# Coordinating Tolerances

**Q.** *Who is responsible for coordinating construction tolerances on a project: the designer or the contractor?*

**A.** Tolerances establish permissible variations in dimension and location, giving both the designer and the contractor limits within which the work is to be performed. The designer specifies tolerances to convey to the contractor the performance expectations upon which the design is based or that the project requires.

One subcontractor's tolerances do not trump another subcontractor's tolerances. While neither is required to achieve perfection, each is required to complete the work in accordance with the tolerance specified for the work they have agreed to provide. Certainly, subcontractors cannot adjust each other's tolerances during the work. Each contractor has bid the project based on their specified (unique) tolerances, and it's likely that any change in tolerances during construction would be costly and extend the schedule.

As confirmed in the following documents, it is the responsibility of the architect/engineer, not the general contractor, to determine tolerance compatibility prior to issuing the project specification and accepting bids:

- ACI 347R-14, Section 5.3.1,[1] states: "The engineer/architect should be responsible for coordinating the tolerances for concrete work with the tolerance requirements of other trades whose work adjoins the concrete construction";
- ACI 117-10(15)[2] commentary states: "Compatibility—Designers are cautioned to use finish and architectural details that are compatible with the type and anticipated method of construction. The finish and architectural details used should be compatible with achievable concrete tolerances";
- ASCC Position Statement #18[3] states: "Contractors coordinate their own work, but they aren't responsible for adjusting tolerances or ensuring that tolerances for the work of other trades are compatible with their own work. Only the design professional can decide which tolerances are reasonable and compatible"; and
- ACI 117.1R-14, Section 3.2.2,[4] states: "It is critical that the architect/engineer account for tolerance requirements in the contract documents and develop details that provide for the required clearances and adjustability between concrete and other construction elements."

While the architect/engineer does not have an easy task, there are some opportunities to make that task easier. These include conducting a constructability review, holding tolerance coordination meetings, and using a bid allowance.

**Constructability review**—Karlson et al.[5] defines constructability as an effective and timely integration of concrete construction knowledge into the conceptual planning, design, and construction of a project to achieve the overall project objectives in the best possible time, with the highest safety, and at the most cost-effective level of quality. Thus, a constructability review should include people with expertise in concrete as well as those with expertise in materials and systems that interface with the constructed concrete. Further, review meetings should occur in the planning and design phases. Other trades that might interface with concrete include masonry; interior and exterior finish systems; and perhaps mechanical, electrical, and plumbing systems.

**Tolerance coordination meetings**—ACI 117.1R recommends a preconstruction tolerance coordination meeting that includes the owner, general contractor, construction manager, architect/engineer, concrete contractor, and all other subcontractors whose work will interface with concrete construction elements. Attendees should address the anticipated tolerance compatibility questions and conflicts applicable to their work so that tolerance issues are identified and resolved before concrete construction. Resolution of tolerance issues after the contract award may result in changes having to be made to the contract terms, which may affect one or more of the parties involved.

**Using a bid allowance**—A bid allowance is a popular concept used for coordination of Division 3 and Division 9 work for floor coverings.[6] While the concrete contractor may meet his or her tolerances as measured within 72 hours, the floor covering contractors will arrive on site 3 to 9 months later. Short- and long-term deflections can change the concrete contractor's work, resulting in challenges for the floor covering contractor. As a result, many contract documents now provide for a bid allowance to cover the gap between Division 3 and Division 9 work created by deflections. This

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concept could be extended to the coordination of Division 3 work with other interior and exterior finish systems.

A bid allowance alerts the owner that coordination, if required, will have costs; allows bidding to be executed on an equal basis; and enables the owner to keep the bid allowance if not needed. Currently, this approach is endorsed by the following organizations:

- Flooring Contractors Association;
- National Tile Contractors Association;
- National Wood Flooring Association;
- International Union of Bricklayers and Allied Craft Workers;
- Tile Contractors Association of America; and
- International Masonry Institute.

Other work that could be affected would include interior walls and ceilings as well as stucco (all covered in Division 9) and curtain walls (Division 8). Volume and temperature changes cause perimeter beams and columns to change their location as work progresses. Many multistory buildings have post-tensioned floors that shorten over time[4,7,8] and, as a result, change the slab edge location and column alignment (plumbness). ACI 117.1R indicates that the slab edge location can move (shorten) as much as 1-1/2 in. (38 mm) from its original location. These changes with time need to be considered in design when considering tolerances and architectural details.

When determining tolerance compatibilities for concrete structures and exterior finishes such as exterior portland cement plaster, two issues demand consideration. As indicated in ASCC Position Statement #18, there are different tolerances for plumbness in ACI 117 and in ASTM C926-20.[9] ASTM C926 calls out a concrete plumb tolerance of 1/4 in. in 10 ft (6 mm in 3 m), while ACI 117 allows a 3/8 in. in 10 ft (9.5 mm in 3 m) tolerance. This conflict should be addressed by the architect/engineer prior to starting construction.

In addition, the ACI 117 tolerance for offsets is often misunderstood. The offset tolerances originated in ACI Committee 347, Formwork, with ACI 347-68, Section 3.3.8,[10] which stated: "Offsets and fins resulting from displaced, mismatched, or misplaced forms, sheathing, or liners, or from defects in forming materials are considered abrupt irregularities." Offsets are generated by mismatched forms in a single placement, so offset tolerances do not apply at discontinuities at construction joints or differences between slab edges and column locations.

In conclusion, the coordination of tolerances is a design responsibility. While potential issues can be mitigated through open communications and remediation, remediation is a contractual obligation not assigned to any specific subcontractor. Further, remedial actions should be approved by the design authority prior to execution. Inclusion of a clause or an allowance for remediation in the contract documents may also be helpful.

## References


1. ACI Committee 347, "Guide to Formwork for Concrete (ACI 347R-14)," American Concrete Institute, Farmington Hills, MI, 2014, 36 pp.
2. ACI Committee 117, "Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary (ACI 117R-10) (Reapproved 2015)," American Concrete Institute, Farmington Hills, MI, 2010, 76 pp.
3. ASCC Position Statement #18: "Concrete Tolerance Coordination," American Society of Concrete Contractors, St. Louis, MO, 2009, 1 pp.
4. ACI Committee 117, "Guide for Tolerance Compatibility in Concrete Construction (ACI 117.1R-14)," American Concrete Institute, Farmington Hills, MI, 2014, 47 pp.
5. Karlson, L.G.; Connolly, E.F.; Garcia, C.M.; and Suprenant, B.A., "Defining Concrete Constructability," *Concrete International*, V. 40, No. 10, 2018, pp. 32-33.
6. ASCC Position Statement #6: "Division 3 versus Division 9 Floor Flatness Tolerances," American Society of Concrete Contractors, St. Louis, MO, 2003, 1 pp.
7. "Construction Tolerance Conflicts in Reinforced Concrete," Engineering Data Report No. 40, Concrete Reinforcing Steel Institute, Schaumburg, IL, 1995, 4 pp.
8. Suprenant, B.A., and Malisch, W.R., "Effect of Post-Tensioning on Tolerances," *Concrete International*, V. 31, No. 1, Jan. 2009, pp. 58-65.
9. ASTM C926-20, "Standard Specification for Application of Portland Cement-Based Plaster," ASTM International, West Conshohocken, PA, 2020, 14 pp.
10. ACI Committee 347, "Proposed Revisions to ACI 347-68: Recommended Practice for Concrete Formwork," *ACI Journal Proceedings*, V. 74, No. 9, Sep. 1977, pp. 397-434.


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