Precast Concrete Justice Facilities Go High-Rise

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Precast concrete is used as the primary structural system for a seven-story justice facility for the City of Jacksonville, Florida. A variety of precast concrete components, including modular cells and modular rooms combined with standard beam, column, double tee, slab and panel units, were employed. The design, manufacture and erection of the precast concrete elements are described.

Arising above a full city block in downtown Jacksonville, Florida, the recently completed City of Jacksonville Pre-Trial Detention Facility (see Fig. 1) provides a new concept of a precast concrete justice facility.

The building, which includes administrative, medical, food services and judicial functions, is designed as a 1200-bed facility with the capacity to expand to accommodate more than 2200 inmates. A heliport is included on the roof of one of the towers. An outdoor activity area is provided in the link at each housing floor.

The total precast concrete building contains a variety of columns, beams, double tees, hollow-core slabs and solid slabs, panels and three types of box modules: (1) cells; (2) shower, library and quiet rooms; and (3) horizontal mechanical chase units. For quantities of the products and other details, see Table 1.

At a height of 164 ft (50.0 m), which is made up of two lower floors plus 15 modules stacked above the base, the building is the tallest of its type in existence. In addition, the 629,000 sq ft (58,400 m²) of structure makes it the largest building in floor area in the City of Jacksonville.

Fig. 2 shows the job site at the start of the project with the footprint of the building taking shape. The base of the building is 180 x 384 ft (54.9 x 117.0 m). The site offered many challenges due to the proximity of existing buildings and expressway structures, with very limited spaces for the location of the erection equipment.

The design solution for the project included two full floors at the base with two octagonal five-story housing towers and a connection link. Fig. 3 is a typical floor plan of the towers and a typical building cross section is shown in Fig. 4.

Each floor in the tower contains two

Table 1. Products and quantities.

Products	No. of components	Quantity
Columns (24 and 30 in. square)	481	12,477 linear ft
Beams (various)	1,483	31,248 linear ft
Double tees (8DT24)	325	56,142 sq ft
Hollow-core slabs (8 in.)	3,700	289,472 sq ft
Solid slabs (8 and 12 in.)	680	67,124 sq ft
Panels/spandrels	181	33,056 sq ft
Cell modules	960	—
Shower/library/quiet room modules	80	—
Mechanical chase modules	280	—
Total	8,170	

Note: 1 in. = 25.4 mm; 1 ft = 0.305 m; 1 sq ft = 0.093 m².

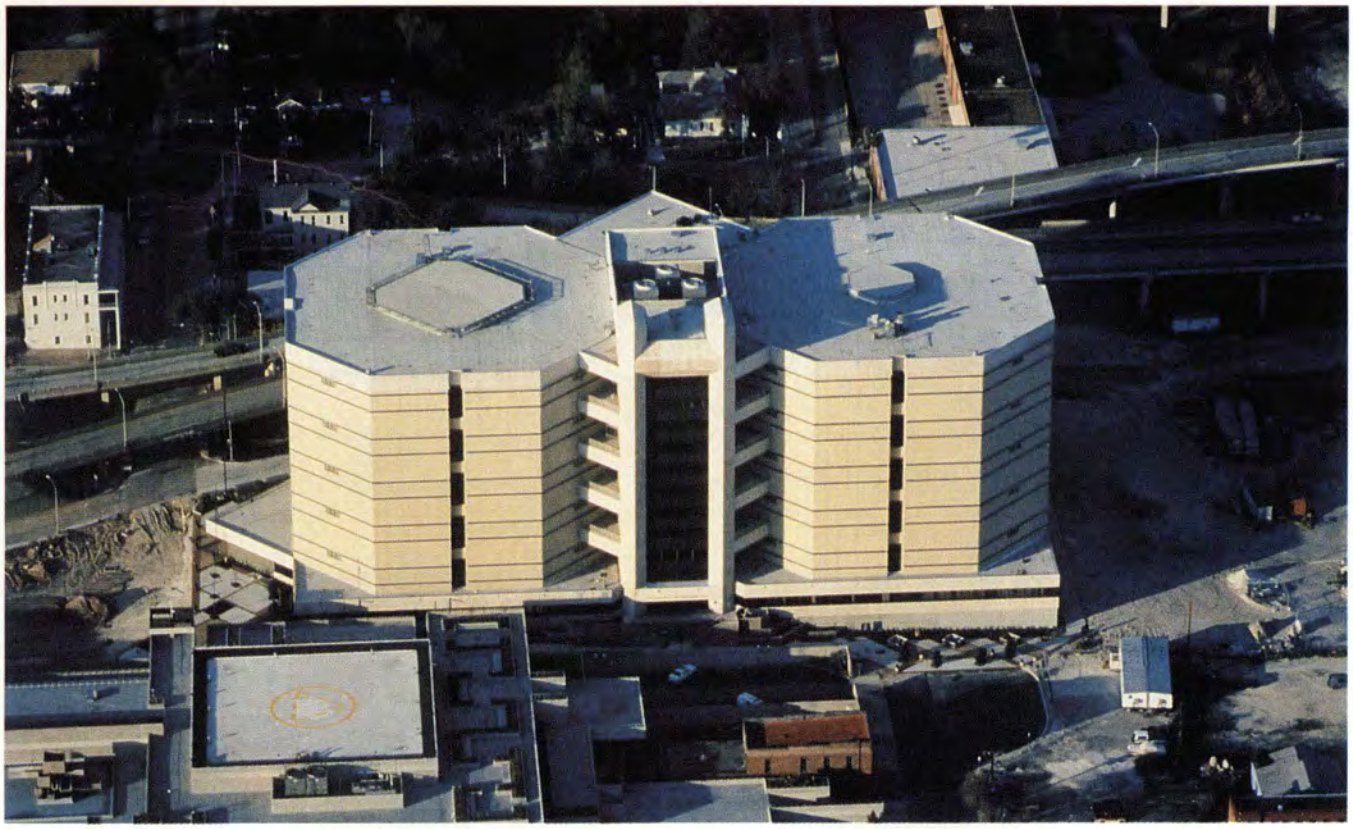

Fig. 1. City of Jacksonville Pre-Trial Detention Facility. (Courtesy: Pierce-Goodwin-Alexander-Linville, Tampa, Florida)

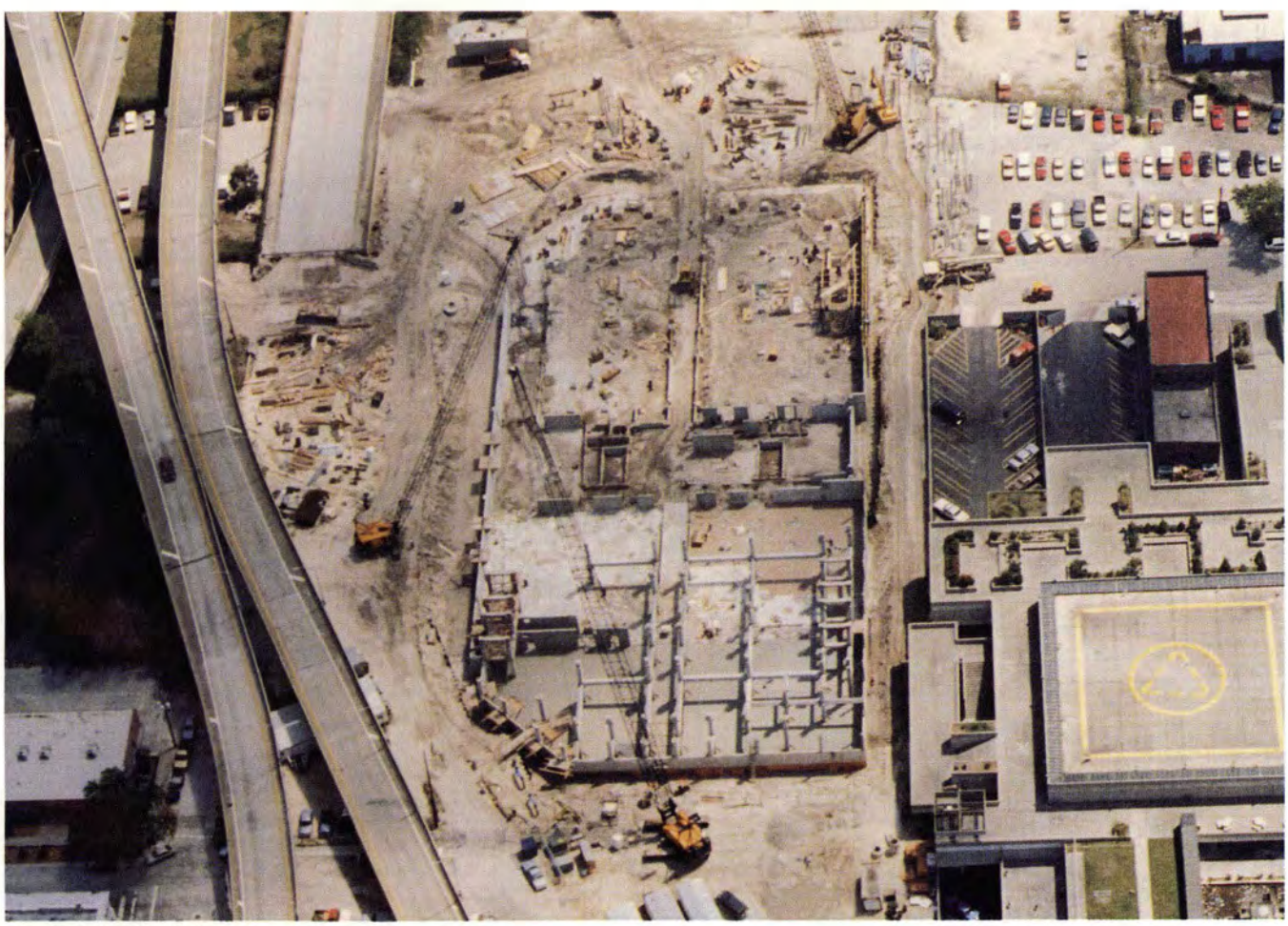

Fig. 2. Job site at start of project.

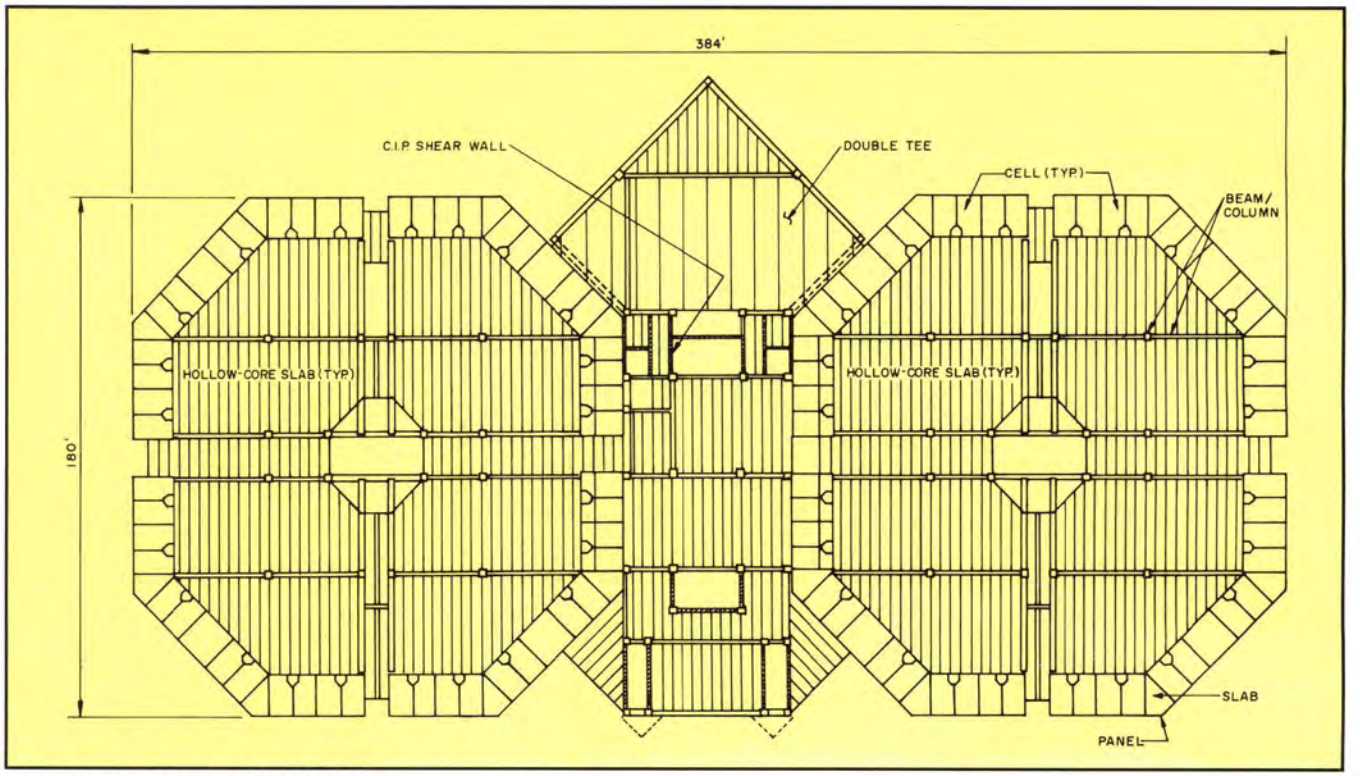

Fig. 3. Typical floor plan of building.

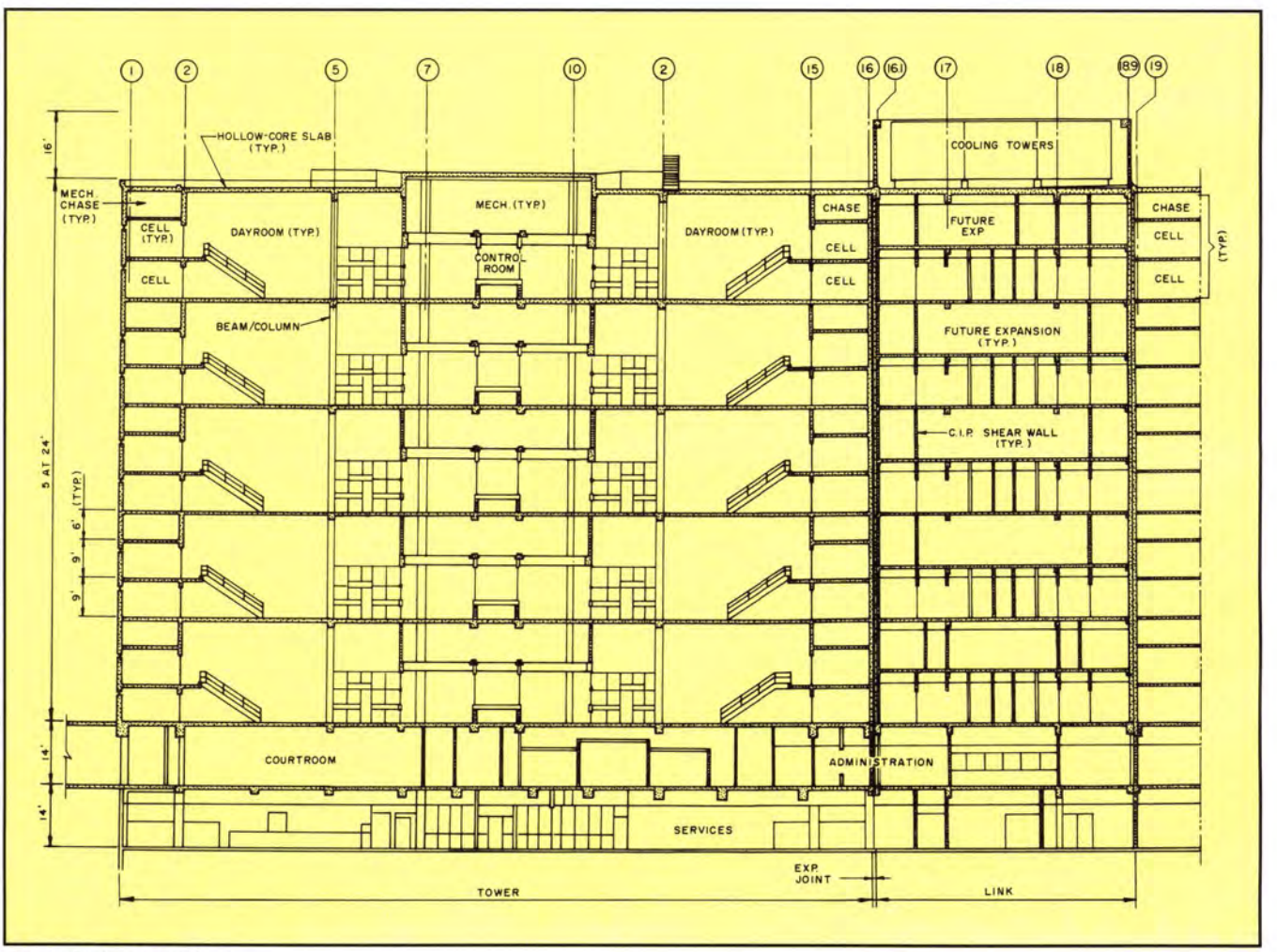

Fig. 4. Building section.

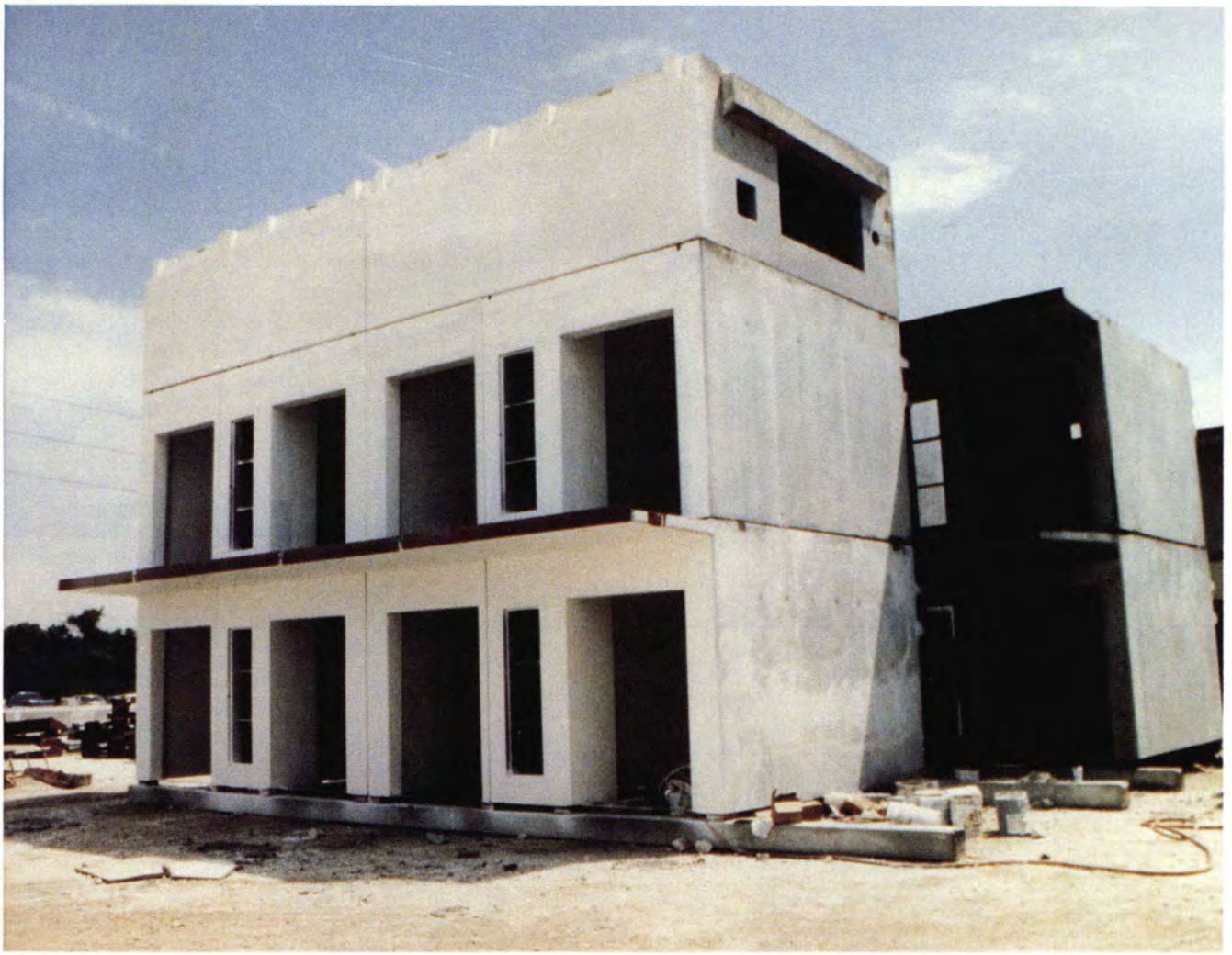

Fig. 5. Cell "three-pack" assembly in plant.

Fig. 6. Pomco portion of joint venture plant.

Fig. 7. Cell module form.

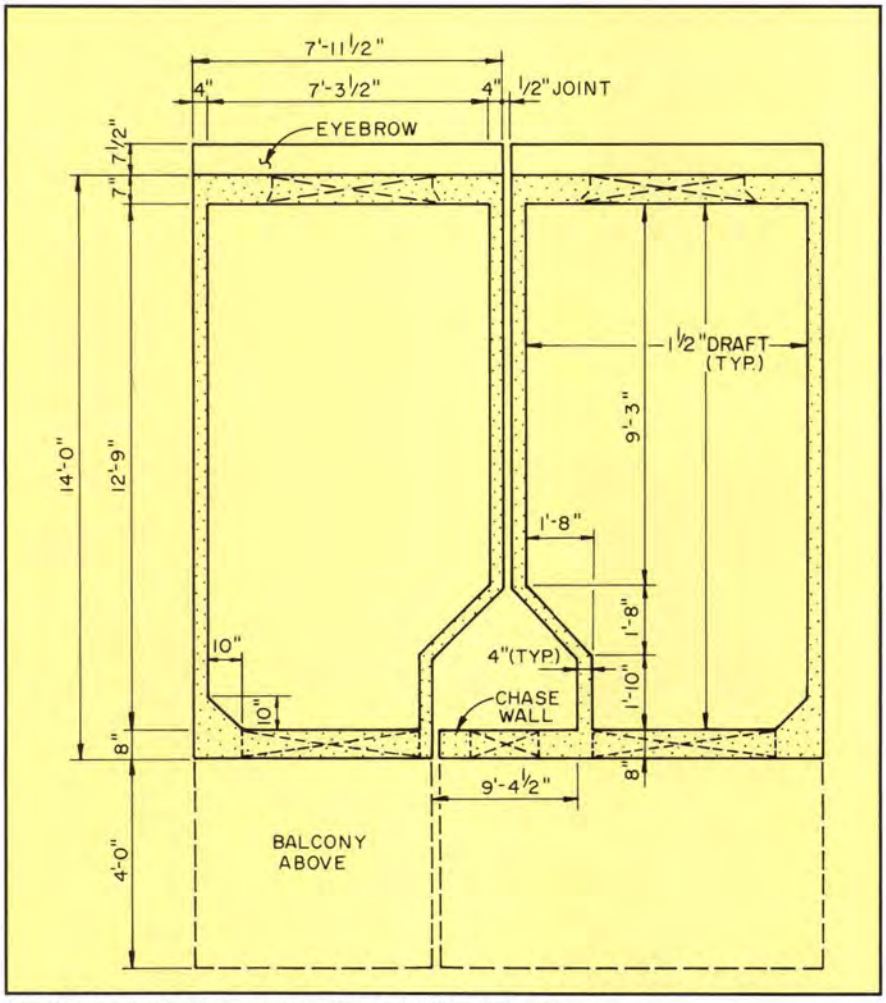

Fig. 8. Cell dimensions; typical 90 sq ft (8.37 m²) cell plan.

cell modules (or two room modules) with a horizontal mechanical chase module above them, comprising a "three-pack" as seen in Fig. 5. In this way, a total of 15 modules (three per floor) were stacked within the tower portion of the 164 ft (50.0 m) tall structure.

All of the precast concrete components were manufactured by a joint venture of Pomco Associates of Palmetto, Florida, and Gate Concrete Products of Jacksonville, Florida. Pomco set up a plant in a portion of the Gate facility (see Fig. 6) to produce all of the modules, columns, beams and panels utilizing concrete supplied by Gate. Gate also supplied the double tees, hollow-core slabs and solid slabs.

A total of 25,000 cu yd (19,100 m³) of concrete was required for the precast concrete units. Concrete was placed in the forms directly from mixer trucks or with a Lorain mobile crane and bucket.

A total of nine module forms was manufactured by Hamilton Form Company, Inc., Forth Worth, Texas. Fig. 7 shows one of the six cell forms. The typical 90 sq ft (8.4 m²) cell is 8 x 14 x 9 ft (2.4 x 4.3 x 2.7 m), as shown in Fig. 8, and weighs approximately 16 tons (142 kN). Alternating cells had the full chase front wall with the chase door frame cast in it. The lower cell in each three-pack had the balcony cast monolithic with the ceiling of the cell.

In addition, there were two horizontal mechanical chase forms and one room module form. The horizontal mechanical chase module is 16 x 14 x 6 ft (4.9 x 1.3 x 1.8 m) and weighs approximately 20 tons (178 kN), while the 160 sq ft (14.9 m²) room module is 13 x 14 x 9 ft (4.0 x 4.3 x 2.7 m) and weighs approximately 19 tons (169 kN).

The module forms were all of the fixed inner core design with drafted walls to facilitate the removal of the modules from the forms. This provided a seamless cell interior ready to receive paint. Casting was done in seven or eight of the nine forms daily.

A variety of items, including hollow metal door frames, window frames, embedded plates, sleeves, and conduits with boxes, were cast into the modules to satisfy the mechanical, electrical and plumbing design requirements. In addition, the bunks, desks with seats, and shelves were installed, and a prime coat of paint was applied in the precasting yard before delivery, as shown in Fig. 9.

The front and back walls of the 15 stacked modules were designed to be loadbearing and provide the structural

Fig. 9. Finished cell ready for shipping.

system around the perimeter of each tower. The modules in the lower floors included extra reinforcing steel to support the required loads. The reinforcement in the cells was a combination of engineered welded wire fabric and mild steel reinforcing bars.

The front wall of the upper horizontal mechanical chase unit in each three-pack contained a bearing ledge to support the hollow-core slabs and solid slabs for the day room floors. Some of the modules had bearing ledges on the sides to support slabs in adjacent areas. In addition, beams were supported in pockets in the front walls of some modules.

The structural framing for the interior of the building was precast concrete columns and beams supporting double tees, with solid slabs under the cells on the lower two levels (see Fig. 10) and solid slabs and hollow-core slabs in the tower and link areas on the upper floors. The columns were spliced at 24 ft (7.3 m) intervals and the beams were simple span design units supported on column haunches.

At the second level, transfer beams, 37 in. (940 mm) deep, were used under the front and back walls of the cells to support the floors and cell

Fig. 10. Lower level deck.

Fig. 11. Column-to-beam framing arrangement.

walls. Figs. 11 and 12 show the beam-to-column framing arrangement in the towers and link.

The connecting link was isolated structurally from the towers with expansion joints. Cast-in-place infill shear walls were used to provide the lateral resistance in the link. The vertical reinforcing steel in the shear walls passed through vertical sleeves in the beams to tie the shear walls together. Due to the complex framing requirements for the project, a large variety of sizes and shapes of columns and beams were needed. The column and beam forms were designed specifically for the variations required. Miscellaneous spandrels and panels completed the approximately 8000 precast concrete components for the project.

All products were handled in the plant with a pair of Mi-Jack TRAV-ELIFT™ straddle-carrier units. The units were all trucked 8 miles (13 km) from the plant to the job site.

The exterior of the building is covered with architectural precast concrete on the lower two levels and an exterior insulation and finish system on the tower and link areas. A dark band at each cell window line is created with dark window glass and infill spandrel glass. Concrete "eyebrows" above and below the windows are cast monolithically with the modules to provide partial shade and to add visual effect to the building. Fig. 13 shows the finished exterior on the completed structure.

All precast concrete erection was done by Pomco with a pair of American 9299 Tower cranes. In addition, the general contractor had one Standard American crane for general material hoisting. Due to the very limited site conditions and the complexity of the precast erection, the construction sequence involved alternating between towers on a floor-by-floor basis as the building went up.

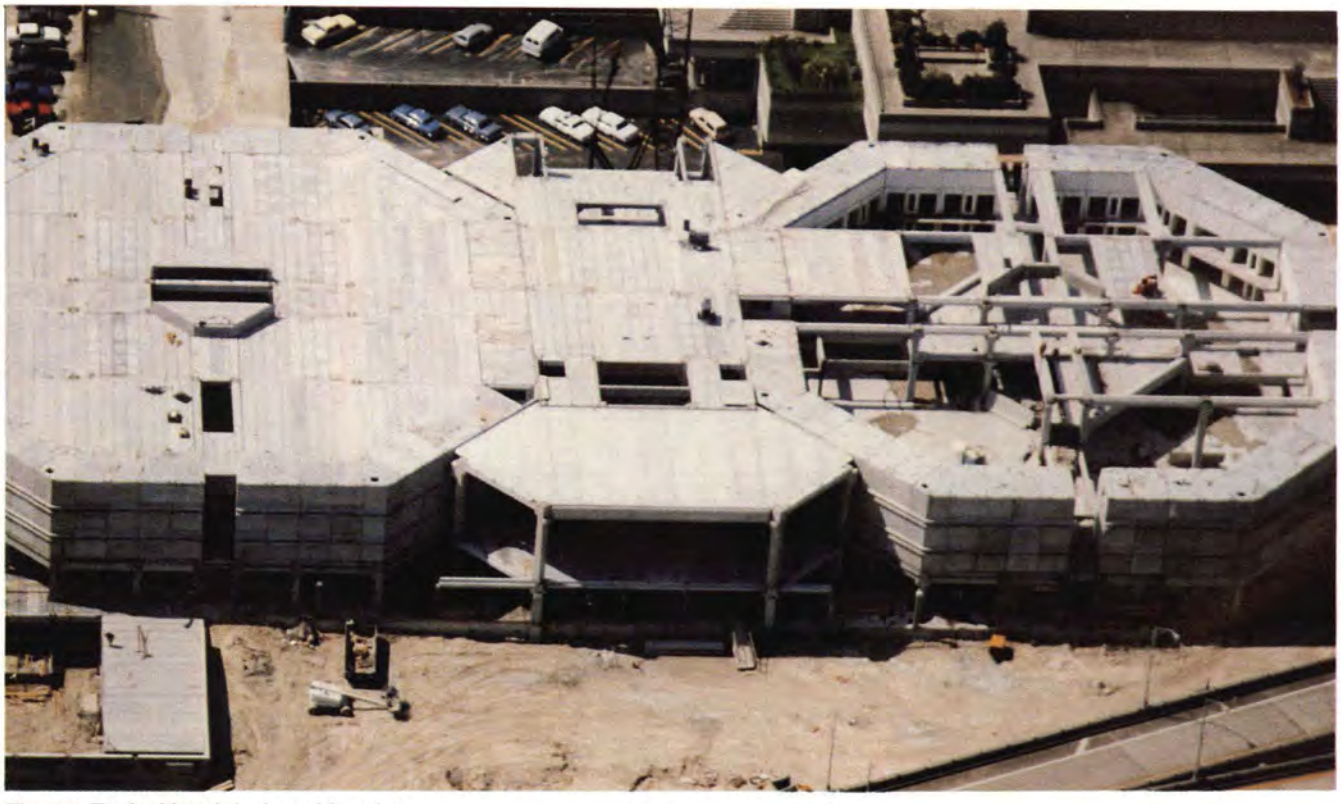

Fig. 12. Typical level deck and framing.

Fig. 13. Completed structure with finished exterior.

Overall production for the project was completed in 11 months while erection was done in 10 months. The total cost of the facility was $66 million, which equals $30,000 per inmate and $105 per sq ft ($1130/m²). Dedication of the project was in January 1991. Fig. 14 shows an overall view of the completed building.

This project demonstrates the effective use of precast concrete components in providing a complicated, yet functional, solution for a multi-use, multi-level justice facility.

Credits

Owner: City of Jacksonville/Duvall County, Florida

Architect: Pierce-Goodwin-Alexander-Linville, Tampa, Florida

Structural Engineer: Sverdrup Corporation, Jacksonville, Florida

Construction Managers (Joint Venture):

- Barton-Malow, Jacksonville, Florida
- Tompkins-Beckwith, Jacksonville, Florida

General Contractor: Taylor-Woodrow Construction Corp., Jacksonville, Florida

Specialty Engineer: The Consulting Engineers Group, Inc., San Antonio, Texas

Precast/Prestressed Concrete Manufacturers (Joint Venture):

- Pomco Associates, Inc., Palmetto, Florida
- Gate Concrete Products, Jacksonville, Florida

Fig. 14. City of Jacksonville Pre-Trial Detention Facility. (Courtesy: Pierce-Goodwin-Alexander-Linville, Tampa, Florida)