Baltimore Convention Center Expansion

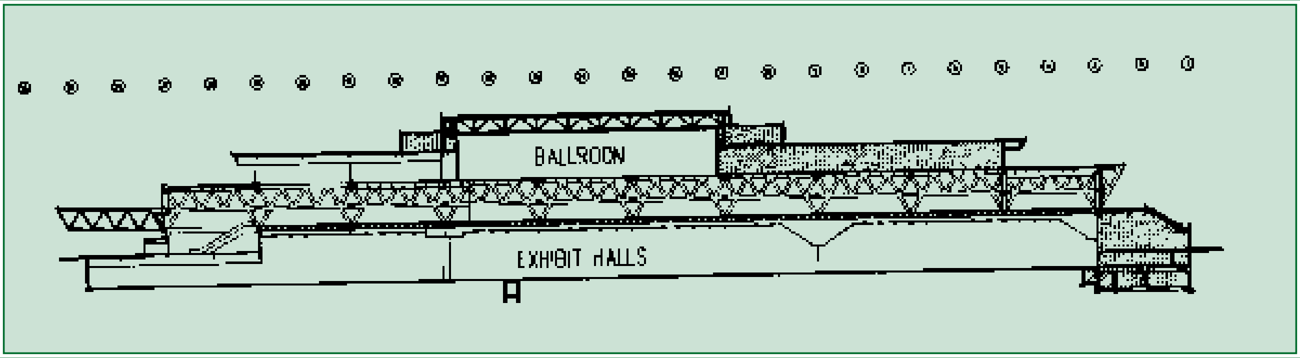
Despite a tight site, an addition tripled the size of the center

By Donald W. Banker, Michael E. Bolinger, FAIA, William F. Kearney, Jr. and Saw-Teen See

THE ORIGINAL 1979 BALTIMORE CONVENTION CENTER HELPED ESTABLISH TOURISM AS ONE OF BALTIMORE'S major industries. But to remain competitive in the highly lucrative convention market, Maryland tourism officials required an expansion of their old convention center. The recently reopened center features 16,000 tons of steel in a 750,000-square-foot addition that triples the size of the original building.

The new facility includes a below grade exhibit hall that has grown from 115,000 sq. ft. to 300,000 sq. ft., the addition of 45,000 sq. ft. of meeting rooms, and a new 36,000-sq.-ft. ballroom, plus accompanying mechanical and public spaces. The fast-track addition was completed on time and opened for conventions in September 1996. Renovation of the existing center was then undertaken, and the entire expanded and renovated Baltimore Convention Center began hosting conventions in April 1997.

Working within the space and program parameters for the expansion of the Baltimore Convention Center presented enormous challenges for the design and construction. Architects for the project were Cochran, Stephenson &

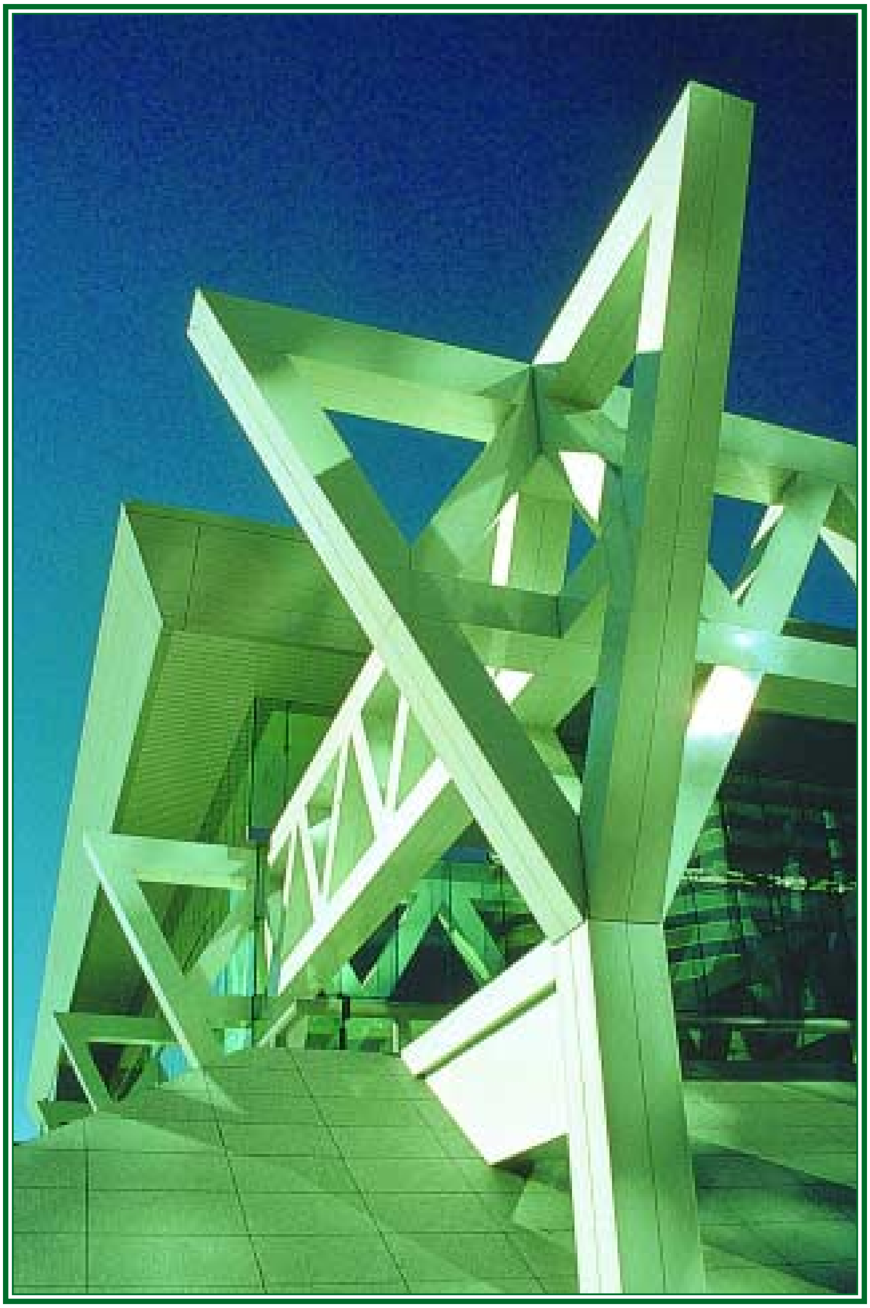


Donkervoet of Baltimore, in association with Loschky, Marquardt & Nesholm of Seattle. Construction manager was Gilbane of Laurel, Maryland. Structural engineer was Leslie E. Robertson Associates of New York. Structural steel fabricator was AISC-member Hirschfeld Steel Co. Inc. Derr Construction, Dallas, was the steel erector.

Program Requirements

The tight urban site of the Baltimore Convention Center imposed major constraints on the expansion. The L-shaped addition was built west and south of the existing convention center on a two-block site hemmed in by the main street in downtown Baltimore, a below-grade railroad tunnel, and a 200-year old church. Oriole Park at Camden Yards with its multitude of baseball fans is directly across the street. Finally, the existing center had to be kept operational at all times, even though the expansion was tied into it.

The architectural layout was driven primarily by the program requirements for the expansion of the exhibit hall. Built below grade to match the floor elevation of the existing exhibit hall, the 185,000-sq.-ft. exhibit hall addition and its accompanying support areas consumed the available building footprint, curb-to-curb. The space constraints led to the stacking of the remaining program elements: a meeting room level was added above the new exhibit hall, and a



ballroom and mechanical rooms were located above the meeting room level.

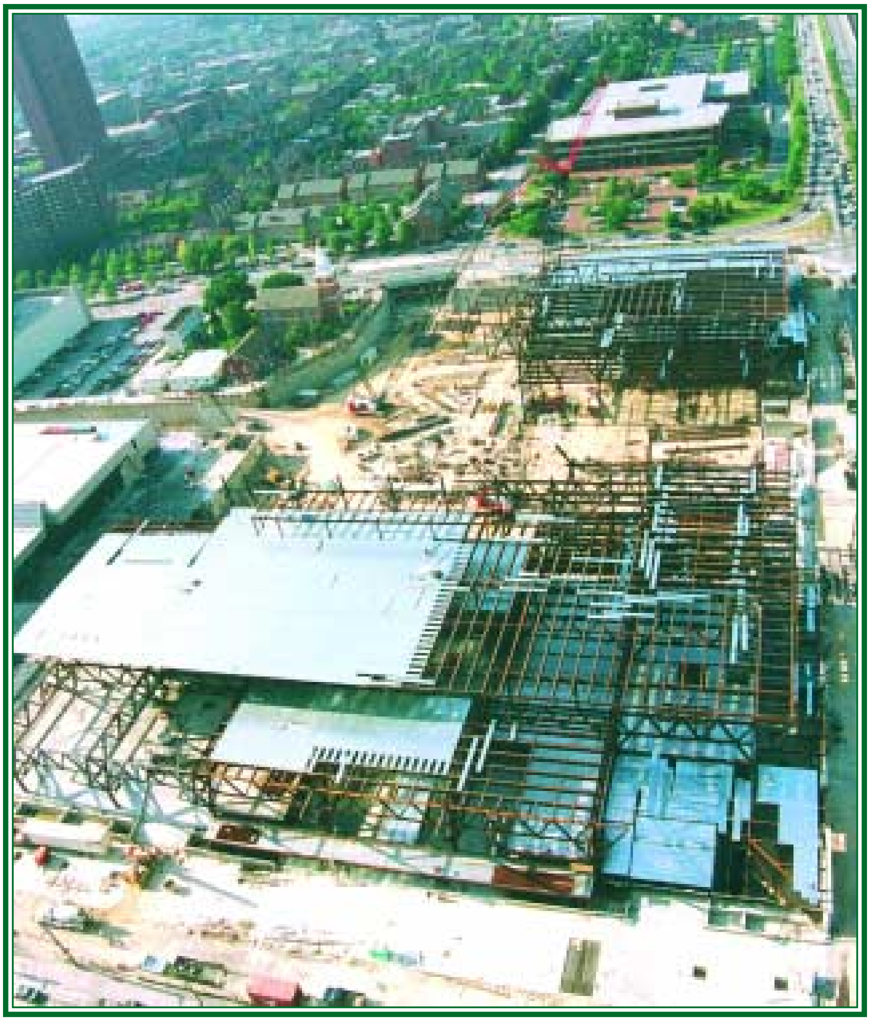
This stacking of elements, combined with the need to maximize open floor space in the exhibit hall, presented a number of challenges for the structural engineers. With only three interior columns in an area the size of three football fields, the structural system had to cover an area 600' long with clear spans of up to 180'. The stacking of elements above the exhibit hall resulted in design live loads of 250 psf for the long spans over the exhibit hall, as compared to about 30 psf for the typical single-story convention centers.

The original convention center had featured four post-tensioned concrete domes over the exhibit hall. It was desirable to maintain the same architectural appearance in the new hall, but with the large design loads and increased module size of 180' by 180', long-span, two-way steel trusses proved to be a more economical solution. The 27'-deep trusses, spanning over the exhibit hall, are spaced at 60' on center in each direction. While the finishes within the exhibit hall are designed to provide a sense of continuity with the existing building construction, the trusses become a featured architectural element at the meeting level above. The three-chord arrangement of the trusses permits free circulation within the 60' by 60' module of the meeting rooms.

The trusses are constructed from W14 sections with their flanges in the vertical plane, with sizes ranging from W14x43 to W14x730. The trusses are continuous in both directions. While this increased the complexity of the analysis and design, the continuity effects permit a more efficient structural design. Additionally, the continuity provides a greater degree of redundancy, always desirable in such long-span systems.

The trusses were originally designed using Grade 50 steel for members governed by strength. In a value engineering effort, the design and construction team concluded that the use of A913 Gr. 65 steel for these members would reduce steel tonnages and lead to an overall savings, even with the longer lead time required to have the Gr. 65 steel shipped from TradeARBED's plant in Luxembourg. The trusses were redesigned accordingly, permitting up to a 25% reduction in tonnage for members governed by strength. A572 Gr. 50 steel came from Nucor in Blytheville, Arkansas. Smaller sections came from Chapparel in Midlothian, TX, and grade 70 plate came from USX.

Truss connections typically consisted of welded flange-to-flange connections for the shop connections and bolted splice plates for field connections. Given the massive scale of some of the members being spliced, more than 200 bolts were required to splice the largest members. The size and stiffness of the splice plates needed for



One especially large truss required special handling. This 100'-long, 16'-wide, 104-ton member was too large to be transported to Baltimore by conventional trailer. Instead, it was fabricated at the Bethlehem Steel Co. plant in Sparrows Point, MD, and mounted on a special dolly with 90 airliner landing wheels. It was moved through the city streets between midnight and 3:00 a.m., requiring three nights to travel the 16 miles to the site.

the large connections invalidated the normal assumption of pin-ended members for truss design. As a result, truss joints were analyzed and designed assuming full continuity. Where the second order effects resulted in excessively large bending moments in some truss members, special pin details were introduced to relieve the moments in these locations.

As A913 steel was not listed in the AWS welding code current at the time, special qualification tests were required. Grade 65 steel took a special 80 yield welding wire to use the full strength of the member. Hirschfeld had to certify all the welds and in doing so created standards on the job for the welding of these jumbo pieces.

To utilize the strength of the steel, quenched and tempered steel plates equivalent to the yield of the steel were purchased with 70,000 yield from USX. Welding quenched and tempered steel to A913 steel required another set of parameters. Therefore, Hirschfeld established three sets of welding parameters with 70 series wire, 80 series wire and 90 series wire.

Because of the weight of the steel for shipping, some field welding was required. The team planned carefully, with the erector developing a 3-D graphics program to pick out how they could split the trusses to find the component with the lower load for field welds. The job was strategically cut up to minimize field welds, and ultimately only about 20 field welded joints were required.

Steel members were fabricated in Hirschfeld's plants in both Texas and Virginia, and there had to be a guarantee that everything would fit together at the site. Initially components from Texas were shipped to Virginia for test fitting. Once everyone was assured of fit, components were shipped directly to the Convention Center from both Texas and Virginia, where they were erected in the field.

A tubular steel canopy cantilevers 60' over the main entrance, and then connects back to the truss system. The canopy steel was left exposed as an architectural feature. The welded pipe-to-pipe connections required special expertise on the part of the welders.

The entire steel fabrication required intricate planning, mock-ups and training of welders. The welding of some of the joints took multiple shifts, the longest weld being 2 ½ shifts or 250 hours for one full joint. Additionally, layout was critical, as the beams had to be cambered before erection. In more than one instance, the camber occurred right at a welded joint and required adjustment.

Erection Planning

The driver in steel erection was getting the cranes in to do the work and then getting them out of the building. Gilbane planned erection in three phases. Phase I, the north section, was 20 feet below grade and was where the expansion tied into the existing building. It was the largest phase of work, and steel erection started here with one of the two 250-ton Link Belt cranes. Phase II, the smaller south section, started three weeks after Phase I with a second 250-ton crane. The erection sequence was timed so the two cranes would finish at the same time in the center of the expansion. Phase III, the center section, continued with the two cranes from Section I and II working side-by-side and backing out of the building on the long service drive that was on grade.

Safety was a major consideration during steel erection. Aerial lifts that reached 60' were used for the first level of steel erection, which were the major large trusses. These lifts created a safety floor and safe and speedy connections, since connectors could get to both the bottom and top of the trusses with these lifts to make difficult connections. Additionally, trusses were erected with safety cable on them, so trades people could tie off when the beam was up. After the first level of trusses was erected, they created a safety floor, and the top level of steel was connected conventionally with Gilbane's required 6' tie off.

Management of the site to create lay-down space for the trusses was also a critical consideration. Lay-down took place directly behind the crane, which had a 60-foot reach. Fortunately the center section did not require the large trusses that the north and south sections required, so lay-down was less of a problem as the site narrowed. Large trusses for the ballroom level were laid down right beside the foundation wall.

Shipping of the steel to the

site was also key to the erection sequence. Because of limited space on the job site, just-in-time deliveries were essential. But planning those deliveries was fraught with complexities. Any load over 12' in width required special super load permits from the highway departments of the states they traveled through. Even with the special permits, there were special time slots for passing through each state. In addition, the City of Baltimore required altogether different traffic permits. Deliveries could only be made in Baltimore on Tuesday, Wednesday or Thursday at light travel times.

If a load missed its time slot for making a transition to a contingent state or entry into Baltimore, it would have to wait until the next time slot. In the case of City of Baltimore requirements, this could be as much as four days, so scheduling was critical. Shipments from Virginia had to be coordinated with shipments from Texas to arrive at the site at the same time. Loads coming from Texas required five days for delivery. To further complicate the shipping of steel, delivery was coordinated to avoid conflicts with convention center events and the baseball game schedule.

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The increased size of Baltimore's new convention center enables it to compete for 85% of the convention and meeting business. But the steel design, fabrication and erection presented enormous challenges for the design and construction team.

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