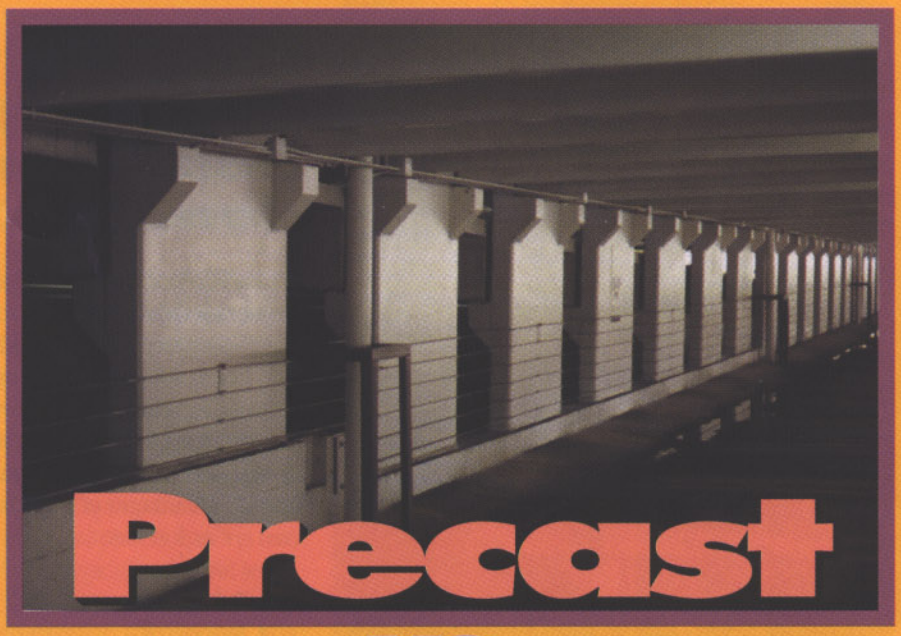


Precast vs. Cast-in-Place

How do they compare?

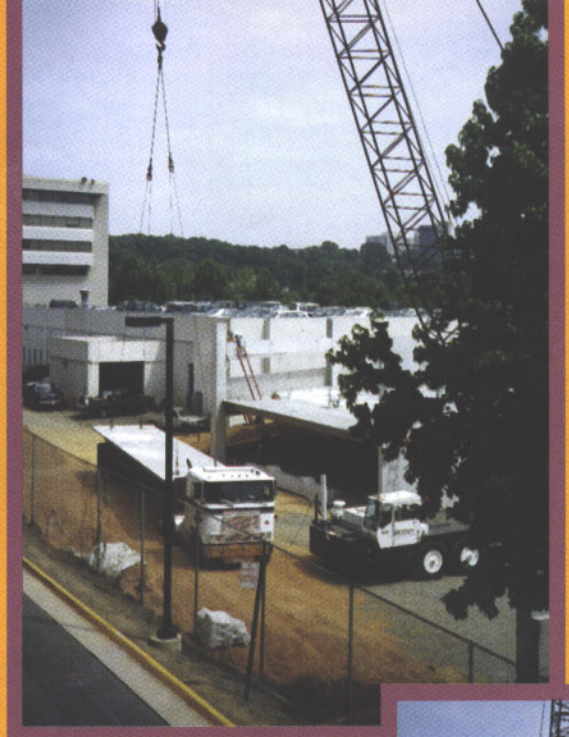
BY GARY CUDNEY, P.E.

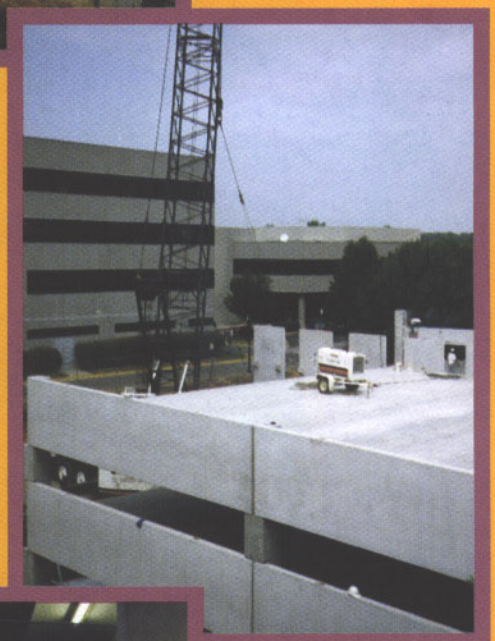
The two primary structural systems used for parking structures today are precast concrete and cast-in-place (CIP), post-tensioned concrete. Carl Walker, Inc. projects generally tend to be equally divided between the two systems. Our projects typically begin with an options analysis of various functional layouts and a comparison of structural systems. This article demonstrates the type of analysis and considerations that go into the selection of a structural system.

Photographs by Gregory Tinius

Precast, Prestressed Concrete

The precast structural system consists of plant-fabricated columns, shear walls, beams, and double tees which are trucked to the job site and erected. The double tees which make up the floor system can be either pretopped or field topped. A pretopped double tee will be cast entirely at the plant and the top surface of the tee becomes the driving surface. With the field-topped system, a 3-inch-thick, cast-in-place concrete topping is applied over the precast tees in the field. Typically, double tees will vary from 24 to 32 inches deep, and are 10 or 12 feet wide with a stem spacing of 5 to 6 feet. The pretopped system can generally be constructed quicker and at a slightly lower cost than a field-topped system. The advantages of the field-topped system are less floor vibration, positive drainage is more easily achieved, and lower initial life-cycle maintenance cost for the joint sealants. In general, the advantages and disadvantages of a precast system compared to a cast-in-place, post-tensioned concrete system are as follows:



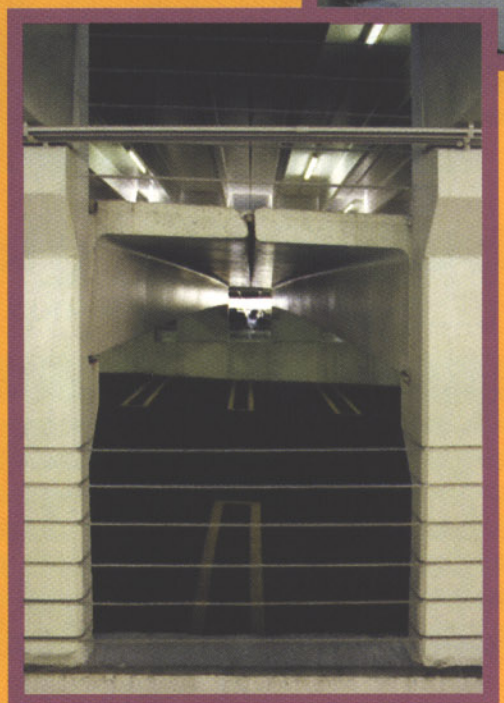


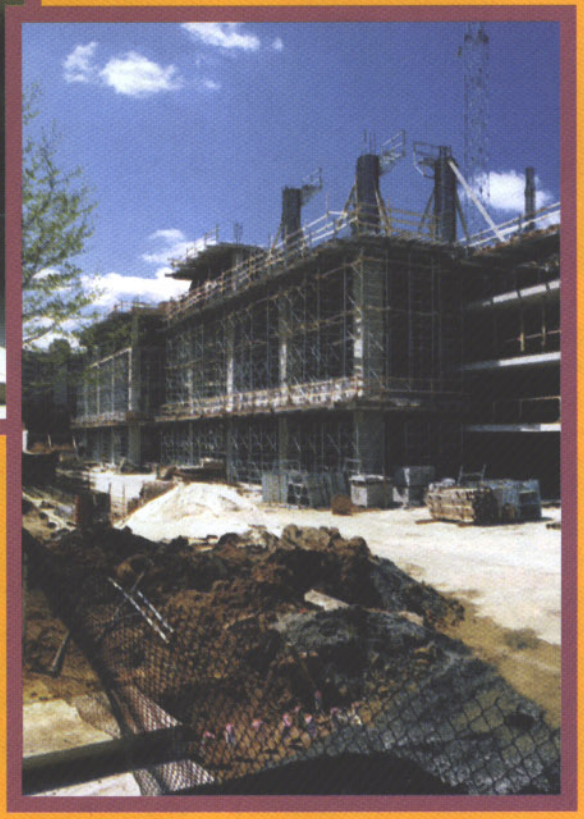
Precast Advantages:

- Slightly shorter on-site construction period.
- Potential for a slightly lower initial construction cost, especially for the pretopped system, if standard sizes and repetition of structural and architectural components are used.
- Long-span construction with typical column spacing of 30'.
- More adaptable to winter construction.
- Potentially better concrete quality control in plant conditions.

Precast Disadvantages:

- Higher maintenance costs; precast systems require a caulk/sealant joint between double tees in order to keep water from leaking. These joints, which are typically located at 10'-0" to 12'-0" on center, create a greater potential for leaks and will need to be replaced approximately every eight to ten years.
- A perceived lower headroom and less desirable lighting distribution and signage visibility due to the depth and spacing of the double tee stems.
- Wind and seismic loads are resisted by shear walls or shear frames. The shear walls/ frames are located on the exterior facades, which affects the architectural appearance, or at the interior, which reduces visibility and openness and can reduce the number of parking spaces.
- Drainage profiles for non-ramping floors are typically flatter than those obtained in a CIP structure. This is due to limits on the amount of warping of the precast without excessive cracking of the tee flanges.
- A longer shop drawing review and fabrication schedule.
- Many cities do not have local precast concrete subcontractors.





PHOTOGRAPHS BY GREGORY TINIUS

Cast-In-Place, Post-Tensioned Concrete

A cast-in-place, post-tensioned concrete system is constructed by pouring concrete in forms at the job site. This system utilizes a one-way, post-tensioned slab that is supported by long-span, post-tensioned beams. Typically, these beams are located at the column lines and are approximately 14 to 18 inches wide and 32 to 36 inches deep. The advantages and disadvantages of this system compared to precast are as follows:

CIP Advantages:

- Monolithic construction, so fewer joints.
- Easier to achieve positive drainage.
- Post-tensioning compressive force reduces cracking in slabs.
- Flexible framing layout to fit the site with typical column spacing of 20 to 24 feet.
- Wind and seismic lateral loads are resisted by frame action and distributed into the foundations through the columns, eliminating the need for shear walls.
- Perception of higher ceiling and more openness.
- Better lighting distribution and visibility of signage due to fewer beam soffit members.
- Lower maintenance cost.
- Construction can often be performed by local subcontractors using local labor and material suppliers.

CIP Disadvantages:

- Slightly longer on-site construction period.
- Less adaptable to winter construction in northern regions.
- Construction quality more difficult to achieve.

Durability and Maintenance Features

When properly designed, detailed, constructed, and maintained, the durability of the CIP, post-tensioned and precast systems are very similar. In both systems, elements such as expansion joints, joint sealants, and exposed painted metal connections and railings will require preventative maintenance, and some repair. However, due to the increased number of sealant joints, the precast system typically requires more maintenance than the cast-in-place system.

In summary, both precast, prestressed concrete and CIP, post-tensioned concrete structural systems are cost effective and durable. The ultimate decision on the selection of the structural system for a project comes down to the following considerations:

- Owner preferences.
- Requirements of the structural components—lateral load systems, foundations, flexibility of the framing, ramping, expansion joints, site dimensions, etc.
- Maintenance considerations.
- Aesthetics, facade treatment.
- Openness, visibility, and lighting.
- Economics, including first cost and life-cycle maintenance costs.
- Construction schedule.
- Ability to utilize local labor.
- Availability of competitive contractors. P

Gary Cudney, P.E., is president of Carl Walker, Inc., a leading national parking consultant with offices in Atlanta, Chicago, Dallas, Denver, Philadelphia/Northern New Jersey, and headquarters in Kalamazoo, Michigan. Cudney has 15 years of experience in the parking industry specializing in the design of new parking structures and parking planning. Carl Walker, Inc. is also a leader in the restoration engineering of parking structures, plazas, and concrete structures.