Meeting the Design Challenges of Today's Parking Structures

Challenges arise for designers as more capabilities are demanded of parking structures

— By Don Monahan, P.E., Walker Parking Consultants

Today's economy and the focus on long-term consequences—both in revenue and environmental impact—are creating new demands for designers of parking structures across the country, for all sizes of projects. Staying abreast of current trends and understanding the challenges that these new requirements will bring can ensure projects are successful from their first day until their last.

Some of the key trends impacting parking structures today include:

1. Multi-Use Capabilities. There is more pressure, especially by city-owned properties, to incorporate retail space into the structure at ground level. Accommodating that need creates a variety of unique challenges that play off of each other.

A key consideration that must be recognized is that such commercial space will raise the per-stall cost of the project. Typically, the first floor of unsupported parking spaces will cost in the $8- to $10-per-square-foot range, with supported levels costing $20 to $30 per square foot. By removing first-floor spaces to add commercial real estate, the cost per parking space overall rises.

During the preliminary design phase, officials at the University of Virginia decided to add a 44,500-square-foot, two-level bookstore above the new parking structure being built on the historic campus. The facility also includes a police surveillance station. Engineer: Walker Parking Consultants

Typically, retail space juts out from the structure about 20 feet and takes up about 18 feet into the structure. This space eliminates one line of parking stalls, which typically will be along the street frontage or wrap two sides if on a corner. Retail on a full-block structure will eliminate all parking along the exterior sides of the first floor. Offsetting this, of course, are the revenues generated by the tenants in these spaces.

The loss of these spaces will mean their number will have to be replaced with additional spaces higher up, possibly with an additional level or other accommodations. Fortunately, most structures can add vertical space without a problem, as they do not impinge on height limits set by most municipalities. However, this aspect must be determined early to ensure a tradeoff doesn't have to be made of retail space for needed parking slots.

2. Ramping Requirements. The addition of commercial space into the parking structure creates additional challenges, especially in the ramping design. In most cases, retail spaces require about a 15-foot floor-to-floor height (creating a 12-foot clear height in the store) rather than the standard floor-to-floor height of 10 to 11 feet on other parking floors.

The additional height requires adjustments to the ramping position and

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Parking structures can provide a variety of sustainable-design attributes, many of which can help the project achieve LEED certification.

slope. The International Building Code (IBC) allows for a 1-in-15 (6.67%) slope with parking on it, but this percentage can be difficult to achieve in most parking structures because the footprint is too small.

That leads to creating a speed ramp with a slope of 10% to 15% for the first portion of the structure, which does not include parking space. Such ramps are inefficient because they eliminate space for parking, increasing the cost per stall even further. If the parking structure is more than two parking modules wide, the second parking level at the retail space could be left out such that there is a two-story high space for the retail and parking floor slopes are not impacted.

3. Market Demand Evaluations. With greater pressure to maximize stalls while increasing revenue on small footprints, requirements of the municipal code come under question more often. These codes often are based on other municipalities' codes established earlier, rather than on actual parking conditions in the municipality where the parking structure is being built. They also were established at an earlier date when conditions could have been significantly different.

More often today, design consultants are being asked to do original market studies to determine the specific property's actual parking needs. This involves creating a recommendation for adapting the zoning requirements, petitioning for a variance and waiver and adding or deleting parking as needed to optimize the use of the space. Accepting the existing zoning code and land-use standards can result in a skewed demand calculation that ultimately leads the structure to be over-sized and more costly than necessary or under-built and not supporting the primary use adequately.

4. Additional Service Needs. The addition of retail space, even general in function, creates the need for fire-separation requirements to meet today's building codes. Until 2003, these requirements were even more significant, as they required that the entire structure to be classified as enclosed parking when retail spaces were available on the first floor. Later editions of the IBC, however, allows mixed-use applications in open parking structures if a fire separator is provided.

Vertical separators can be provided by masonry block wall or concrete walls, either cast-in-place concrete or precast concrete. Horizontal, between-floor separation can be achieved with precast concrete double tees or cast-in-place concrete, either of which can provide a 2-hour fire separation. For situations that require a 3-hour rating, added concrete cover provides sufficient protection.

Providing retail space also impacts the mechanical and electrical services needed in the structure and their accessibility will impact the design. Impacts created by restaurant applications can be more challenging, particularly if they were not anticipated as the design was created.

Restaurants will require grease separators and flues for ovens and grilles. This piping may require penetrations in the structure and can also impact spacing and layout, if the pipes are run up through the structure. This requirement can become an issue if it

Many owners are trying to disguise the appearance of their parking structure to help it blend with the surroundings. The rich tradition of masonry architecture in Fort Collins, Colo., provided the inspiration for this 900-space parking structure, which includes 15,000 square feet of retail on the first floor. Engineer: Walker Parking Consultants

is not considered as soon as the restaurant's needs are known.

5. Sustainable Elements. Sustainable design and adherence to qualities set forth in the Leadership in Energy & Environmental Design (LEED) program administered by the U.S. Green Building Council are becoming dominant factors in building today, and that extends to parking structures. Even if the projects are not submitted for LEED certification, many developers are following those guidelines when economically feasible, as they understand the benefits that can be achieved over the life cycle of the structure.

Precast concrete can help to achieve LEED Certification and contribute to sustainable goals in a variety of ways. Some of these include recycled content, local manufacture, habitat protection, green-roof support, heat-island mitigation, waste and run-off water management, and innovative use of materials. For specifics on options, see the accompanying chart.

One method that aids LEED certification is to use specialized treatments for the top level or roof of a parking structure to minimize the heat gain (albedo) caused by absorption from the sun shining on the exposed roof all day. Concrete is light in color so will re-

The 325 space parking structure, at 915 Walnut in Kansas City, MO, features a 16,000 square feet rooftop garden. The garden serves as a key selling point for the adjacent condominiums and provides residents with a safe, fun, and beautiful area for walks, picnics, or just to enjoy the outdoors. Engineer: FDG, Inc.

flect more light than is absorbed, particularly if white cement is used.

Another way to mitigate this gain that is growing popular is to install a green roof, which also provides benefits in adding vegetation and creating additional user amenities. Solar panels also are being installed more often, as they can generate enough electricity to run the parking structure lighting. Although the solar panels absorb more heat than the roof, the heat energy is converted into electricity which is a more important benefit than the heat island effect. (For more on green roofs, see the Sustainability Insight article starting on page 16.)

6. Lighting Design. One factor in maximizing LEED points unrelated to the structural shell is the choice of lighting fixtures. Because energy conservation is such a significant part of LEED consideration, this specification has become a much more important portion of the parking design.

In the past, most parking structures relied on high-pressure sodium, or metal-halide fixtures. These options are not energy efficient enough for today's designs. They are being replaced with new technologies, such as fluorescent lights with electronic ballasts, which use 40% less energy for an equivalent number of footcandles. Another option is induction lamps, in which the fluorescent bulbs have no electrodes and use a magnetic field to ignite the phosphorous in the bulb, so they last up to three times longer than a typical fluorescent lamp. Another option is light emitting diode (LED) fixtures in which many small silicon chips are provided in a housing and glow when an electric current is passed through.

These newer fixtures are more expensive than traditional lighting, which makes owners hesitant to use them. However, they can provide a 100,000-hour life, which significantly decreases costs over their life span. Energy consumption comprises 85% of the life-cycle cost for lighting in a parking structure, so the payback in investing a few hundred dollars during initial fixture selection pays back its cost rapidly.

In most cases, it is recommended that fixtures should be considered to offer a 25-year service life to calculate their replacement needs. By that point, gaskets will be wearing out and lenses start to yellow, and replacing them is more cost-effective than continuing to maintain them.

7. Maximizing Daylight. In its efforts to minimize energy costs for lighting, LEED places a strong emphasis on maximizing the use of daylight. This can create challenges for parking structures, which don't lend themselves easily to providing atriums or skylights that can draw light into the structure.

Lite walls, which are interior walls that have rectangular openings provided in them, can aid this process when appropriate. These structures also provide more visual connection for users, which enhances safety and their level of comfort in the structure. The use of daylight sensors, which automatically turn off lighting when daylight is sufficient, also can reduce costs while ensuring illumination levels are appropriate regardless of weather conditions.

A key way to bring daylight further into the building is to create courtyards or light wells into the center. These, of course, take up space that could be devoted to parking spaces, so this design proposal requires careful consideration.

Walker recently provided this design for a four-bay, four-level parking structure for the National Renewable Energy Laboratory in Golden, Colorado. Needless to say, they were amenable to using as much daylight as possible in their own facility. But to accomplish that took special consideration of the layout.

Typically, daylight can be considered to penetrate about 60 feet into a building, or about the width of one bay, and this structure was to be 240 feet wide. That meant the middle 120 feet would have no daylight. To avoid this, the structure was split into two with a 12-foot light well down the center. This brought a minimum of 90 footcandles of daylight to the lowest level of the four-story structure, providing lighting to all areas all day. Occupancy sensors keep lights turned off entirely most days. The project now is in its final design.

8. Aesthetics. The architectural style desired for projects varies widely and typically is driven by its location. Influences can include nearby buildings, so the new structure will complement the surrounding neighborhood, or the owner's desire to make a specific statement with the structure, such as to serve as a gateway introduction to a campus of buildings.

Providing a light well at the center of a parking structure can bring daylight into the center of a wider building, minimizing lighting needs during the day, as in this example at Wells Fargo Financial in Des Moines, Iowa. Engineer: Walker Parking Consultants

Some owners are looking for a highly functional, unremarkable appearance that offers a low-cost way to provide support for other buildings' users. Others want the parking structure to hide its purpose and resemble commercial buildings or storefronts, adding elaborate finish treatments, window details and other amenities.

One treatment that is gaining ground in all types of aesthetic treatments is a desire to reduce light pollution, or the illumination that spills over from the parking structure into the surrounding environment. Architectural mesh is being used more often to dampen this spillover and to provide an aesthetically pleasing appearance. Reducing light pollution also can help in achieving LEED points.

An expert source for more information about achieving this goal with parking structures is the International Dark Sky Association (www.darksky.org), which is drafting a model light ordinance for use by municipalities to help control light pollution. Minimizing this concern will help ensure the structure remains a good neighbor and reduces the chances that local officials will decide that legislation needs to be enacted to control it separately. ■

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