Building on a Winning Combination

BY LEN TSUPROS AND ROBERT ANDERSON, P.E.

Design-build collaboration saves tons of steel—and cash.

THE LATEST ENTRY into the Pennsylvania gaming industry—the Sands Casino Resort Bethlehem—opened its doors in May 2009 and has been attracting record crowds to the former brownfield site of the legendary Bethlehem Steel Corporation plant. Designed to highlight the steelmaking heritage of the location, the new casino preserves many of the original mill features and incorporates a new, 3,200 car parking garage that features a fully galvanized steel frame.

Built by Carl Walker Construction, Inc., the $40 million parking structure is located on a 209,000 sq.-ft site that is approximately two football fields wide and two football fields deep. It climbs six stories into the air, and is immediately adjacent to the casino. In addition, it houses an intermodal transportation facility to accommodate the constant flow of tour busses that carry patrons to and from the resort.

This is one of the largest of the more than 400 parking facilities Carl Walker Construction has constructed. It incorporates 5,300 tons of galvanized steel and was built in approximately 11 months. Carl Walker Construction partnered with CMC Steel Products and CMC South Carolina Steel to develop the design based on preliminary RFP specifications by Walter P Moore, Houston, and the project architect, RTKL, Chicago. Working together, Carl Walker Construction and CMC significantly reduced the amount of steel needed to do the job, and ultimately, lowered the overall project cost by about $3.25 million.

The RFP basically provided general conceptual guidelines for a structural steel framed garage with 6-in.-thick, cast-in-place post-tensioned concrete decks. It detailed a flow pattern for the garage, gave the number of parking spaces desired for cars and busses, and made recommendations for desired depths from floor to floor. The RFP also provided some general notes on aesthetics. The client wanted to expose as much of the steel structure as possible, and wanted the new steel garage structure to blend in with the surrounding structures that previously had been used for making steel. What the RFP did not provide was instruction on actual structural design.

Carl Walker Construction worked closely with CMC to perfect and execute the design of the parking structure, which was estimated to cost approximately $43.5 million if traditional materials and construction techniques were to be used. To address the client's request for a structure that emulated the look of existing steelmaking buildings on the site, they relocated structural bracing to the exterior of the structure. Doing so allowed them to achieve the desired visual effect and to adjust the rhythm of the structural columns from 40-ft centers to 20-ft centers.

Next, they focused on the structural members. Given the param-

Opposite page: With an entrance framed by a bridge structure from the Bethlehem Steel Works that previously occupied the site, the casino's new garage offers parking for 3,300 cars and provides an intermodal center for bus traffic.

Right: Of the more than 400 garages Carl Walker Construction has built, the Sands Casino Resort Bethlehem parking structure is one of the largest. It uses a fully galvanized steel frame and cellular beams, which reduced the steel required by 1,300 tons.

Below: The casino's new garage offers parking for 3,300 cars on seven levels and provides an intermodal center for bus traffic.

eters outlined in the RFP, everyone on the team quickly agreed that the most economical approach would be to use cellular beams for all secondary framing applications. CMC already had worked with Walter P Moore on a few projects in the Southwest that used this type of design. Both firms were well aware of the significant savings that could be achieved by using this design strategy.

Using standard beams for the secondary framing, the total weight of the structure—including beams, columns and bracings—would have averaged about 15 lb per sq. ft. By specifying cellular beams, structural weight could be reduced by approximately 30%. That reduced the amount of steel required by approximately 1,300 tons, and helped cut $3.25 million from the estimated cost. In turn, that dropped the cost to roughly $12,500 per space, far below the 2009 average of $17,777 per space for free-standing above-grade garages.

After reviewing all RFP responses, the owner selected Carl Walker Construction, Inc., and CMC Steel Products for the job, and CMC immediately began fabricating the cellular beams.

As specified in the approved design, the secondary framing structure of the parking garage would be built with 36-in.-deep cellular beams that would be set on approximately 20-ft centers. Each beam would be between 56 and 57 ft long, and would typically weigh approximately 73 lb per ft.

CMC fabricated the asymmetric cellular beams at its Arkan-

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Two dissimilar wide-flange beams cut with a series of alternating radius cuts are recombined to make a deeper section with no additional weight. For a project this size, the resulting savings in material can be substantial.

In addition to the weight savings, the openings in cellular beams provide a ready-made path for piping and conduit, as well as creating an open and light-filled atmosphere where patrons feel safer.

sas and Virginia facilities using W24x62 for the top sections and W24x84 for the bottom sections. The initial raw beams were first cut down the web with a series of half-circle patterns using a 12-in. radius. The half-circle cutting pattern was then reversed to create web posts, which lined up when the beams were separated and offset. The aligned web posts of the two cut beams (W24x62 top and W24x84 bottom) were continuously welded together to form the finished cellular beam (LB36x62/84).

The new beams were 36 in. deep, or 1.5 times as deep as the original 24-in. materials from which they were fabricated. The resulting beams have significantly more stiffness than the original wide flange beams used to create them but with no increase in overall weight.

After the beams were fabricated, they were coped and connection holes specified in the engineering drawings were drilled to accommodate bolting in the field. The cellular beams were then sent to one of the two galvanizers used on this project.

All structural members were galvanized for two key reasons. First, it provides outstanding protection for the structural steel that will stand up to the elements for at least 50 years—far longer than any other coating system would last. Next, the look of galvanized steel coordinated with the appearance of the existing buildings on the site, which met both the owner's and the architect's visual expectations.

The steel was shipped to the galvanizers in a specific order that ensured all structural members with connecting holes remained in the same lot. After the galvanizing operation was complete, the entire lot was stored in sequence at the galvanizing facilities because there was limited laydown area at the job site. When the lot was needed on the jobsite, the material was loaded on trucks—in sequence—and shipped.

Ironworkers erected the structure in 52-ft by 60-ft sections. As they moved along from section to section, they constructed six stair towers, each outfitted with precast stairs and galvanized handrails. When all the structural components were installed, the post-tensioning tendons were stressed and the structure was bolted into its final position. When the tensioning operations were complete, concrete was placed to form the elevated deck surfaces.

Many people in the parking and construction industries believe that for parking structures, a garage with post-tensioned decks and a galvanized structural steel frame really is the gold standard. However, when you combine the level of quality and craftsmanship found in that type of structure with innovative design—weight reducing cellular beams and the most efficient wide-flange structural shapes—you move the garage to new levels of structural and cost efficiency. With this garage, the owner made a sure bet on an efficient and low maintenance future. MSC

Owner
Sands Beth Works, LLC

Executive Architect
RTKL, Chicago

Structural Engineer
CMC Cary Engineering, Greenville, S.C. (AISC Member)

Steel Fabricator (garage)
CMC Steel Products, Hope, Ark. (AISC Member)
CMC South Carolina Steel, Taylors, S.C. (AISC Member)

Design/Build Contractor
Carl Walker Construction, Inc., Pittsburgh (IMPACT Member)