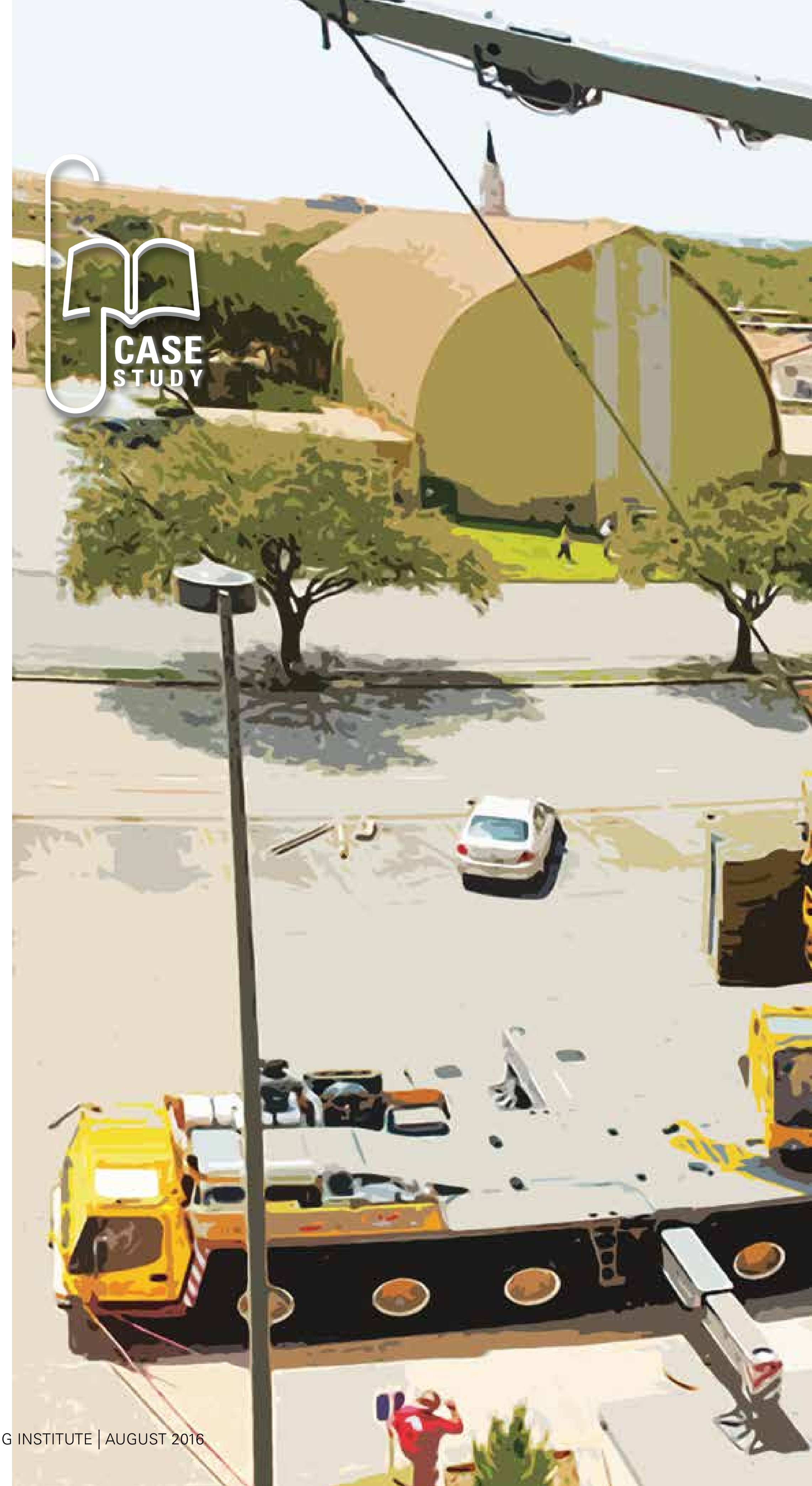
GOING UP

CASE STUDY



Villanova University expands a garage skyward, increasing capacity and campus visibility.

By William F. Kavanagh, AIA, NCARB

As part of the Campus Master Plan implementation at Villanova University, outside Philadelphia, Pa., there was a need for additional parking on campus. Phase 1 consisted of the creation of new surface parking lots and the vertical expansion of the Saint Augustine Center (SAC) garage by two additional levels. Upon their completion, the parking spaces from the existing Pike surface lot were relocated to allow for Phase 2, a new 1,300-space parking garage, to commence. When the Pike Garage is complete, the existing Lancaster Avenue parking lot will be replaced with new residence halls for 1,135 upperclass, undergraduate students. Finally, Phase 4 of the plan will be the construction of a new performing arts center beside the new Pike Parking Garage.

The existing SAC garage, with a capacity of 270 spaces, was increased to 493 spaces during its vertical expansion. This resulted in a net gain of 223 spaces for the university. The original precast concrete garage consisted of two levels: grade plus a supported level. Because the garage is recessed into the sloped site, each flat parking level is accessed directly from grade and not interconnected via a ramp.

Challenges

The many challenges associated with this vertical expansion of the existing precast parking garage included:

- Providing new shear walls for the lateral stability of the taller, vertically expanded garage.
- Integrating a new access-ramp connection between the existing and new parking levels.


Before

- Adding a new elevator and new pedestrian bridge for improved accessibility.
- Enhancing the architectural appearance of the expanded garage.
- Guaranteeing crane access around garage perimeter on a tight site.
- Maintaining an aggressive construction schedule.

Design Solutions

The original garage was designed in the early 1990s with reserve capacity to be expanded by one level in the future. An analysis of the existing foundations by the structural engineer and the geotechnical engineer found that a two-level vertical expansion was possible. However, the original design did not provide adequate lateral support for such a two-level vertical expansion. The lateral design criteria had become more stringent under subsequent editions of the building code. New cast-in-place concrete shear walls had to be inserted into the existing precast garage. This required excavation for new shear wall foundations within the existing garage footprint. Micro piles were selected due to the low overhead working clearances beneath the existing garage floor. In addition, holes had to be cut into the existing floor of precast double tees to allow for shear wall continuity up to the new floors. The cast-in-place shear walls were tied into the existing double tees of the existing supported floor. New precast shear walls were installed on top of this as part of the new precast superstructure of the expansion above.

A new internal ramp was required for accessing the two new upper levels from the existing supported level of the garage. Galvanized steel framing, cast-in-place concrete, and special precast detailing were required to provide a smooth transition between the new and existing garage portions. The initial ramp from the existing flat double tee floor was a speed ramp without parking before transitioning to a lesser sloped ramp with parking.

An elevator and a pedestrian bridge were added at opposite ends of the expanded parking garage. The elevator was provided to allow for accessibility to all floors. The elevator shaft was carefully inserted into an opening in the existing garage that previously accommodated a stair. Careful design and detailing as well as some underpinning of an existing retaining wall at the elevator pit allowed for the elevator to be accommodated within the existing garage footprint without the expense of an external elevator tower. The pedestrian bridge connected the new third level with the adjacent grade for a better and more convenient connection to the heart of the Villanova campus. The bridge spanned over the sloping site.

Fitting In

The architectural design of the newly expanded parking garage was important to the university. The size of the original two-level garage was obscured by the sloping site and landscaping. The perceived mass of the new expanded garage was much greater and required

appropriate architectural detailing to break down its scale and blend more contextually with the campus. Keeping with the collegiate gothic style prevalent on campus, buttressed shaped column covers with integral stone veneer cast into the precast were provided. They provide a three-dimensional quality to the facades, helping to break down the scale of the building. Stone veneer was also added to the shear walls at the ends of the garage. The difference architecturally between the original and the vertically expanded garage is very pronounced and has been well-received by the university's community.

Sufficient crane access around the perimeter of a garage is essential for a vertical expansion with precast concrete. Typically, for new precast garage construction, a large crawler crane erects the building from within the garage footprint. This allows for the crane to get very close to the structure during erection. With a vertical precast expansion, the crane has to be on the perimeter and reach over the existing garage for erection of the expansion. Instead of a crawler crane, a very large, wheeled, mobile hydraulic crane—a Grove GMK7550, 550-ton capacity crane—was utilized. This crane was required to erect the precast expansion from two opposite sides of the garage. The greater mobility of the wheeled crane versus a crawler crane was beneficial for this reason. Additional site constraints that affected the construction of the expansion included the sloping site, existing trees, and the adjacent railroad tracks. The sloping site resulted in increasing the distance between the road where the crane was located and the garage itself. The longer distance required a bigger crane with a longer reach and lifting capacity. Several trees were removed to allow room for the crane to swing its loads into place during erection. A couple of very large trees were required to remain and required special means and methods to work around. Finally, the proximity to the adjacent rail lines required special approvals.

An aggressive construction schedule was specially tailored to minimize disruption to the campus and its academic calendar. The faculty and staff who utilized the original garage were displaced during the construction of the vertical expansion. The time the entire garage was closed was reduced by installing the foundations for the vertical expansion with partial closures of just the required immediate area. Also, the use of precast allowed for the schedule to be compressed further. The precast elements were fabricated offsite at the same time the foundations were being installed.

Conclusion

Vertical expansions of existing garages are inherently more complicated than that of new construction. Combining the existing construction with the new expansion required careful coordination. As a result, the construction costs are usually greater for a vertical garage expansion than that of a new garage. However, sometimes building upon an existing asset has the greatest outcome, where the resultant garage is better than the sum of its parts.

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