PLANNING FOR THE FUTURE

As the service life of parking structures lengthen, technology and demographic changes could impact the buildings' usefulness. Can they be adapted for other uses? Will they need to be?

— Craig A. Shutt

HIGH CLEARANCE
The Ash Skyline Plaza in Fort Wayne, Ind., which combines seven stories of parking with first-floor retail and some office space, created 15-ft clearance on the first level to accommodate a bank's drive-through window. Higher clearances make it easier to adapt levels to commercial needs. Photo: Coreslab.

As precast concrete producers find creative methods to extend the service life of parking structures, this added resiliency and prolonged life cycle could prove to be a double-edged sword. While durability decreases maintenance and operating costs, it could make the structure obsolete if parking supply exceeds demand, or supply is not located where needed. With many technological advances and generational mindsets offering the potential to alter people's relationships with their automobiles, the industry is considering whether it needs to adapt, and in what form.

"Conversations about the future need and format of parking are not yet prevalent, but interest in these ideas is growing," says Anne Ellis, founder and CEO of Ellis Global in Washington, D.C., an AEC (architecture, engineering, and construction) technology and innovation consultant. "The conversation about adapting parking facilities to future needs currently is taking place among thought leaders rather than early adopters. In large part, that's because it's still unclear what trends will predominate and shape the future of parking."

The variety of trends coming to the fore makes it clear that assumptions about transportation, especially for short distances, are evolving, notes Sanjay Pandya, a parking practice builder and senior project manager with Kimley-Horn, a planning consultancy in Pleasanton, Calif. These trends include the steady movement of people into city centers, millennials' lessened interest in owning a car, the growth of car-sharing services, and cities putting more emphasis on pedestrian activities and providing and encouraging more public transportation, including light rail.

ADAPTING SPACES
The RWJ Fitness& Wellness Center in New Brunswick, N.J., includes levels of parking above and beside the commercial and retail space. Such designs offer potential for later adaptation to other uses if they are designed for that flexibility and future trends reduce parking demand. Photo: TimHaahs.

MOVEMENT TO URBAN CENTERS

"There has been a mass migration from suburbia to urban centers," says *The Parking Professional* magazine. In 2013, 2.3 million more people lived in metro areas than the previous year, according to U.S. Census Bureau data.

"The shift in population to America's metro areas has been increasing since 2010 with the economic recovery," says Jim Lewis, director of sales for architectural façade systems of Clark Pacific. Even so, suburban areas remain dominant, aided by people in rural areas moving to suburban centers. "America remains a largely suburban nation," according to a 2016 report by the Urban Land Institute.

The key lies in demographics, as those moving to urban centers are young professionals and baby boomers, who want easy access to entertainment. The growth of ride-sharing services, public transportation, and an emphasis on pedestrian access has lessened the need for them to own cars. Millennials have been less likely to obtain driver's licenses than previous generations, and they take fewer and shorter car trips, using alternative means of transportation. "Driving is not a social activity, which lessens their interest when there are other options for transportation." says Lewis.

The rise of transportation network companies (TNCs) has dramatically expanded the number of people who leave their cars at home and use ride-hailing apps to move short distances. At Dallas-Fort Worth International Airport in Texas, for instance, parking revenue was up in the first six months of the current fiscal year compared to last year, but it was nearly $4 million lower than projected, in part because of TNCs, according to Jenni Bergal at Pew Center.

FUNCTION DISGUISED
The new parking structure at Baylor University in Waco, Texas, features a façade design that disguises the building's function and smoothly blends in retail space. Adapting parking structures for future uses will require adapting exteriors to reflect those purposes. Photo: Carl Walker, a division of WGI.

AUTONOMOUS CARS' IMPACT

A significant game-changer could be the autonomous car, which dominates auto headlines today. Self-driving cars might not only drive passengers to a destination, they might then drive themselves away to be parked at a far location, explains Ellis. That could drastically change parking needs at large-volume sites such as airports and congested theater or entertainment districts.

"If drivers don't need parking in close proximity to their destination, which is often in congested areas with low supply and sky-high pricing, they might choose to use their own vehicle, which self-parks to transport them to events rather than take TNCs or public transportation," Ellis says. In essence, their own car, in which they're comfortable, could be used as a taxi service, parking miles away at a low rate and returning as soon as needed.

That could also change the type of parking needed. "If you are parking cars that self-park and can be retrieved automatically, you can use a more efficient parking layout than one requiring people to have access to the cars," Ellis points out. Self-parking vehicles can be parked closer together, and stair towers and elevators facilitating pedestrian access may not be necessary. "Designing parking structures for machines will be different than designing for people who control machines."

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Some technology analysts predict subscription-based, on-demand vehicles will bring about the end of individual car ownership. But that scenario was challenged in a recent survey of building owners, developers, analysts, planners, designers, builders, and code officials conducted by Ellis Global for PCI. "Automated vehicles will be the death of mass transit," said one respondent. "We will need more parking, not less, as vehicles diversify in type and size."

The true unknown is what one respondent called the "personal connection" that people have to their cars and their personal spaces. "People use cars for storing and transporting things," notes

Photo: Carl Walker, a division of WGI.

Ellis. "They want to use their own car seats that they know were installed competently and by someone they trust. Individual modes of transport will be with us for a long time."

Some point to other examples of technological advances that were predicted to generate rapid changes in society, such as electronic books that would eliminate printed books. The tactile sensations and pricing, among other factors, have kept e-books from dominating the market. Likewise, despite much talk of the "paperless office," paper producers are still producing products.

Certainly, the recent Apple Park project in Cupertino, Calif., indicates the current state of requirements, regardless of new technologies. Apple's new precast concrete facility provides 11,000 parking spaces for 14,000 workers, because the city requires that many in its employee/parking ratio. Apple built more square footage to park employee cars than for office space. "Does that make sense for future needs?" *Curbed* magazine . "If companies don't require that much parking space, what will they do with it in the future?"

In some instances, companies are building their offices atop parking structures, using it as a base when footprints are tight. The Celgene headquarters in Summit, N.J., is one such project to take that approach, adding columns into the lower parking levels to support the steel-structured office levels above. (For more on this project, see the Overview article in this issue.) For such projects, being able to adapt those lower levels for office or commercial space in the future may provide significant benefits.

ADAPTING TO NEW USES

Mixed-use projects that incorporate parking levels especially need to consider future needs. Building flexibility for other purposes into these spaces could keep them useful and generate revenue that continues to keep the project successful even if parking needs decline. But can parking structures, with their unique design profile, durable construction, and specialized functions, adapt to other uses? Some say they can be adapted, but it will be easier if that need for adaptability is acknowledged upfront.

Other benefits to adapting unused parking space include the increases in property value if changes create higher value land usage, tax credits, and other advantages gained from sustainable adaptability rather than tearing down structures, and the added revenue that can be generated within the structure if new services are added—even minor adaptations such as turning one level into a refueling station and car wash, as many of the consolidated rental car facilities at airports now include.

"The tactics needed to adapt the function of parking structures are not a new design and construction consideration. These tactics have been employed previously," Ellis says. "But what is new is the concept of adapting for a future impacted by autonomous vehicles. There are many things that can be done to accommodate future scenarios."

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Consider the electric vehicle. Many parking structures have added electrical infrastructure, she notes, to charge electric vehicles and to access solar panels that generate electricity to run the facility and more. Some are adding conduits, floor height, and space for future electrical needs.

Warehouses have long been adapted for residential units, notes Lewis, because their basic structure is durable and appealing, which is similar to what parking structures can offer. But the adaptations will be more extensive. "Substantial changes are needed to convert a space built for cars into one for humans, whether for housing, office space, or retail," he says. "But it can be done if they are designed for that adaptation from the start."

LMN Architects, for example, has announced plans for the 1.2-million-ft^2 skyscraper at 4th and Columbia Street in Seattle, Wash., that will include 840 residential units, 160,000 ft^2 of office space, 30,000 ft^2 of retail, and 400 parking spaces. That includes four floors of aboveground parking that can be converted to residential units.

"I feel we do have the responsibility, if the parking uses do change, to design to be able to adapt to that change," John Chau, a partner at the firm, told Wired.com in November 2016. The project is still being reviewed and won't open until 2019 or later.

Aiding this adaptability function for the project is that Seattle has already changed its parking minimums to reduce space requirements for projects near public transportation. More such changes by cities will be needed to encourage design changes if car usage drops and many of those in use remain on the street or park much further from the actual destination, eliminating the need for nearby parking for those vehicles.

Designers at Arrowstreet in Boston, Mass., also have considered the impact of new technologies on parking designs. By the time parking structures being permitted today are built, self-parking cars and autonomous vehicles likely will be a reality, notes Amy Korte, design partner. The firm's planners are forecasting a two-pronged approach to adapting to design needs.

PHASED EVOLUTION
Designers at Arrowstreet in Boston anticipate two phases of changes to parking structures in the coming years as autonomous vehicles become more popular. Renderings: Arrowstreet.

Phase 1, until 2025 or so, will include adjusting upper floors to create "hyper-efficient" parking layouts for autonomous cars while leaving lower levels more accessible. Phase 2, beginning in about 2025 and continuing for 10 years, will allow adaptation of upper floors to other uses, while lower floors will be re-laid out for autonomous cars that recharge as they wait for use. (For more on these concepts, see the renderings.)

Standalone projects offer different challenges than mixed-use projects that offer parking, Korte notes. "Standalone projects must evolve to address new technologies impacting user and fleet requirements. Most likely, they will be built more often on the outskirts of town, where cars will go to recharge until needed."

Arrowstreet is working on a design for a mixed-use structure in Boston's Seaport district using these concepts. The design for the residential/hotel/retail/parking building, which was permitted in 2014, was reengineered to adapt to anticipated changing parking needs. The initial plan, calling for three levels of below-grade parking for 643 cars, was revamped to offer one story of parking with a 15.5-foot ceiling. That height will allow stackers to be used, creating space for between 200 to 460 cars in a more efficient design.

"The goal is to design with short-term flexibility with higher ceiling heights to accommodate stackers if needed, or allow adaptation to other uses," Korte explains. The project is planned for completion in 2020. The changes saved costs, she adds, as it will save construction time and material by requiring fewer levels to be built. "We don't anticipate this change in design will add costs."

Their design already has been adapted. The plan provides space on the first floor to serve as pickup and queuing area for cars, but it's been redesigned to add space. "We realized there would need to be more space based on the multiple needs for parking in the mixed-use building." Currently, the plan is to use valets to transport cars to parking spaces.

WAYS TO ADAPT

Parking structures feature unique design elements that challenge their ability to adjust to other uses. But those restrictions aren't overwhelming. Some of the key areas to examine when considering future uses for excess parking spaces, according to Pandya, include:

- **Higher floor-to-floor heights.** By increasing ceiling heights to 15 ft on the first floor and 12 ft on upper floors, buildings can meet needs for commercial/retail space and ceiling heights of 9 ft and higher for office space with heating, ventilation, and air conditioning (HVAC) equipment added.
- **Removable interior ramps.** Floor framing can be designed to allow ramps to be easily eliminated to separate floors more effectively.

- **More accessibility.** Pandya suggests adding a 30-ft-wide light well between parking bays to provide space for future stair and elevator towers within each level. Placing perimeter stair and elevator cores outside of the building's footprint can facilitate removal of these structures, if needed, so better entries can be created.
- **Support for vertical expansion**. Columns, walls, and foundations can be designed to allow new levels to be added for residential or commercial space.
- **Higher floor loading.** Residential and commercial space requires higher design live loads than parking structures. A typical parking structure has a minimum-allowed live load of 40 lb/ft^2, but other uses might require 50 to 100 lb/ft^2, Lewis notes. Taking these considerations into account during the design phase can add flexibility for later adaptations.
- **Level flooring.** Parking structures typically offer sloped floors to aid vehicle circulation and drainage. This slope can be mitigated by providing additional floor drains.
- **Capabilities for new services**. Plan for future electrical services, HVAC, plumbing, and fire-protection services, including sprinklers. Allowing for electrical and mechanical chases that will accommodate duct work and cabling will make adjustments easier to any function, Pandya explains.

Many precast concrete producers report already being involved with projects that incorporate some of these tactics for adaptations. More than half, for instance, reported to Ellis Global that they have worked on projects in which higher live loads and increased floor-to-floor heights were provided. Other features in projects they have been involved with included flat floors, ability to reconfigure spaces, removable external ramps, and transformable façade systems. For more details, see Chart 1.

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At the same time, precast concrete producers indicated they have worked on projects that incorporated new technologies that are growing in popularity. More than half, for instance, said they have worked on designs that provided upgraded electrical capabilities to recharge electric vehicles. More than half also said they have assisted with designs to incorporate additional parking technologies of various kinds. Other high-scoring technologies included automated car-parking systems and autonomous parking systems designed for driverless cars. For more details, see Chart 2.

Although these changes may sound daunting (that is, expensive), they all can be accomplished without drastic alterations to plans. Precast concrete producers estimate that the alterations to structural designs would add about 10% to 15% to current pricing. "A low price point is important, because owners and developers don't want to boost their budget without some idea that the premium will pay off down the road," Ellis notes.

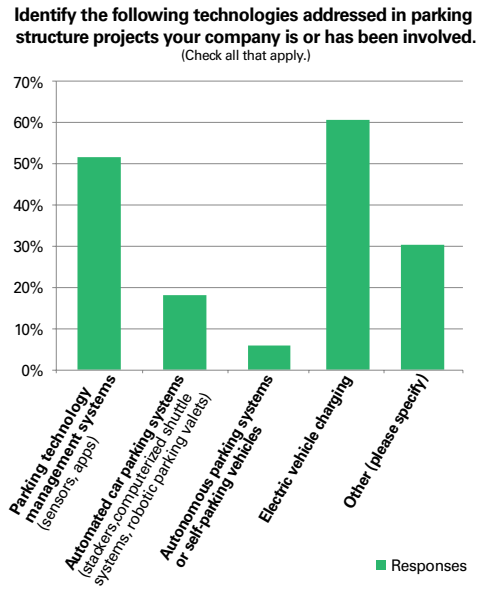

CHART 1. PRODUCERS INVOLVED
Precast concrete producers reported they had been involved with parking structure projects that incorporated a variety of new technologies, according to a recent survey by Ellis Global for PCI.

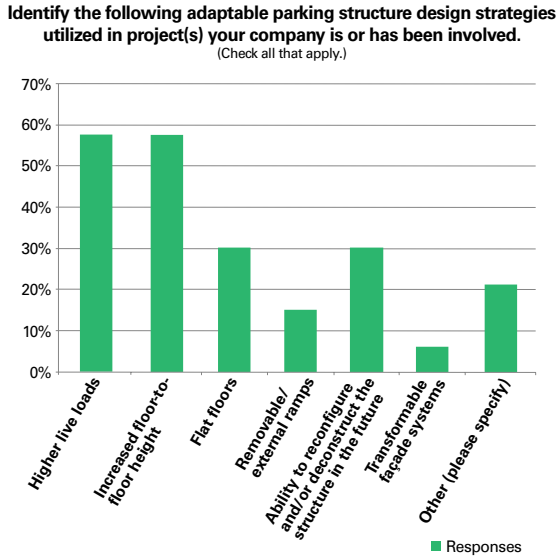

CHART 2. FEATURES INCLUDED
Parking structure designs often include features that make them more easily adapted to other uses in the future, according to respondents in a recent survey by Ellis Global for PCI.

FORECASTING CHANGE

The problem facing developers is that they must commit today to plans for a future that is rapidly evolving in ways no one fully comprehends yet. "There is neither clarity nor consistency concerning the potential impact of the autonomous vehicle on the built world," Ellis says.

BLENDING SPACES
The Zaragon West student resident in Ann Arbor, Mich., includes parking for 40 cars on levels two and three, behind a façade that blends with the rest of the building's residential nature. Such placement can add benefits when adapting space to other uses, if the parking levels were designed with that potential. Photo: maconochie photography.

That creates risks for developers. "Our buildings may be designed for a design life of 50 years or more, the investment period in the rate-of-return analyses may be shorter—7 to 10 years is common," she explains. "Cities and industry need to begin looking at ways they can smooth the connection between technology and those looking to build to suit future needs."

Regulatory and enabling infrastructures must be adapted and adopted to ease the path forward for those in the construction industry, she says. "AVs [autonomous vehicles] will require changes to regulatory standards, including building codes, legal, and insurance frameworks. These changes will take years to develop and adopt across many building jurisdictions in the United States."

That means reviewing current standards and generating an industry consensus and voice, with guidance and standards on matters outside current industry norms, she says. Cost information on each design alteration and more information on how they can fit into the existing International Building Code are required.

"The best people to understand how to adapt our cities, infrastructure network, and buildings to accommodate any changes are the planners, designers, builders, and regulators. They need to be part of the dialogue. Technology people seem to be discussing it, but few in the design industry are looking at it closely yet. I believe the first impact that autonomous cars and demographic trends will have will be seen on parking structures, but we don't know where and how much that will be."

These trends will evolve in stages, initially with the early adopters followed by a rise in popularity that makes these changes grow. Whether that will follow the trend line of growth in hybrid and electric cars, or be slower (or faster), can't be determined. "It will happen step by step, but how fast those steps come could be surprising," Ellis says. She anticipates the initial deployment of autonomous cars that will begin to impact parking structure uses will come in the next 10 years.

Key indicators may provide clues to the force of the impacts, she notes. "Look to what the tech giants—Apple, Google, IBM, Tesla, etc.—are building and what technologies they are investing in." The caveat there, as seen at the new Apple headquarters, is that even large technology companies are restricted by what local zoning and building ordinances require, especially if they lag behind even the most recent codes.

She also suggests keeping abreast of TNC investments, as well as news of improvements to electric vehicles and battery advancements, which could enhance electric car appeal. City, state, and federal officials, including state departments of transportation, also need to be part of the discussion, to encourage changing policies and increasing incentives to prepare for the future as developments arise.

One good sign, as shown in the design concepts by LMN, Arrowstreet, and others, is that awareness of the potential for adaptive reuse has begun to appear and make its way into conceptual plans. "Awareness of these concepts is growing among planners and owners," says Ellis. "Now, it has to make its way to architects, engineers, contractors, and suppliers. The diversity of A/E/C perspectives will help ensure the approaches are constructible and cost-efficient."

Those conversations should include precast concrete producers, she stresses. "Precast producers know how to be efficient and effective, and they are involved in a large majority of the decisions on parking structures. They know how to meet owners' needs and create efficient designs. We need more discussions about what those needs are and what the future holds for parking structures during the service life of those being planned today. We need to help our clients plan and prepare for the future."