What Kind of Joint Is This?

Choosing the Right Joints and Sealers for the Job

By Floyd Dimmick, Sr.

When applying coatings to floors, it is vitally important to pay proper attention to the joints. But joint technology can be confusing. Over the years the term, "Control Joint," has been used by tradesmen and designers alike to describe joints that control concrete slab cracking. Unfortunately, this term has been widely expanded to include contraction, construction, expansion, and isolation joints. Before any discussion of joints can occur, it is important to understand and use the correct terminology.

Are they Control, Contraction, or Construction Joints?

As defined by ACI 116R-00 "Cement and Concrete Terminology," a construction joint is "the surface where two successive placements of concrete meet, across which it may be desirable to achieve a bond and through which reinforcement may be continuous." (See figures 1 and 2, page 60) A contraction joint is "a formed, sawed, or tooled groove in a concrete structure to create a weakened plane to regulate the location of cracking resulting from the dimensional change of different parts of the structure." (See figures 3 and 4, page 61) An expansion joint is either "a separation provided between adjoining parts of a structure to allow movement where expansion is likely to exceed contraction; or a separation between pavement slabs-on-grade, filled with a compressive filler material." Finally, isolation joints are defined as "a separation between adjoining parts of a concrete structure, usually a vertical plane, at a designed location such as to interfere least with performance of the structure, yet such as to allow relative movement in three directions and avoid formation of cracks elsewhere in the concrete and through which all or part of the bonded reinforcement is interrupted."

The two types of joints that are subject to the most confusion are contraction and construction. Not only are the names similar, but also these types of joints are typically treated similarly and look alike.

The Necessity of Joints

Joints are necessary in floor construction and comprise an integral part of the structural design of concrete slab-on-grade and floor systems. They are typically located at midspan or in the middle third of a span of concrete.

For most concrete projects, it is the project designer who establishes the joint spacing, thickness, and reinforcement requirements. For unreinforced concrete slabs, joint spacing of 24 to 36 times the slab thickness up to a maximum spacing of 18 ft (5.5 m) has generally produced good results. ACI 302.1R "Concrete Floor and Slab Construction" provides

A filled and leveled contraction joint allows for seamless, thin overlays to cover the joint. However, self-leveling joint fillers do not always completely fill the joint *(left, top and bottom)***. Self-leveling fillers tend to settle lower in the joint void than the upper concrete surfaces. Should this occur, the joint will require a second filling because the sealed joint must be completely even with the surrounding concrete. A semi-self-leveling joint filler** *(above)* **is often the best choice for quickly and easily making the sealed joint even with the concrete on either side of the filled joint void.**

additional information on other slab conditions and joint spacing.

When to Use Each Type of Joint

Some slab-on-grade concrete slabs will only need contraction joints. However, on large projects such as buildings, pavements, playgrounds, and recreational areas, both contraction and construction joints may be necessary.

How do you know when to use each type of joint?

Construction joints are made in concrete surfaces before and after interruptions in the placement of concrete, or the positioning of pre-cast concrete units. Because concrete cannot always be placed continuously, construction joints are designed at given locations to allow the work to be resumed at a later point.

Given that shrinkage and temperature changes will cause volume changes in concrete, additional joints — called contraction joints — are provided to relieve these tensile or compressive stresses. Contraction joints are made after the placement of the concrete in order to regulate cracking in desirable and maintainable locations. Contraction joints are used to divide large thin concrete surfaces, such as floors and pavements, into smaller panels.

Basically a pre-emptive crack, the contraction joints create a plane of weakness causing the concrete to crack in an area that can be controlled. These joints may be created by installing thin metallic, plastic, or wood strips when the concrete is placed. (See figure 4) They may also be created by hand-grooving or sawing the concrete soon after it has hardened. Contraction joints are usually located on column lines, with intermediate joints located at equal spaces between column lines.

Contraction joints should be continuous, not staggered or offset. On large slab projects, sawcutting with an electric or gasoline powered saw fitted with an abrasive or diamond blade is a more convenient and cost effective way to create these joints. Depending on the type of job, three saw types are available to complete the cutting process: a conventional wet-cut; conventional dry-cut; or an early-entry dry-cut unit. The width and depth of the sawcut should be maintained at all times to create the plane of weakness. The standard depth of the saw cut is 25% of the concrete thickness as recommended by ACI 224.3R "Joints in Concrete Construction."

Why Fill Joints?

Once the contraction or construction joints have been cut, they need to be properly sealed to protect the concrete slabs on each side of the joint. If the joint void is not filled with a protective joint

sealant, the open joint void will become compacted with debris, water, chemicals, and dirt. Thermal movements will also cause additional compaction to open joints. Any one of these stresses could cause the concrete to crack adjacent to the open joint. Also any exposed steel reinforcement crossing through the joint void will be subjected to the corrosive affects of water, chemicals, and air. Should any vehicles drive over the unprotected joint, it can cause the joint edges to deteriorate. This deterioration leads to a condition known as spalling. Spalling creates a rough and uneven surface that is directly adjacent to a smooth concrete surface. This poses a considerable safety hazard that increases rapidly with wear. Given the high potential for problems, it is important that joints are properly sealed. Joints are typically filled with materials, such as a polymer joint sealant, by pouring or pumping the products into the joint void.

Joint Restoration

If the damage has already occurred, there are several steps for repairing joints. Ideally, concrete slab-on-grade construction details, including joint designs, should be kept on file and shared with the flooring contractor when repairs are needed. Unfortunately, in the real world of rehabilitation, the contractor must rely on his experience and knowledge to provide concrete surface improvements. Diverse and sometimes conflicting guidelines are found for joint spacing. Sometimes the joints are working and just need repair or replacement of the correct joint-filling material.

If random cracking has occurred, carefully check the existing joints to see if a crack has developed at the bottom of the joint. If it has not, and there are cracks near the joint, the joint is not functioning as designed. In this case, the joints may have been cut after cracking had already started. The cut may have been too shallow, or the joints may have been placed in the wrong location.

If a crack has already developed at the bottom of the joint, a foamed backer rod may be pushed to the bottom to prevent loss of materials. A backer rod may also eliminate the need to refill the joint. However, installation of a backer rod is a solution which is not part of the basic joint design.

Other options for repairing failed joints include: cleaning the joint, re-cutting the joint; crack repair; spall repair; adding polymer concrete nosings on each side of the joint in heavy traffic locations; filling the joints with the appropriate joint sealant; and possibly adding new joints.

Joint Materials

Art and science have blended to develop a successful polymer joint sealant for slab-on-grade decks and floors. In industrial and commercial applications, especially applications where people walk or drive over the joints, the joint materials used must perform flawlessly. The sealant must support the concrete vertical joint surfaces and prevent the exposed concrete joint edges from spalling. Elastomeric materials cannot provide this protection because they yield under loads and expose joint edges to damaging impact. Conversely, materials that are too rigid will also stress the concrete should any compression occur.

Years of experience have shown that the sealing of contraction and construction joints requires a polymer with unique strength properties. To provide top-quality protection, the polymer must be designed so that if there is a structural failure, the polymer-filled joint will

Figure 1

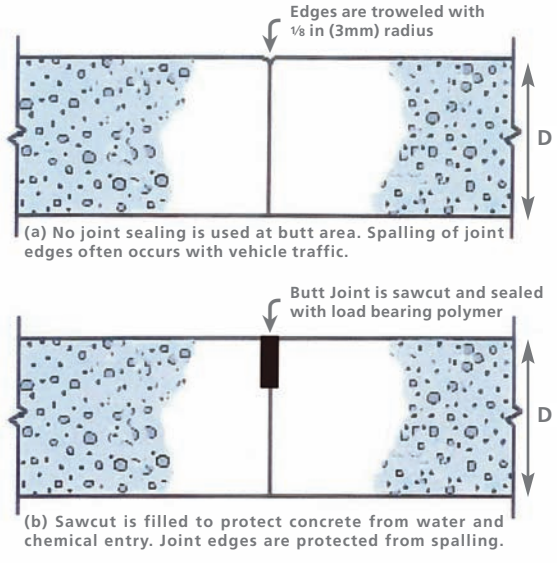


Figure 1 illustrates unreinforced construction joints. These joints are used to create "stopping points" in the concrete placement process. They can also be used as contraction joints. These types of joints require sealing.

Figure 2

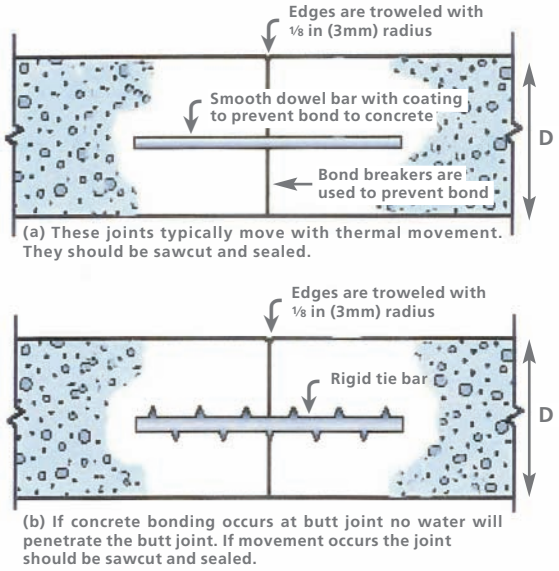
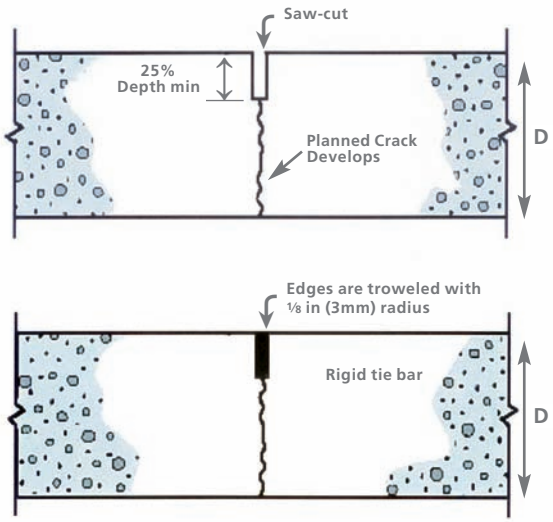


Figure 2 shows reinforced construction joints. It is important to remember that all construction joint designs have the potential to become contraction joints and to lose adhesion at the butt joint connection.

Figure 3



Contraction joints provide for horizontal movement in the concrete slab. As demonstrated in Figure 3, contraction joints can be sealed with polymers. A sealed joint will protect steel and concrete from corrosion. In this method of joint filling, the joint's saw-cut opening is filled with a load-bearing, two-component polymer.

Figure 4

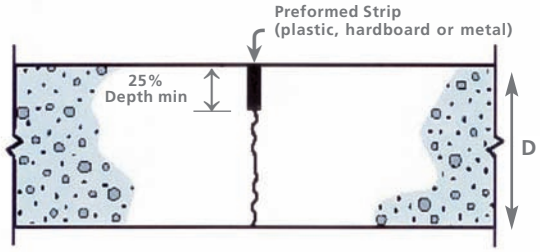


Figure 4 illustrates the premolded, unsealed insert method for filling contraction joints. These joints open and close with thermal movements. It is important to note that these unsealed, premolded joint fillers do not prevent water or chemicals from entering into the concrete crack. They offer no protection from corrosion. The main function of these types of joints is to induce controlled cracking in the concrete slab.

yield before the concrete does. This act of yielding will save a floor should a heavy load fall on it, or in the occurrence of an earthquake or explosion. In order to be water-, chemical-, insect-, and dust-proof, the polymer must have excellent adhesion to the concrete. Polymer sealers must not yield or tear when loaded. They must also provide a flat, even surface between the concrete surfaces so that there is no danger of spalling.

Currently, there are two polymer families widely used for contraction and construction joint sealing: aromatic polyurea and modified epoxies. Whether they are polyurea or epoxy, polymer fillers share some common characteristics. Both types of joint fillers are 100% solids with no shrinkage or VOCs. They also offer high degrees of acid resistance; solvent resistance; cold temperature curability down to 0˚F (-180˚C); and electrical conductivity. Special epoxy formulas are available for heat resistance to 360˚F (180˚ C) and better UV resistance.

Filling the Joint

Basically, joints are filled by pouring or pumping the polymer into the joint void. On larger projects, contractors can typically mix with a two-component mixing pump. For smaller projects, joints may be sealed by pouring polymer from a container and pumping from a two-component cartridge. In either case, the entire depth of the sawcut must be filled with the polymer sealant.

The use of self-leveling polymers is not always desirable as they often settle lower in the joint void than the upper concrete surfaces, requiring a second filling. There must be no bumps or low spots in the sealed joint because it needs to be completely even with the concrete. To best achieve this goal, the joint sealing material needs to be a semi-self-leveling formula. A bead height of approximately ⅛-inch (3 mm) above the concrete surface is ideal as it can be evenly cut off, creating a smooth transition over the joint. If the polymer is not cut off at the right time, the filler will need to be sanded or grinded in order to smooth it down.

As a word of caution, when working with polymers, never put sand in a sawcut joint. The sand will change the physical properties of the polymer sealant, creating polymer concrete, which is too rigid to withstand compression and could possibly cause the joint to fail.

No Magic Cure-Alls

No one formula can solve all the stresses to which joints are exposed. However, filling joints will help protect against some of the damaging conditions to which concrete is exposed, as well as prepare the surface for coating. Careful selection of the product capabilities is a significant part of specifying joint-filling materials for a project. Be sure to ask the sealant manufacturer for recommendations on use of their products. Choosing the right polymer joint sealant for each individual job will extend the protective life-cycle of the joint material, and the concrete surface itself. CP

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