



PHOTO: SCOTT BAUER

Flatness and Levelness + Durability =

LONGEVITY

CONCRETE FLATNESS AND LEVELNESS DOESN'T GUARANTEE A QUALITY, LONG-LASTING FLOOR.



Owners, designers, and builders of warehouses and distribution facilities often perceive that the quality of a concrete floor is defined by its surface flatness and levelness.

The reality, however, is that flatness and levelness numbers only define the surface profile of a floor and don't guarantee the overall quality. In many cases, efforts to produce extreme flatness actually can reduce the floor's surface durability and serviceable life.

Other factors, such as durability, should be considered. Why flatness is so often used to judge quality is understandable. F-numbers are easy to understand; they can be specified before construction and confirmed during a project, and easily used as the basis for acceptance.

F-numbers became critical with the development of material handling concepts, such as very narrow aisle (VNA) warehouses, that required superflat tolerances for defined traffic floors. As distribution and lift truck technology advanced, flatness and levelness requirements became important for random traffic floors as well. The F-number system was developed to specify and measure surface profiles. Designers began to specify a higher level of flatness for the construction of concrete floors to increase operating productivity. They also began seeking a select type of concrete floor contractor who could deliver floors constructed to the higher tolerances.



Quality Floor Construction Awards

Flatness award programs have been good for the floor construction industry. The Fricks Co. Inc, Fort Worth, Texas, which I founded more than 30 years ago, has won numerous awards for flatness and we are proud of each one.

However, I challenge the floor construction industry to raise the bar for defining exceptional floor construction quality. The industry needs some form of recognition that rewards quality specific criteria, such as durability, abrasion resistance, and other standards, that promote performance.

Projects should be judged and awards given by a committee of unbiased industry authorities. The floor construction industry needs a standard by which to award exceptional concrete floor construction.

Twenty five years ago, F-numbers revolutionized the floor construction industry. Finally there was a way to confirm specified surface tolerances. To achieve high F-numbers, contractors needed to pay more attention to detail. Tighter controls on concrete mix designs and delivery had to be considered. All the components of floor construction would have an impact on the ability to meet specified tolerances. The industry also learned the value of a controlled placing and finishing environment. As a result, the overall quality of floors improved. F-numbers were the driving force for the development of the finishing equipment used today.

Requirements that were once very difficult to achieve now are easily attainable, thanks to tools such as the laser screed and double rider trowel

machines with pans. Years ago, the advancing technologies of lift trucks and distribution design challenged the floor construction industry. Today, however, the reverse is true--the advanced technology of floor construction easily exceeds lift truck requirements. F-numbers are easily achievable; the tendency in recent years is to specify higher F-numbers than necessary. There is no real benefit to a higher F-number beyond what is specified by the lift truck manufacturers. When high F-numbers become the primary focus, proper finishing procedures often are modified and shortcuts taken. When this happens, surface durability suffers.

The correct F_F and F_L numbers are critical to a floor's performance. However, when the dust settles following construction, retainage is paid and



Tighter controls on concrete mix designs, delivery, and placement result in higher quality floors.

PHOTOS: SCOTT BAUER



Flatness tolerances need to address the profile of the floor at construction joints.



Long-term durability of the concrete surface can be accomplished with proper finishing techniques.

awards are presented. End of story? No. More is needed! Durability must be considered in order to guarantee longevity and reduce maintenance of the floor. Of course, this statement raises questions. What is durability? How is it measured? How is it specified?

Defining durability is simple. Durability is the ability of something to resist wear and tear. Measuring durability is difficult. Durability can't be measured with a machine or instrument for instant verification. It can't be seen or confirmed until after the floor is put to use. So the industry must use empirical knowledge and experience. For this, contractors must look to the people who own and operate facilities for feedback. A good source for this are people in the food industry. Yes, food. No one understands the

importance of concrete floor quality better than owners of food or perishable goods distribution facilities where there is demanding, round the clock floor traffic. In this environment, the benefits of a true quality floor quickly are seen. Food people will tell you that along with flatness, durability, abrasion resistance, and joint performance equal quality and longevity.

A variety of factors, including design, materials, placing environment, and construction techniques, can lead to cracked, curled, and broken down

floors. Deficient floors with inferior joints damage precision lift equipment and wheels, adversely affecting productivity and through-put. Owners who save a few dollars on a lesser quality floor design and installation ultimately pay more in operating cost over the life of the facility.

To specify durability, feedback from customers about their expectations is needed. When expectations include durability and longevity along with flatness, specifications must be more specific and include more details.

Quality specific requirements

What constitutes a quality floor and how do you achieve it? The following attributes and considerations help to contribute to a floor's overall superior quality.

Concrete mix. Specifying a performance-based mix design is critical to a quality floor. Knowledgeable floor contractors have a good understanding of local materials and know the importance of maintaining the correct concrete mix design. Shrinkage and cracking are reduced when the amount of paste (cement, sand, and water) in the mix is reduced. This can be accomplished with properly graded aggregates, proper proportioning of the coarse and fine aggregates, and in some cases, use of larger coarse aggregate.

Joints. Joints are usually the first area of a distribution floor to deteriorate,



Properly designed and constructed joints are critical to achieving a durable floor. PHOTO: MIKE HAAG

and joint repair is very costly. Failed joints are the leading cause of lift truck and other material handling equipment repairs. Joint spacing and location must be considered, keeping as many as possible out of harm's way. There must be load transfer devices embedded in the concrete, such as diamond plate dowels

at all joint locations (construction and contraction joints). This can be accomplished at contraction joints (sawed joints) with load plate baskets. The joints exposed to forklift or pallet jack traffic should be armored to protect them.

Use fewer joints if possible by using shrinkage compensating concrete—a

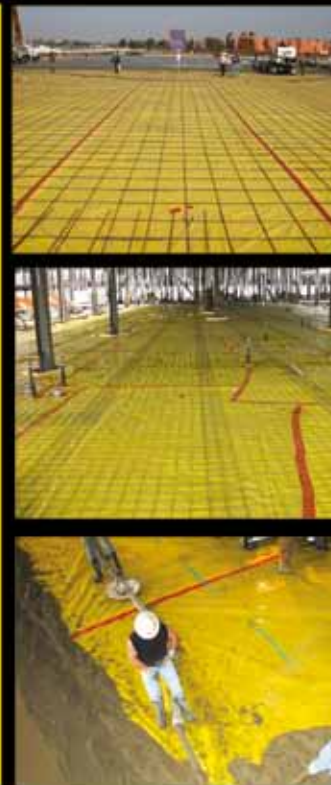


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system very popular in the food industry. All sawed contraction joints are eliminated with this system. Shrinkage compensating concrete systems are designed with 90% fewer joints. With fewer joints, thousands of dollars can be saved in maintenance costs.

Flatness. The flatness and levelness of the floor are very important to the performance of the material handling operation. However, the correct F-numbers must be specified for the intended use. Recently, the tendency has been to specify higher numbers than needed. Current flatness tolerances also fail to address the profile of the floor at construction joints, where measurements start and end 2 feet from the joints. This may be okay for foot traffic but not for floors supporting forklift traffic. For high-traffic floors, specifications should require measurements extend to the joint with additional measurements across the joint.

Finishing. Long-term durability of the concrete surface can be accomplished with proper finishing techniques. With modern equipment, it is possible to produce a floor surface that is flat and shiny but not durable. When shortcuts are taken, durability is sacrificed. There are several steps involved and each must be timed properly. The goal is to create a very hard and dense wearing surface. To do this, a gradual transition from the finest particles of paste at the surface to the coarse aggregate below is needed. Finishing should start with floating followed by panning as an intermediate step. Panning should be discontinued early enough to consolidate the surface with combination blades. Burnishing, the final step, can be done

with finish or combination blades. No water should be added to the surface at any time. The timing and duration of each step is critical.

Surface durability. To further enhance surface durability, a mineral aggregate hardener, such as traprock, can be specified and incorporated into the surface during finishing. A two-coarse floor with dewatered topping is an option for extreme cases where concentrated traffic is anticipated.

Subgrade. Floors will not remain flat and level, nor will they perform as intended, if placed on inferior subgrade. Soil condition should be confirmed before the floor slab is designed. A good stable base material that supports construction equipment should be provided and maintained during construction of the floor.

Controlled construction environment. Experience says better quality is achieved when floors are built in a controlled environment. Although this is not always possible, when walls are up and the roof is on, results are much more predictable.

Demand more from your floor

Demanding more will yield exceptional results. Establish detailed quality specific requirements involving joints, specific concrete mix criteria, reinforcing type and location, abrasion and impact resistance, proper placing and finishing techniques, curling and shrinkage limits, and other factors mentioned earlier.

Look for designers and contractors specializing in building superior concrete floors. Seek professionals with experience in specifying and building floors for the type of use expected in the facility. Design for functionality and economics. The additional capital cost to build the right concrete floor will pay for itself in a short time.

Don't be misled by the perception of quality by flatness. Demand more from your floor. **CC**

Terry J. Fricks is the founder and past president of The Fricks Co. Inc., Fort Worth, Texas.

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