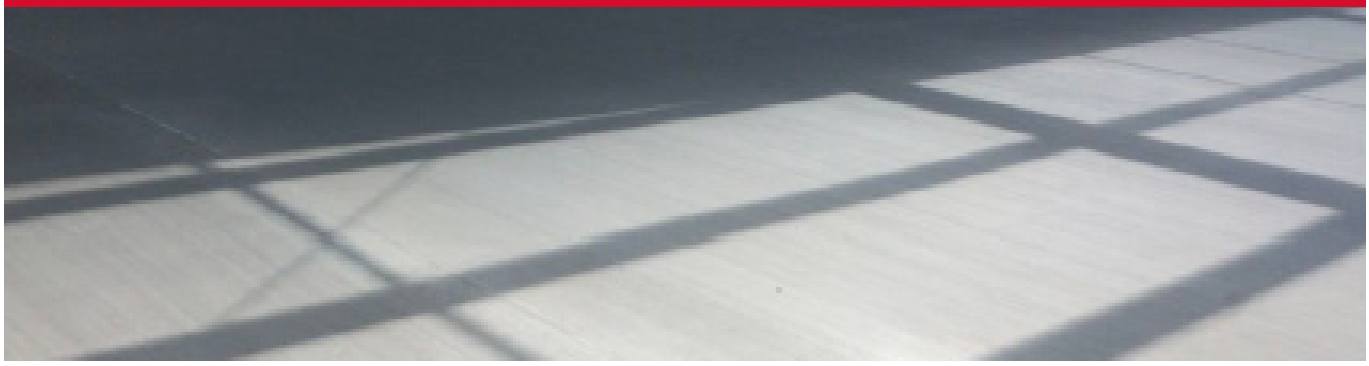
THE FIRST YEAR IN THE LIFE OF YOUR NEW FLOOR

METZGER/McGUIRE

2017 LTD LESA SYSTEMS
ENGINEERED CONCRETE FLOOR SYSTEMS



As owner or manager of a new industrial facility, you are probably still in the process of settling in. Although you may not have noticed, your concrete floor is also adjusting to its environment.

Have you looked at your floor recently? If you do, chances are you will notice cracks that weren't there when you first moved in. You may also see that the filler in your floor joints has separated from the concrete edge. When vehicles cross joints, you may hear a "thump" or feel the slab vibrate.

Should you be concerned about these changes? Should you contact the architect, engineer, or general contractor? Should you ignore the possible problems, or attempt to correct them?

The purpose of this article is to tell you about your floor, how it was built, why see changes, what the changes mean to you and what, if anything, you should do. Consider this article a primer on floors, an owner's manual. Our focus is on joints and cracks since these constitute more than 70% of owner floor problems.

WHAT IS A CONCRETE FLOOR SLAB?

A concrete slab is comprised of cement, coarse and fine aggregate, water and possibly additives. Your floor may or may not be reinforced with steel (mesh, rebar, etc.). After the concrete was placed, it was densely finished on the surface and then cured. The process sounds simple, but it's not.

Placing a concrete floor is much art as science. Due to variables such as people, material, mix design, weather, grade conditions etc., no two floors are ever precisely the same. But the one constant is that for at least the first year or two, your floor will undergo changes, it may settle, it will get harder, and it will shrink in size.

FACT #1 - ALL FLOORS SHRINK

All concrete mixes include a significant amount of water, which is needed for workability and to make the cement react. When the concrete hardens, it still contains much of this water, which will eventually evaporate over an extended period. As the water evaporates, the result is that the concrete shrinks in lateral dimension. All floor slabs shrink, including yours. The big questions are how fast and how much.

HOW FAST?

After the concrete is placed, an effort will be made to initially retain the water until the cement is fully reacted (hydrated). This process is called "curing" the slab. Proper curing yields a stronger, more durable floor. After the curing process, the shrinkage rate of the slab escalates initially, and then progressively slows down.

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JOINT FILLER
Technical Bulletin 4

CONCRETE SLAB SHRINKAGE RATE

One Portland Cement Association (PCA) study indicates that a 150mm slab-on-grade has a typical shrinkage rate of:

First 30 Days	15%
Next 335 Days	50%
Total, One Year	65%

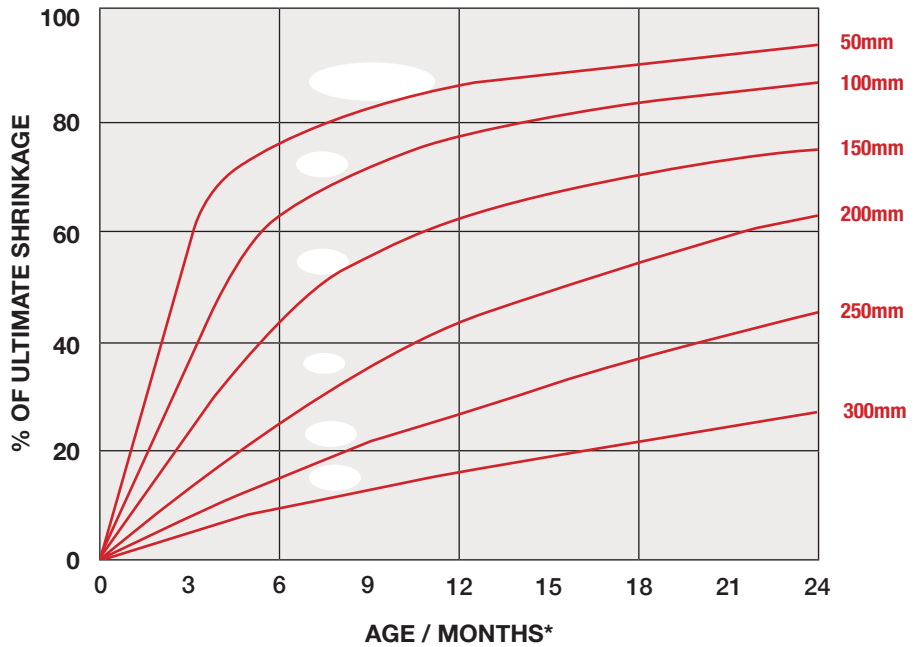
YOUR FLOOR IS SHRINKING AS YOU READ THIS ARTICLE!

HOW MUCH?

How much a slab-on-grade will shrink in dimension will depend on a number of variables, including, but not limited to, slab thickness, water-to-cement ratio, size of the large aggregate, etc. As a general rule, you can assume that a 150mm conventional thick slab will shrink 3.0mm to every 6.0 lineal metres.

TECH NOTES

A 200mm thick slab will shrink at a slower rate than a 150mm slab, if all other factors are equal.



*Drying in Laboratory Air From PCA Dev. Dept. Bulletin 103

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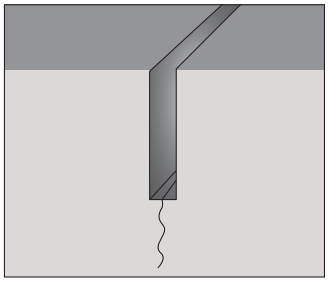
FACT #2 - SHRINKAGE MEANS CRACKING

Imagine taking a section through your floor slab. Since the top of the slab is exposed to the air, allowing moisture to evaporate, it can dry fairly rapidly. As it dries out, tension is created on the surface. The bottom is also shrinking, but at a slower rate, creating additional tension and can cause cracking of the slab.



CONTRACTION / CONTROL JOINTS

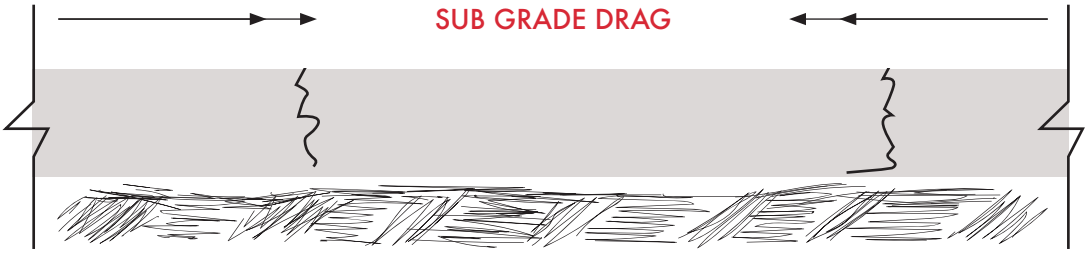
To relieve the shrinkage tension in long runs of concrete, the slab is cut into smaller segments. These cuts are called contraction (control) joints. They weaken the slab at regular intervals, causing the slab to crack beneath the cut instead of randomly. Thus, a control joint can be considered a designed crack.

A contraction/control joint must be cut deep enough to weaken the slab, and early enough before shrinkage tension exceeds the tensile strength of the concrete to be effective. If not, random cracking will occur. But proper jointing doesn't always prevent all cracking.

There are numerous reasons for cracking, including:

A. SUB-GRADE DRAG

As a slab section contracts, it drags across the base it has been placed on. If that base is uneven, restraint is caused that could result in slab cracking.



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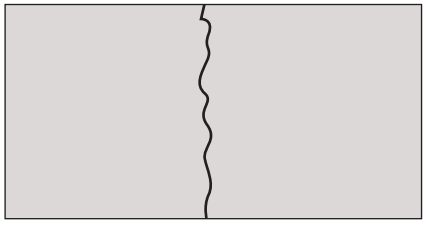
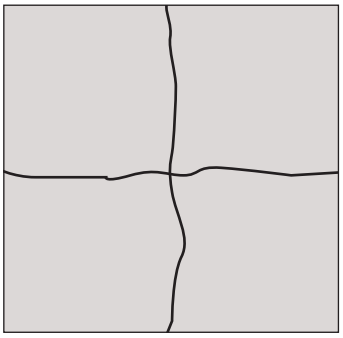


IRREGULAR PANEL SHAPE

B. IRREGULAR PANEL SIZE

Concrete shrinks at an even rate on the top and at another even rate on the bottom. If a slab panel is rectangular in shape, uneven shrinkage stresses could occur and result in cracking.



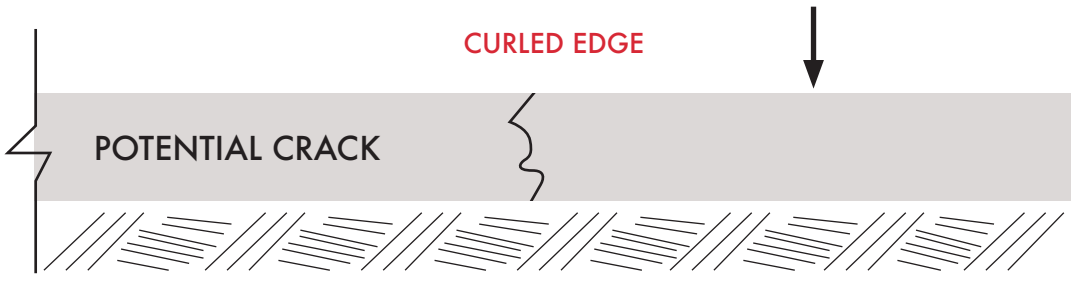
OVERSIZED PANELS

C. JOINT TOO FAR APART

PCA studies have resulted in charts showing the proper joint spacing for slabs-on-grade. Proper spacing will depend on may variables related to shrinkage rates (water-cement ratio, aggregate size, slab thickness etc.) If joints are spaced too widely, cracks can occur even in square–shaped slab panels.

D. JOINT EDGE CURL

We stated earlier that the top of a slab shrinks at a faster rate than the bottom. As shrinkage occurs, it is entirely possible that tension from the rapid shrinkage on the top can pull the slab edges upward, this is called curl.



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If the edge raises too far off the grade, imposed loads can cause the slab to crack. There are numerous other causes for cracking. It may take an expert to determine the causes of your cracking.

But there are several things you need to know about cracking:

1. Most cracks, if narrow, will not affect the structural integrity of your slab.
2. Reinforcement (steel mesh, rebar, etc.) will not prevent cracking. It merely keeps the cracks tight.
3. Most cracks are wider at the top than at the bottom due to shrinkage rate differential. In fact, many cracks never extend to the bottom of the slab.

Cracking is a normal function of concrete shrinkage. Cracks do not make a floor bad unless they interfere with operations or lead to surface problems.

FACT #3 - SHRINKAGE WIDENS JOINTS

We stated earlier that contraction/control joints are, in essence, designed cracks to compensate for anticipated shrinkage. We also stated that shrinkage is a long-term phenomenon, with significant shrinkage lasting about two years. Thus, it can also be presumed that joints will continue to open for several years.

Let's assume that your contraction/control joints in 150mm slab were cut with a 3.0mm wide diamond blade at 6.0m centres. You can expect that 3.0mm joint to eventually open to a 6.0mm wide. This fact will have a profound effect on your joint filler.

FACT #4 - SHRINKAGE AFFECTS FILLERS

The present American Concrete Institute (ACI) and PCA recommendations call for the use of a semi-rigid epoxy joint filler for the joints in industrial concrete floors. The function of the filler is to refill the cuts and thus support wheel loads as they pass from slab panel to panel. The filler also supports and protects the joint edges against damage caused by hard wheel impact and loads.

TECH NOTES

The timing of joint filling often relates to project size. Smaller buildings take less time to complete, and thus filling is done earlier. ACI recommends that joint filling is deferred as long as possible; later is better.

To provide this support the filler, must be fairly stiff (semi-rigid). Our MM-80 semi-rigid epoxy was developed in the late 60s for floor joints and remains the standard for the industry to this day. But MM-80's load supporting relative hardness also means it has minimal expansion capability and will not expand as the joints open wider due to shrinkage. The same is true of all other semi-rigid fillers.

In a typical construction project, the floor joint filling is performed when concrete is still relatively new, with most of its shrinkage yet to come. As the joints open wider, something must yield, preferably not the concrete. Thus MM-80 is designed to separate adhesively from the concrete. It usually separates in a leap-frog pattern, jumping from, side-to-side.

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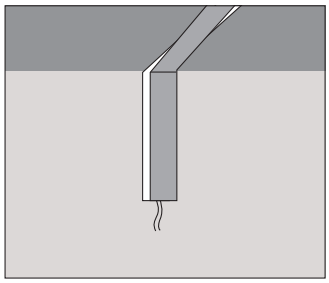


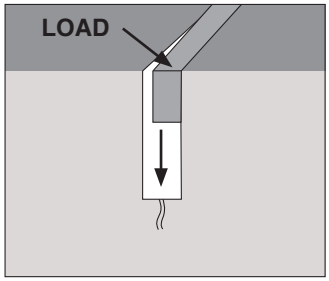
JOINT FILLER SEPARATION

If this is what your joint filler looks like, the MM-80 (or other filler) is performing as intended. Joint filler separation is not a failure- it is a practical solution to the inevitable concrete shrinkage.

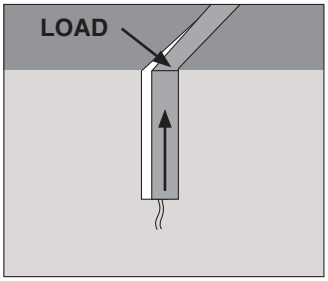
It is important at this point to explain the proper method of joint filling.

We know that the floor will shrink, and we know the filler will separate. So how can the filler still be effective in its functions of load support and edge protection?

The filler must be installed full joint depth to be effective. Shallow filler will be driven down into the empty joint after separation occurs. When the filler is installed full depth, the base of the cut helps MM-80 resist deflection-under-load, even after moderate separation.



WRONG



RIGHT

Take a look at your filler. If it has dropped below the surface of the floor, it may not have been filled full depth.

To test for depth, drill a 3.0mm hole through the filler. If it is not full depth, contact your general contractor promptly, since the joint edges are vulnerable to damage (spalling).

It is also important that the top of properly installed filler be flush with the surface. The fundamental principle behind MM-80 is that it restores the continuity of the slab surface, thus allowing traffic to flow with no interruptions or impact points.

WHAT TO DO ABOUT CRACKS?

As there are so many possible causes for cracking, all we can do in the context of this article is to provide you with some general guidelines.

CRACK REPAIR GUIDELINES

1. If you have occasional cracks, don't be too alarmed. But if you have many cracks, contact your architect/engineer or an independent consult and ask them to determine the cause(s).
2. Remember that your floor is still going through its shrinkage process. Don't do anything to a crack that will restrict its movement. If you 'weld' the crack with a structural epoxy, you may end up with a crack parallel to the first.
3. Whenever possible, do not widen a crack (by saw cutting etc.). Wider cracks mean more wheel exposure.

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WHAT TO DO ABOUT JOINTS?

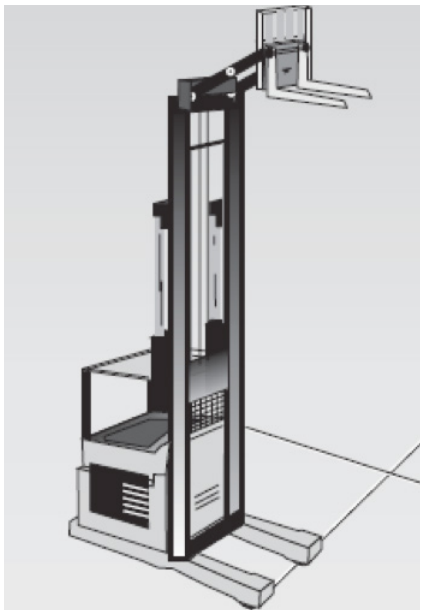
There are several problems that may occur to the joints during the first year. The most common problems are:

1. Joint filler separation
2. Joint filler depression (due to shallow filling)
3. Joint edge deterioration (spalling)*

*** Note on Joint Edge Spalling – spalling may have occurred due to a lack of edge protection at the void, or due to inherently weak concrete. It is important to determine the true cause.**

CONCLUSION

Your floor is probably the most important element of your building because it is the work platform for your operation. Therefore, it is vital that you monitor its condition during the first two years, and have any minor deteriorations corrected before they become major problems that interfere with your productivity.



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