

CASE STUDY: OCCUPANCY A (ASSEMBLY) BUILDING

Large Religious Structure with Special Design Implications



PROJECT NAME: Woodstock Baptist Church, Woodstock, Georgia

GENERAL CONTRACTOR: Brasfiled & Gorrie, Atlanta, GA

**FRAMING
SUBCONTRACTOR:** Marek Interior Systems, Marietta, GA

ARCHITECT: Niles Bolton Associates, Atlanta, GA

STRUCTURAL ENGINEER: Al Lagerstrom & Associates, Atlanta, GA

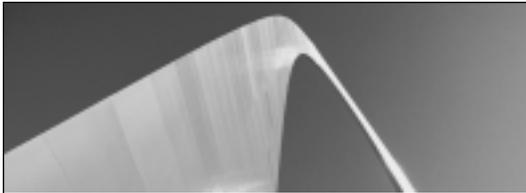
**COLD-FORMED STEEL
SPECIALTY ENGINEER:** Starzer Brady Fagan Associates, Inc., Atlanta, GA

PROJECT OVERVIEW: Woodstock Baptist Church is as unique as it is similar to other large religious structures across North America; special design implications like the main sanctuary, 300-foot dome, cupola and 30-foot cross weighing over 50 tons, required expert designers, engineers, and a flexible, strong, light weight, and compatible building material. Light gauge steel framing was the perfect answer for this project's unique and somewhat universal, structural needs.



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“...we were able to come up with solutions that were structurally sound, relatively inexpensive, and could be constructed using light gauge steel materials that were either onsite or could be quickly ordered.”

Stephanie Kokan, Project Engineer, Starzer Brady Fagan Associates, Inc.

PROJECT OBJECTIVE:



Curved openings using light gauge steel framing, from inside the cupola.

Woodstock Baptist Church consists of several interesting and challenging architectural features. The main sanctuary is a large circular area, with a structural steel trussed dome spanning over 300 feet. The cupola and its 30 foot tall steel and aluminum cross, weighs over 50 tons and sits at the center of this dome. The top of the cross is over 150 feet above the surrounding parking areas.

With special design considerations, this project had critical construction objectives that had to be met in order for the structure to be built on time and on budget, as follows:

- Construct an arena-sized church with immense, monumental windows, large vertical spans, and a seating capacity equivalent to a medium-sized sports arena.
- Provide a product that is able to adjust and compensate for out-of-tolerance construction by other trades.
- Provide adaptability when built in conjunction with other mechanical, electrical, and structural systems.
- Provide exterior accents in special framing areas: cupola, fins, curved walls and curved openings.

The job required expert designers, engineers, and a flexible, strong, light weight, and compatible building material. With a total project budget of \$70 million, there was little room for error. Light gauge steel framing was chosen for this project's unique design elements, providing a highly flexible material for what could have been a complex and costly framing system.

SOLUTION:

With design challenges like these, it was essential for the design team to select materials that were light, strong, resilient, and adaptable to changing and demanding conditions. Cold-formed steel framing was a natural choice, according to the architects and designers of Niles Bolton Architects in Atlanta. "With these large spans, and expansive curved exterior walls, we turned to steel, with very little consideration for other products." For the cupola, the weight of the structure made a huge difference, for both gravity loading and seismic loading. "We wanted the cupola and cross to be a monumental feature, visible in the neighboring foothills of Cherokee county."



Large curved exterior wall framed with light gauge steel.

Light gauge steel framing allowed for the ability to configure wall systems around other structural systems that were out of tolerance. It also provided enough flexibility for use in framing fins, exterior roof and wall accents, and the high cupola, over 150 feet above the surrounding parking areas. Framing of the curved walls and openings used both field techniques and pre-manufactured specialty items. Furring clips and slip connectors permitted the installation of a curtain wall system to allow movement of the structure, as well as accommodate interference from other systems and framing members. And lower in-place weight of the system reduced design loads as well as erection time and cost.

FRAMER'S PERSPECTIVE:



Curved tracks at the parapet tops use both machine-fabricated option on left, and field-fabricated option on right, both approved for their structural capacities.

The framing around the cupola is built entirely with steel, and the large “fins” that add architectural accent use the flexibility of framing and furring members to support the aluminum cladding. “The aluminum system has much tighter tolerances than the structural steel frame below.” According to John Files, project Superintendent for Marek Interior Systems. “In several cases, where the structural members were a little off, we had to take up the difference in the framing. The aluminum system allows you to shim only about 1/4 inch”. We were able to do field fabrication and get designs from the specialty engineer that allowed our field personnel to keep working with the metal stud materials we already had on hand, without having to wait for new pieces to be fabricated in the shop and brought to the jobsite.”

“When they removed the shoring from the center of the dome, it dropped about 1-1/2 inches,” Files said. “We were concerned about the effect it would have on the framing we had already installed.” However, because of the deflection clips and the inherent ductility and flexibility of the steel system, it was able to accommodate this movement with no damage and very little additional stress.

“The availability of custom cut long lengths was especially helpful in the tall stairwell areas around the outside of the building,” Files added. “We had areas spanning up to 70 feet tall that we had to span on the outside of the stairwell area. Some of the spans supporting brick were over 25 feet tall. We had to use two segments of stud to span that area, but having them custom cut really helped the installation.”

SPECIALTY ENGINEER'S PERSPECTIVE:



Spliced track at curved parapet.

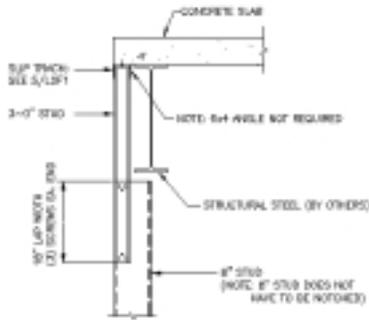
The walls on the high cupola, as well as the main sanctuary, are all curved, with curved openings for both windows and louvers. “These curved openings were especially challenging, because we had to design headers to resist both lateral and gravity loads,” according to Stephanie Kokan, Project Engineer with Starzer Brady Fagan Associates, Inc. of Atlanta. “Using steel, we were able to pull from our standard details and our design tables for this type of opening, and alter them only slightly to account for the curvature.”

In addition, several urgent calls from the field were made to Kokan’s office, due to alignment problems with the structure. “Because of steel’s design flexibility, as well as the experience and innovative ideas from Marek’s installation team, we were able to come up with solutions that were structurally sound, relatively inexpensive, and could be constructed using light gauge steel materials that were either onsite or could be quickly ordered.”

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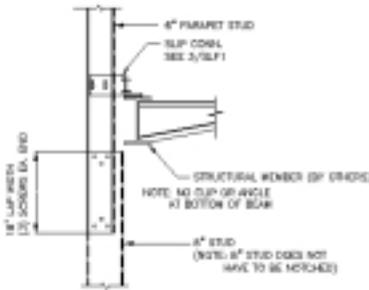
Technical Data:

Project Budget: \$70 million



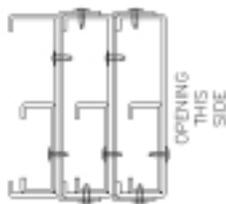
LAPPED CONNECTION
AT ELEVATED SLAB

HIT TO SOLE



LAPPED CONNECTION
AT PARAPET

HIT TO SOLE



LOUVER TYPE C1, C7,
DOOR TYPE T
USE (3) 8" STUDS WITH (3) 3/8"
STUDS AND (2) 8" TRACKS.



Special solutions steel framing provided on this project:

- Ability to configure walls around other structural systems out of tolerance
- Flexibility for use in framing fins, exterior roof and wall accents, and the high cupola, over 150 feet above the surrounding parking areas
- Framing of curved walls and openings, using both field techniques and pre-manufactured specialty items
- Furring clips and slip connectors permit installation of curtainwall system to allow movement of the structure, as well as accommodate interference from other systems and framing members
- Lower in-place weight, reducing design loads as well as erection time and cost

Highlighted project details:

1. Lapped Connection at Elevated Stud (Stud by Beam) – Allows the bypass of studs in areas where the structural beam and fireproofing are in the way.
2. Lapped Connection at Parapet (Parapet by Beam) – Same situation as described in the detail listed above, but it occurs at the top of the wall, where the narrow studs can form a parapet. Note the bypass slip connector used at the roof slab bypass.
3. Jamb Plan Detail – Bypass of beam at multiple jamb studs used studs with smaller flanges to nest inside 8" studs with larger flanges and webs.

Standard solutions steel framing provides for on large assembly commercial construction:

- Non-combustible
- Available in any length, custom cut at the factory
- Specialty connectors available for thermal and structural movement
- Termite proof
- Can be custom cut and assemblies fabricated in the field
- Recycled material
- 100% recyclable, including jobsite scrap
- Connection options include screws, bolts, welding, and other fasteners
- Commercial trades familiar with construction methods and options
- Tools available for engineers and designers (software, spreadsheets, standard details)



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1201 15th Street, NW, Suite 320
Washington, DC 20005
T: 202.785.2022
F: 202.785.3856

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