

A STEP **Above**

Barracks at National Guard training center takes full advantage of total-precaster concrete system to provide blast protection, hurricane resistance, and 100-year service life

— **Craig A. Shutt**



National Guard units set high standards for the buildings comprising their massive Operational Readiness Training Centers (ORTC), which transition soldiers from domestic duty to combat roles overseas and vice versa. The buildings must provide significant blast resistance as well as hurricane protection, energy efficiency, and a long service life to minimize maintenance costs. For the four-building barracks project built as part of Mississippi's new ORTC, designers found that a total-precaster concrete system would help meet those needs.

The four four-story buildings comprising the barracks unit is the first phase for the development of the ORTC, which will be used by several states for guard training. The \$50-million project encompasses 198,957 ft² and houses 1280 soldiers. The development also will comprise two officers' barracks, a dining hall, training facilities, eight company offices, a battalion office, a vehicle-maintenance facility, and storage buildings.

'We investigated alternative systems and determined the precast concrete design offered the best solution.'



THE FOUR-STORY BARRACKS BUILDINGS AT FORT SHELBY, MISS. The four-story barracks buildings at Fort Shelby, Miss., represent the first phase in the development of a new National Guard Operational Readiness Training Center (ORTC), which transition soldiers from domestic duty to combat roles. Photo: Johnson-McAdams.

The new facilities replace outdated CMU buildings from the World War II era, essentially Quonset huts that offered simple sleeping quarters with no bathrooms or other amenities, explains Robin Henry, an architect and the project manager at Johnson-McAdams Firm, the ORTC designers. They created a master plan for the 12-building facility and will design each segment as they come on line.

“These spaces were just sleeping rooms, spread out over the base,” Henry explains. “The new plan will significantly upgrade the facilities and condense them, adding space on the base by reducing the footprint needed for these functions.”

TOTAL-PRECAST SYSTEM USED

The barracks feature a total-precast concrete structural system consisting of insulated sandwich wall panels, double tees, stair panels, stairs, and elevator panels. The designers specified the total-precast concrete system after the design development had begun, when the allotted square footage was reduced by 5000 ft² per building. The buildings had to still provide for all required functions and occupancy.

“This reduction without a corresponding reduction in occupant load or function created issues for us,” Henry says. The designers value-engineered their concept for a structural steel frame with a typical veneered envelope to the total-precast structure. “The original concept wouldn’t support the occupant load and the requirements for progressive collapse and other resiliency needs. The column placements we would need would interfere with the placement of beds. We investigated alternative systems and determined the precast concrete design offered the best solution.”

The use of load-bearing exterior walls combined with long-span double tees eliminated the need



INTERIOR SPACES

Long-span double tees provided open interior spaces. Walls consist of the interior face of the load-bearing precast concrete panels, which have a smooth troweled finish. Photos: Johnson-McAdams.



CAMP SHELBY ORTC

LOCATION

Camp Shelby, Miss.

PROJECT TYPE

National Guard barracks

SIZE

198,957 ft²

COST

\$43 million

DESIGNER

Johnson-McAdams Firm,
Greenwood, Miss.

OWNER

Mississippi National Guard,
Jackson, Miss.

STRUCTURAL ENGINEER

Johnson-McAdams Firm,
Greenwood, Miss.

CONTRACTOR

Yates Construction, Biloxi, Miss.

PCI-CERTIFIED PRECASTER

Gate Precast Co., Monroeville, Ala.

PRECAST COMPONENTS

Total-precast concrete structural system consisting of load-bearing insulated sandwich panels in various sizes, double tees, stair panels, interior wall panels, interior wall panels with door and elevator openings, and stairs.

for additional structural columns, creating the flexibility needed to meet the occupancy requirements. The structural design was revised to feature precast concrete exterior and interior walls and partitions, with some nonstructural partitions made of concrete masonry. "Once this design path was taken," Henry says, "we looked at how we could utilize this system to improve the sustainability of the facility."

The total-precast concrete system had become familiar through the educational efforts of Gate Precast, which provided the components for the project. "We are working to get the military to change from block and brick construction to precast concrete," explains Mo Wright, marketing director for Gate and at the time sales director for the area. "We made several presentations in Savannah and Mobile, and they listened."

The concrete wall system features integral core insulation with a 4-in. interior structural wythe of concrete, 3 in. of insulation, and a 3-in. exterior architectural wythe. They provide the building with an *R*-value of R13.

The panels also provided the structural system, which is designed to resist progressive collapse. The panels are 14 ft 10 in. tall with a maximum width of 37 ft 8 in. and were designed to provide a counterlevered support for the structure above, acting as a counterlevered beam. "This was the beauty of using the precast concrete wall system for this design," Henry says. The double tees used for the floor structure feature a reinforced 4-in.-thick topping that ties the system together and provides additional counterlevered support benefits.

TWO ARCHITECTURAL FACES

The panels were cast with architectural finishes on both the interior and exterior faces. The exterior face features a combination of thin-brick inlays and exposed aggregates with a sandblast texture to create a limestone-like finish for accents, while the interior face features a smooth troweled finish. Concrete used in the panels contained an integral color that eliminated the need for additional field painting. The panels arrived to the site already finished.

"The panels are architectural, although they perform structural functions," Wright notes. They were cast in a plant with C3A certification from PCI, which provides A1 architectural finishing as well as structural casting.

"Providing an attractive finish on the interior side was an



EFFICIENCIES IN DESIGN

The erection process moved smoothly, with plenty of staging area. Efficiencies in design and construction brought the project in at \$7 million below budget. Photo: Gate Precast.

important point for the base commander," he says. "The barracks have soldiers coming and going constantly, and they require a lot of durability, more than drywall could provide." The base has a small maintenance budget, he adds, so they wanted a material that could stand up to the requirements without needing constant attention.

The building's exterior look provides a dramatic step up from the existing "hut" buildings, Henry notes. We wanted to set a tone with these buildings we could carry through the remainder as they're built that would be attractive and economical." Adds Chris Ard, sales and marketing division of Gate, "These barracks definitely provide a step up in the aesthetic style of the current landscape of the Camp Shelby base, which is predominantly covered with single-story block buildings."

The progressive-collapse design aided with hurricane protection too, Henry notes. "We met to discuss the added requirements for wind protection, and we looked at the design and said, 'We're already there,'" he reports. "The progressive-collapse calculations were higher than for any hurricane zone, and we're in one of the highest there is, near the Gulf Coast."

In fact, barracks could potentially serve as temporary shelter for refugees during a hurricane. "All we had to do was specify high-quality connections to meet the wind-load needs, as the rest of the structure met the force requirements easily," Henry says.

LEED STANDARDS MET

The insulated walls helped the building meet LEED standards, although the facility won't be submitted for certification. It also features laminated solar panels on the roof that provide some of the building's electrical power. The thin panels were simply glued between

'The progressive-collapse calculations were higher than for any hurricane zone.'



PRECAST MEETS CHALLENGES

The precast concrete structure helped the buildings meet a variety of challenges, including progressive-collapse requirements.
Photo: Johnson-McAdams.

the standing seams on the roof system, with little structural loading required.

Additional LEED points were generated from the use of local materials being manufactured within 500 mi of the site, with fewer raw materials used for the thin bricks than for traditional masonry. Brick-firing costs were reduced and more brick fit onto flatbed delivery trucks, resulting in fewer trucks being needed and lower fuel costs. The panels also were cast and cured off-site, eliminating any dust or airborne contaminants from drying or curing compounds during construction, which improved construction site air quality.

“Using precast concrete meant very little construction waste,” Henry says. “There were no leftover studs or materials.” Low-VOC (volatile organic compounds) materials were used as well, and storm water is being captured, stored, and reused for soldier equipment wash.

The site offered plenty of space for staging components prior to erection, which moved smoothly. “Mississippi’s military department was very pleased with the speed with which the precast concrete could be erected once the site was ready,” Henry says.

The four buildings replicate each other, but they were turned on the site to create distinctions. “We didn’t want to try to create mirror images or change them in other ways, so repositioning them on the site provided differences and avoided the appearance of the same façades in a row.”

The positioning aided the overall budget, notes Ard. “It created quite a bit of repetition within the panels, ultimately reducing the amount of mold protection required.”

The erection was aided by advance planning to create blockouts and conduit runs in the panels. Coordination meetings were held with the completed design team, contractors, and the precast producer’s engineering team at the precast manufacturing plant to integrate the mechanical, electrical, and plumbing systems as much as possible into the panels. “There were several miles of conduit integrally cast within both the interior and exterior of the panels,” says Ard.

“The system is basically an erection set,” Henry says. “There were no mistakes in the field or adjustments needed. We could simply pull wires through the conduit and hook it up. Ductwork openings were blocked out so everything went in very quickly.” The project had less than 1% change orders, which was unusual for a project of this size and complexity, he notes.

“This was a very positive experience all the way around, and the nicest military project I’ve ever been involved with,” Henry says. “A lot

of thought went into planning upfront to make the construction move very quickly. Bob Baylor, the Mississippi Military Department’s project manager, is one of the most knowledgeable project managers I’ve ever worked with. His guidance and understanding of the industry is amazing.”

The planning paid off where it matters most: budgeted at \$50 million, the value-engineering and other efficiencies planned into the design and construction brought the project in at \$43 million, a substantial savings.

With that success in place, Henry already has created plans for improving the next stage. Upcoming projects also will use the total-precast concrete structural system, with interior panels featuring a new concrete admixture that has shown great promise. The admixture creates a durable finish that protects against marks and stains, allowing even permanent marker to be wiped off. (For details, see the sidebar.)

“We’re looking at what we’ve learned from this first experience to improve on later buildings,” he says. “We can improve on our initial design concepts to make them more efficient in the future and create even better finishes. I can’t wait for the next building to get started so we can improve on what we’ve done already.”

Admixtures Offers Durability

A new concrete admixture offers potential for creating durable interior finishes that allow marks and scuffs to be easily wiped off. The E5 Concrete Slab System from Specification Products uses reactive co-polymer solids to internally cure concrete without the use of prewetted lightweight aggregates while reducing drying shrinkage, curling, and volume-loss cracking.

The E5 mixture can be applied topically or integrated into the concrete mix. It retains 95% relative humidity for many months, exceeding the requirements of ASTM D7234 *Standard Test Method for Pull-Off Adhesion Strength* only nine days after poured slabs. Perm tests at that time show relative humidity as low as 4.7% to 4.8%.

The material will be used on future precast concrete buildings at the Shelby OTRC and is currently being tested in a unique way: as part of a concrete monument for fallen soldiers designed by Robin Henry of Johnson-McAdams and constructed and installed by SP at Camp Shelby. The monument is being evaluated over time to determine how well the concrete retains its durability while exposed to the harsh southern Mississippi environmental elements.

To date, Henry has been impressed. “Based on the successful performance of the installed system and the high standards set forth by its developer, I plan on using the system on all of my projects,” he says. “The E5 system sets a new standard for quality in concrete.”