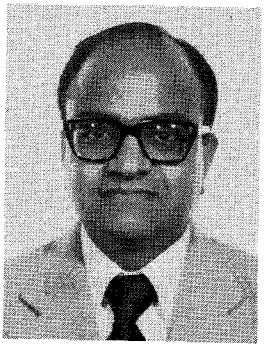
Major Development Complex Uses Precast Concrete



K. S. Rajagopalan, PhD, PE
Vice-President, Mullen & Powell, Inc.,
Consulting Engineers,
Dallas, Texas; also
Adjunct Professor, Civil Engineering
Southern Methodist University.

The Tandy Center complex, a privately developed commercial project in downtown Ft. Worth, Texas, has 280,000 sq ft of precast concrete construction. Precast concrete was used to supplement cast-in-place concrete for economy, continuity of design, aesthetics, and to expedite construction and reduce traffic disruption.

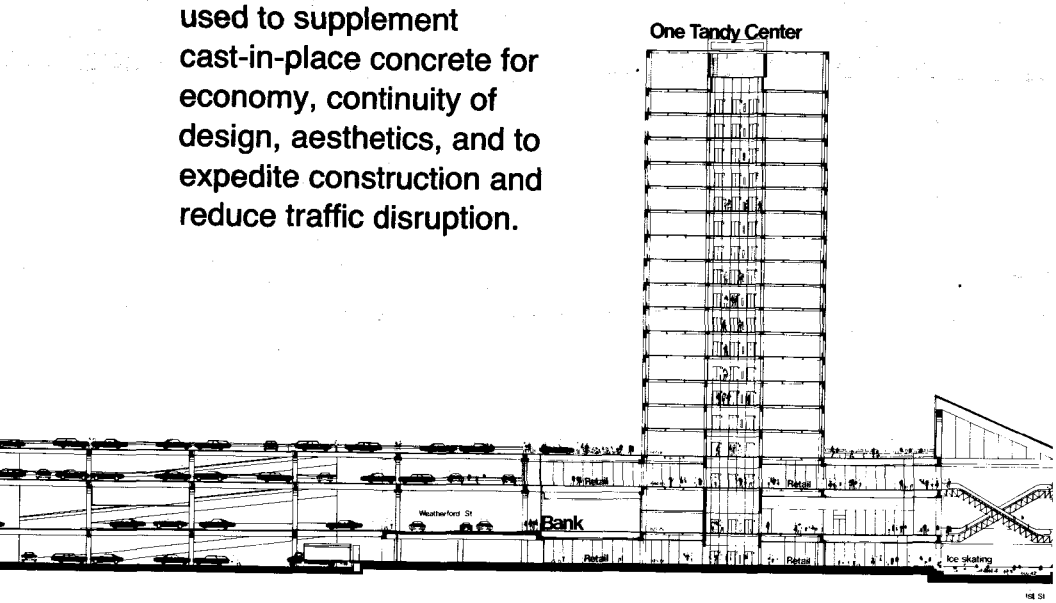


Fig. 1. Partial section through Tandy Center. Precast construction is used except in office tower and basement under Weatherford Street.

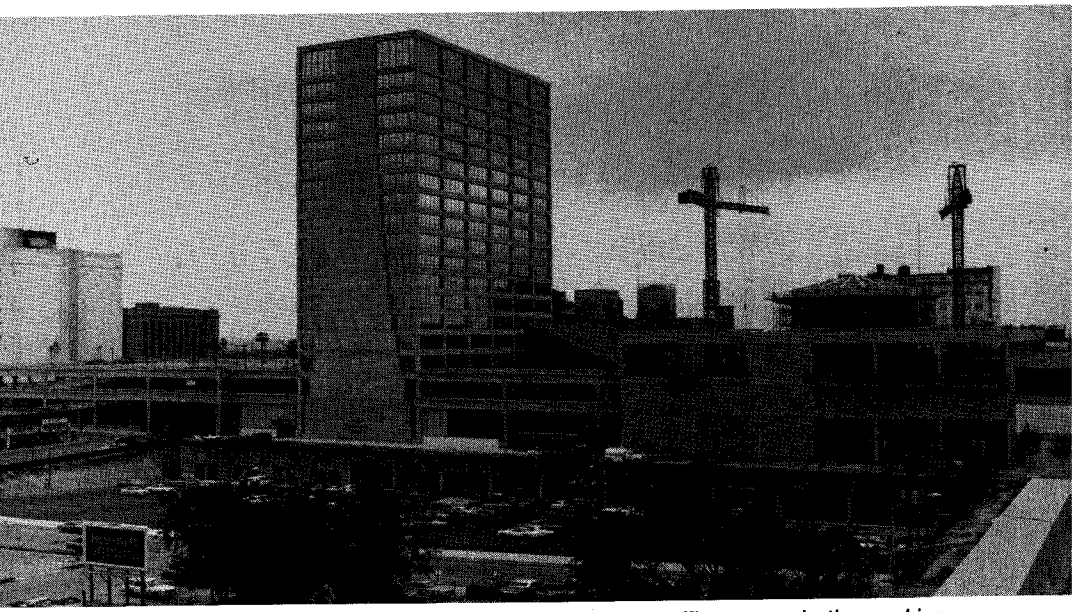


Fig. 2. West elevation of the complex. To the left of the office tower is the parking structure, of precast concrete. A major city thoroughfare is bridged, also to the left of the tower. To the right is the ice rink atrium with a sloping roof–also in precast concrete construction.

Tandy Center, owned by Tandy Corporation, is a privately developed downtown commercial project in Ft. Worth, Texas, stretching across several city blocks. The Tandy Center Complex consists of both cast-in-place and precast construction. An area more than 280,000 sq ft (26,000 m²) large (see Fig. 1) is precast; sizes of the various precast elements are shown in Table 1.

To date, two 20-story office towers, a downtown department store, another building housing several retail stores, a large three-level parking structure, and a large shopping mall surrounding an ice rink atrium, have all been built and occupied (Fig. 2). Further construction in the complex is underway. This paper describes the use of precast concrete in this major development.

There are five distinctive areas of precast construction in this project:

1. The three-level parking structure (Fig. 3)
2. The ice rink atrium (Fig. 4)
3. The shopping mall surrounding the ice rink
4. Major structures spanning over city thoroughfares (Figs. 5 and 6), and
5. The underground private subway terminals (Figs. 7 through 9).

North of the cast-in-place office tower is a three-level parking structure built with double tees, and precast beams and columns, as shown in Fig. 2 (left of the tower is the north side in this picture). A major downtown six-lane street is bridged by the precast structure. The spans vary from 51 ft 9 in. to 64 ft (15.8 to 19.5 m) for the double tees and the column spacing in the other direction is 28 to 30 ft (8.5 to 9.1 m). The ramp structure consists of spandeck elements spanning between L-beams that serve as handrails also.

The hub of the entire complex is an 85-ft (25.9 m) tall atrium housing an ice rink providing a functional space in an

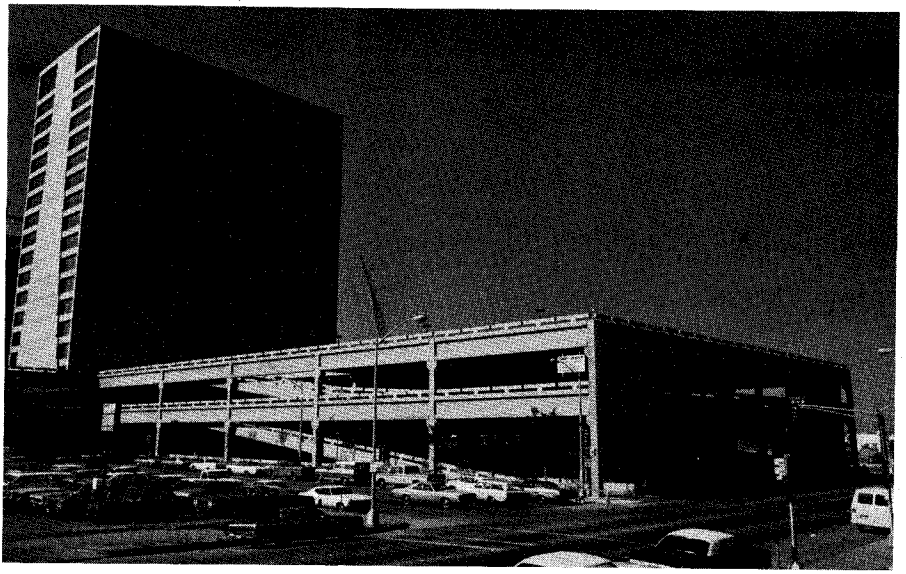


Fig. 3. View of three-level precast concrete parking structure.

Table 1. Size of Precast Units.

Number and dimensions of precast components:
530 7 ft to 7 ft 6 in. (2.1 to 2.4 m) wide, 36 in. (914 mm) deep double tees, 51 ft 9 in. to 64 ft (15.8 to 19.5 m) span
24 48 in. (1.22 m) deep L-beams, 51 ft 9 in. (15.8 m) span
14 12 in. (305 mm) wide rectangular beams, 51 ft 9 in. to 64 ft 0 in. (15.8 to 19.5 m) span
239 12 or 8 in. (305 or 203 mm) thick spandeck elements of varying spans
148 Precast Prestressed bridge slab panels, 7 ft 10 in. (2.4 m) span
15 Modified Texas 54 Highway beams, 70 ft (21.3 m) long
114 48 in. (1.22 m) deep inverted tee beams, 28 to 30 (8.5 to 9.1 m) span
36 24 x 36 in. (610 x 914 mm) rectangular beams, 28 ft (8.5 m) span
35 6 ft 3 in. (1.9 m) deep special spandrel beams 28 to 64 ft (8.5 to 19.5 m) span
87 24 x 24 in. (610 x 610 mm) or 30 x 30 in. (762 x 762 mm) precast columns
72 7 ft 6 in. wide, 48 or 50 in. (1.22 or 1.27 m) deep single tees, 86 to 90 ft (26.2 to 27.4 m) long
16 Wall panels of varying heights
Total area of precast construction: 280,000 sq ft (26,000 m^2)

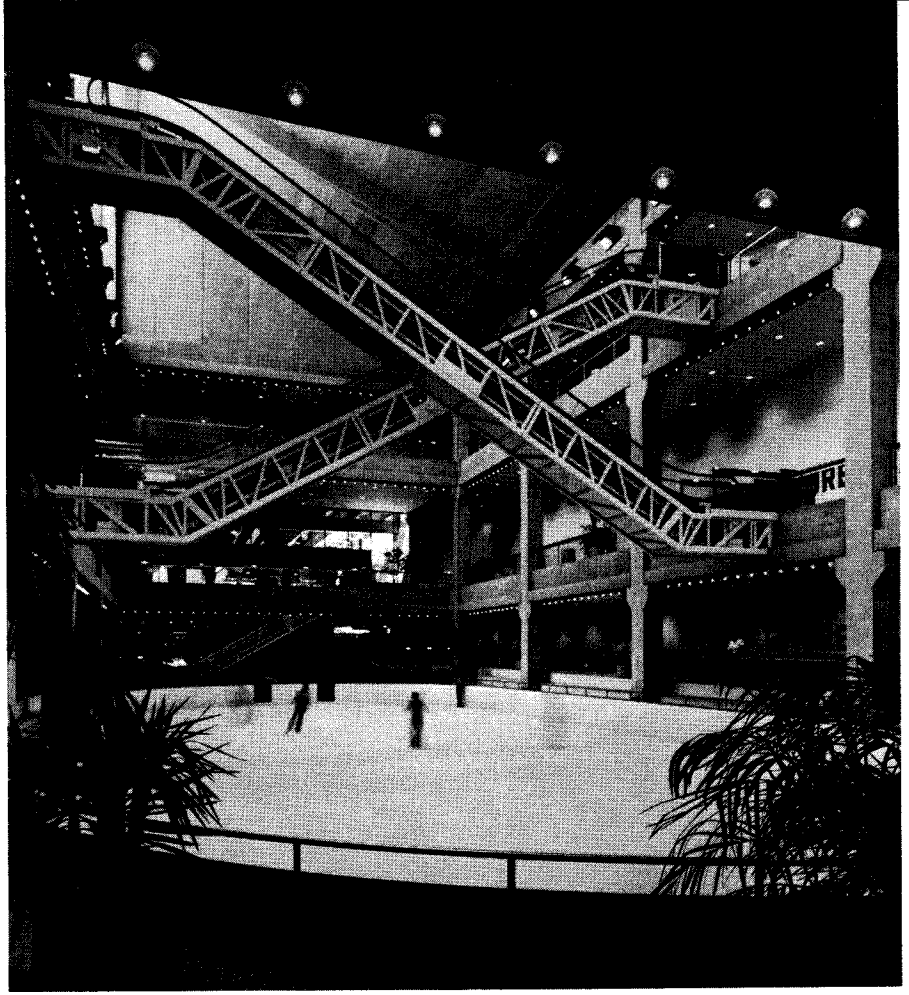


Fig. 4. View of ice rink atrium; precast columns, beams, wall elements and spandeck roof slabs are all architecturally expressed.

appealing environment (Fig. 4). Large column free spaces, a sloped ceiling with a northern clerestory, and crisscrossing escalators directly above the skating surface characterize this area. The precast columns, inverted tee beams, spandeck roof units, and precast wall panels are all exposed and expressed as the main aesthetic element of the architectural design.

Surrounding this ice rink atrium is a three-level retail mall. Here again, the visual aspect of the atrium necessitated large spans between columns. A structural system consisting of double tees spanning 60 ft (18.3 m) supported on precast inverted tee beams and precast columns provided an economical and appealing solution.

East of the ice rink, a six-lane downtown thoroughfare with 12-ft (3.7 m) wide sidewalks was bridged at two levels using single tees 90-ft (27.4 m) long supported on precast beams and columns. Figs. 5 and 6 show this structure just above the street level.

In addition to the parking structure within the complex, there is also an underground private free subway providing transportation to and from a remote parking area. The subway terminal situated west of the ice rink has three

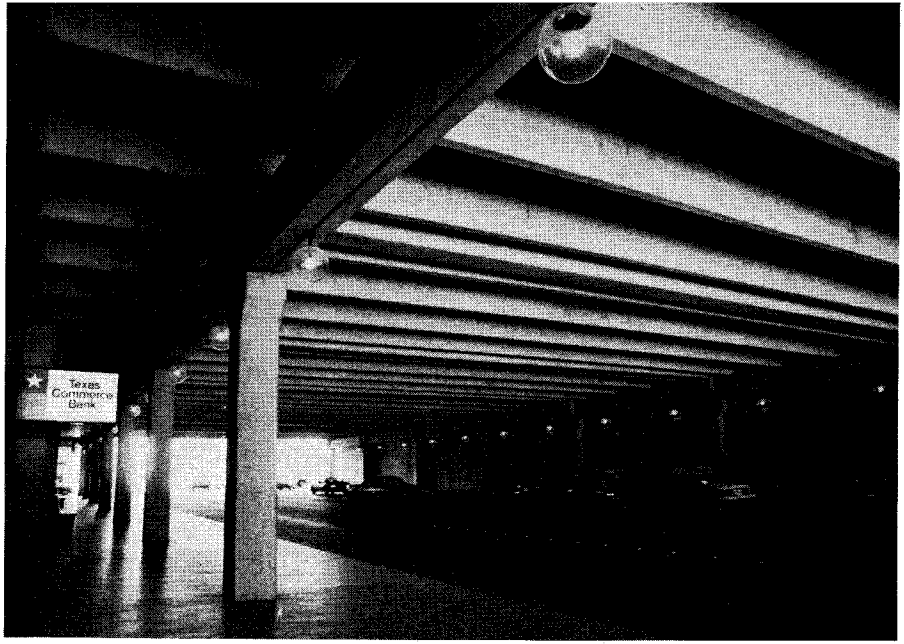


Fig. 5. View of structure bridging Throckmorton Street — a six-lane city street. Precast single tees span 80 ft (24.4 m) between supports and cantilever 10 ft (3.05 m) beyond.

different, staggered passenger loading platforms. Such an arrangement required a column-free structure spanning a minimum of 60 ft (18.3 m) to support the city street above. The structural solution was to use highway-type precast beams spanning perpendicular, rather than parallel, to traffic; with precast composite slabs bridging the space between the beams.

Unlike the usual highway bridge construction, the street traffic was normal to the span of these beams. With four lanes of traffic it is not unlikely that each of these beams has to support three or more truck axles simultaneously during the lifetime of the structure. Such a severe loading could not be supported by even AASHTO Type IV beams.

The structural scheme was to use the side forms of Texas 54 beams on a 22-in. (559 mm) AASHTO Type C beam soffit (see Fig. 7). A precast slab 4-in. (102 mm) thick with 4 in. (102 mm) of cast-in-place concrete slab on top (totaling 8 in. (203 mm) of slab) acts compositely with this beam for live loads.

A load test was conducted on the 4-in. (102 mm) thick precast slab panels and these slabs behaved very well at substantial overloading (DL + 2.5 LL) without any failure. Figs. 8 and 9 show the precast beams being set in place and the slab elements atop these beams.

Why precast?

The architectural intent was to express the structural framework as the principal aesthetic vein of the design. Such an intent is clearly fulfilled by the concrete structure shown in Figs. 2 through 4.

A substantial portion of this project was in cast-in-place concrete. However, precast concrete complemented the cast-in-place construction without any loss of design continuity.

Since this project was in the heart of a downtown area and several major streets surrounded the project site, continued construction required that traffic be disrupted through some of these busy thoroughfares. The use of precast

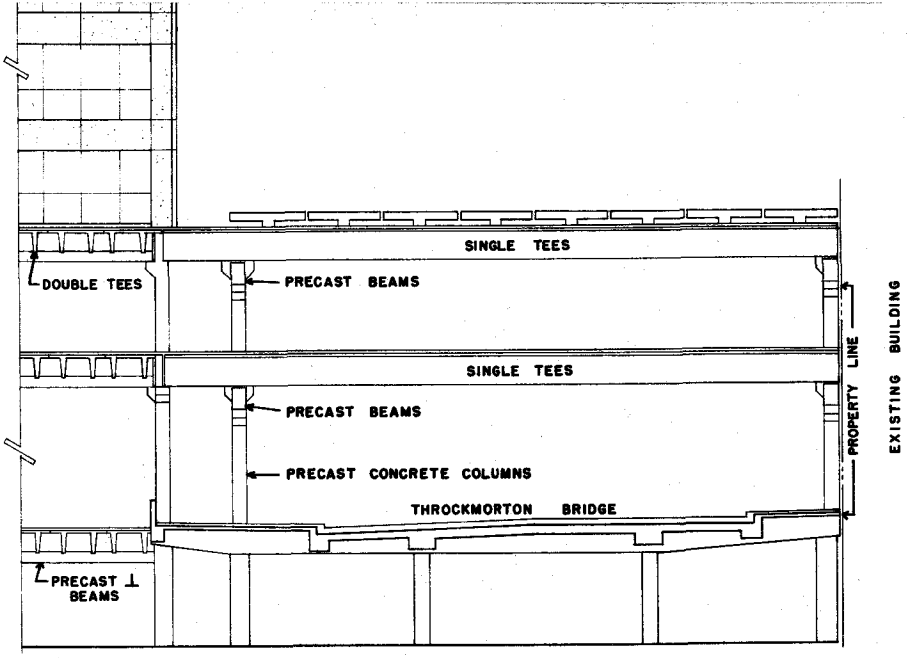
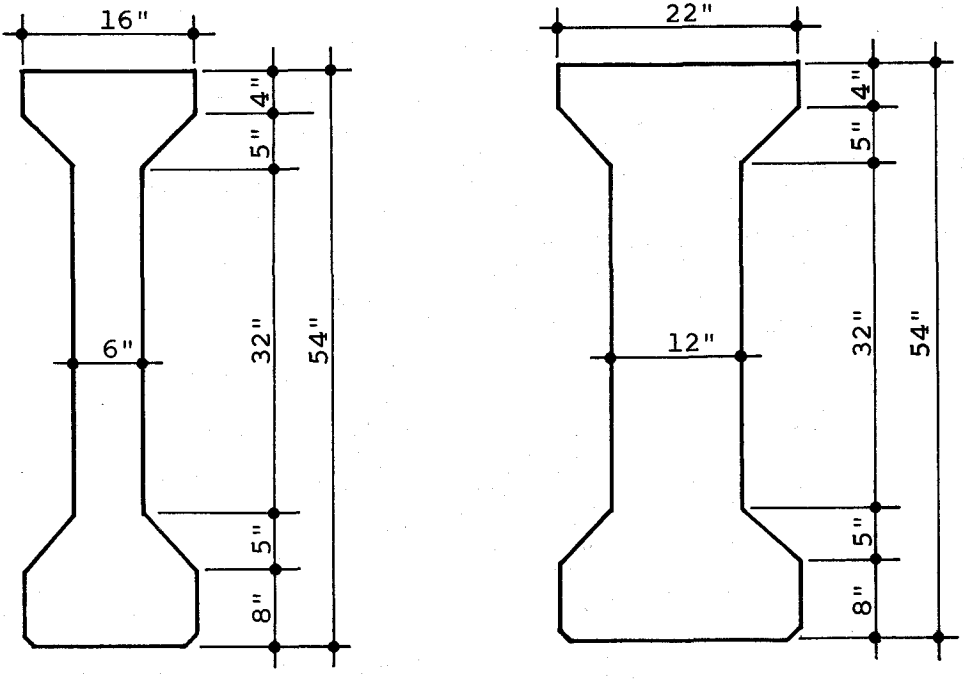


Fig. 6. Section through parking structure showing Throckmorton Street bridging structure.



TEXAS 54 BEAM

BEAM FOR TAYLOR STREET

Fig. 7. Comparison of Texas 54 beam and beam used in the subway construction to support Taylor street loads on a span of 60 ft (18.3 m).

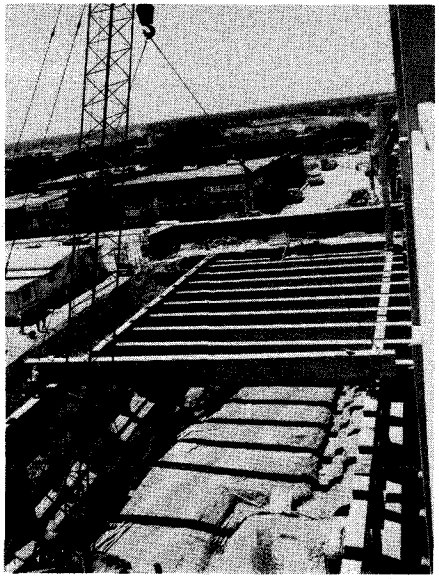
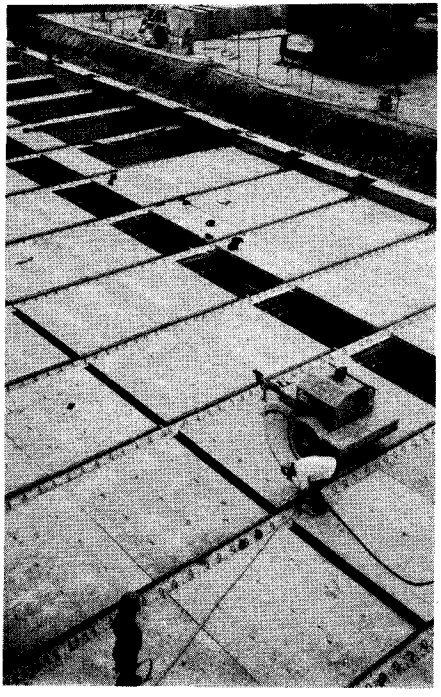


Fig. 8. Precast beams for subway being erected.

Fig. 9. Precast slabs set in place over precast beams–Taylor Street structure over the subway terminal.



units shifted a major portion of the construction activities from this busy downtown area to the precasting yard, thus speeding up construction and reducing the traffic disruption on the thoroughfares that surround the project.

Another advantage of the precast construction was that it provided the necessary fire resistance without the added expense of fireproofing. Also, precasting provided a better quality assurance of the units.

Further, the precast construction enabled the economical use of large spans that led to an efficient parking layout in the garage, visually appealing spaces around the atrium, and structurally feasible bridges over wide city streets.

Also, the precast construction supporting Taylor Street (near the subway terminal) provided formwork-free working areas allowing construction to proceed simultaneously and expeditiously at both the street and the subway terminal levels.

In short, the precast construction supplemented the cast-in-place concrete construction in economy, continuity of design, and aesthetics, thus providing a practical solution in a major downtown construction project.

Credits

Owner: Tandy Corporation, Fort Worth, Texas.
Architect: Growald Architects, Inc., Fort Worth, Texas.
Structural Engineers: Mullen & Powell, Inc., Dallas, Texas.
Civil Engineers: Carter & Burgess, Inc., Fort Worth, Texas.
Mechanical & Electrical Engineers: Herman Blum Consulting Engineers, Dallas, Texas.
General Contractor: Henry C. Beck Company, Dallas, Texas.
Precaster: TXI Structural Products, Inc., Dallas, Texas.
Forms: Hamilton Form Company, Inc., Fort Worth, Texas.