Precast Design and Construction of the Greene County Justice Center

Bill Johnson, P.E.
President and General Manager
Prestressed Casting Company
Springfield, Missouri

Tim Salmons, P.E.
Principal
Salmons P.C.
Albuquerque, New Mexico

Precast, prestressed concrete was used successfully to provide the new Greene County Justice Center (Missouri) with a detention center that doubled the capacity of the existing facility. The new building is sandwiched by a historical limestone courthouse on one side and a modern precast concrete courthouse on the other, so the new addition had to blend architecturally with the contrasting construction forms. Precast concrete provided both the architectural skin and the structural system to handle all design loads, and it had the added benefit of furnishing a durable cell partition that would be easy to clean. Special framing in the form of deep, thick-flanged double tees supported by heavy beams, columns, and loadbearing wall panels were needed to meet the criteria for a wide open layout. This article presents the design considerations and construction highlights of the project.

In 1998, Greene County, Missouri, had a pressing need to double the capacity of its inmate housing facilities in Springfield, Missouri. County representatives toured similar facilities under construction in neighboring states and were particularly impressed with the design and construction of a new precast concrete detention facility in Tulsa, Oklahoma. The success of the Tulsa project was a major influence on Greene County's decision to select precast concrete for its Springfield facility expansion program.
After several interviews with a number of firms, the County selected Flintco Constructive Solutions as the construction manager and the joint architectural team of BKL, Inc., and HDR Architecture, Inc., as the project's designer. These two companies had worked successfully on the Tulsa project and had the same responsibilities. Bill Knowles of BKL had designed a number of area detention facilities with precast concrete and liked it for its excellent durability, cost effectiveness, and functionality.

The new building was to be sandwiched by the historical courthouse constructed of local limestone on the south and a modern precast concrete courthouse building on the north (see Fig. 1). For the new structure, precast concrete appeared to be the logical material choice for two reasons: First, it would provide the insulated architectural skin as well as the structural system to handle gravity and lateral loads. Second, precast concrete would yield a durable and cleanable jail cell partition (see Fig. 2).

Greene County required that inmates be able to move securely between the new courthouse building and the second floor of the new jail and between the second floors of the new and existing jail buildings. This provision dictated that nearly 200 additional two-inmate cells would be located on the second floor and the elevated mezzanine level of the new jail and that the administrative, classroom, kitchen/dining, and mechanical equipment spaces would be located on the ground floor. These areas required large open spaces without columns or shear walls that would interfere with visibility.

SPECIAL FRAMING

The architect and engineer knew that it would take special framing to span 64 ft (13.5 m) and be able to transfer all loads from the cell units and the 100 psf (500 kg/m²) live load from the dayrooms to the first floor (see Fig. 3). To solve this problem, Prestressed Casting Co. of Springfield, Missouri, proposed a second floor system of deep, thick-flanged double tees to span the 64 ft (13.5 m). These double tees would be supported by heavy beam and column framing or load-bearing wall panels.

The precast system appeared to solve the difficult structural problems while meeting other layout and clearance criteria, and the details of this scheme were incorporated into the working drawings (see Figs. 4 and 5). Prestressed Casting Co. continued to provide input to the architect and engineer on framing, architectural treatments, specifications, and budget issues throughout the design phase. In the late summer of 1999, bids on the precast package were submitted to Flintco, and Prestressed Casting Co. was selected to fabricate and erect the structural and architectural precast concrete at a contract price of approximately $3.5 million.

The precaster began the shop drawings, and Salmons P.C. of Albuquerque, New Mexico, who had worked with the precaster throughout the preliminary framing scheme during the design phase, was contracted for engineering services on the project. The design was to comply with the 1996 BOCA Code. The structure is totally precast concrete, with lateral
stability provided by precast shear walls. While seismic requirements for this area are not high, it governed the design in this case.

Numerous engineering challenges needed to be overcome. For example, because of the large open spaces required on the ground floor and the heavy dead and live loading from two levels of cell units and dayroom areas above, a 50 in. (1270 mm) deep, 62 ft (18.9 m) long double tee narrowed to 7 ft 6 in. (2.29 m) wide (to correspond to the cell widths) was designed for the span (see Fig. 6).

**DESIGN DETAILS**

The erection and construction sequence dictated that a 4 in. (102 mm) flange be utilized so that two levels of cell construction could be erected before placing the cast-in-place topping, thus freeing up precast erectors to continue their work with little interference from other trades. The 4 in. (102 mm) flange accommodated a straight strand design, which greatly improved member performance in terms of camber and deflection.

The massive double tees had to carry an equivalent unfactored uniform loading of 375 psf (1830 kg/m²), not including the topping, and had factored individual stem reactions of up to 95 kips (422 kN). Under all loads, the members are virtually level and

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Fig. 2. Precast cell walls and decks provided durable, easy-to-clean surfaces.

Fig. 3. The second floor framing supported the dead load of the second level and elevated mezzanine levels of cells as well as the 100 psf (500 kg/m²) live load of the dayroom between them.
are designed to deflect less than 1/4 in. (6 mm) under the application of maximum live load from a position of sustained live load.

The heavy stem reactions required special end support systems for the double tees. At interior column lines, an L-beam was considered, which would have provided more vertical clearance than a rectangular beam, but with desired tee bearing lengths of 10 in. (254 mm), it would not have been able to resist the torsional stress. Finally, a 32 x 56 in. (813 x 1422 mm) rectangular beam was designed to carry one end of the second floor double tees as well as the 9 in. (229 mm) loadbearing cell backwall (see Fig. 7). This beam supports an unfactored superimposed load of 21 kips/ft (306 N/m) and spans 30 ft (9.14 m). At the...
Fig. 6. Section through dayroom. Long-span, deep double tees carry two levels of cells and 100 psf (488 kg/m²) of live load from the dayroom. The double tees are supported by yoke wall panels at one end and 32 x 56 in. (813 x 1422 mm) beams at the other end.
Fig. 7. The 32 x 56 in. (813 x 1422 mm) rectangular beams span 30 ft (9.1 m) to carry deep second floor double tees.
Fig. 8. Section showing the 8 in. (203 mm) irregular shaped double front cell wall panels.
Fig. 9. Complex framing was required to accommodate the first floor open spaces; including the exterior 12 in. (305 mm) yoke loadbearing walls supporting one end of the deep double tee with the 32 x 56 in. (813 x 1422 mm) beam supporting the other end. This picture also shows the antenna tower guy wire around which erection equipment and crews had to work.

exterior wall, a 12 in. (305 mm) thick insulated wall panel with an extended yoke was designed to carry the other end of the second floor double tee. The yoke extends 12 in. (306 mm) and consists of a 16 in. (406 mm) deep beam section spanning the width of the panel to pilaster sections along each edge.

Other precast products principally included cell wall, floor, and ceiling panels, 9 in. (229 mm) solid interior shear wall panels, 32 x 32 in. (813 x 813 mm) columns, 10DT32 roof double tees, and 9 in. (229 mm) insulated exterior wall panels. Special lifting frames had to be designed for stripping, stacking, and erecting the 8 in. (204 mm) irregular shaped double front cell wall panels (see Fig. 8). The largest of the 9 in. (229 mm) insulated panels was 12 x 50 ft (3.66 x 15.2 m), had 12-point pickups, weighed 52 kips (23590 kg), and had to be rotated to vertical and off a trailer within a 60 ft (18.2 m) bay.

In order to blend the contrasting styles of the old courthouse and the new court building adjacent to it, the architect chose contrasting architectural panels cast with local limestone aggregate. One panel type was cast with ribs with a light brush sandblast; the other type was cast smooth with a medium sandblast finish.

FABRICATION AND ERECTION

Precast component fabrication and erection were both performed by the precaster’s own equipment and personnel under a very tight schedule and restricted conditions. The start of manufacture was delayed by rebidding of subsequent mechanical, electrical, security, and other bid packages, which in turn delayed coordination of blockouts and other details.

Fabrication of the precast concrete components began in January 2000. Erection started in late April 2000. Two lanes of Boonville St. were closed to accommodate the construction. Workers had to direct traffic so that the trucks could get in and out of the project site. Further complicating erection was the presence of an antenna tower with guys within 10 ft (3.05 m) of the north elevation of the new structure (see Fig. 9).

After the first bay was erected, working footing to roof and backing out of the bay setting all precast components as erection proceeded, a second crane and crew joined the process as planned for approximately 50 percent of the work. The original crane and crew buttoned up the final bay and completed the front elevation erection. The remainder of the work was routine.

CONCLUDING REMARKS

In eight months from January to September 2000, 1286 precast concrete components were manufactured, hauled, and erected. Flintco vice president Bart Boatright, in a letter to Prestressed Casting Co. president Bill Johnson, stated: “With a project that provided many challenges with design and installation, your team successfully worked through all these challenges and provided great expertise and quick resolutions to the various difficulties that occurred throughout the construction.”

Presiding commissioner David Coonrod commented, “I enjoyed watching the construction as the very complicated erection process moved to completion. We have had rave reviews on the functional layout, the crisp clean cell surfaces, and the overall appearance of the new facility. We are especially pleased that a local company played such a major role in the new jail construction.”

The nearly $19 million jail addition, housing 390 inmates, is now open and functioning very well. In retrospect, the objectives of the county and the design-construction team have been fulfilled.

CREDITS