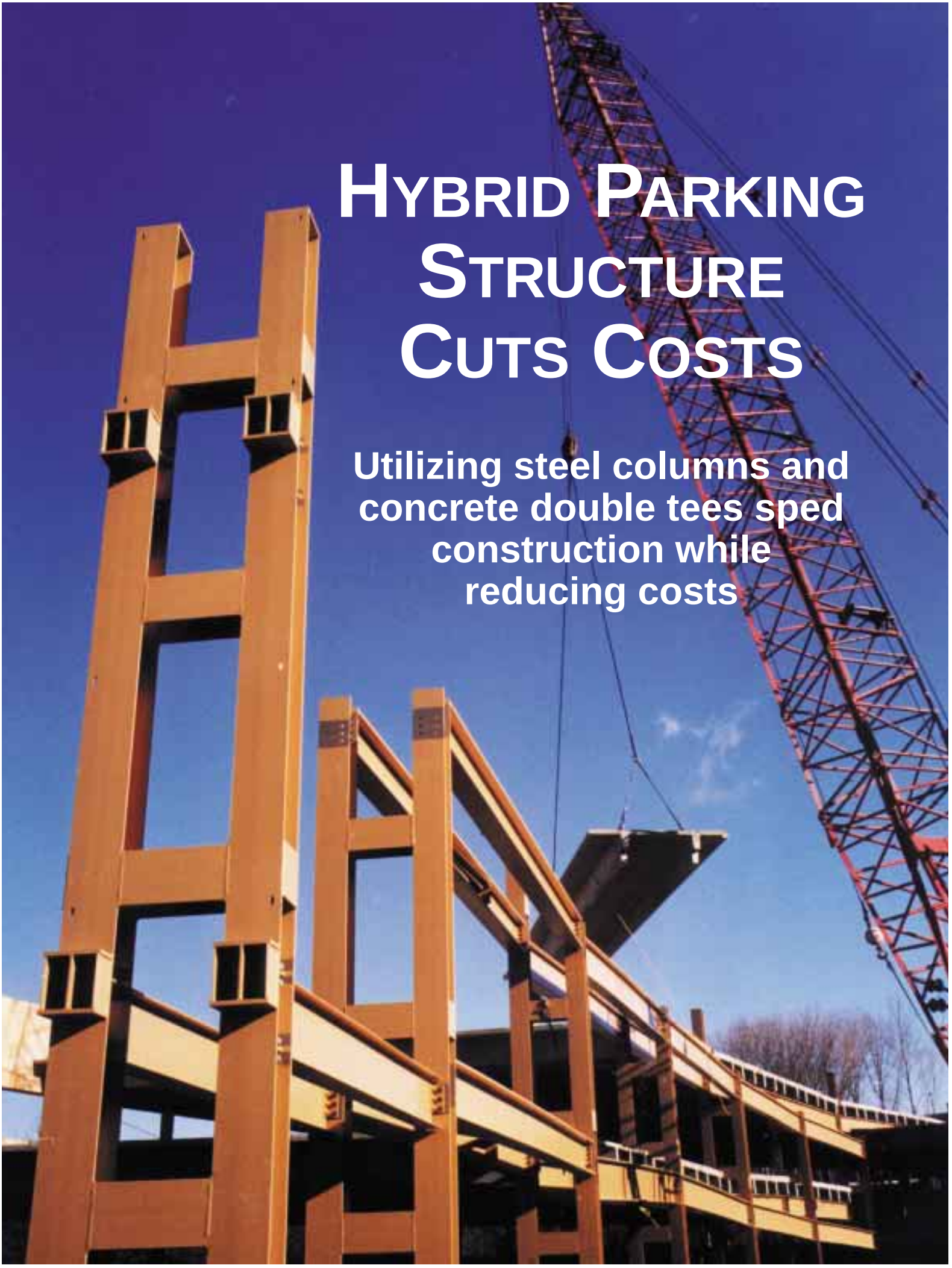

Hybrid Parking Structure Cuts Costs

Utilizing steel columns and concrete double tees sped construction while reducing costs

WHEN AT&T BEGAN DESIGNING A NEW OFFICE COMPLEX IN WARREN, NJ, for Lucent Technologies, a new company formed by a divestiture within AT&T, it was expected that the four office buildings would be steel-framed and the related parking decks would be concrete and design-built. Everything was proceeding as planned until the fabricator working on the office portion of the project made an innovative proposal for a more economical parking structure alternative.

"We were working on the site fabricating the steel for about 800,000 sq. ft. of office space when we heard about a separate bid package for the decks," explained Robert Abramson, president of AISC-member Interstate Steel. "The parking structures were originally designed as concrete, but by working with an experienced engineering firm, Zaldastani Associates, Inc. who initiated and developed the Hybrid System, we managed to come up with an alternative that reduced construction costs by more than $1 million.

As a result, Zaldastani and Interstate Steel proposed a Hybrid System combining precast concrete floor members with structural steel frame. "It wasn't a pure design/built effort; it was more like partnering," according to Abramson. "Precasters work with contractors and engineers in this type of partnering arrangement quite often and it's important for steel fabricators to start getting involved in these arrangements."

Zaldastani has been designing parking structures since 1962. "During that time, our experience shows that the best material for parking decks is precast concrete, while the best material for the structural support system is exposed steel," stated Michael J.A.H. Jolliffe, P.E., president of Zaldastani Associates in Boston. "Precast concrete has greater durability than poured in place. And steel that is exposed to view is more easily maintained than rebar buried in concrete, which loses its ability to protect the steel when its alkaline environment has been changed by the intrusion of acidic ions."

The guts of the Hybrid System for parking structures developed by Zaldastani Associates, Inc., are double steel columns supporting concrete tees. In this incarnation of the system, precast architectural panels incorporating a 2" brick tile were designed to be capable of supporting the precast floor units which spanned 60' from the interior column line. The spandrels, in turn, were supported on the steel columns.

Before accepting the proposal, AT&T's project management team visited another Hybrid project designed by Zaldastani, a parking facility at Becton Dickinson & Co. in Franklin Lakes, NJ (see September/October 1990 Modern Steel Construction). After examining the building and studying the proposal from Zaldastani and Interstate Steel, AT&T decided that the system had both performance, cost and schedule advantages over other proposed systems and accepted the bid.

"The adoption of this Hybrid System generates several advantages over conventional systems." according to Jolliffe. "Particularly relevant to this project was the rapid delivery and erection which could condense the design and construction process into a 10 month period. This was advantageous

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The four parking structures accommodate 3,600 cars and were designed to blend in with the rest of the office complex. Despite the large size of the project, the use of the Hybrid System enabled the parking structures to be designed and constructed in just 10 months.

due to the delivery timetable of office buildings that the parking decks supported. Also important were the durability of the precast deck and the steel beam/column structure.

Other characteristics of interest were the system's ability to accommodate different exterior architectural expressions, which allowed the parking structure to adopt the appearance consistent with its office brethren, and an open appearance that generated excellent sight lines and a sense of security for both drivers and pedestrians. The system also was readily adaptable to both the rectangular and the three curved decks that were part of the project's master plan.

As part of the design process, Zaldastani worked to reduce the number of pieces in construction. For example, stair framing was modified to fit between structural elements as opposed to requiring additional support columns to frame the conditions.

The four parking structures offer 3,600 spaces, with the largest holding 1,500 cars on three levels. This large structure serves two office buildings and is three bays wide and three levels high. The other decks, all of which are curved in plan, are similar in design with three bays and a central sloped floor.

Structural Design

Structurally, the facilities rest on spread footings on rock and natural granular soil. Changes in grade required the use of retaining walls at various locations. The interior lines of paired columns and girders are of steel construction and are designed to both support precast floor deck and also provide lateral stability to the construction both during and after construction. The paired columns are interconnected by paired plates at 5'-on-center vertically. These columns were erected to the full height of the structure and the columns were then interconnected at each floor with steel girders at each of the two column lines. This arrangement provides vertical stability in the transverse direction by the ladder frame cantilevering from the ground; and in the longitudinal direction by conventional frame action.

Using the frame to provide stability during erection greatly enhanced the speed and safety with which the structures could be constructed. Of particular note for this project was the recent adoption in New Jersey of the 1993 BOCA Building Code, which imposes much stricter criteria for seismic loading and seismic design/detailing than in previous years. This led to the adoption of details for the moment resisting frames that enabled the steel supported structure to readily resist the required seismic forces without the introduction of bracing or shear walls, which would have impacted on the openness and usefulness of the parking structures.

At the exterior, precast architectural panels incorporating a 2" brick tile were designed to be capable of supporting the precast floor units which spanned 60' from the interior column line. The spandrels were supported on steel columns. This approach was a slight modification from the normal Hybrid System approach, which uses steel spandrel girders, but was readily feasible and allowed the desired aesthetics. The columns were designed and detailed to allow for erection of the precast spandrels with minimum bracing prior to the double tee installation. The supporting elements had to be concealed to respond to the desired aesthetic treatment.

The floor system consists of precast double tees that were attached to the top flange of the frame's steel girders. The flanges of the double tees were welded together in the manner normally provided for pre-topped tees and a connection was made between the end of the tees in a shaped cast-in-place concrete infill that incorporated the floor and roof drains.

As is characteristic of the system, sloped floors, which was the method adopted for vertical circulation, were achieved by vary-

ing the installation height of the girders on the columns as the slope progressed up the ramp. The speed of the erection was noteworthy in that the curved 700-car structures were each erected in less than three weeks, the speed primarily being limited by the rate at which precast floor units could be delivered to the site.

The design/detailing process was put on a fast track. The steel was blast cleaned to an SSPC-SP6 and coated with Tenmec 90-97 zinc rich primer and then shop coated with Tnemec 70-73 urethane. The connections are all Class B with the coating present to improve durability and reduce costs. Galvanized TC-Bolts were used; once the tips were removed, the ends were coated with ZRC and then top coated to match the rest of the steel, which was painted a pumpkin orange to match the precast concrete spandrels.