



STEEL FRAMING INDUSTRY ASSOCIATION



CASE STUDY

STRUCTURALLY SOUND, RELATIVELY INEXPENSIVE CURVED WALLS

WOODSTOCK BAPTIST CHURCH
WOODSTOCK, GEORGIA

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OVERVIEW

PROJECT

Use

Religious structure

Size

300-foot dome, cupola and 30-foot cross weighing more than 50 tons

Project Budget

\$70 million

PEOPLE

Owner

Woodstock Baptist Church,
Woodstock, Georgia

Architect

Niles Bolton Associates,
Atlanta, GA

General Contractor

Brasfield & Gorrie,
Atlanta, GA

Structural Engineer

Al Lagerstrom & Associates,
Atlanta, GA

Cold-Formed Framing Contractor

Starzer Brady Fagan Associates, Inc.,
Atlanta, GA

STEEL

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

The Woodstock Baptist Church's main sanctuary is circular, built with cold-formed steel curtain walls and a structural steel-trussed dome. The steel-and-aluminum cross rises 150 feet above ground level.



Cold-Formed Steel's Flexibility and Low Weight Saves Money

The Woodstock Baptist Church is unique. How many places of worship can boast a 300-foot dome with a giant cupola that anchors a 30-foot-tall, steel-and-aluminum cross? Woodstock's dome, cupola and cross together weigh more than 50 tons.

Therein lay the challenges. Complexity. Weight.

"We needed real design experts, a knowledgeable team of engineers and a strong, light-weight and flexible building system for this project," says Don Allen, P.E., DSI Engineering, Norcross, Georgia, who worked on the church while at Starzer Brady Fagan Associates, Atlanta. "The structure had rather difficult details. Cold-formed steel was the perfect choice."

LARGE SPANS, EXPANSIVE CURVES

The Woodstock Baptist Church is the size of a small sports arena. Its main auditorium, or sanctuary, has 1,000 square feet of floor space. Clearly, structural steel was needed


to support the dome overhead. But what material would make the best choice for the exterior curtain walls — not just to save money, but also to provide a framing assembly flexible enough to accommodate an interesting design and even out-of-tolerance construction?

"We gave little consideration to other products," Allen says. "Cold-formed steel was the only real choice to accommodate the large spans and the expansive curved outer walls."


The costs of constructing a massive, arena-sized church could easily get out of hand. Woodstock, for example, has monumental windows, large vertical spans and curved walls throughout. Cold-formed steel framing system proved flexible enough for use in long-run spans, creating the arcs and in constructing many special features, the design aesthetics specified by the architects. For example, large exterior, overhead "fins" feature cold-formed steel framing and furring to support aluminum cladding. The curved



In the cupola, curved openings use cold-formed steel framing.



The cold-formed steel curtain wall system easily handled the church's radius design.



Cold-formed steel transitioned from large jamba (bottom) to small jamba (top) at structural steel beam bypasses.

cupola walls included openings for windows and louvers.

“These curved openings were especially challenging, because we had to design headers to resist both lateral and gravity loads,” Allen says. “Using steel, we were able to pull from our standard details and our design tables for this type of opening, altering them only slightly to account for the curvature.”

FLEXIBILITY HELPS WITH PROFITABILITY

The installers used both field techniques and pre-manufactured specialty items. Furring clips and slip connectors allowed the installation of a curtain wall system to allow movement of the structure, as well as accommodate interference from other systems and framing members.

“We had to adjust and compensate for out-of-tolerance construction by other trades,” Allen says. “We built in conjunction with the mechanical, electrical and structural systems and often we had to make our marks and our lines match theirs.”

This is an example of how cold-formed steel can help with construction profitability.

“In several cases where the structural steel members were off, we took up the difference in our framing,” says John Files, Project Superintendent, Marek Interior Systems. “We got updated designs from the specialty engineer and did fabrication in the field. That allowed our field personnel to keep working with the stud material we had on hand, rather than wait for new pieces to be fabricated and brought to the jobsite.”

In other words, the cold-formed steel helped keep man-hours and material costs in line with budgets.

Files adds: “The availability of custom-cut long lengths was especially helpful in the tall stairwell areas around the outside of the building. We had areas spanning up to 70 feet tall. Some spans supporting brick were over 25 feet tall. So, we used two segments of studs to span those areas. But, being able to custom-cut in the field really helped with the installation speed.”

PROBLEMS AVERTED

In some cases, flexibility of the cold-formed steel framing system helped to avert problems.

“When they removed the shoring from the center of the dome, the dome dropped 1-1/2 inches,” Files relates. “We were concerned about the effect it would have on the framing we had installed.”

It had no effect. The cold-formed steel accommodated the movement with no damage and little added stress due to the use of deflection clips, but mostly due to cold-formed steel’s inherent ductility and flexibility.

“The framing was structurally sound and relatively inexpensive,” Allen says. “Marek’s installation team was innovative. They made a lot of adjustments and found many solutions onsite.”

The final weight of the cupola structure made a huge difference for both gravity and seismic loading. The low, in-place weight of the system reduced overall deadweight stress, shortened erection time and cut material costs. That was good. The owners could direct dollars where they wanted to make them count.

“They wanted the cupola and cross to be monumental features, visible far into the neighboring foothills of Cherokee county,” Allen says.

STRUCTURE

COLD-FORMED STEEL SOLUTIONS

- Walls configured around structural systems out of tolerance
- Used in the framing of wall accents, architectural aesthetics and a large cupola
- Framed curved walls and openings — customization provided in the field and by the manufacturer
- Furring clips and slip connectors allowed cold-formed steel curtain walls to move with the structure and accommodate interference from mechanical systems
- Reduced in-place weight cut erection time and costs

DETAILS

- Lapped connection at elevated stud (stud by beam) — allowed the bypass of studs around structural beams and fireproofing
- Lapped connection at parapet (parapet by beam) — occurred at wall tops where narrow studs form a parapet
- Jamb plan detail — bypass of beam at multiple jamb studs used studs with small flanges to nest inside 8" studs with larger flanges and webs

COLD-FORMED STEEL BENEFITS

- Non-combustible
- Available in any length, custom cut in the factory or the field
- Connection options include screws, bolts, welding
- Specialty connectors available for thermal and structural movement
- Termite proof
- 100% recyclable
- Construction trades familiar with methods and options
- Software, spreadsheets, standard details available for engineers and designers

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Curved tracks on the parapet featured machine-fabricated systems (left) and field-fabricated, spliced track (right). Both options were approved for their structural capacities.