Garage designs have changed over the years, using this adaptable material in a variety of ways.

Steel, A Perfect Choice for PARKING STRUCTURES

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MANY FINE GARAGES HAVE BEEN BUILT IN STEEL since the first parking structures were built in the early 1900s. Over the years, though, technological advances in construction materials and changes in parking methods have altered the way garages are built and designed.

Many, if not all, of the transient garages built before 1950 were designed as attendant-parked structures with short spans, generally with two to three cars to the bay. Many of the earliest garages were built of structural steel with short-span beams and poured concrete floors. Customers never saw the upper floors; cars were always parked by a valet who deftly maneuvered between columns to park the automobiles.

The early 1950s saw a transition to self-service parking, which reduced labor costs and provided quicker entry and exit. Owners also discovered that self-service parking structures could serve more cars by creating a higher turnover—and generate more net revenue—than attendant-parked facilities.

Mechanical garages also become popular in the late 1940s. They almost always were built with structural steel frames because steel provided the lightest way of building such frames. Mechanical garages consisted of an elevator that moved along a center core and with which cars could be moved up to shelves or platforms within the structure. These were simple designs that didn't require stairs or elevators for pedestrians. All that was

needed was an economical and lightweight frame, and steel satisfied these conditions.

Many of the earlier garages were configured with 60° angle parking, which required just 54- or 55-ft spans. However, the switch to self-service parking also led to the creation of garages with longer spans, going as high as 64 ft. This new approach to designing structures required new materials, and the parking industry went through a period in which steel parking became less common.

In the early 1960s, precast concrete garages started to come onto the scene. Precast concrete began to supplant structural steel as the predominant material for the construction of parking structures, followed by the twin tee garages which are prevalent today. Today, precast concrete continues to be the most common material for parking development, with about 45% of garages being built in precast concrete and 36% using cast-in-place concrete. In recent years, structural steel or some hybrid form has come to represent about 19% of the market. Although structural steel is not dominating the parking garage market today, in the right situation it can be an excellent choice.

In the early 1970s, steel parking enjoyed a mini-renaissance with the introduction of portable parking structures, which, again, were generally short-span steel parking facilities. They offered three-car bays, in the area of 28-by-30-ft grid spacing, and structural steel with flat precast concrete floor slabs. The steel elements could be bolted together, rather than welded, making it much easier to dismantle and move. Many of these garages started out as temporary structures that could be moved to other sites once they had accomplished their purpose, although some have not been moved and are still standing today.

The 1970s also saw the introduction of castellated beams, with hexagonal or round void areas in the web of the beam. This permitted the use of longer steel beams by lightening the weight of the structural element while at the same time maintaining its ability to carry the load. Although this approach is still in use, today more parking designers are using a hybrid of concrete and steel. This combination has been particularly popular for airport facilities, and has been used in at least four recently developed airport structures. For instance, JetBlue's new parking structure at John F. Kennedy International Airport in New York combines a system of a double steel center column, steel perimeter columns and long span precast twin tees spanning the beams between the columns on a shorter span. It lends itself to rapid construction, and because no shear walls are necessary within the garage, this approach offers outstanding visibility and is very secure. The JetBlue garage married the optimum floor surface with a flexible steel structure.

Before this, Portland (Maine) International Jetport built a garage of similar construction with precast twin tees and steel columns with the "H" frames. In the Portland garage, even the spiral ramp was constructed of structural steel, using the steel members as the floor supports on the columns over which the concrete slab was placed.

In addition to the design benefits steel provided in these structures, there are a number of additional advantages to steel parking, including speed of erection and the ability to add on to the structure for future expansion.

One example of this type of expansion is offered by the

This page: The JetBlue garage at the Portland (Maine) International Jetport uses a steel framework on the spiral ramp to support the floor slabs.

Opposite page: The transition to self-service parking in the 1950s led to structures that were more open and designers turned to steel to provide the longer spans this required.

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4th and Williams garage in Ann Arbor, Mich. The facility originally was developed as a two-module, cast-in-place concrete structure. When the city needed additional parking spaces, the solution was to expand the garage by adding exterior structural steel columns. Additional steel columns were put down through the middle of the garage to create new foundations for additional floors, which were built of structural steel erected over top of the existing garage. Architectural treatment on the garage exterior enables the painted steel to blend with the original garage. Through this creative use of steel, designers were able to solve what was originally considered to be an unsolvable problem.

While it's clear that steel presents a number of advantages to parking designer, it also creates challenges. For instance, fire codes sometimes restrict floor areas unless the steel is protected by either concrete coating or expensive intumescent paint to create fireproofing on the steel columns. The cost of meeting these code requirements can be prohibitive.

Maintenance is also a key issue; all parking structures need to be properly maintained. Just as a concrete structure cannot be left for years without maintenance, steel structures also must be protected from the elements, and covering concrete must also be protected and maintained. In a steel structure, it is a simple matter to remove and replace degraded concrete areas without affecting the structural frame of the building. And in structures in which steel members are exposed, it is easy to observe where maintenance is necessary and catch problems early—a luxury that isn't available with reinforced or precast concrete.

Finally, cost can have a huge impact on whether designers choose steel when creating new parking structures. Steel has not always been available at a reasonable price because of fluctuations in market conditions. For instance, if there is a lot of office building development in the area, the demand for steel can raise the cost to unacceptable levels. This is particularly true when the garage under development is a very large building with stringent fireproofing requirements.

Of course, no two situations are alike, and the decision whether to use steel, concrete, or a hybrid approach must be based on the unique challenges and opportunities presented by the individual project. However, in the right situation, steel can be an excellent choice when developing a parking structure. MSC