Steel Framing with Classic Style

By David R. Wittes, P.E.

As the New Hackensack Church project proves, even a modest sized project can offer a structural engineer the opportunity to develop singular details and framing schemes to resolve the spatial concepts of a creative architect. Located in the picturesque town of Wappinger Falls, NY, 75 miles and a world away from New York City, the church was ordered by the FAA to vacate its white brick Greek Revival Church due to its position on the flight path of a growing airport.

James Oleg Kruhly, a Pennsylvania architect particularly noted for his design of religious buildings, designed a new church and activities complex on a safer site. The first prerequisite of the building committee was that the new sanctuary resemble the original, treasured church. Kruhly explained that, while he could not design a clone of the existing building, he could create a church with the same attributes, ambiance and essence of the original church wrapped around a contemporary structure. As finally conceived, the sanctuary building became a square meeting room 70'×70' that raises to an undulated hipped-roof, broken by a dormer over the choir balcony below. To further complicate

the roof framing, a belfry tower eccentrically located to bring daylight over the nave was introduced. The adjoining education building and administrative offices integrated with the sanctuary building using local stones and regional materials.

Finding a satisfactory and economical framing system to accommodate the multi-plane roof, the belfry tower and dormer, as well as adjust to the different clearances necessary for the multi-faceted ceiling was not obvious. In particular, the clear-span roof over the main sanctuary building required special consideration.

After reviewing the alternatives, Wittes and Associates elected to place two parallel steel fabricated, wishbone shaped members that would span the building on each side of the bell-tower without interruption and act as dual spines to receive the total roof framing. The two hybrid members were fabricated as both a truss and a built-up girder and were shaped to receive the varied and heavy traffic of roof purlins arriving at different locations and elevations. The plate girder center portion of the wishbone developed the expected bending moments while the truss portion at each end allowed access for mechanical ducts and accommodated the clearances necessary for the unusually shaped ceilings. The belfry tower was shop assembled of welded hollow structural sections (HSS) and field bolted to the top flanges of the spines. This method of framing permitted the use of standard and readily available warehouse sizes for the many roof purlins. By using special shop fabrication for just two main members, the structure proved very cost effective to produce.

A major seismic event is not likely during the life of this project since it resides in a low seismic area. Nevertheless, the 40' high sanctuary building, without any internal floor system to distribute the expected wind or possible seismic loads, required special attention. To safely

View of wish-bone shaped trusses at bell tower.

View of tower being erected.

View of structural steel frame.

Interior view of sanctuary.

receive these loads, the exterior periphery wall steel was developed as a special moment resisting frame (SMRF) by using two story rigid frames along each wall. The appreciable moment connections, located at each exterior column, were developed by shop welding top and bottom angles to the column flanges and field bolting the beam flanges of the rigid frames to the outstanding legs on the in-place angles. Shim pads at the top flange allowed for erection clearances. This method of developing moment connections at each exterior column accelerated construction of the project by avoiding field welding and resulted in further savings.

The structure was designed using Load and Resistant Factor Design (LRFD), and all structural members were fabricated from ASTM A572 Gr.50 steel, the emerging industry standard. The bell-tower and special entry details used HSS meeting ASTM A500 Gr. B.

To insure a high standard of quality control, all welding for the project occurred in the shop. Except for the wishbone truss-beam, most of the welds included single pass filet welds. The connections in the field consisted of A325 bolts using A490 bolts at appropriate locations. Because a shop primer is unnecessary when the steel will be enclosed within a controlled environment, encased in concrete or coated with contact-type fireproofing, only solvent cleaning to remove oil, dirt and similar contaminants was used.

The New Hackensack Church with its aura of calm reflection proves that beautiful and meaningful structures with their roots in the past can still be forward thinking in design and construction techniques.

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