As building owners become aware of the benefits of superflat defined-traffic specifications for concrete floors, the popularity of these specifications will continue to grow.

Understanding Specifications for Superflat Floors

Beware of specifications for random-traffic floors when superflat (defined-traffic) tolerances are needed

BY TERRY FRICKS

Many floor slab specifications in the United States now include the F-number system to identify surface tolerances. There are two basic floor categories: random traffic and defined traffic.

The vast majority of the floors in the United States are classified as random traffic. Forklift or pedestrian traffic is able to move across the surfaces of these floors in any direction. Random-traffic floors typically are found in warehouses, manufacturing plants, schools, hospitals, and shopping centers. Defined-traffic floors are usually only required for specialized applications, such as very-narrow-aisle (VNA) warehouses, where forklifts travel the same path, day after day.

Currently, fewer than 1% of the floors constructed in the United States are classified as defined traffic. However, their popularity is growing as owners become more aware of the benefits associated with them. In VNA warehouses, forklifts travel 6-foot-wide aisles between storage racks with the aid of rack-mounted rails or a wire guidance system embedded in the floor. The lift-truck dimensions are approximately 5 feet wide and 7 feet long. While moving down the aisles, these lift trucks can raise their forks to retrieve or place products at various levels. For these forklifts to perform as intended, defined-traffic floors must be extraordinarily flat and level, or superflat.

What Are Superflat Tolerances?

For a contractor to successfully construct a superflat floor, the floor must be properly specified.

CURRENTLY, FEWER THAN 1% OF THE FLOORS CONSTRUCTED IN THE UNITED STATES ARE CLASSIFIED AS DEFINED TRAFFIC.

However, one of the most common mistakes is for specifiers to call for random-traffic tolerances when superflat tolerances are needed. This mistake usually results from a misunderstanding of requirements or an attempt to save money. Unfortunately, almost no information is available to the writer of superflat specifications; very little can be found on the subject in American Concrete Institute or ASTM standards. This lack of information usually causes confusion.

Lift-truck manufacturers publish recommended floor tolerances to ensure the proper operation of their equipment. This information often adds to the confusion. Unlike random-traffic floors which have F_F and F_L requirements, superflat is a minimum tolerance and should be written as follows:

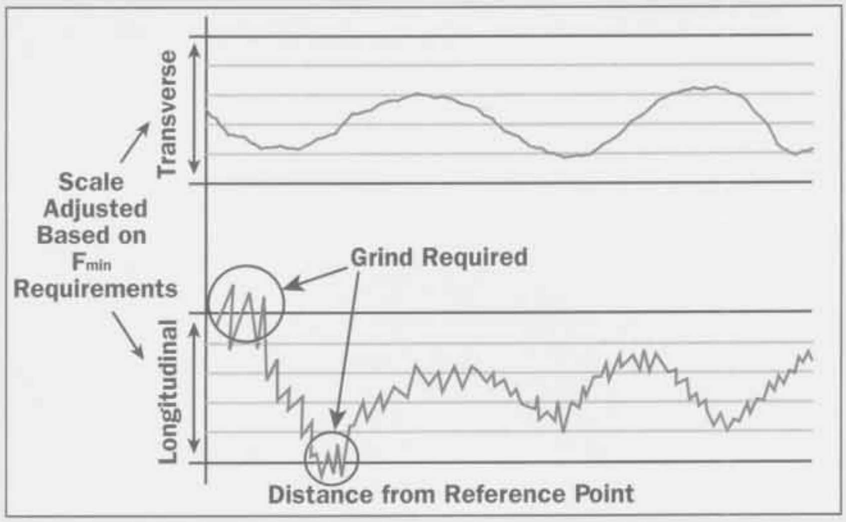
Example: F_{min} 100
or
F_{min} 60

The higher the number, the flatter *and* more level the floor. The most common tolerance is F_{min} 100, with F_{min} 50 being about the lowest number used.

Since the lift truck travels the same route over and over, the smoothness of the wheel paths in superflat aisles becomes extremely important. Although superflat slabs are placed in long, narrow strips approximately 15 feet wide, tolerance only needs to be confirmed in the wheel tracks. Changes in wheel elevation and the rate of change must be specified and confirmed in both the transverse and longitudinal directions.

Superflat F_{min} 100 tolerance is based on a ⅛-inch change in ele-

F_{MIN} MEASUREMENTS

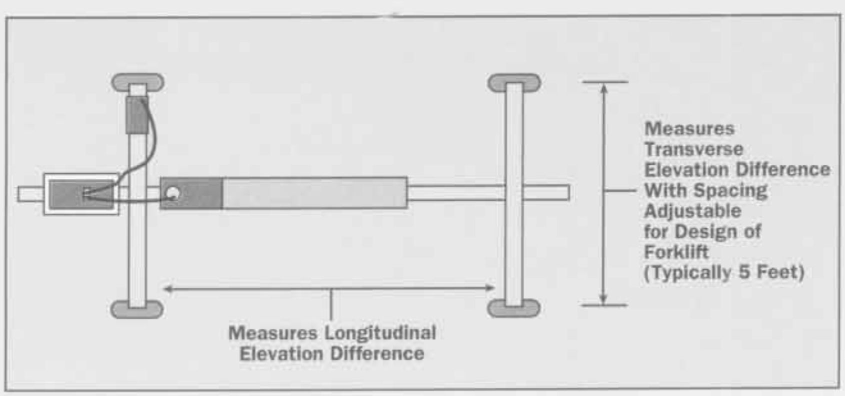


After construction of a defined-traffic concrete floor, the F_{min} is not calculated like the F_F or F_L measurements of random-traffic areas. The F_{min} is actually a direct measurement of the floor surface in the wheel paths of the vehicle for which the defined-traffic area was designed.

An F_{min} 100 specification is a baseline number corresponding to a flatness tolerance of ⅛ inch in 10 feet. Lower defined-traffic area tolerances result in lower F_{min} requirements (for example, an F_{min} of 50 corresponds to ⅛ inch in 5 feet, or ¼ inch in 10 feet).

The wheels of the profilograph, along with the scale and band widths on the profilograph trace, are adjusted for the F_{min} requirement and distance between wheel paths. The profilograph continuously records the difference in elevation between the wheels in both the longitudinal and transverse directions. Since the machine records elevation *differences*, the trace is not actually a true profile of the floor surface.

An F_{min} number is not usually reported for a defined-traffic floor; as long as the trace stays within the band, the floor meets the required F_{min} flatness. Spot grinding is required in areas where the profile trace moves outside the band.



vation from a level plane 10 feet in length. The wheels of most VNA lift trucks are 5 feet apart, requiring a tolerance of 1/16-inch change in elevation. The tolerance is changed to correspond with the lift-truck dimensions.

Common Specifications Errors

Contractors should beware of superflat specifications that should actually be random-traffic specifications. Superflat slabs are not equally flat everywhere, and tolerances are measured only in wheel tracks in one direction. Producing a floor surface that meets the F_{min} 100 (defined-traffic) tolerance in any direction on the floor is comparable to producing a floor surface meeting F_F140/F_L100 (random-traffic) tolerances (measured according to ASTM E 1155).

These F_F/F_L tolerances would be extremely difficult to achieve, especially if measurements included the construction joints. Television-studio floors require this type of specification, but these floors usually have been overspecified. Realistically, random-traffic floors should be specified at a maximum tolerance of F_F 70/F_L50.

Contractors as well as specifiers should understand that F-100 is not the same as F_{min} 100. An F-100 floor is much more difficult for the contractor to build, and it may not meet the owner's requirements. To save money, a lower random-traffic tolerance might be substituted for the F_{min} 100 tolerance. This usually is a mistake. Instead, a lower defined-traffic tolerance may be a better option.

Many VNA lift trucks will operate satisfactorily on a floor measuring less than F_{min} 100. In the early days of superflat specifications, a contractor's construction methods and associated costs were about the same for all superflat floors. In other words, an F_{min} 60 floor cost the same to build as an F_{min} 100 floor. As superflat-floor contractors have gained experience over the years, they have fine tuned their procedures and can now offer cost savings for lower-tolerance superflat floors.

Before bidding a project, contractors should have a clear understanding of how superflat surface tolerances will be confirmed, and they should be familiar with the measuring equipment to be used. Remember, only the wheel track of an F_{min} specification is confirmed. The confirmation of a random-traffic floor is based on random measurements and statistical information; it does not determine how a lift truck will perform in a defined traffic path.

To verify compliance with the minimum superflat requirements in defined-traffic aisles, use a continuous-recording floor profilometer configured to run in the traffic wheel tracks. Do not use equipment designed to measure random-traffic areas.

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Confirming Superflat Tolerances

Several instruments are available for accurately measuring random-traffic floors, but these instruments should not be used for measuring defined-traffic floors. Instead of a random sampling, each of the traffic paths should be directly measured, using a continuous-recording floor profilometer configured to run exactly in the wheel tracks.

As the profilometer rolls down the floor, it measures and records both the transverse and longitudinal elevation differences of the wheels. The results of the measurements do not produce F-numbers, but simply confirm compliance with the minimum requirements.

A tape produced by the profilometer tells the contractor if the work is "in tolerance" or not. The tape identifies the exact locations of any defects so the contractor can grind these areas to meet the tolerance.

Attempts have been made to measure defined-traffic floors with equipment designed to measure random-traffic areas. This method does not work very well because the equipment must first measure and record information from each wheel track independently. This information, along with the elevation difference of the two starting points, is then interpreted and compared using computer software.

This method would be more reliable if there were no errors associated with the measuring equipment, but even the finest measuring instruments are allowed some margin of error. Errors are compounded as the measuring equipment travels farther from its starting point. This is especially true of the rolling equipment designed to measure random-traffic areas. Imagine trying to identify and correct an area that may only be a few thousands of an inch out of tolerance but is measured from a starting point that is several hundred feet away. Error is minimized with the continuous-recording profilometer because it measures elevation differences as it rolls along the aisle.

Corrective Grinding

It is impossible to produce superflat floors without imperfections. Superflat specifications should allow the use of a grinder to correct areas that are out of tolerance.

Corrective grinding should be minimal and is only required in the lift-truck wheel path. Some specifications allow for a maximum grinding amount of 15%. All percentages are based on aisle lengths, not individual wheel tracks. The average amount of grinding is about 3% to 5%, with experienced contractors grinding less than 2%. In addition to the experience of the contractor, the amount of grinding is directly related to the quality of the concrete materials and working conditions.

Areas to be ground are normally small and often require removal of only 0.010 to 0.020 inch. These areas are easily identified when the proper measuring equipment is used.

Misunderstandings will be avoided if specifications are written and interpreted properly. Both specifier and contractor should be familiar with standards and procedures. The best specifier or contractor in the world will not be able to meet or exceed expectations if they are the wrong expectations.

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