

Taking it to the Next Level

BY LEN TSUPROS

Parking capacity is expanded at a growing university hospital thanks to hybrid steel and concrete design.

CHANGE IS A FACT OF LIFE, PARTICULARLY WITH LARGE, GROWING ORGANIZATIONS. To support expansion and all the benefits that come with it, it's essential to have parking facilities that can keep pace with changing programs and use requirements. It's also critical to construct those facilities in a manner that maximizes convenience and safety, minimizes maintenance costs, and leverages the full potential of the land they're built on.

In congested urban areas, surface parking lots are often viewed as less-than-ideal uses for open land. As a result, multi-level parking structures are frequently the preferred option. Building an urban parking structure can, however, pose some formidable challenges. Unlike garages built in suburban settings, urban garages must fit onto tight land parcels surrounded by existing structures. In addition, they must be constructed vertically to provide enough parking capacity and revenue potential to justify the cost of construction. Finally, because many of the structures surrounding parking garages typically house businesses that can't be

disrupted or relocated during construction, every phase of construction activity must be carefully coordinated.

At Ruby Memorial Hospital, the teaching hospital for West Virginia University Medical School in Morgantown, W.V., the growth of the university's state-of-the-art cancer treatment programs demanded expansion of the parking facility serving the hospital; the hospital's campus had been augmented with the addition of a new cancer center building, a structure that was built on land previously used for surface parking adjacent to the hospital.

With real estate at a premium and the demand for parking growing quickly, it was essential for the hospital to maximize the capacity of its existing parking garage. However, since the parking structure was landlocked by the cancer center, other nearby hospital buildings, and the university's football stadium, a horizontal expansion was out of the question. Instead, it was necessary to expand parking capacity within the footprint of the existing structure, and at the same time maintain access to the hospital's emer-

gency room, which emergency vehicles accessed through the first level of the garage.

Creating a Hybrid Strategy from the Ground Up

Simply adding another level to the existing parking garage was, however, not an easy task. When Carl Walker Construction designed and built the original structure in 2003, the client decided not to include foundation structures designed to accommodate future vertical expansion. At that point in time, the cancer treatment facility was not yet on the drawing board, and it was anticipated that the capacity of the garage would effectively meet the needs of the hospital for years to come. But by 2005, as the hospital was putting the final touches on its new cancer center, it became apparent that the existing 225-space parking structure lacked the capacity necessary to support the parking volume created by the additional building. Aware of the foundation limitations and unwilling to demolish the entire structure and start from scratch, the hospital contacted Carl Walker Construction. The client challenged them to revisit the original designs of the building and provide a solution that would accommodate the construction of another parking level that would provide 105 additional spaces.

“Due to the weight considerations involved with the precast structural components, we knew from the outset that we couldn’t simply add another level using the same type of structural system,” observed Len Tsupros, president of Carl Walker Construction. “The foundations of the garage—and in particular, the network of precast beams supporting the center of the structure—were not heavy enough to handle the additional load. We needed to devise a structural system that was lighter in weight than the cast concrete components. We also needed to design a way to effectively attach that structural system to the existing garage. Whatever approach we took, we knew we couldn’t do anything without significantly reinforcing the center supports.”

To meet the challenge, Carl Walker Construction turned to the project’s original engineer, Charles Churches, P.E., for guidance.

Churches agreed with Tsupros that significant reinforcement of the structure would be needed to support the weight of the additional parking level. He then worked with Tsupros and his team to devise a reinforcement strategy that would deliver the required support and weight distribution, and to evaluate structural systems that could be married to the existing precast components.

Within a few weeks, Tsupros returned to Ruby Memorial Hospital with a comprehensive plan that would accomplish those goals and allow the new deck to be added to the structure. The hybrid construction strategy would directly link support of a new steel-framed, cast-in-place concrete post-tensioned deck to the existing foundation, and would not place additional stress on the precast columns already in place in the center of the garage. It would also minimize the overall weight of the additional deck and would provide a framework to mount and secure a series of precast panels. Those panels would seamlessly integrate with the existing building finishes and make the post-tensioned system essentially invisible when the job was complete. The project estimate was \$2 million, or approximately \$19,000 per additional parking space.

A steel-framed, post-tensioned slab system can be a good solution when foundation loads are an issue.

Bringing Together Old and New

After receiving the client’s approval on the budget and the innovative design strategy, the demolition and strengthening phases of the project quickly commenced in January of 2007. Throughout the entire construction process, the garage remained open to hospital visitors, staff, and emergency vehicles.

“To install the new structural columns in the center of the garage, we began by using a Bobcat outfitted with a jackhammer to break through the concrete floor on the first level between each of the eight previously installed precast columns,” remarked Tsupros. “This allowed us to auger down, expose the grade beams that comprised the original garage foundation, and pinpoint areas where cast-in-place concrete columns could be directly attached to the grade beam system.”

Once the concrete column bases were positioned on top of the



WVU’s growing medical campus prompted the need for more parking.



The expansion to the garage added 105 parking spaces.

grade beams, the construction team inserted rebar cages around each junction point. Then, it backfilled each cage with concrete, which flowed around each grade beam and locked the column bases into position. When the concrete had cured in and around the cages, the team then poured concrete up to the floor level to close the holes. With firm footing in place, the team then constructed the concrete columns that would rise through the top deck of the precast structure, cutting through the existing decks to provide raceways for each new column.

With the reinforcement phase of the project complete, Century Steel Erectors and Carl Walker Construction began installation of the structural steel that would form the framework for the new post-tensioned parking level. The steel beams were connected to the new cast-in-place concrete columns—shear studs are welded to the girders—then bolted and welded in place to ensure structural stability. At the same time, the original elevator bank was extended up by one floor with the installation of an additional precast concrete section that was lowered into place by crane.

When the structural steel and the elevator shaft extension were completely installed, precast panels were trucked to the worksite and hung on the steelwork to integrate with the appearance of the original façade. Both the steel erection and precast installation phases of the project were carefully scheduled to minimize pedestrian and traffic obstructions, and to maintain ingress and egress from both the garage and the hospital's emergency department.

Lateral bracing for the new level was accomplished with the connection to the existing precast light wall and the precast façade panels. The panels have rods inserted at the floor level and are also composite with the floor slab. This also provides for the bumper restraint requirement at the perimeter.

Once the new precast-clad, post-tensioned structure was installed, work began on constructing the steel-reinforced parking deck surfaces. Shear studs welded to the steel members make the new slab act compositely with the steel. The concrete slab was supported by a temporary framing system that fit snugly between the steel beams supporting the new deck. When the concrete cured, the framing was removed from the underside of the new deck. The construction phase of the project was completed by May of 2007. One month prior to completion, cars were allowed to park on all but the top level of the newly expanded garage. Project clean-up and punch-list items were completely addressed by August 2007.

Well-Received Results

Tsupros was also pleased with his firm's accomplishments on this project. "This job required some out-of-the-box thinking, as well as a considerable amount of coordination between the client and our strategic partners," he said. "The end result, however, illustrated how marrying two different structural systems can expand the capacity and lifespan of existing parking structures. Our approach allowed Ruby Memorial Hospital to leverage the potential of their original precast structure and to obtain the additional capacity they needed to support their enhanced service offerings."

"I would encourage anyone who currently has a precast parking structure to consider the potential of a steel-framed post-tensioned addition if they need additional parking capacity and are facing foundation and structural load limitations." **MSC**

Len Tsupros is president of Carl Walker Construction.