

Technique No. 2 January 1998 (Revised July 2012) Flatness and Levelness of Concrete Subfloors to Receive Resilient Flooring

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Flatness and Levelness of Concrete Subfloors
to Receive Resilient Flooring

I. HISTORY

For over 50 years, concrete floor surface tolerances were typically measured and described by the maximum gap allowed under a 10-foot (3-meter) long straightedge placed anywhere on the floor. This manual method was difficult, especially for large areas, and often results were deceptive, too stringent, and not reproducible. Clearly, a better measurement technique was needed.

During the 1970's and 1980's, sophisticated instruments were developed to measure floor flatness, particularly in response to the need for producing super flat floors in high storage rack, narrow aisle warehouses to control the sway of moving forklifts. There are two accepted measurement methods using such instruments today. One is described in the latest edition of the ASTM E 1155 "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers." The other measurement method is described in the latest edition of the ASTM E 1486, "Standard Test Method for Determining Floor Tolerance Using Waviness, Wheel Path, and Levelness Criteria."

II. THE F-NUMBER SYSTEM

The American Concrete Institute now recommends that flatness and levelness be described using the F-Number System as outlined in the current editions of ACI 302.1R and ACI 117R. This system identifies two numbers: FF controls local surface bumpiness (or waviness) by limiting the magnitude of successive 1-ft (300-mm) slope changes. FL controls overall levelness by limiting differences in the average of 10-ft (3-m) elevations along sample measurement lines.

The current edition of ACI 117R (Commentary) states: "None of the conventional concrete placement techniques in use today can adequately compensate for form or structure deflections that occur during the concrete placement and, for this reason, it is inappropriate to specify levelness tolerances on unshored floor construction." 1 For concrete slabs receiving resilient floor covering, therefore, it is most important to describe limits of floor flatness.

... In practice, FF and FL values generally fall between 12 and 45. The scale is linear, so that relative flatness/levelness of two different floors will be in proportion to the ratio of their F-numbers. For example, an FF 30/ FL 24 floor is exactly twice as flat and twice as level as an FF 15/ FL 12 floor.²

III. GUIDELINES FOR F-NUMBER SUBFLOOR FINISH TOLERANCES UNDER RESILIENT FLOORS

The current edition of ACI 302.1R gives F-number results that can be achieved by following various slab construction procedures. It recommends that slabs to receive thin-set flooring with moderate or heavy traffic have composite flatness and levelness of FF 35/FL 25. However, it also advises

that the selection of the proper FF/ FL tolerances for a new project is best made by measurement of a similar satisfactory existing floor.

The "Evaluations" Part of MASTERSPEC[®] Guide Spec Section 03300, Cast-In-Place Concrete, has a guide to floor flatness and levelness tolerances for various floor use categories. It recommends a minimum FF 20/FL 17 for subfloors receiving thin coverings that will not mask the subfloor condition. (Some industry sources suggest these limits are too low because subfloor ripples begin to telegraph through highly reflective coverings when FF is in the mid-20's range.)

SPECTEXT[®] Guide Spec Section 03346, Concrete Floor Finishing, includes "Appropriate Options for Slabs Under Various Floor Finishes." It recommends a minimum FF75 /FL 50 under glossy resilient finishes, and a maximum variation using a straightedge of 1/8" to 1/4" under seamless resilient flooring. (These F-numbers are much higher than other industry guidelines and may be too expensive to accomplish and unnecessary where thin floor coverings are to be applied.)

At a World of Concrete seminar in 1992, it was proposed that slabs on grade where vinyl tile is used in places such as public areas of shopping centers and hospitals should have a specified overall value of FF 36/ FL 20 and a minimum local value of FF 24/ FL 15.3 (Experience shows that these values may be appropriate where resilient floor coverings are employed.)

IV. WAVINESS INDEX

Another more recent measurement method is described in the current edition of ASTM E 1486. This method was developed primarily to measure floor surface wavelengths from 2 to 10 feet--- those that most affect forklift ride ability at typical speeds on floors designed for random vehicular traffic. Proponents of this method have submitted proposed guidelines to ACI Committee 117 suggesting tolerance standards. These guidelines include the recommendation that concrete floors with vinyl tile covering be specified with a Surface Waviness Index (SWI2-10) of 0.12 inches. This is approximately equivalent in the tested area to FF 28/FL 20 and to a 1/4" gap permitted under a 10-foot straightedge.