April 20, 2010

Armed Forces Reserve Center

A Case Study in Total Precast Design-Build Integration

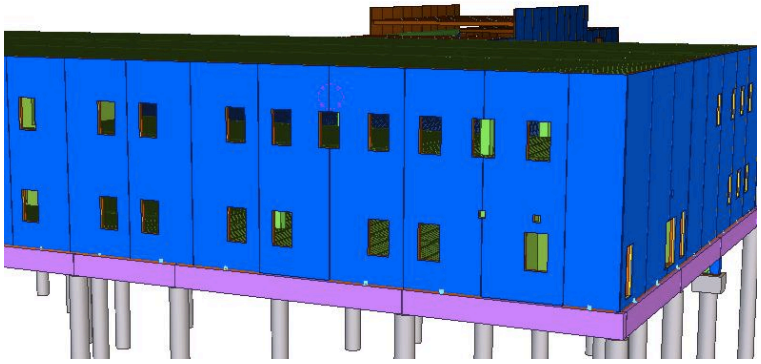
San Marcos, TX

By Brian Estes and Gil Heldenfels

Total precast concrete building construction has been utilized and perfected over the past 50 years in many parts of the country yet remains a relatively new concept in the Central Texas region. However, this emerging construction technique is gaining ground. Long employed in the parking garage market for its speed, durability, flexibility and low cost, the precast building systems model is increasingly being applied to commercial buildings. Architects and structural engineers are able to achieve the desired structural requirements, thermal efficiencies, and expedited construction schedules without loss of aesthetic appeal.

When the United States Army Corps of Engineers selected Sattterfield & Pontikes as their Design-Build Contractor on the proposed Armed Forces Reserve Center in San Marcos, they did so because of the accelerated construction schedule, the inherent sustainability of concrete structures, and the durability of the precast concrete building system. The Armed Force Reserve Center (AFRC) is comprised of three main buildings using a total precast building system. Each of these buildings serves a specific purpose and therefore had unique design requirements. The final product was designed as three freestanding buildings with a total usable floor space of 109,000 square feet. All three buildings were designed as total precast building from the precast grade beams to the double-tee roof systems. The project was designed to meet the criteria of the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design silver certification - a mandate for all proposed Federal projects. This project was also designed to meet the US Army Anti-Terrorism, Force Protection (ATFP) requirements, also required for all Federal projects.

The design-build project utilized Building Information Modeling (BIM) and involved a large effort early in the process to coordinate architectural design, structural elements,



and MEP components, all with a precast concrete system as the superstructure of the buildings. Schwab Structural Engineering, Inc. utilized TEKLA in developing the precast superstructure which was then integrated into the overall REVIT BIM model prepared by lead architect/ engineer PBS&J. Design assistance was provided by the precast manufacturer in order to maximize the amount of repetition of pieces, optimize internal connections, and determine grade beam sizing for the anticipated loads of the structure.

The project site presented challenges as well. Expansive clay soils required 10-feet of excavation and replacement with select fill to achieve an expected Potential Vertical Rise (PVR) of 1-inch. However, rather than the traditional method of excavation and embankment with slab on grade, S&P chose to employ a precast suspended slab. This system of precast grade beams with either hollowcore or double tee floor planks can be economically adapted to any building system while helping to expedite project schedules. In the case of the AFRC, the system was designed so that it integrated seamlessly with the rest of the total precast structure.

The framing design transferred vertical and shear load to the foundation by utilizing three connection types. In the case of a continuous beam to beam connection, the beams meet and bear directly upon the drilled, cast-in-place piers. In the case of a corner or junction of more than two beams a pier cap distributes the loads into the piers. And in the case of a load bearing column, the grade beams were set into haunches on the column directly bearing on the cast-in-place pier.

The 56,000 sf, 2-story main building contains the offices, training facilities as well as an attached 1-level assembly center. 8” and 10” hollowcore was used for flooring in the main office where additional clearance was needed for MEP components, as well as raised access flooring. The attached assembly area utilized 24” double tees for both the flooring as well as the roof where a 70 foot clear span was needed.

Upon completion, the 23,700 sf Operational Maintenance Shop (OMS) will contain maintenance bays with heavy HS-20 load requirements and a clear roof span of over 70 feet. Again, 24-inch double tees were used to meet the clear span requirements for the roof while the same cross section with a 6" thickened deck was designed to handle floor loading. Also of note, load bearing precast columns were used to support the bridge crane tracks over the maintenance bays.

The heated storage building is approximately 28,500 sf and contains a large arms storage vault. The vault section was cast in place on precast grade beams. The rest of the structure was total precast construction utilizing precast grade beams with 24" double tee floor and roof.

By beginning the design as a total precast structure, the architect and structural engineer designed the buildings to consist of precast grade beams, hollow-core planks and double-tees, column and beam structural framing, and load-bearing exterior CarbonCast™ High Performance Insulated Wall Panels. As mentioned above, by taking advantage of up to 70-foot clear spans, the design team was able to reduce column intrusions throughout the building. This design led to a strong, durable final product that is highly energy efficient, yet economical as well.

Heldenfels Enterprises began the fabrication of the components in January 2010. By the end of March 2010, all the precast pieces had been cast, erection of the main office building was complete and the OMS building was more than 50% complete. Precast Erectors, Inc. began erection in mid-February amid a pattern of rainfall that inundated the project site on an average of every 8 days.

"The speed with which we were able to get the foundations set during one of the rainiest spring season's we've had in years has kept this project on schedule. If we were using traditional cast-in-place foundation design, we would have had significant critical path delays." - James Dubuisson, Project Manager, Heldenfels Enterprises, Inc.

The site access was limited; however the entire foundation of the main building was in place within 21 days of erection kickoff. All structural elements of the main building, such as columns, beams, and CarbonCast™ High Performance Insulated Wall panels were delivered and erected within 14 days. The roof system of double-tees was placed on all three buildings to finalize the assembly of the structure.

"The San Marcos AFRC is a Design-Build project with a Fast Track schedule approach, and this system has been key in meeting the demanding schedule needs of this project" - Alejandro Gonzalez LEED® AP, Project Manager, Satterfield & Pontikes Construction, Inc

Precast erection for the project will be completed by the end of April 2010. The entirety of the building foundations, structural components, exterior shell, and roof system will have been installed in approximately a 75 day total duration. The project is to serve as a training facility for US Army Reserves and Texas National Guard units. The fully integrated design-build approach led to a very energy efficient building that was constructed at a rapid pace, yet will maintain its durability for an extended building lifecycle. All of the precast components in these structures were perfectly suited for the needs of these buildings. By taking an integrated approach to the design, cost savings were realized in both the design and construction of the project.

Design-Build Team:

Prime Contractor:	Satterfield & Pontikes
Architect/Engineer-of-Record:	PBS&J
Precast Structural Engineer:	Schwab Structural Engineering, Inc.
Precast Manufacturer:	Heldenfels Enterprises, Inc.
Precast Manufacturer:	Gate Precast Company
Erection Subcontractor:	Precast Erectors Inc.

HELDENFELS ENTERPRISES