

practical solutions

Site Cast Tilt-Up Concrete as a Solution for Basements

By Conor Coburn, P.E., Structural Engineers Inc.

Difficult economic times have forced today's structural engineer to pursue innovative and cost-effective solutions to design challenges. Known for its cost saving attributes, site cast Tilt-Up concrete construction is proving to be the solution for more than just the traditional boxy warehouse. Beyond cost savings, concrete's inherent durable properties provide a long-lasting and secure solution. All of these elements made Tilt-Up the choice for a unique project that was nominated for a 2004 Tilt-Up Concrete Association (TCA) Achievement Award – a basement that houses the mechanical equipment for the campus of a leading life science research company.

A Home for Innovation

One industry that is constantly in the throes of change is genetic and scientific research. New technologies emerge daily that assist researchers in their quest to find cures, causes and the history of disease. Recognizing the tremendous growth of this industry, Applied Biosystems – a company that provides innovative products, services and knowledge resources that are helping researchers develop new, integrated approaches to scientific discovery – decided to begin construction on a new office campus in Pleasanton, Calif. The 80-acre campus will encompass more than one million square feet of laboratory, office, assembly, and support spaces. Phase One of the project consisted of the construction of a two-story building, a three-story building and the Central Utility Plant (CUP), which

was designed to ultimately serve the entire campus. In order to maximize the efficiency of the buildings on the site, it was decided to house the 46,000 square foot CUP within a basement beneath the three-story building. Additionally, the critical nature of the CUP dictated that it be designed to a higher seismic performance level than conventional buildings. This created larger lateral design forces that had to be considered in the interaction between the steel superstructure and the concrete basement.

Designing for Stability

Steel framed buildings with sub-terranean concrete basements are common in today's construction. Concrete basement walls have historically been constructed using conventional formwork, or by "shooting" concrete against a single form in a process

known as shotcrete. As the project evolved, it became evident to the structural engineering consultant, Structural Engineers, Inc., that the heavy congestion of reinforcing steel, particularly in the pilasters supporting the steel columns above, along with the presence of many steel embeds, prohibited the effective use of shotcrete. Alternatively, conventional formwork can accommodate congested steel; however, formwork construction is time consuming and not very cost effective. For these reasons, Tilt-Up construction of the basement walls was explored. It was concluded that the walls could be cast as individual panels in approximately 20-foot long segments. Panels would be interconnected with cast-in-place closures, approximately three-feet wide. Closure forms could easily be installed by attaching to the erected panels on each side. After completion of the closure pours, the concrete walls would closely resemble cast-in-place walls.

Partnering for Success

"Redesign of the basement walls with Tilt-Up panels required close coordination between the contractor and the engineer," said Ron Cruz, P.E. at Structural Engineers Inc. Each of the 51 panels was thoroughly coordinated with the other disciplines. Embeds for connections to the steel structure above were carefully located. Additionally, a CUP facility has a substantial amount of utilities that pass through the walls to serve the equipment that is within it. In some areas, there were as many as 20 penetrations within a five-foot square. Virtually all of the pipe penetrations were designed to be cast with the panels in order to avoid the cost of coring through the 12-inch thick panels after erection. Large embedded steel items were detailed with access holes to facilitate the pouring of concrete around the steel.





Foundation Formula

The excavation for the basement was done using a sloped cut. This avoided the need for any temporary shoring of vertical cuts. The panels were formed and cast on the basement floor slab. The basement walls did not require any special architectural finishes. Consequently, the concrete finishing and patching requirements were minimal. After the panels were cast and cured, they were erected into place. A survey was conducted to assure that the alignment of the anchor bolts and other embeds in the panels were within the tolerances required for the erection of the steel above the basement. After panel adjustments were made, the closures were cast and the panels braced, thereby locking them into position to receive the steel above. Additional stability was provided by erecting all of the horizontal steel at the first level prior to erecting any vertical steel.

To facilitate the first floor construction, Lenton form saver couplers were used in the connection between the top of the walls and the concrete fill on the first floor metal deck. The couplers were supplied with mounting plates to the formwork and pre-assembled to the rebar. This assembly reduced installation time and minimized construction errors. After completion of the structure, the basement walls were waterproofed in a conventional manner, using Bentonite drainage panels (Paraseal) attached directly to the surface of the walls and a drainage system behind the walls.

About the Tilt-Up Concrete Association (TCA)

TCA was founded in 1986 to improve the quality and acceptance of Tilt-Up construction, a construction method in which concrete wall panels are cast on-site and tilted into place. For more information about the TCA, visit www.tilt-up.org or call Ed Sauter at 319-895-6911 or e-mail esauter@tilt-up.org.

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"The consensus among the team members was that the decision to use Tilt-Up basement wall construction was a tremendous success. The contractor determined that approximately 90 days were saved in the construction schedule with a construction cost savings of approximately \$300,000," said Cruz.

According to Jim Baty, technical director for the TCA, Tilt-Up is being used for projects that would have never seemed possible 20 years ago. "Tilt-Up is not only being selected as the solution to uncommon project challenges, but also for a wide variety of end-use facilities, including residential homes and religious facilities," said Baty. "As the medium continues to evolve beyond the box, product suppliers, design professionals and contractors will keep exploring creative uses for Tilt-Up." ■

Conor Coburn, P.E., Associate, a graduate from the University College (Cork, Ireland) in 1990 with a Bachelor of Engineering degree in Civil Engineering, has been a Project Engineer at Structural Engineers, Inc. (SEI) since May 1996. Coburn can be reached at (415) 951-7936 or ccoburn@structuralengineersinc.com.