Steel Framing Helps Ease Parking Congestion

More Steel-Framed Parking Structures are Evident Every Day

When the need arises for a multi-story parking building—by municipalities, airports, hospitals, downtown stores, colleges, etc.—parking authorities find that interest is focusing increasingly on the steel-framed, open-deck parking structure.

John Fujiwara, president of Des Man Parking Associates, New York City, which specializes in design of parking structures, says: “While we’re impartial as to choice of construction materials, steel certainly has its place where conditions warrant it and can often bring substantial economies to a project. We’ve designed three garages in Portland, Maine, and steel framing’s speed of erection made it the choice because of the area’s short construction season.

“We also used structural steel in a 530-car garage for the St. Francis Medical Center, in Trenton, N.J. Here, neighboring homeowners demanded an attractive structure that screened the parked cars from view yet didn’t appear out of scale with the surrounding residences. Our design resulted in a handsome, five-level garage with a bronze-tone metal grille screen that has pleased everyone.”

A strong trend to the open, steel-framed structures is reported by Joseph F. Mulach, Jr., chairman of Mulach Parking Systems, Bridgeville, Pa., a leading design/build firm specializing in parking garages. Mulach states that a new development is their placement in dual-occupancy buildings, featuring a garage either above or below commercial or residential space. The firm believes that a steel

Designed by Seymour Gage Associates, these steel-framed parking structures embody different features. At top, the Scarsdale, N.Y. commuter parking building can handle 500 cars, provides a bridge to the railroad station over adjoining tracks. At bottom, in Binghamton, N.Y., the two upper, steel-supported levels were added 20 years after the original building was erected, to offer 200 more car spaces.
frame with post-tensioned concrete slab floors offers the maximum durability which owners and developers are seeking in multi-level parking buildings.

Says Seymour Gage, of Seymour Gage Associates, architects/engineers in White Plains, N.Y.: “We’ve already designed 25 steel parking structures, including the tallest ever built in steel, an 11-story, 1,386-car unit here in White Plains that cut costs $800,000 when it switched from precast concrete to steel. Now, we’re also working in the retrofit market, taking old steel facilities and bringing them up to date functionally and aesthetically. Europe, incidentally, is way ahead of us in erecting steel-framed garages. National Car Parks, in England, has constructed 800 garages, with a substantial number in steel.”

Three Factors . . .

According to parking professionals, three significant reasons account for the trend:

• Generally, steel-framed parking facilities are now more economical to construct than competitive framing systems, although cost is always dependent upon varying market and local factors. This economy takes on added importance when considering that the frame, foundation and floor slabs normally constitute 60 percent of the costs of these buildings.

• Steel’s potential as a prime structural material for parking purposes really commenced in the mid-1970s. That’s when building code authorities permitted exposed steel construction, at first for small, low-rise garages, then for larger and taller facilities. The three major code organizations—Building Officials and Code Administrators, the Southern Building Code Congress and the International Conference of Building Officials—all approve exposed steel framing, and most regions, states and municipalities follow their guidelines.

• Thirty and 40 years ago, the image of steel parking structures was strictly utilitarian . . . i.e., buildings that performed their function with little or no regard to aesthetics. Now, their appearance is second to none, the result of architect designs and the ability of steel framing to be combined attractively with a variety of exterior materials.

Essentially, the system is based on a clear-span, structural steel frame with girders spanning transversely 55 to 64 feet apart to provide maximum flexibility of layout. The steel most frequently employed is a high strength/low alloy, columbium-vanadium steel, ASTM A572, grade 50, with a yield strength of 50,000 psi and a tensile strength of 65,000 psi. Another commonly-used construction steel grade is A36. With 320 square feet considered the average parking space size, approximately 1 to 1¼ tons of framing steel are used to support each space, 7½ pounds of steel per square foot.

The key durability factor in a multi-story, open-deck parking structure is the floor deck system. Proper slab design is the best assurance of an extended service life; otherwise, the con-
crete floor slab can literally be the weakest element in the overall structure. Three popular options are now available.

One is the cast-in-place, concrete post-tensioned slab, 5” to 6” thick. It encompasses tendons of steel wire sheathed in plastic and post-tensioned in both directions to offer the closest to a crack-free slab system. Post-tensioning compression tends to minimize or close shrinkage cracks in the concrete, thus limiting the entrance of chloride-laden moisture from winter application of deicing salts.

A second deck system is a cast-in-place, reinforced concrete slab, usually 4½” or 5” thick, with steel reinforcing bars as the reinforcing agent. In snow/ice areas where deicing salts are heavily used, a minimum 5”-thick slab is often chosen to provide extra protective coverage against corrosion of the rebars.

Upand-coming in favor is the precast, prestressed concrete wideslab deck, 8’ wide and 2¼” to 3” thick, with approximately three extra inches of supplemental concrete added in an on-site pour. Ultimately, both thicknesses act as a composite unit.

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**Tips to Maximize Efficiency, Service Life . . .**

The following are proven practices to heighten the functional effectiveness and durability of steel-framed parking structures.

1. All concrete floor decks expand and contract with temperature changes, which are sometimes extreme over the course of a day. To minimize cracking, this movement must be accommodated. It’s best done by pouring concrete into independent deck sections, separated from each other by expansion joints or slip planes. Any movement that does occur is absorbed by the thermally-responsive joints and the flexibility of the steel frame. Volume changes in one slab will not affect adjacent areas.

2. Avoid having floor areas where water can collect into ponds. Deicing products will collect with the water and start the salt penetration process. To eliminate ponding, all deck surfaces should slope to drains; a ¼” in 12” minimum slope is desirable. Locate floor drains at the ends of the parking
The 510-car St. Francis Hospital garage, in Wichita, Kan., employs a vertical precast concrete facade to provide the open appearance desired for the facility’s security. So strong is the steel-framed structure, designed by Mulach Parking Systems, that it incorporates a heliport on its roof.

spaces to prevent surface water from draining over the framing members.

3. A related problem, common to any structure using improperly-designed concrete floor slabs is spalling—delamination, potholes, and other defects—traceable directly to corrosion of the reinforcing bars embedded in the concrete deck. The cause is penetration of salt from certain concrete aggregates and deicing compounds. The proven solution is to use epoxy-coated rebars, where the coating is fusion bonded to prevent chlorides from reaching the steel surface. Depending upon the deck system, these will mean an additional 15 to 25 cents per square foot premium (one percent or less of the entire project cost), cheap insurance for the added protection against concrete deck failure.

4. The University of Akron uses a weathering grade for all 1,000 tons of structural steel in its 1,270-car, five-level facility, built to help solve its campus parking problem. It also includes a weathering steel guard rail system. Although premium priced, life-cycle economies can accrue through weathering steel’s elimination or minimizing of painting.

5. Improved, longer-lasting paint systems are now available to help protect the structural steel against corrosion. Mulach Parking Systems claims a 15-year life expectancy for its paint process: a shot blast cleaning of the steel, followed by application of 2.5 mils of a high-solids, zinc-rich epoxy in the steel fabricating shop, then 2 to 5 mils of a high-solids epoxy polymide at the job site.
6. Those needing to construct a parking structure on a steep hill can emulate the 663-car garage for the Roanoke Memorial Hospital, in Virginia. On its 30° slope, located between two streets, the seven-story structure permits traffic to enter on the upper street, descend the multiple parking levels on a continuous ramp and exit onto the lower street. An elevator transports visitors directly from the parking levels to a pedestrian underpass, which provides a safe and weather-free route to and from the hospital lobby.

7. To increase customer security, Detroit’s 1,523-car First-Bagley garage designed each of four stair towers as entire grade-to-roof glass walls. Patrons using the lighted stairs can be seen from the outside, a popular visibility feature believed to hinder the incidence of crime.

8. Need more parking spaces in an all-concrete garage? Do what the City of Ann Arbor, Mich. did and add three steel-framed levels that straddle the existing, four-level structure and provide 388 additional parking spaces. Even more spaces are possible on the same frame, which was erected within the lot bounds of the existing structure. The City of Binghamton, NY, did much the same in a 200-space addition atop its three-level Collier Street facility.

9. Furthering a garage’s profitability is accomplished by setting aside the grade floor for store rentals, as does the 506-car Temple Street facility in downtown Portland, Maine. It makes available a 12,500-square-foot commercial area, with fire protection required only for the steel columns and beams surrounding this commercial level. A spray-on fireproofing provided a two-hour rating for these members.

10. From now on, design and construction of any parking garage should anticipate its use by a rising percentage of smaller cars. Some parking specialists project that an 8 to 15 percent increase in parking capacity will be needed for the compacts of the 1980s and 1990s. This increased capacity might be achieved through reduction of parking module size to fit shorter and narrower cars, painting stripes at a different angle, and improving traffic flow patterns to take advantage of the shorter turning radius needed by smaller cars.