

When lifting tilt-up panels, should you operate the crane on or off the floor slab? A contractor evaluates the pros and cons of each option.

Crane Quandary

By Robert Dorazio

When my company won the contract for its first tilt-up job, I soon faced one of the most important decisions of the project—choosing the best crane location for panel pickup. As with most tilt-up jobs, the choices boil down to operating the crane from the building perimeter or on the floor slab. The tough part is analyzing all the factors that can affect the final decision.

Wall panels for the job—a 20,000-square-foot warehouse addition to an existing 5-year-old tilt-up building—weren't particularly large. The building was designed to take roof loads on steel columns instead of the walls, so the largest panels were 25 feet wide, only 6½ inches thick, and about 27 feet high.

The floor was designed as a 6-inch-thick slab on grade with #4 rebar spaced at 18-inch centers in both directions. This design was adequate for occupant loads from small forklifts and warehouse racks. But was it strong enough to support crane loads during panel erection? As I considered this question, phrases from construction documents kept coming to mind:



Choosing the best crane location for panel pickup is one of the more important decisions for a tilt-up job.

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■ Contractor is responsible for all temporary loads during building erection.

■ Contractor shall employ necessary measures to assure protection of building elements from all construction or temporary loads.

■ Contractor shall replace any damaged concrete floor sections at the contractor's expense.

■ Contractor shall permit no heavy loads on concrete slabs.

What's more, the owner expressed concern about the larger-than-desired number of cracks in the floor of his existing facility, which had been built with the crane operating on the floor slab. So my priority on the job became clear: Protect the floor from cracking caused by crane loads during construction. However, providing that protection wasn't as simple as I thought it might be.

Working from the outside

I could eliminate crane loads on the floor by spotting the crane outside the building and off the slab. But how far from the slab? Contractors generally minimize required lifting capacity, and thus crane cost, by using the shortest pick distance possible from the boom pivot to the hook. Spotting a truck-mounted crane close to the floor slab reduces the pick distance but has a disadvantage. Most tilt-up panels are cast with the exterior side down. Because the panels are lifted with a face pick instead of an edge pick, each panel hangs during lifting with the top leaning toward the outside of the building. With the crane also outside the building, the boom angle may be such that the crane operator is in the fall zone if the rigging or lifting system fails and the panel drops.

I researched crane standards and could find no specific exclusion for this practice, but I preferred not to arrange for a lift with the crane in the fall zone. I also learned there are other hazards associated with heavy lifts, and simply moving the crane from the fall zone doesn't eliminate risk.

Increasing the boom angle to move the operator out of the fall zone creates a longer pick distance that may require a larger crane capacity and increase crane cost. For our project,

the longer pick distance would have required a 225-ton crawler-mounted crane. Because the jobsite was 4 to 5 hours away from the nearest crawler-crane rental company, renting a crane of this size would have cost more than \$20,000 for setup and move out, in addition to a \$350-per-hour rental cost.

On small-lot tilt-up projects, crawler-cranes may have to travel over or operate on adjacent properties, where property improvements or legal issues prohibit this approach. In our case, a crawler crane operating outside the warehouse addition would block access for delivery trucks needed to keep the business operating during construction.

Because of these constraints, I considered operating the crane on the floor of the building to be constructed.

The on-floor option

My main concern was minimizing floor cracking that might occur as a result of the crane entering and exiting the floor slab and operating on the slab. For most tilt-up jobs, the foundation elevation is anywhere from 4 to 18 inches below the finished-floor elevation, leaving the slab edge virtually unsupported. So before the crane mounts or leaves the floor, workers must place a compactible fill ramp at the access point. For our job, we considered using compactible fill and large steel plates of the kind that carry highway traffic over open trenches.

To determine the effects of crane operation on the floor slab, we asked the crane manufacturer to provide us with axle and outrigger floor loads for a crane rigged and unloaded and for the same crane placing the panels in a pick-and-carry operation. We forwarded this information to the geotechnical engineer and the building structural engineer. Preliminary assessments by the engineers indicated that cracking of the 6-inch floor as designed was likely under the crane loads we provided. Possible crack-prevention measures included:

■ Increasing the floor thickness to 12 inches and adding two mats of closely spaced, large-diameter rebar. This approach would have doubled the materials cost for the floor.

■ Post-tensioning the floor, in-

creasing floor cost about 30%.

■ Providing a substantially thick layer of compacted road-base material under the original 6-inch-thick slab to increase the modulus of subgrade reaction. This option would have increased floor cost about 20%.

Though these options are still less expensive than using the 225-ton crawler at an exterior location, I decided to abandon the on-floor option for the crane and go back to an exterior location. However, I plan to minimize rental costs by using a locally available truck-mounted crane rather than the 225-ton crawler-mounted crane. The truck-crane setup and move-out cost is about \$2,000 and the per-hour rental cost is \$250. Though the crane I chose can't safely reach the center of the floor slab, I can overcome this problem by stack-casting the panels on the floor perimeter.

However, stack-casting of panels is not without disadvantages. This method requires changes to the connections (they must all be flush) and a longer schedule for panel pours. It also may not provide as good a finish since a panel surface won't be as flat as the floor surface and may have features that will "ghost" onto the panel cast above.

Lessons learned

The planning exercise for this one facet of tilt-up construction illustrated the complexity of a seemingly simple decision about crane spotting. I found little help in published literature and guidelines, yet the decision is especially critical when an owner expresses concern over cracking of the floor slab. ■

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