# Changes to ACI 318 for Tilt-Up Wall Panels

*By James R. Baty II*

*Placement of concrete to the tilt-up panel forms is followed by vibration, screeding and floating for desired finish. Courtesy of Concrete Strategies, St. Louis, MO.*

A change is coming this year to the familiar ACI 318, *Building Code Requirements for Structural Concrete*, published by the American Concrete Institute. The existing format of ACI 318 dates back to the 1960s, and feedback from code users in recent years has made it clear that a modernized version is necessary. Especially for rapidly evolving parts of the industry, such as tilt-up construction, the new code should ensure greater overall consistency and accuracy.

But what exactly will be different? Here James Baty, technical director for the Tilt-Up Concrete Association, answers a few questions about the revised code.

***Q: Why are we hearing so much about ACI 318 right now?***

**Answer** ACI 318 is published in successive three-year cycles, and ACI 318-14 is being released soon. The reason why so much publicity surrounds this particular version is that the code has been completely reorganized. A herculean task for any document, but especially so for a code document with references and relationships connected from cover to cover.

*Prepared for concrete placement, the tilt-up panel forms permit visible inspection of all structural reinforcement required by the engineer of record and panel engineer. Courtesy of Panattoni Construction, Sacramento, CA.*

***Q: Why was such a major overhaul necessary?***

**Answer** The purpose of the reorganization was to distill the complex relationships of physical behaviors in materials and forces into compartmentalized design elements of a building. In real-world scenarios, once the overall structural system for a building has been determined, a designer considers the structure one piece at a time. Therefore, the code that directs the design – based on the behavior of any one of these elements – should maintain a logical focus for the designer. The existing 318 layout forces the designer to traverse an entire document to reference a variety of behaviors and sub-parts. In other words, a designer should be able to design a concrete column with information contained in one location within the code and be able to follow that design step-by-step in a logical progression. It is ineffective to have to design for one force and then go somewhere else in the code book to do a reference check on a separate analysis.

***Q: Can you give an example, specific to tilt-up, of how the previous version was cumbersome to use?***

**Answer** Tilt-up wall panels, primarily those used as load-bearing structures, are designed based on an analysis of not only the moments from applied loads, but also secondary moments due to the P-Δ effect. In order to proceed with the design of a common tilt-up wall panel spanning from roof to floor with no intermediate bracing, ACI 318 was first applied through Section 14.8 to determine the strength requirements. Based on these results, the designer then needed to check Section 9.3 and 10.3 for tension-controlled flexural members. Once the applied loads were determined, the

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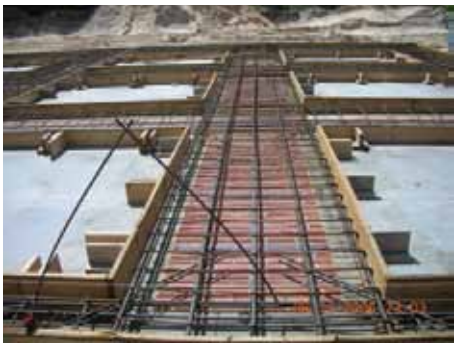

*Tilt-up panels are easily designed to accommodate large openings while maintaining performance of the perimeter structure. Courtesy of Panattoni Construction, Sacramento, CA.*

designer then used Section 9.2 to determine the controlling load combination. Once the vertical steel was determined, the designer headed back to Chapter 10 to check for the tie requirements around the vertical steel, and did a check against Chapter 21 for determining whether the panel would behave like a column or a beam. The behavior between panels and resistance to sliding or overturning forces were checked in Section 16.5, and the shear resistance in Chapters 11 and 21. All of this took place before connections were detailed in Appendix D. Of course, this is a simplification of the procedure, but it does demonstrate how well a designer must know ACI 318, as well as why there are some very good design guidance documents that have been produced in the last five years.

***Q: Can you give an example, specific to tilt-up, of a construction detail or process that has a more streamlined layout in ACI 318-14?***

**Answer** As presented by ACI staff engineers during the past several months, the new organization ensures each chapter will contain all requirements for a given building element. For example, there was a "Walls" chapter in ACI 318-11; however, it did not contain all of the requirements for walls. The designer had to read the requirements in the "Walls" chapter and understand how they modified the core behavior-based chapters (7 through 12) in order to meet the code. If the wall was precast or tilt-up concrete, the designer would also have to read Chapters 16 and 18 and understand how those requirements further modified Chapters 7 through 12 and 14. ACI 318-14 now has all of the information needed for walls in one chapter. An example of this simplification is the minimum reinforcement required for a wall. In ACI 318-11, the designer would have had to read Sections 11.9.8, 14.2.7, 14.3.1, 14.3.2, 14.3.3, 16.4.1, 16.4.2, 18.11.2.1, and 18.11.2.3 to have a complete understanding of the minimum reinforcement requirement. In ACI 318-14, all of these requirements have been moved to one location in an easy-to-understand table (11.6.1). The table is read from the left starting with the type of wall. Then the designer applies the conditions and limits as they move across the table to the answer on the right.

***Q: Will the new code help increase the use of tilt-up concrete?***

**Answer** I do expect this new code organization to simplify the design process so that a broader cross-section of engineers feels comfortable with the design procedure for tilt-up buildings. It should eliminate some of the frustration that can come with a complicated method of design. Certainly, it should also aid in the general response of design to condition rather than evidencing excessive design parameters for conservative engineers that do not have as strong a command of the intimate behaviors.

***Q: Will the new code be helpful as an educational resource?***

**Answer** Absolutely. This, perhaps, is one of the revision's most important aspects. There is no denying that talented and experienced engineers leading the industry have complete confidence in the use of and design response to the current code(s). However, tomorrow's building is already in the hands of the next generation(s) of talent, and therefore a document with more efficient design procedures and methodologies will only quicken their command of the medium and increase the level of their creativity for great and effective solutions.

***Q: One benefit of ACI 318-14 is that the new structure is expected to be easier to expand upon in the future. Is this particularly important to a rapidly evolving part of the construction industry, such as tilt-up?***

*Tilt-up panels, as the structural envelope, are secured with temporary bracing until all structural connections are completed.*

**Answer** Unequivocally, yes. The hardest part of updating a complex code is ensuring that a change in one section does not conflict or constrain the design intent in a later step. By maintaining an efficient focus on the design requirements and procedures for a given element, desired or needed changes can be more easily tracked through the process without losing sight of the net result.

***Q: Can you explain how ACI 318-14 will help ensure that buildings meet code requirements?***

**Answer** Perhaps the biggest impact that 318-14 will have on the general industry is ensuring that key elements of a design are not overlooked. The nature of a code is to ensure the effectiveness of an element for long-term serviceability and performance. Missing an important section for performance, behavior or a check means that, at some point, the design element may be conservatively designed and therefore less economical than it otherwise may have been. It also means that there could be a critical error in the potential behavior, perhaps caught by a specialty engineer or an experienced contractor resulting in change orders or having other ramifications. A code that provides more consistency – as well as assurance that all features of the design process are identified and easily referenced in logical succession – will only improve the relationship of that element to the meticulous code requirements that have been developed.

***Q: When can we expect 318-14 to come out?***

**Answer** Although there is never an official publication date for an industry document such as this, every indication from ACI is that it will be available for order in the late fourth quarter of 2014. The public is expected to see a review period this summer.▪