



STEEL FRAMING INDUSTRY ASSOCIATION



## CASE STUDY

# STRENGTH TAKES SUSTAINABLE BUILDING TO A NEW LEVEL

CONVENT HILL  
MILWAUKEE, WISCONSIN

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## OVERVIEW

### PROJECT

**Use**  
Senior apartments, street-level retail

**Size**  
10 stories, 120 units

**Total construction cost**  
\$9.9 million

**Start Date**  
June 2006

**Completion date**  
January 2008

**Recognition**  
2008 Milwaukee Mayor's  
Urban Design Award

### PEOPLE

**Developer**  
Housing Authority of the City of Milwaukee

**Architect**  
Zimmerman Architectural Studios

**General Contractor**  
Gilbane Building Company

**Structural Engineers**  
Norris & Associates, Matsen  
Ford Design Associates

**Cold-Formed Framing Contractor**  
Worthington Building Systems

### STEEL

Pre-fabricated cold-formed steel  
studs, joists and rim track

43-68 mils (interior), 43-68 mils  
(exterior), 97 mils joists at longer spans



## Cold-Formed Steel Supports Green Terraces

Around 1900, the School Sisters of Notre Dame settled on a wooded hill in Milwaukee. According to the Milwaukee Journal Sentinel, the nuns built “a little pioneer home hidden under mighty trees.”

More than a century later, greenery crowns another home built on the same hill: Convent Hill, a 10-story senior residence with roof terraces filled with day lilies, spirea, phlox, shrubs and grass.

“The terraces are extensive. They hold lightweight soil filled to a depth of three inches, ground cover plants and wild flowers, and irrigation systems,” says John Matsen, P.E., Principal, Matsen Ford Design. “Most architects

are probably not aware that cold-formed steel framing can support green roofs.”

### NEW LEVEL OF SUSTAINABILITY

The City of Milwaukee had the Convent Hill complex built in 1959. For the present redevelopment, the city wanted to take advantage of the latest environmentally friendly building designs. The structure represents “a new level of sustainable and green technology,” states the Milwaukee Journal Sentinel, which features 12,000 square feet of green roofs.

But how could the structure support the green roofs without a large and significant use of structural steel?



The design features pre-fabricated cold-formed steel joists, rim track and structural blocking.

Matsen Ford Design Associates, Waukesha, Wis., engineered the project's cold-formed steel system, which comprises the majority of the structure's support system.

"Structural steel beams were used at the second level for support of the load bearing walls,"

lower slab and shallow footings. The main lateral resisting system is cast-in-place reinforced concrete stair and elevator cores.

The combination of concrete and some structural steel with cold-formed steel supports 120 senior apartments and five roof-

plumbing and sprinkler runs. The perimeter of the holes are also rolled to add stiffness over the entire span of the joist.

Made using 54 mil cold-formed steel joists with a 12-inch web depth, the roof structures at Convent Hill are sturdy enough to sup-

## Structural steel beams were used at the second level for support of the load bearing walls...But the top eight floors of Convent Hill are cold-formed steel all the way.

Matsen says. "But the top eight floors of Convent Hill are cold-formed steel all the way."

### FIVE GARDEN TERRACES

Indeed, cold-formed steel framing is the primary load-carrying structure for the upper residential stories. Cast-in-place concrete was used for the foundation walls,

top garden terraces.

From the second floor upward, the structure features cold-formed steel joists that are prefabricated into panels to shorten construction times and eliminate on-site labor. These joists leverage the strength and formability of cold-formed steel with punched holes to accommodate HVAC, mechanical,

port five terraces each filled with a variety of greenery.

The School Sisters of Notre Dame would be proud. The little hill in Milwaukee where they had built their home remains verdant, filled with life. The owner, too, is proud of the green contribution Convent Hill makes to Milwaukee's Park East corridor.

Milwaukee's Convent Hill is a 10-story senior housing complex built using cold-form steel framing.



Exterior cold-formed steel framing is the primary load-bearing system for the top eight floors.



Hot-rolled steel was used strategically only for the first two floors.

## STRUCTURE

### SUMMARY

Cast-in-place concrete foundation walls, lower slab and shallow footings

Cast-in-place reinforced concrete stair and elevator cores

Second floor and below: hot-rolled steel framed with post-and-beam and cold-formed steel joists

Upper eight stories: cold-formed steel framed bearing walls and joists

### WALL FRAMING

Cold-formed steel — 362S162-43 to 362S200-68 (interior), 600S162-43 to 600S200-68 (exterior)

**Bridging:** Cold-rolled channel with clip angle

Stud panels compressed for tight seating in top and bottom track

Prefabricated on site

### FLOOR JOISTS

Cold-formed steel — 1000S200-54 — at 24" o.c., 925S162-54 at corridors, fastened to pre-punched tabs on rim track

Rim track used in many locations to eliminate load-bearing headers in the stud walls

Track fastened to the sides of the wall studs with screws or welds

S162 C-deck run up to bearing walls

Bridging at 6' to 7' o.c. with typical solid blocking — RC furring substituted for continuous bottom flange bridging in some locations.

### ROOF JOISTS

Cold-formed steel — 1200S200-54 at 24" o.c., 2x 1200S200-97 at long-spans, 925S165-43 at corridors

Screw-fastened S150 B-deck with tapered insulation and ballasted EPDM roofing

Bridging at 6' to 7' o.c. with typical solid blocking — RC furring substituted for continuous bottom flange bridging in some locations.

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