METZGER/McGUIRE
P.O. Box 2217 Concord, NH 03302 (800) 223-6680
Known by the Floors We Protect

CRACKS AND DETERIORATED JOINTS IN YOUR CONCRETE FLOOR

What Happened? How Do You Prevent Future Problems?
How Do You Correct Current Problems?

Do you remember when you first moved into your warehouse or distribution center? The joints were sharp and narrow, and you had only a few isolated, random cracks. Now, as you walk through the facility you see that all the joint edges are severely crumbled and random cracks are everywhere. What happened? How did your great new floor turn into a nightmare that causes material handling vehicles to slow down and wheels to deteriorate?

This article will help you understand concrete floors in general, and more specifically, why floors crack and joints deteriorate. To do justice to the subject would fill a book, so I'll focus on just the most common floor problems we see in our consulting practice. Hopefully the condensed information contained here will help you avoid the same problems on future floors and offer some solutions to make your present floor more tolerable.

Floor deterioration causes generally fall into one or more of the following categories:

1. Deficiency in Design
2. Deficiency in Construction
3. Owner (or Tenant) Abuse or Neglect

This article will focus on design and construction deficiencies since they are by far the most prevalent causes of deteriorated floors. A high quality floor can tolerate some owner neglect, but even top notch maintenance cannot overcome built−in problems.

A Primer on Concrete

Concrete is basically a combination of Portland Cement, large aggregate (rocks), fine aggregate (sand) and water. Sometimes additives may be used to accomplish certain objectives such as workability, etc. For concrete to prove durable, all components must be in a proper balance. Too much or too little of any component can cause problems later. For example, let's look at the water component.
Water serves to react (hydrate) the cement, make the mix homogeneous and make the concrete workable and placeable. But too much water can result in excessive shrinkage and weakened concrete.

All concrete mixes contain more water than is actually needed to hydrate the cement. This excess water eventually evaporates. One primary objective is to retain the water until the cement is fully hydrated, then let it evaporate slowly over a prolonged period of time. This moisture retention process is called "curing" the concrete.

As concrete loses moisture, it shrinks in dimension, usually at a rate of approximately 1/8" in every 20' of slab. If concrete were left as it is placed, it would crack in random patterns. To avoid random cracking we create joints at regularly spaced intervals, thus weakening the slab in a grid pattern. These joints, called control (or contraction) joints force the cracking to occur in straight lines beneath the joints which are usually saw cut. Thus, a control joint is actually a designed crack.

Concrete slabs shrink at a relatively slow rate because all the moisture must evaporate through the top of the slab. A reasonable shrinkage rate estimate is:

30% in the first 30 days
50−60% in the next 335 days
80−90% in the first year

In other words, the slab is still shrinking long after you have taken occupancy. Thus, joints will continue to open up and new

random cracks may occur at any point in the first year or two.

When we created the control joints we caused interruptions in what would otherwise ideally be a continuous surface. To restore the floor's surface continuity for the purpose of material handling vehicle flow, we must refill the joints. The filler must accommodate two conflicting objectives: be hard enough to support hard wheeled traffic, yet allow the joint to continue to open until the shrinkage process is complete.

So What Went Wrong with Your Floor?

In the design and construction process there are literally hundreds of mistakes that can be made. The following are the most common that we encounter.

Common Causes of Random Cracking

SHALLOW JOINTS

The joints were not cut deep enough to induce the crack, leaving the slab to crack randomly.

SLAB THICKNESS

If the slab thickness varies, the slab contraction will encounter restraint, causing the slab to crack.

JOINT SPACING

Joints were spaced too far apart and the concrete cracked between the joints, rather than at the joints.

DELAYED JOINTING

The shrinkage stresses in the slab exceeded the strength of the concrete before the joints were cut.

INADEQUATE BASE

The base under the slab must be smooth and evenly, densely compacted. Uneven bases create restraint, causing the slab to crack.

JOINT RESTRAINT

If the dowels at construction joints are misaligned, or if rebar is used instead of smooth, greased dowels, the joints will be restrained and random cracks will occur, usually parallel to the joints.

IMPOSED LOADS

In tilt−up construction the crane's outrigger may rest on a panel corner and break it off.

CURLED EDGES

All concrete curls upward at the ends of pours. If this curl is severe enough, leaving the panel end cantilevered, the slab may crack when loads are imposed.

RE−ENTRANT CORNERS

Irregular corners cause irregular stress points that will cause cracking.

ADDITIONAL CAUSES OF CRACKING

Concrete mix was too weak (too much water, etc.).

Additives may cause excessive curl.

Slab was subjected to wind or sun,
causing rapid drying and early stress build−up.

Steel reinforcing was improperly
positioned.

Floor was designed for light loads, but
operations imposed are heavy loads.

Slab was not properly cured to prolong water

retention.

Base was not adequately compacted, especially
common near foundation walls, docks, RR sidings.

Common Causes of Joint Deterioration

INSERT JOINTS

Instead of saw cutting joints some contractors use insert−type joints. If these inserts are out−of−plumb, the joint edges break off.

METAL KEYS

Metal left−in−place key forms created cantilevered nosings that break off under loads.

WEAK EDGES

If the edges of joints were not properly cured, they may be inherently weak. Another cause of weak joint edges is cutting too early, causing micro−fractures in the edges.

UNFILLED JOINTS

Joints must be filled to restore surface continuity and eliminate impact points from hard wheels.

INADEQUATE FILLERS

The filler must be firm enough to support crossing loads. If the filler deflects, the joint edges are left exposed to wheel impact.

FILLING TOO EARLY

If the filler is installed too early, severe separation may occur between the filler and concrete, leaving edges exposed to impact.

CHEAP FILLERS

Some cheap fillers become brittle in as soon as 6−12 months. Once brittle, the fillers deteriorate and fail to protect joint edges.

SHALLOW FILLING

To properly support traffic, the filler must be installed full depth in saw cuts and 2" deep in thru−slab construction joints. If the filler depth is inadequate, the fillers will drop and leave joint edges exposed.

Note: Surveys show that 70−90% of all joint filling is deficient!.

Intentional or not, deficient floor joint filling has reached epidemic proportions in the U.S. and worldwide. Improper installation can result in severe floor damage once in use and can cost a facility owner a lifetime of floor repairs and reduced productivity. To find out how you can prevent cheating call (800)223−6680
and ask for the article How To Avoid Deficient Joint Filler Installations.

ROCKING SLABS

If slab end curl is severe, and joints are not doweled, the slab panel may "rock" as traffic crosses. This rocking will see one panel drop as the opposite panel remains high, exposing it to wheel impact.

HIGH−STRENGTH FILLER

Fillers must allow slab panels to move. High−strength fillers weld slab sections together, causing adjacent concrete edges break off.

Correction of Cracks

There is no one correct way to repair cracks. Considerations include:

Age of slab
Cause of cracking
Width of crack
Is crack a clean snap, or does it have islands, fractures, etc.

Is crack posing structural problem
Does slab rock at the crack
Relative strength of concrete

The basic principles of crack repair are as follows:

DON'T MAKE CONDITION WORSE

If the crack is of hairline width, it is usually better to leave it alone. For additional protection against deterioration apply an epoxy coating over crack.

CUT OUT ONLY WHEN NECESSARY

If the crack snapped cleanly, with no islands, and if the edges of the crack have not spalled, merely fill the crack with a proper epoxy (semi−rigid).

CUT OUT AS NARROW AS POSSIBLE

Don't use a cutting tool (router, etc.) that will create a 1/2" wide repair of a 1/8" wide crack.

CUT OUT DEEP ENOUGH

When cutting out cracks, always go at least 1/2" deep to provide enough "bite" for the epoxy along the joint walls.

DON'T WELD THE CRACK

Most cracks in slabs−on−grade do not present structural problems. Welding the slab together at the crack may merely result in another crack occurring adjacent to the first. Use a semi−rigid epoxy for most crack repairs, especially for the first two years.

DON'T FEATHER−EDGE REPAIRS

To feather means to taper to −0− thickness. Instead, create a vertical edge of at least 1/2" deep on all crack repairs.

Repair of Deteriorated Joints

DON'T FEATHER EDGE REPAIRS

Joints are designed to accommodate slab movement. If the joint opens after a feather−edged repair, the thin section of the repair epoxy will break off under load.

USE SEMI−RIGID EPOXIES

Joints may open and close as seasonal temperatures vary. Semi−rigid epoxies will allow for movement. Joint repairs are best done in cold weather when joints are at their widest.

REMOVE ALL PREVIOUS FILLERS

Most fillers will not adhere well to themselves or other fillers. It is critical that the epoxy bond directly to bare concrete.

REFILL TO PROPER DEPTH

To function as an edge protector the filler must be installed full depth in saw cut joints, taking advantage of the support provided by the base of the cut. In thru−slab construction joints install the filler 2" deep to make up for the lack of base support.

WIDE DETERIORATION MAY REQUIRE SPECIAL TREATMENT

Seek assistance from repair product manufacturers, contractors or consultants before attempting wide repairs (over 1/2" etc.). Different defects may require different products and procedures. Also, it is important to analyze why the deterioration got so wide.

Conclusion

The causes of cracking and joint deterioration are numerous. So too are the techniques and products required to perform permanent floor repairs. It is vital that you have an understanding of what caused the problem before you decide on a corrective approach.

Metzger/McGuire publishes a ***GUIDE TO BASIC FLOOR REPAIRS*** that is available upon request, with no cost or

obligation. Your floor is a critical part of your warehouse or distribution center's operational productivity. Simply put, better floors equal greater productivity.