

## A New Fix for Loose Slab Joints

System offers rapid installation, immediate return to service, and solid results

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BY GEORGE GARBER

**L**oose joints can be a problem in concrete floors. A loose joint is one that shifts when the slab on one side of the joint is loaded, with one side sliding up or down relative to the other. Loose joints cause serious trouble in industrial floors, where they break down fast under traffic, make noise when driven across, and can even damage forklift tires. Floors that get only foot traffic and occasional heavy loads are less vulnerable, but in offices and retail stores, any loose joints look bad and create tripping hazards.

### LOOSE JOINTS

Joints become loose mainly because they lack an effective load-transfer device such as dowels, tie bars, or reinforcing steel. Other factors include excessive curling or warping, high drying shrinkage, and wide temperature swings.

A loose joint isn't the same thing as a wide joint. A joint can open wide without becoming loose, as long as it contains an effective load-transfer device. A plain vertical construction joint without a load-transfer device, however, can become loose after opening up only a few thousandths of an inch.

Changes in floor design have made loose joints more common than in the past, when many floors had reinforcing steel (typically wire mesh or reinforcing bars) passing through sawcut joints. That steel went a long way toward keeping the joints stable. The problem of loose joints was largely confined to construction joints that typically had no reinforcement passing through but relied instead on keyways. Because the number of construction joints was small compared to the number of sawcut joints, the problem was limited.

In contrast, new floors are often designed without any

steel except dowels at the construction joints. The sawcuts—and some floors have hundreds of them—rely only on aggregate interlock to transfer loads. Sometimes aggregate interlock does the job, but often it doesn't. As joints widen from drying shrinkage and temperature changes and as load cycles add up, aggregate interlock becomes less and less effective.<sup>1</sup>

The rising use of unreinforced floor slabs has not just increased the number of loose joints, but has changed the location of the problem. In older floors, it was the construction joints that were most likely to become loose. In newer floors, it's the sawcut joints.

### TRADITIONAL FIXES

Until now, if you wanted to repair a loose joint, you had four options:

- Retrofit dowels;
- Full-depth joint replacement;
- Semi-rigid joint filler; and
- Subslab grout injection.

Each method has advantages and drawbacks.

Retrofit dowels are steel bars embedded in deep grooves. The grooves are sawn into the concrete at right angles to the joint. The smooth steel bar dowels are held in place with a strong mortar and are typically spaced 12 in. (300 mm) on center. This repair method comes from the transportation industry, where it has been used extensively on concrete highways. Retrofit dowels have a pretty good record, but they cost a lot and require rerouting of traffic while the mortar sets.

Full-depth joint replacement starts by cutting out a wide strip of concrete at the joint, all the way down to the

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sub-base. Dowels are inserted into holes drilled on both sides of the gap, which is then filled with concrete. This method also comes from the transportation industry, where it's the main alternative to retrofit dowels. Full-depth joint replacement reliably eliminates the loose joint, but it creates an extra joint that wasn't there before, and it leaves an area that is often rougher and less flat than the rest of the floor. It costs even more than retrofit dowels and requires more downtime.

Semi-rigid joint filler, though not usually thought of as a load-transfer device, can stabilize joints by closing the gap between two concrete slabs. This is the cheapest method of all, but you get what you pay for because it often fails. If the differential movement at the joint was large to begin with, or if the joint continues to open after it has been filled, the repair is unlikely to hold.

The first three methods have one thing in common. They attempt to stabilize the joint by improving load transfer. The fourth method, subslab grout injection, comes from another direction altogether. It attempts to support both sides of the joint from below, reducing movement without establishing any connection across the joint itself. Holes are drilled through the concrete, and grout is pumped into the sub-base. Subslab grout injection usually works—at first—but sometimes the problem returns as slabs continue to curl or warp or the subgrade sinks. Even when it works perfectly, grout injection costs a lot and requires substantial downtime. To save time, some contractors replace the traditional cement grout with polyurethane foam, but that costs even more.

### A NEW FIX

A fifth option, the *SD7 Joint Saver*, is now available. This new method

relies on the 3 in. (75 mm) diameter, split aluminum cylinder shown schematically in Fig. 1. As shown in Fig. 2(a), the device fits into a vertical core-drilled hole, centered on the problem joint. The cylinder contains a screw-and-wedge mechanism that is tightened with a torque wrench, as shown in Fig. 2(b), and pushes the cylinder halves apart with about 8000 lb (36 kN) of force. This force effectively locks the device in place against the concrete on each side, bridging the joint as shown in Fig. 2(c). An internal spring keeps the cylinder firmly locked in as the joint opens and closes, within limits. The devices are typically set about 4 ft (1.2 m)

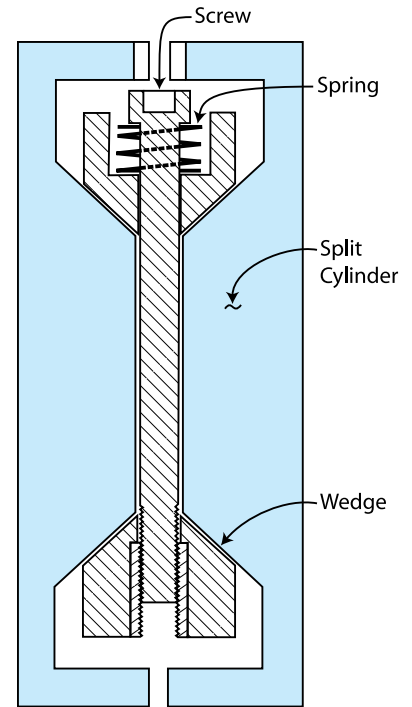


Fig. 1: Schematic of the SD7 Joint Saver

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**Fig. 2:** Steps required to install a device: (a) after removing the core from a core-drilled hole centered over the joint, the split cylinder is inserted into the hole; (b) using a wrench inserted through a hole at its top, an internal screw is tightened to expand the cylinder; and (c) with the cylinder joint aligned with the floor joint and the cylinder top flush with the slab surface, a torque wrench is used to tighten the internal screw to the torsion recommended by the manufacturer

**TABLE 1:**  
Relative joint movement before and after installation of SD7 Joint Savers

Joints tested	Differential movement before repair	Differential movement after repair
Mean of all 10 joints (160 total readings, 16 readings per joint)	0.021 in. (0.53 mm)	0.001 in. (0.03 mm)
Worst joint (greatest movement before repair)	0.050 in. (1.27 mm)	0.002 in. (0.05 mm)
Best joint (least movement before repair)	0.003 in. (0.08 mm)	0.001 in. (0.03 mm)

apart, but the exact spacing depends on the severity of the problem and on traffic patterns. Including drilling the hole, each device can be installed in as little as 10 to 15 minutes. Immediately after the device is locked in place, the slab can be returned to service.

The *SD7 Joint Saver* is available in the U.S. from the Somero Matson Group and in Canada from Surface Dynamics Canada. As of August 2007, they've been installed in 10 floors—eight in the U.S. and two in Canada—all with good results so far. Slab thicknesses have ranged from 5 to 7 in. (125 to 180 mm). The most extensive and most closely watched trial is at a 400,000 ft<sup>2</sup> (37,000 m<sup>2</sup>) warehouse in New York state, built in the late 1990s.

The New York floor was designed as a 7 in. (180 mm) thick slab with sawcut joints laid out on an 18 ft 8 in. x 20 ft (5.7 x 6.1 m) grid. The slab contained no reinforcement but had doweled construction joints that were few and far between. The design relied solely on aggregate interlock to keep the sawcut joints stable under traffic loads. The owner complained of loose joints soon after moving in.

Ten joints were retrofitted using 120 devices during February 2005. Table 1 shows the joint movement before and after the work. Movement was measured with an electronic inclinometer held across the joint as a loaded forklift passed across (Fig. 3). Readings were taken about 12 in. (300 mm) from one of the forklift's load wheels.

The devices have now been working in the New York floor for 2-1/2 years. They have kept on working under intense forklift traffic and through hot summers and cool winters. Although the warehouse is heated in cold weather, it's only heated to about 55 °F (13 °C), and it's not air conditioned. Even though the floor joints have widened since they were installed, the devices have stayed tight.



**Fig. 3:** The relative deflection of the two sides of each joint was obtained using an electronic inclinometer while the wheel of a forklift crossed the joint

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*SD7 Joint Savers* are also working successfully in the nine other floors where they've been tried, but the other installations are smaller and, with one exception, not as old as the one in New York. From these trials, however, it's clear that the system works. What's more, the devices offer advantages over all the common alternatives. They cause less disruption and require less downtime than any other method. They always cost less than full-depth joint replacement, and they usually come in cheaper than retrofit dowels or subslab grout injection. Compared with joint filler, the new system costs more, but it's far more likely to succeed.

When you face the problem of loose joints in a concrete floor, *SD7 Joint Savers* are worth a look.

### References

1. Colley, B.E., and Humphrey, H.A., "Aggregate Interlock at Joints in Concrete Pavements," *Bulletin D124*, Portland Cement Association, Skokie, IL, 1967, 18 pp.

Selected for reader interest by the editors.

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