Concrete Slab Profile Quality

Introduction
All finishes, equipment, partitions, and furniture in a facility rest on the floor slab, either directly or indirectly, so the slab must provide a flat and level bearing surface. If a slab surface is not flat and level, full contact cannot be achieved and shims, leveling legs, scribed trim pieces, and other methods of installation must be used. An uneven surface profile will also pond water and negatively impact the aesthetics and detailing of flooring. To avoid these issues slabs must be appropriately flat and level, especially in high performance facilities.

The surface profile of a slab is generally the result of workmanship and is under the control of the concrete contractor. It is incumbent of the designer to determine the required characteristics of the slab and include them in the construction documents.

In older specifications the maximum allowable surface unevenness was defined as a 1/8” deviation in 10 feet. This metric is problematic because it is not reliably replicable; it depends on where on a slab a 10-foot straight-edge is placed. However, with the advent of computerized profile measurement instruments, the quality of a slab surface can be determined more objectively and specified using F-numbers.

F-Numbers
A slab surface can vary in either flatness or levelness, and the values of each are quantified as F-numbers (Figure 1). F-numbers range from low (bad) to high (good) and should be specified appropriately for the use of the space. Very high F-numbers are costly to achieve and should only be specified where necessary in critical facilities. All slabs should have a specified F-number so that appropriate surface profiles are defined and achieved.

After the installation of a slab, profiling instruments take measurements in multiple perpendicular directions (figure 2). The F-number values for that slab are determined based on an analysis of the resulting measurements.

Flatness is a measure of waves or roughness in the concrete surface. The F-number measure of flatness is \( F_F \). \( F_F \) range from 10 to 150. As a point of reference, \( F_F \) 50 is roughly equivalent to the traditional 1/8” deviation in 10 feet.

Levelness is the degree to which a slab tilts or pitches and varies from true level. The F-number measure of levelness is \( F_L \). \( F_L \) also range from 10 to 150.

Resources
ASTM E1155: Standard Test Method for Determining \( F_F \) Floor Flatness and \( F_L \) Floor Levelness Numbers - This test covers a quantitative method of measuring floor surface profiles to obtain estimates of the floor’s characteristic \( F_F \) Flatness and \( F_L \) Levelness.

American Concrete Institute ACI 117: Specification for Tolerances for Concrete Construction and Materials - This specification provides tolerances for concrete installations including slab surfaces.