Parking Structures for Sprint World Headquarters – A Precast Bonanza

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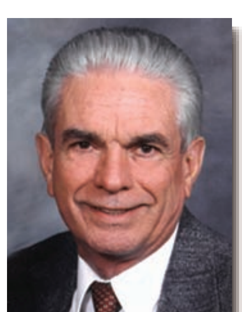

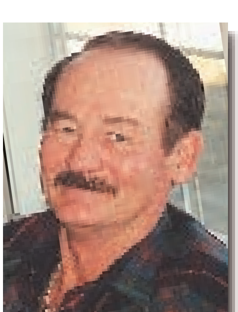

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Twenty buildings and 14 precast concrete parking structures make up the new Sprint World Headquarters in Overland Park, Kansas. Creating such a massive complex required close communication among trades and coordination of all design elements. The parking structures were designed using two basic plans, for a three- and four-bay layout, with the only variations coming in ramp access and first-floor designs due to the sloping grade across the campus. The design used pocketed spandrels to eliminate ledges around the structures' perimeters and clean, simple finishes with ribbed details to add interest. The 14 parking structures were completed in slightly more than three years. This article presents the design considerations and construction highlights of the project.

The new Sprint World Headquarters facilities in Overland Park, Kansas, which includes 20 buildings and 14 precast concrete parking structures on 200 acres (81 ha) of land, is the largest known private construction project in North America. To be completed in 2002, the project is a testament to close communication, logistical planning, and design flexibility (see Fig. 1).

The precast concrete parking structures are a strong example of all of those elements. The 14 structures were built one after another using a three- or four-bay plan, with only slight variations to each design to accommodate traffic access and grade levels (see Fig. 2).

Designed to support the office tenants and visitors to the 4 million sq ft (360,000 m^2) corporate headquarters complex, the parking facilities offer convenient, accessible parking for 14,000 vehicles. They follow the outside of a loop encir-

Fig. 1. The overall campus features a looped roadway with fourteen parking structures along the outside and twenty buildings along the inside.

cling the campus, with the office buildings on the loop's interior side. The parking facilities complement the campus environment and give the employees easier pedestrian access than could be provided with surface-parking facilities.

This article describes the design features of the parking structures and gives highlights of their construction.

DESIGN FEATURES

The parking space was broken into 14 smaller structures for two reasons. First, it provided a smaller, less dominant series of structures rather than one or two monolithic presences that gained too much prominence. The smaller structures created a more pleasant campus environment with additional green space around all buildings.

In addition, the parking facilities were planned to support each of the individual buildings on the interior loop, which include 17 office buildings, a central-services building, a central utility plant, and a fitness center. The parking structures were sized and located on the campus master plan to offer smooth access for the type and amount of traffic each related facility would receive through the work day.

Each parking structure features three or four supported levels, depending on need in that location. Within the basic scheme, the design team developed different configurations of the bay schemes, changing the ramping and access from one side of the structure to the other to best maximize the location on the site. This initial design planning involved input from the owner, architect, construction manager, and parking consultant.

To help the team make final decisions on the ramping and configura-

Fig. 2. Parking structures at Sprint's Worldwide Headquarters in Overland Park, Kansas, were designed with a simple style with a few decorative touches.

Fig. 3. Ribbed details were used on column covers to add a decorative touch.

tion plan to be used throughout the project, the consultant drew up a matrix of key attributes to be considered. These included efficiency of design, passive security, ease of construction, user friendliness, required ramp slopes, horizontal façade appearance, traffic flow, and other key elements.

A rating was attributed to each factor for each of several designs under consideration, with a weighting given to that factor's importance in the overall plan. A final score was achieved for each design, with the selected design coming out on top. This design proved ideal for the specific site, project, and owner needs. Had any of those factors been different, another plan might have been chosen.

Material choices went through a similar matrix plan. Both cast-in-place and precast concrete were considered for the construction, with precast concrete being selected. The precast option provided long-term durability, ease of maintenance and construction speed, which were key considerations when multiplied by 14 structures. Its aesthetic versatility also was a consideration, as was its ability to cast components offsite, reducing some of the on-site construction traffic and logistics that had to be dealt with during the construction.

The final parking designs were based on taking advantage of precast concrete's strengths. These included the ability to minimize form costs by providing considerable repetition in component design as well as in available span lengths. Each structure was built to a length of 300 ft (91 m), which provided not only an attractive length for users to maneuver through, but also an ideal length for creating a precast design that did not require an expansion joint.

The goal in designing the structures was to create similar but not identical structures. This ensured that users traveling through one parking structure would feel comfortable if using another one. But the variations in layout and approaches ensured there was no "cookie cutter" feel to the facilities. In all, eight of the structures feature four-bay widths with the two center bays sloped in a side-by-side helix, and six are three bays wide with the center bay sloping.

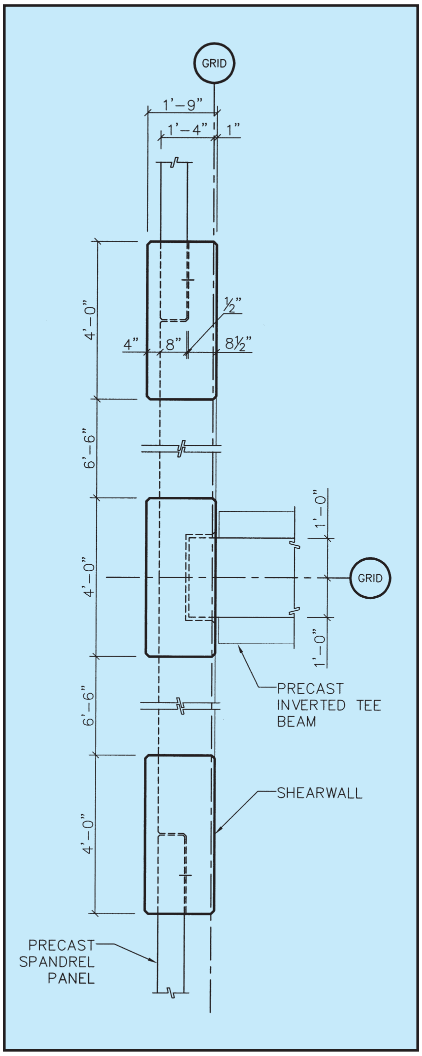


Fig. 4. Plan view of exterior shear wall used on upper floors shows the openings that were added into the one-unit piece.

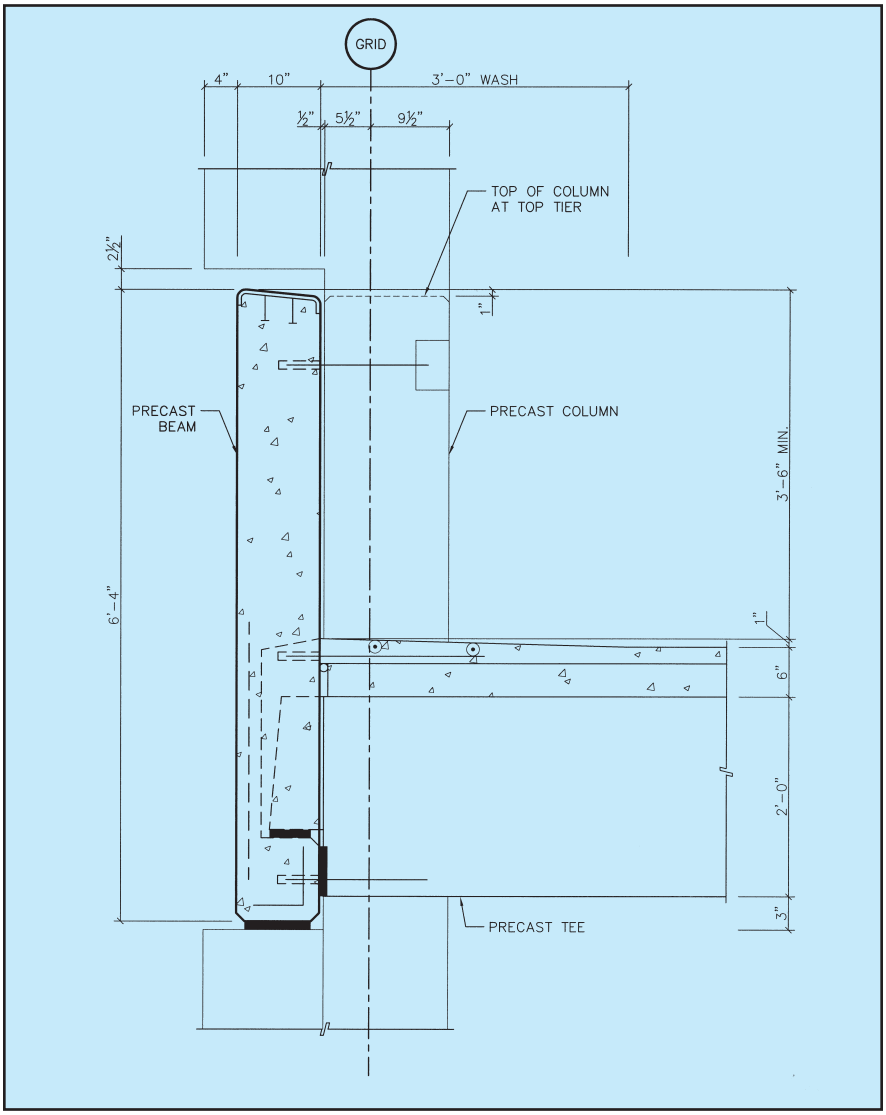


Fig. 5. Typical exterior panel, showing where the double-tee frames into the pocketed precast beam.

Another objective was to reduce the cost for the parking structures where possible to retain more of the budget for creating distinctive architectural features. This also was in keeping with the design aesthetic of making the overall appearance of the campus more refined as a visitor moves closer to the center of the area. Thus, the parking structures on the campus perimeter were to be kept modest looking, creating differentiation without trying to hide them.

In that spirit, the use of laid-up brick or adding inset brick to the precast spandrels was discussed in the conceptual phase, but it was decided to save that additional expense for use in the center ring of the campus. Instead, the designers chose a cost-efficient yet attractive exposed-aggregate style with retarded and sandblast finishes (see Fig. 3).

Each facility consisted of 10 ft (3.0 m) wide, field-topped precast double tees. Shear walls located outside the perimeter of the structures were designed in horizontal panels about 25 ft (7.6 m) in length and matched the floor-to-floor height of 10 ft 4 in. (3.1 m). The shear walls included punched openings to enhance security and featured a ribbed, sandblasted finish (see Fig. 4).

The exterior spandrels were pocketed to accept the double-tee stems, which reduced cost through the elimination of L-beams (see Fig. 5). Doing away with these beams also eliminated hundreds of ledges that would have attracted nesting birds, creating an enormous and ongoing maintenance problem.

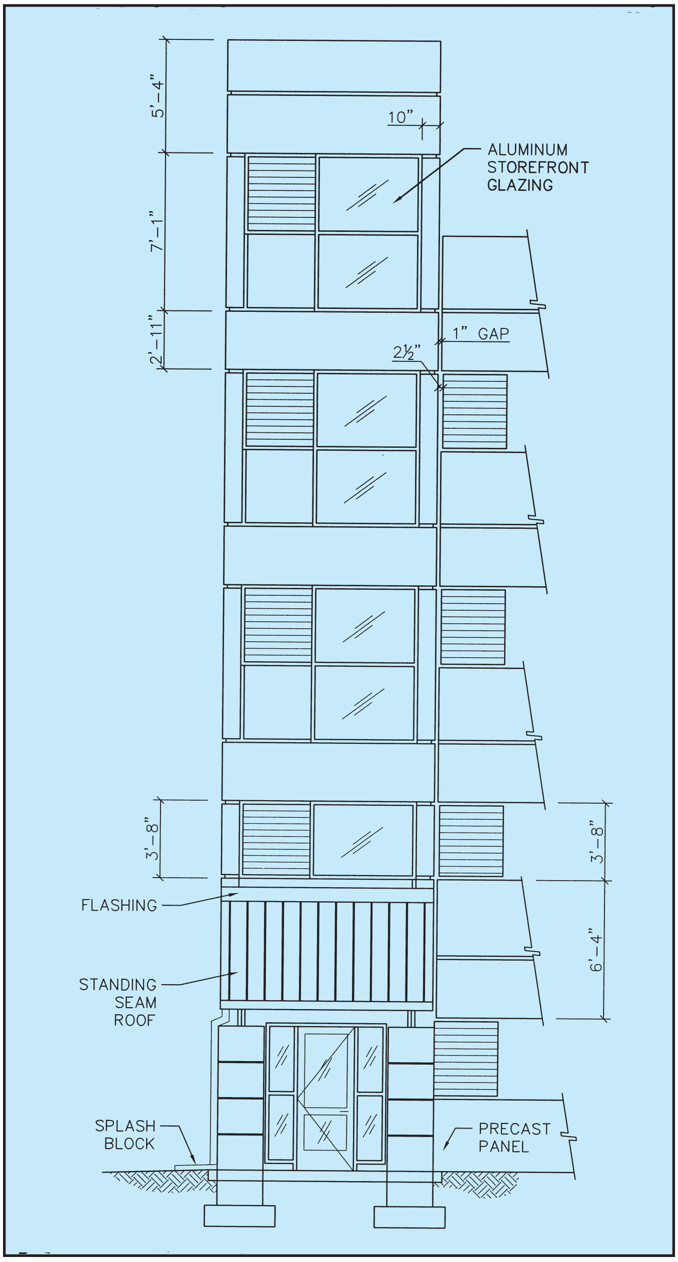
The field topping consisted of high-performance concrete enhanced with a 5 percent silica fume additive. It was 4 in. (102 mm) thick at the washes and $2^1/_2$ in. (64 mm) thick at midspan to offset the effects of tee camber. The addition of the silica fume will significantly reduce the potential for chloride penetration over time and ensure the topping sealant will not have to be reapplied in later years.

The field topping also provides a smoother ride over the tees in the transverse direction, compensating for the differential in camber from tee to tee. The schedule was designed so that no topping had to be completed during the winter months, although erection of components continued during this period.

The horizontal interior litewalls, parallel to drive aisles along the main

Fig. 6. Interior litewalls allow bay-to-bay ventilation, visibility, and light distribution.

Fig. 7. Stair towers were designed to stand out, helping to orient drivers to entries as they arrive and to add visual interest.



column lines, were specified to simplify the erection process, eliminating the need to support tall vertical walls during construction. Chainlink-style fencing protects pedestrians at the litewall locations. The use of the precast double-tee flooring system, precast litewalls and precast external shear walls created clear-span, user-friendly floor plates. This accommodation eliminated internal shear walls and improved the facility's overall openness, enhancing passive security, and adding to pedestrian safety and driver visibility (see Fig. 6).

Precast concrete stair/elevator towers were designed to offer a consistent style element from one structure to another, featuring overhangs and a standing-seam roof at the entry to give visitors protection from the weather (see Fig. 7). A larger design was used for the combined stair/elevator towers compared to the stair-only towers. This distinction helps orient users as they approach the facilities and provides information on which services are available and in what locations (see Fig. 8).

The stair/elevator towers are free-standing designs with their own lateral load systems, isolated from the main parking structure by a 2 in. (51 mm) joint within the structure's footprint (see Fig. 9). The towers feature glass panels facing the exterior, with their interior walls painted white to enhance brightness and visibility for security purposes. The elevators also are glass-backed to aid passive security. Hidden connections were used in the precast components at these points to create a more attractive look (see Fig. 10).

The key distinction among the different structures' design, beyond the basic three- or four-bay configuration, came on the first floor, where each structure had to be aligned with the grade level at its location. The campus grade changes by 80 ft (24.3 m) from side to side, requiring significant adaptations on the first level to accommodate the slope. As a result, some of the structures feature a half level on the first floor, with an express ramp providing quick access to the parking levels above (see Fig. 11).

Some structures feature 15 ft (4.6 m) floor-to-floor heights at grade, while the typical support levels have 10 ft (3.0 m) heights.

A few structures were designed with 10 ft (3.0 m) or 20 ft (6.1 m) tall retaining walls adjacent to them (see Fig. 12). These were built about 2 ft (0.6 m) away from the parking structures to provide light and air on the back side of the structure. This design keeps the lateral load off the parking structure itself. This approach eliminates the need for the parking structure to do double duty and lets it expand and contract naturally without being restrained by the retaining wall.

The architectural finish features two special aggregates and specially manufactured sand. Reveals, sandblasting, water washing, and a concrete retarder produced accent stripes on the façades of the structure (see Fig. 13). A key design element was created with the column covers, which were conventionally reinforced and included 4 ft (1.2 m) wide haunches for architectural interest. The architectural finish on the columns complement the ribbed and sandblasted shear walls. Columns also feature horizontal ribbed formwork in squares, which were integrated into the stair towers and wrap around the corners to create focal points on the towers. These designs helped create the similar-but-different design look for each individual structure (see Fig. 14).

Fig. 8. Stair/elevator towers feature tall, gabled roofs to help orient visitors.

With the significant amount of repetition in design and component pieces, designing the ultimate look of each parking structure was accomplished relatively smoothly. But coordinating the construction of these facilities, with the attendant number of deliveries and crane positionings, was far more complex.

A key driving force in the schedule was the owner's desire to have each parking structure completed in conjunction with the office buildings it would serve, thereby allowing some employees to occupy the building as it was completed.

A significant aid in facilitating the process was that the precast contract was let as a single bid rather than breaking it into smaller units and spreading it out to other precasters. This was done to facilitate communication and to smooth the document process, ensuring the precaster had the drawings needed to begin erection. When the construction began, the precaster had one full set of construction documents for one structure, along with plans for the next three structures that were in design development. The remaining structures were in the schematic design phase.

The construction manager used a "bulk-buy" approach to maximize the efficiency of the project's purchasing power. For instance, the owner purchased all parking lighting fixtures from one supplier, receiving a bulk discount, and had them shipped to the site on a staggered basis as needed.

As the structures were ready for their lighting installation, the subcontractor would pick up the necessary lighting components, which were already on-site. This alleviated the need for the lighting subcontractor to estimate product costs in his bid or worry about having the products delivered in time (see Fig. 15).

PRODUCTION AND ERECTION HIGHLIGHTS

Ensuring the appropriate components were cast, delivered, and staged at the correct times and locations proved to be a logistical challenge. Simply maneuvering all the delivery vehicles among all the other traffic into and out of the site took considerable effort. A storage yard was provided at the site to facilitate delivery of components for future use, and this traffic also needed to be coordinated. Fortunately, the learning curve to determine how best to facilitate these needs was quickly mastered, and traffic flowed smoothly once the system was established.

Casting sequences for the precast components proved relatively simple, because of the similarity in the designs. Essentially, two lengths of double tees were used, eliminating the need for continuous form changes that would have slowed down production. Once a new structure was begun, the components could be cast rapidly, as the configuration was similar to previous projects in the sequence.

Nonetheless, the sheer magnitude of the job, in casting so many parking structures in a three-year period, made it challenging from scheduling and delivery aspects. For instance, one goal was to maintain a 100-piece precast inventory on the site at all times to be ready to erect structures as sites were ready.

Construction of the office buildings drove the schedule for erecting the parking structures. Since each parking facility could be erected in approximately three months, and each office building took about 18 months, aligning the two so both finished together was not difficult. This process was aided by the factory-cast precast components, as no time had to be added to the schedule to allow for weather delays that could have arisen with other types of materials.

Erecting the structures required an early analysis of piece-by-piece sequencing between the erector and the precaster, as each structure had its own access requirements due to the

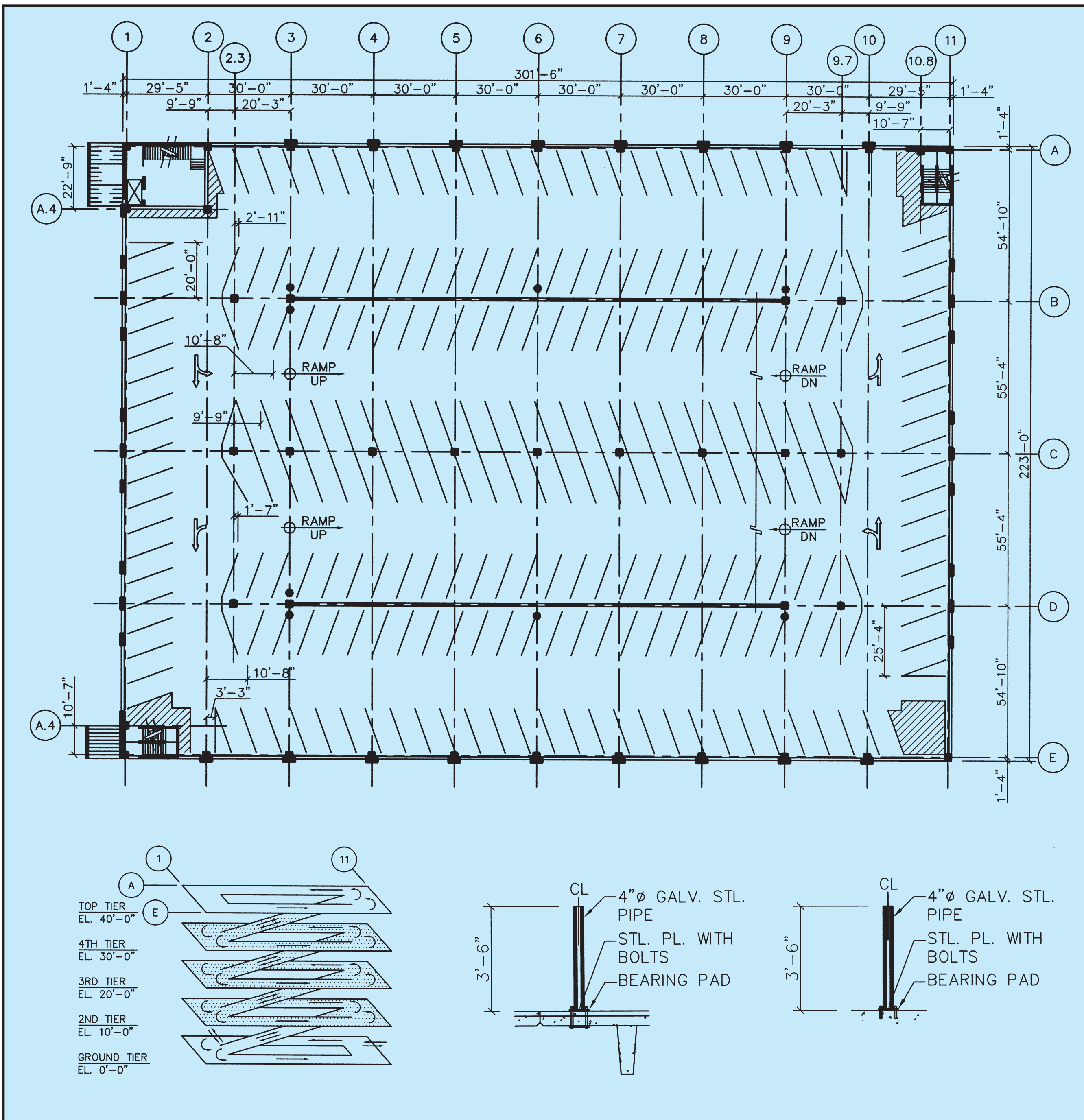


Fig. 9. Stair/elevator towers were created as stand-alone structures with their own lateral-loading systems, separated from the main structure by a 2 in. (51 mm) joint.

grade slope (see Fig. 16). Day-by-day scheduling and load requirements also had to be coordinated.

This process was complicated at several points when changes of sequence and access occurred due to two of the parking structures being expanded in size to accommodate changes in the building design on the interior of the campus. This required repricing and rescheduling the projects while work continued in other areas. The ability to move cranes to a site as it was ready provided some efficiency, but any changes to the timetable that required unplanned crane movements added further complications to the scheduling.

Building Erection Services Inc. erected the first 11 parking structures, with the final three in the last phase of work erected by the general contractor. In all, the 14 structures comprise 12,074 precast concrete components, including double tees, columns, beams, architectural spandrels, litewalls, architectural shear walls, stairs, and other components (see Table 1).

The precast components were manufactured by CSR Quinn at their plant

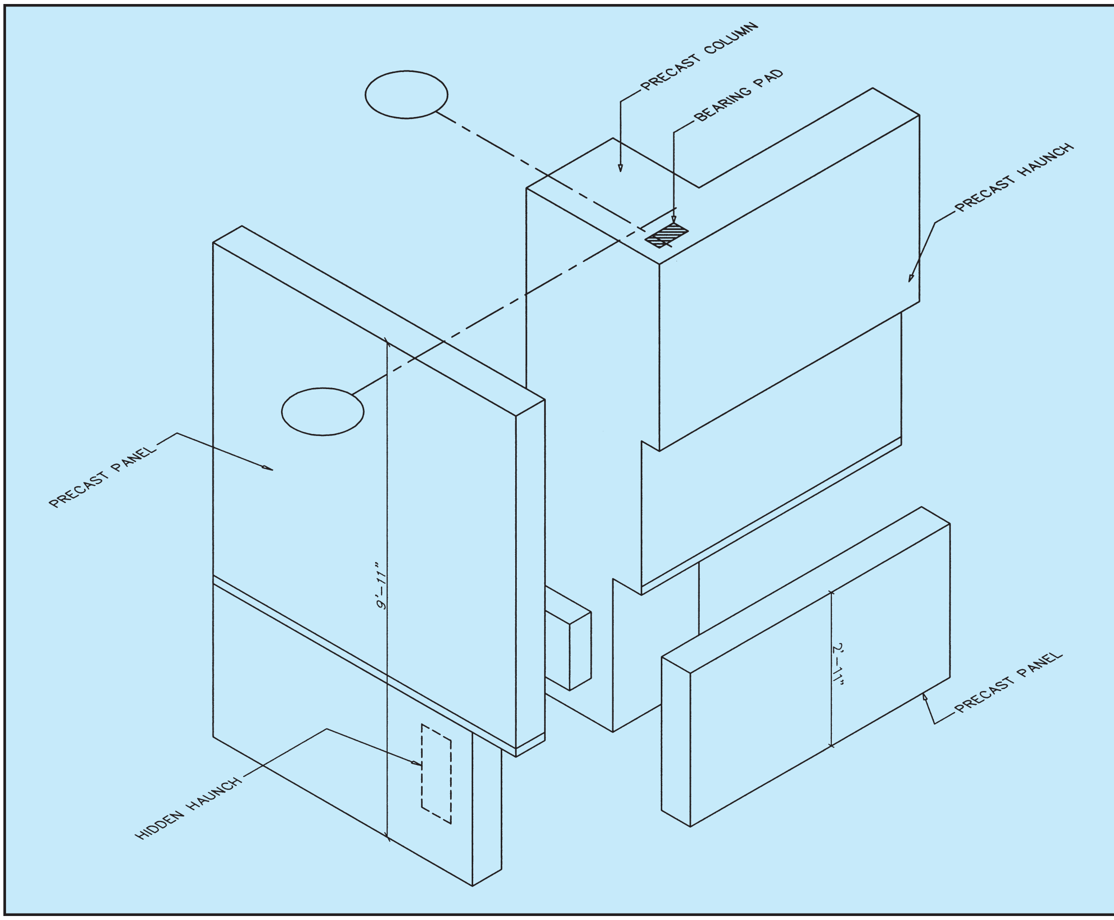


Fig. 10.
Hidden connections were used to connect corners of the stair towers.

Fig. 11.
Variations in slope created some challenges in laying out the first floors of the structures.

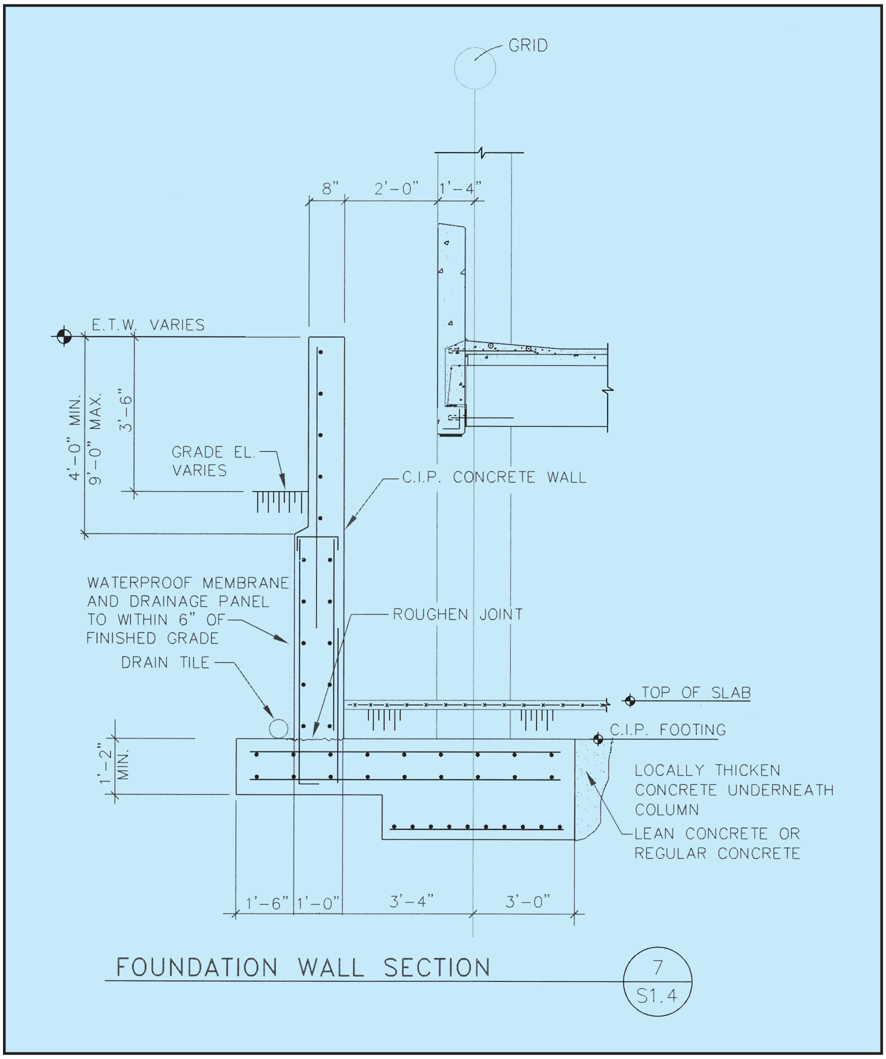


Fig. 12. Cantilevered retaining walls were installed adjacent to some of the structures to relieve the lateral load from the retaining wall and provide expansion and contraction space.

in Marshall, Missouri. The precast components were shipped by truck/trailer to the project site – a distance of about 100 miles (160 km).

The structures typically have precast members requiring both 200- and 225-ton (181 and 204 t) cranes with the reach and capacity to safely and efficiently move these components. During some portions of the project, three erection crews were working on three different structures at the same time. At the peak of the work, the erection subcontractor also had four other erection crews working on projects in other areas of the market.

This stretched the available labor, producing additional scheduling challenges. Determining, acquiring, scheduling, and delivering the crane rigging and the erection equipment required for the project was a major coordination effort. The erection subcontractor also provided all of the structural grouting for the precast components as well as all filling and patching of the lifting eyes and the recessed connections.

The precast fabrication began in early 1998, with erection beginning in June 1998 and continuing through February 2001 for the initial 11 parking structures (see Fig. 17). The three parking structures in the final phase of construction were completed in March. Space for two additional park-

Fig. 13. Reveals, sandblasting, water washing, and a concrete retarder produced accent stripes on the façades.

Fig. 14. Erection of one of the parking structures. Note the ribbed column covers.

Table 1. Types and quantities of precast components.

The Sprint Worldwide Headquarters campus in Overland Park, Kansas, features 14 precast concrete parking structures containing 4 million sq ft of space and 14,000 parking spaces in all. The precast concrete components used in the project comprise:

5696	double tees
766	columns
994	beams
1662	architectural spandrels
756	litewalls
385	architectural shear walls
316	stairs
1499	architectural and miscellaneous walls
12,074	total pieces

Fig. 15. Interior view of parking structure showing special lighting.

Fig. 16. The site's grade level drops 80 ft (24 m) from side to side, requiring the first floor of each parking structure to be carefully designed.

ing structures is available for future expansion.

A view of a completed parking structure is shown in Fig. 18.

CONCLUDING REMARKS

Most of the parking structures are in use today and include a sophisticated signage system that directs users effortlessly through each facility. A unique feature of the system is a counter that tracks entering and exiting vehicles and alerts patrons when the structure is 95 percent filled, directing them to the next structure.

A final touch was provided in landscaping that was planned around all of the structures. In keeping with the informal concept for the outside perimeter of the campus, the roadway's sides have been planted with a double layer of foliage, with maple trees along the road and evergreens behind them and along the parking structures. This helps pull together the different structures and soften the building shapes. The parking structures also are tied into a pedestrian crosswalk system that makes access between parking and the office buildings move smoothly.

Fig. 17. Overview of erection of precast parking structure.

These elements show the tremendous amount of planning and attention to detail that went into unifying the campus and ensuring the best use of green space and pedestrian access. The use of precast concrete for these facilities allowed the design and construction team to take advantage of the material's flexibility to create structures that not only make strong architectural statements but also meet budgetary, construction phasing, and scheduling requirements.

On a parking complex of this size, the ability to design and buy in bulk resulted in significant cost savings and ensured consistency of the product, enhanced schedule adherence, and simplified critical fabrication and construction phase tasks. It has proved to be a very successful project that offers ideas for other designers involved in large-scale, repetitive projects.

Construction of the parking structures is on schedule and the project is expected to be complete in 2002.

CREDITS

Owner: Sprint, Overland Park, Kansas

Architect: The Hillier Group, Princeton, New Jersey

Engineer: Walker Parking Consultants Inc., Wayne, Pennsylvania

General Contractor: J.E. Dunn Construction Co., Kansas City, Missouri

Precast/Prestressed Concrete Manufacturer: CSR Quinn, Marshall, Missouri

Erection Contractor: Building Erection Services Co., Olathe, Kansas

Fig. 18. Finished view of parking structure.