Carmel High School

Carmel, Indiana

The Carmel High School basketball arena was originally constructed in the 1950s, and the superstructure consisted of wood bowstring trusses spanning 151' over a bowl-type arena with a seating capacity of 4,000. In recent years the trusses had suffered significant distress, and conventional repairs had been made, such as the installation of tension rods along the bottom chord to reduce the tension in the original chord. Several engineering consultants had performed analyses of the original roof framing system, and all agreed that the long-term viability of the structure was in question.

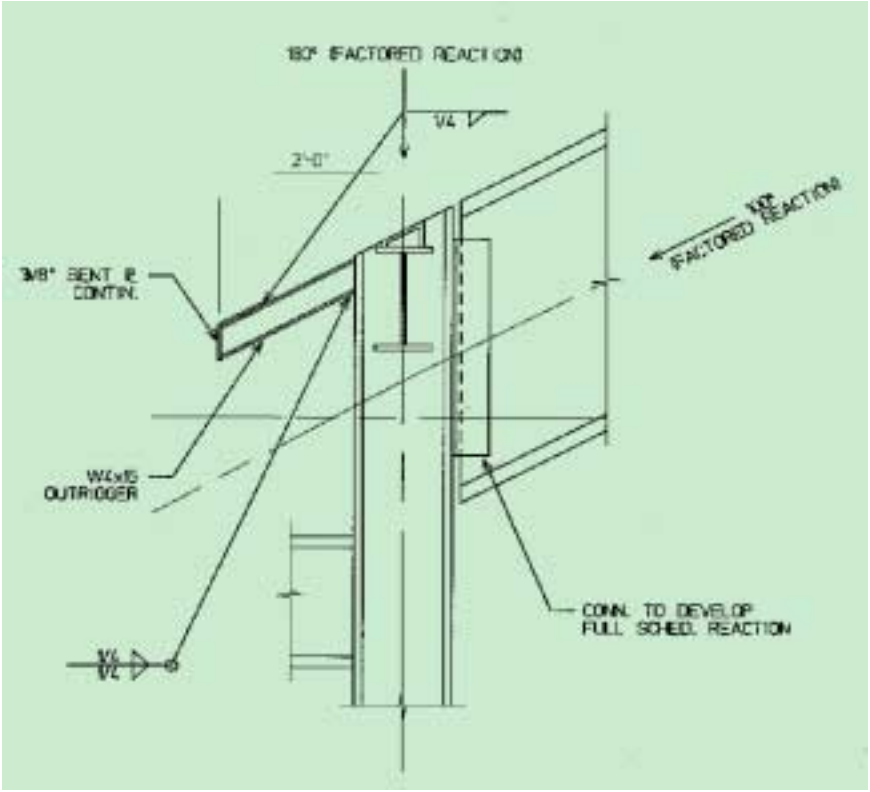
The objectives for the owner's/architect's program were as follows:

- Replace a deteriorating wood bowstring truss gymnasium roof structure with a durable steel-framed system.
- Allow a basketball season to proceed undisrupted (Carmel High School typically hosts regional competitions in its 4,000-seat arena); schedule construction over two summers, allowing basketball to be played between construction seasons.
- Maintain an enclosed and dry structure; rainfall and moisture infiltration would be detrimental to the significant portion of the structure that was to be retained.

Decision to Replace

The decision to replace the roof was accelerated by the fact that additions planned for both sides of the building would imminently constrict access to the arena. Furthermore, it was critical to keep the building reasonably dry and enclosed so as not to "lose" a basketball season during construction.

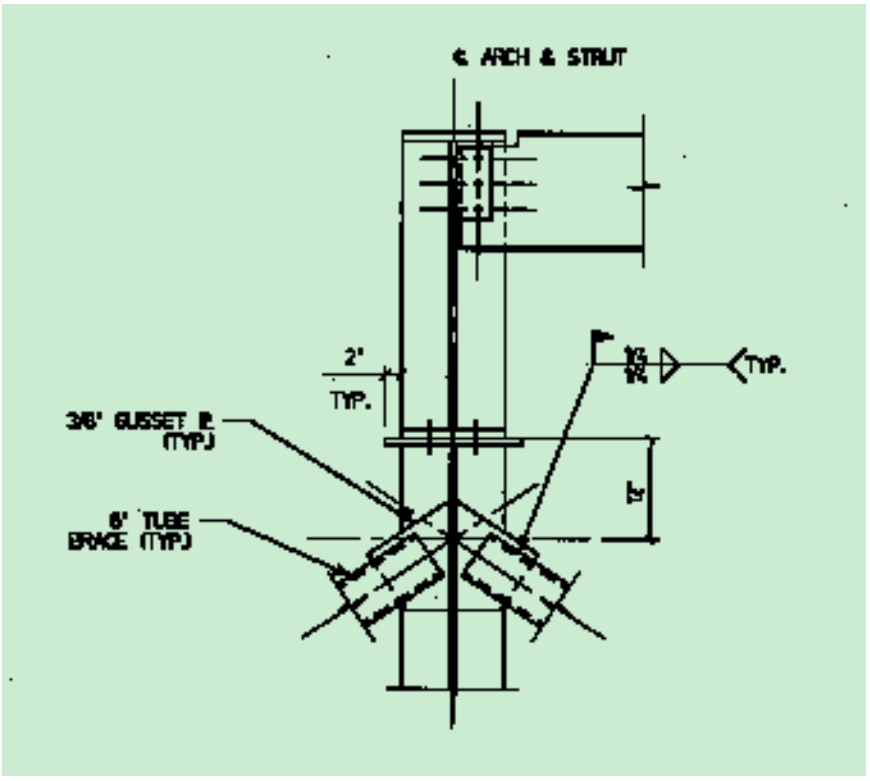
Once the decision was made to replace the existing roof framing system, it was quickly determined that a steel framing system was the appropriate solution. A curved roof form similar to the existing bowstring trusses was the most desirable, from aesthetic and feasibility standpoints. A tied arch system was developed that achieved all of the program objectives.



First Construction Season

A curved W36x170 was designed to support a new roof, 10' above the existing roof. These members were supported on temporary columns located near the first row of seating and, at their ends, by permanent columns located outside of the existing building perimeter. The resulting 176' span covered an enlarged area around the top of the seating bowl, providing improved entry access and wheelchair seating.

The temporary columns were located so that the curved roof structure could be placed over the existing roof and support the arched beam, while not interfering with the use of the basketball court for the following season. These column locations then had to coincide with the position of the verticals in the final tied arch system that was to be completed during the second summer. The temporary columns were supported on new footings and placed through small openings in the existing roof that were sealed



after installation of the columns. The seating areas that were removed to install the footings were repaired, temporary protection of the floor was removed, and basketball proceeded throughout next season; the temporary columns were the only obvious change inside the facility.

Second Construction Season

During the second summer, the original roof and bowstring trusses were removed. The tie members were erected from the gym floor, and the tied arch system was completed. The portion of the temporary column below the tie member was then removed. A bolted cap/base plate was provided, in the temporary column at the bottom of the tie, to allow for easy removal of this member and eliminate the need for any additional field welding or repairs at one of the most critical points in the system. The column bases were cut with a conventional torch and removed. The actual deflections that occurred, when the load transferred to the final structural system, matched the calculated deflections.

In the completed structure, the tied arches are spaced at 30' on center, with W14 purlins 7' on center spanning between the arches. Acoustical metal roof deck of 1½" wide-rib was used to span between the purlins. Horizontal x-bracing in the plane of the roof and vertical x-bracing at each corner provide lateral resistance to wind pressures. All of the roof-framing members, bracing, decking, and roofing were installed during the first summer to ensure stability. Following installation of the final tied arch members, x-type bridging was provided to stabilize the tension chord. Sag rods were utilized to prevent deflection of the horizontal bottom chord, an 84' long W10x68. Following completion of the structure, a new gym floor and basketball standards were installed, and the seating was completely refurbished.

Project Completion

Three-dimensional models were used to analyze the structure to ensure stability and integrity under several configurations. Coordination with the structural steel detailer, fabricator, and erector resulted in a structural system that was fabricated and erected with no significant problems or delays.

The increased volume of the building, which was completed in the Fall of 1997, and the slenderness of the structural system provide a dramatic facility for Indiana's #1 high school sport.

Carmel High School, Carmel, IN

Owner: Carmel School Corporation

Architect: OWP&P Architects, Chicago, IL

Structural Engineer: OWP&P Architects, Chicago, IL

Fabricator: Geiger & Peters, Inc., Indianapolis, IN *(AISC member)*

Detailer: Geiger & Peters Inc., Indianapolis, IN *(AISC member)*

General Contractor: Huber Hunt & Nichols, Indianapolis, IN