which comprises about 18 percent of typical concrete, results in about 1 pound of CO^2 emitted per pound of cement.) Thermal isolation of the concrete from the steel frame — the connecting stud is specially coated to reduce thermal transfer — improves thermal efficiency of the building.

In a study comparing precast panel versus Slenderwall construction for a five-story commercial building in a location with low seismic activity, direct savings from using the studcast system were $130,000, more than 8 percent of the costs affected by the comparison. Reduction of contractor's overhead from time savings gained an additional $100,000. The amount of floor space gained was worth almost $100,000 more. If the building had been taller, or located in a high seismic zone, savings would have been even greater. ▼

Steven H. Miller, CDT, an associate of Chusid Associates, is an award-winning writer and photographer specializing in construction industry issues. He can be reached via www.chusid.com.