

Tolerances for Suspended Concrete Slabs

Concrete floors are often placed on a suspended structural system consisting of a metal deck supported by open-web steel joists, steel beams, or precast concrete members. Tolerances for the floors placed on these suspended systems are often misunderstood. ACI 117-90, “Standard Specifications for Tolerances for Concrete Construction and Materials,” gives only two tolerances for these applications:

- Thickness tolerance: $+3/8$ in. and $-1/4$ in. (for slabs 12 in. thick or less); and
- Flatness tolerance: F_F or gap under straightedge, depending on the floor profile class.

ACI 117-90 requires no level alignment tolerance for the concrete because levelness depends on the location and placement of the supporting structure and, after the concrete is placed, deflection of the supporting structure. The steel, precast erector, or both dictate the floor elevation relative to the design elevation. ACI 117-90 states that the levelness tolerance F_L shall not apply to slabs placed on a supporting structure that is unshored, cambered, or inclined. The final deflected shape of the slab influences the floor levelness and is not solely a function of the concrete floor placement.

Some designers add ACI 117-90 to their project specifications, but also require that the floor be placed level. This specification requirement is typically not consistent with the ACI 117-90 thickness tolerance. When floors are placed on a metal deck supported by open-web steel joists, maintaining a level surface requires extra concrete in the middle of the bay due to deflection of the structural frame. The added thickness of the floor may be $3/4$ in. or more, exceeding the $+3/8$ in. thickness tolerance.

The extra concrete increases costs and can add up to 20% more load to the columns and foundations,

which may not be designed for the added load. Using ASTM A 572 Grade 50 steel in a structural frame or using flexible metal deck open-web joists systems may be an economical steel design, but might increase the total project cost due to the extra concrete needed and the higher column and foundation loads. Designers should evaluate these factors before requiring a level floor surface in their specifications.

If the project specifications do not require the floor surface to be placed level, contractors will provide a uniform concrete thickness that meets the thickness and flatness tolerances. ASCC contractors caution designers that level concrete toppings placed on cambered precast panels or tees will be thicker at the ends of the precast members than in the middle. The thicker topping may bury embedded conduit sleeves, and—at openings—stairs, or other prefabricated items may not fit due to the change in elevation.

If the project specifications require a level floor, a tolerance must be assigned. ASCC concrete contractors recommend using the ACI 117-90 level alignment requirement that the elevations of the top surface fall within a $\pm 3/4$ in. envelope. This envelope is not related to design elevation. It simply requires that all elevation measurements on the slab surface vary by not more than $3/4$ in. from the average elevation.

For further information on these issues, see “Construction of Elevated Concrete Slabs,” a three-part series in *Concrete Construction*, November 1990, January 1991, and March 1991; “Controlling Deflection of Composite Deck Slabs” in *Concrete Construction*, September 1997; and ACI 302.IR-04, “Guide for Concrete Floor and Slab Construction.” ASCC concrete contractors will work with all parties in addressing these issues. If you have any questions, contact your ASCC concrete contractor or the ASCC Technical Hotline at (800) 331-0668.