HAHN READY MIX

Jointing: How & Why

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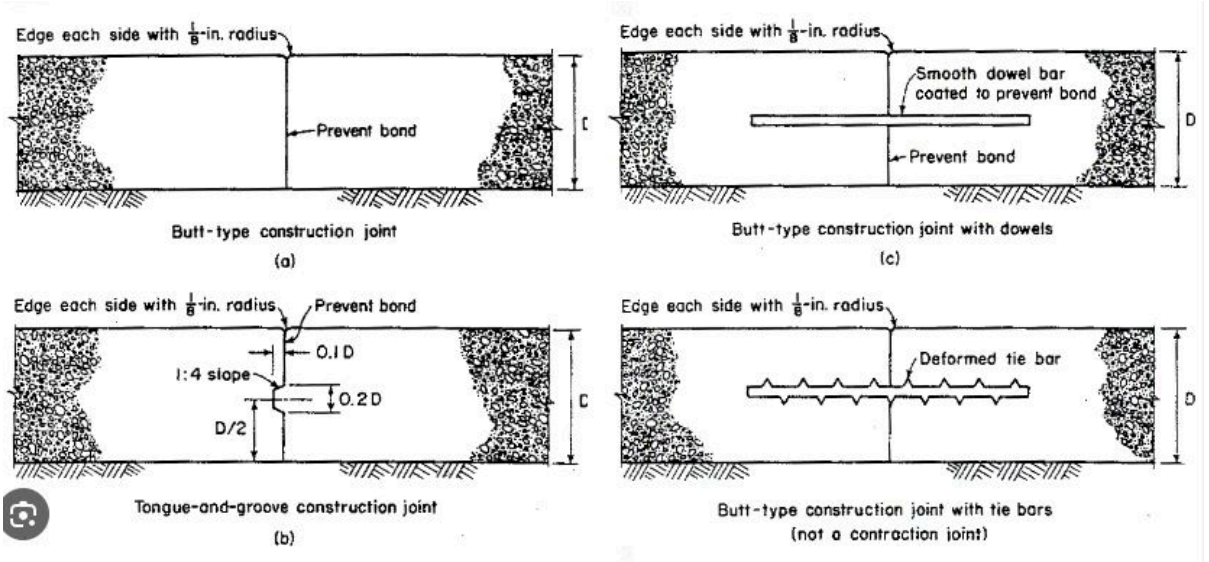
Jointing is a critical step in the concrete flatwork finishing process.

We've spent some time discussing cracks this year (Tech Bulletin #28), and shrinkage last year (Tech Bulletin #24). In doing so we've covered what can go wrong and some innovative ways to get around or reduce jointing. However, today is a good day to get back to the basics: joints in concrete.

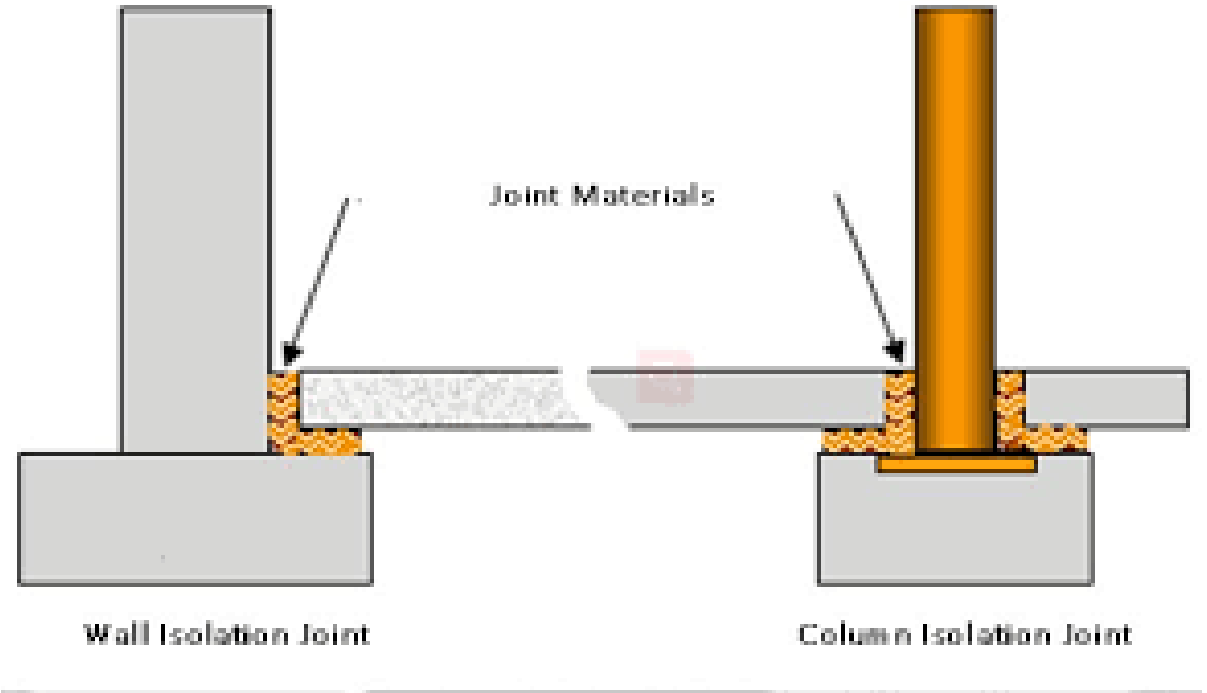
Types of Joints

Construction Joints



Construction joints are simply where one concrete flatwork pour meets up with another. The goal of a construction joint is to allow horizontal movements but not vertical movements. To achieve this, sometimes the slabs on either side of the construction joint have load transfer devices. A keyway to create a tongue-and-groove joint are a traditional way of providing load transfer, but they have gone out of style a bit. If there is excessive shrinkage of the concrete slabs, the keyed joint may no longer touch and will allow vertical movement. This is highly undesirable in a warehouse slab or any flatwork subjected to vehicular traffic. Dowels (bars, plates or diamond) are a better solution for load transfer over a joint. It's critical to make sure dowels are properly aligned and horizontal in the concrete.

Isolation or Expansion Joints

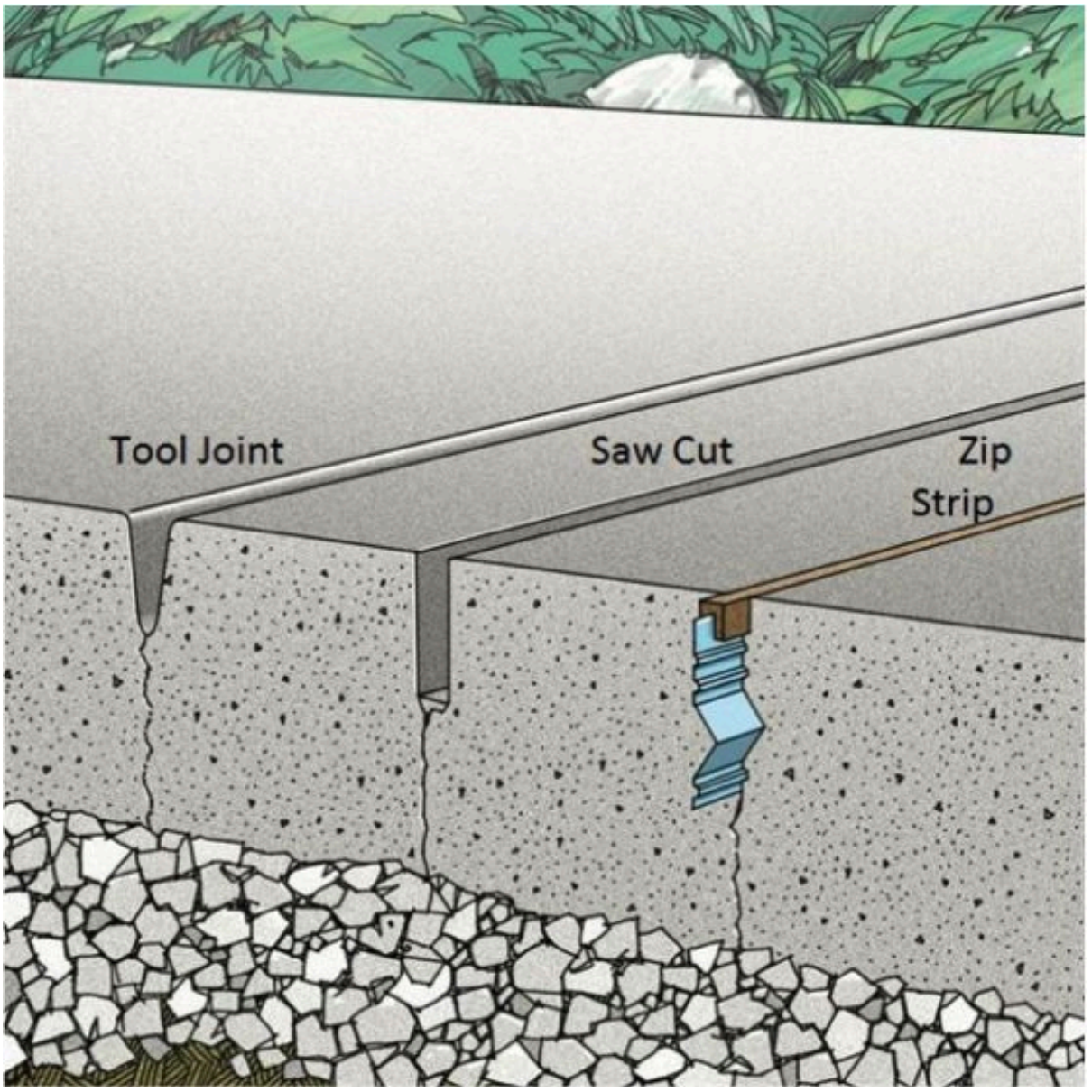


Sometimes characterized as two different things, the purpose of isolation or expansion joints are the same. To allow two different concrete elements to move horizontally *AND* vertically independent from one another. This is critical on concrete slabs butting up to a column or wall. We see so many instances where

concrete slabs are tied or abutted to a concrete element that has a footing below the frost line. **This situation will almost always result in severe cracking.** On exterior slabs, they will tend to heave with frost development underneath the slab, raising the elevation. If the slab is tied or restrained by an adjacent wall or column with a footing that is not experiencing an elevation change, the strain on the concrete will be immense. Isolation and expansion joints are formed by inserting a pliable material into the area between the concrete. As the concrete moves, this material will flex, bend, compress, or expand to allow independent movement of the joint. Typically, these joint materials are made of foam, rubber, or wood fibers. Expansion joints are necessary at regular intervals on concrete roads to allow for heat expansion in the summer. Without these joints, pavement blowouts can occur.

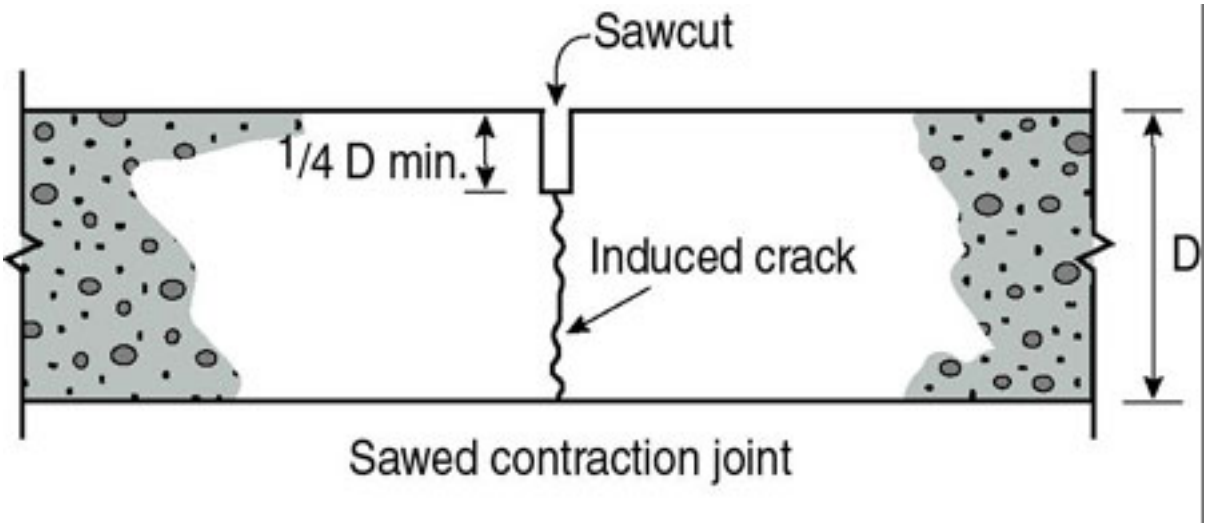
Contraction Joint

The most common type of joint are contraction joints, sometimes called control joints. As concrete hardens and begins to shrink, if there is anything restraining the shrinking movement, like subgrade material, then tensile forces will build in the concrete and cause a crack. Contraction joints exist simply to preplan where those cracks occur by creating a weak spot in the concrete at regular intervals. These joints can be placed by using a tool to groove a joint into plastic concrete, sawing joints into recently set concrete, or installing joint strips into plastic concrete. The most common and quickest method is sawing. Once a crack forms underneath a joint, we call that joint "activated". Dowels can be put in place ahead of pouring to provide load transfer over a contraction joint. Joint depth, spacing, pattern, and installation timing is critical to successful crack control.



Joint Depth

One of the most critical parts of tooling or sawing joints is achieving proper joint depth to initiate a crack. A joint too shallow may not create enough of a weak spot to induce cracking in the joint. A rule of thumb for tooling or early-entry sawing is 1/4 the depth of the slab. An exception to this is if the early entry saw window has passed, 1/3 of the depth of the slab is an appropriate depth for wet sawing.
Longitudinal joints on mainline paving are also required by the Iowa DOT to be 1/3 depth.



Joint Spacing

Joint spacing is also important to allow relief for shrinkage stresses at a regular pattern. Joints spaced too far will often have drying shrinkage cracks at the midpoint in the joint. Joint spacing has long been recommended as no more than 24-36 times the depth of the slab (ie for a 6" slab, there should be no more than 12-18' between joints), but more recent studies and the experience of higher shrinkage with Type IL has brought the maximum spacing to simply 24 times the depth on roads and 30 times the depth on parking lots, as recommended by ACI. Without an extended joint system, joints should never be spaced more than 18' and on thinner members like driveways or patios, 10-12' should be considered a maximum. Minimizing joint spacing will result in decreased crack potential, decreased curling effects on an individual joint, but will also result in more joints, which are natural areas of weakness and intrusion.

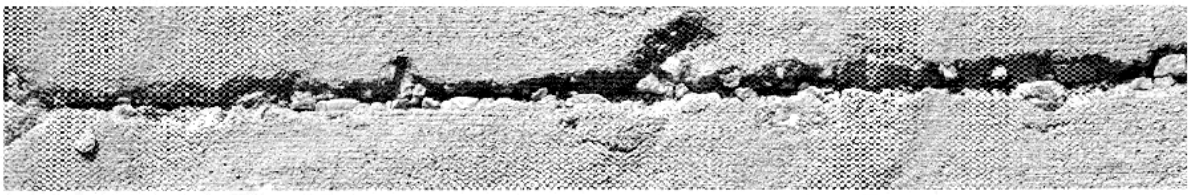
Joint Pattern

A lot of times, the joint pattern will be determined by a designer. However, if you find yourself developing one on your own, here are some tips and tricks. Concrete loves squares. Try to get the aspect ratio of resulting concrete pads as close to 1:1 as possible, and never exceeding 1:1.5. Keep the joints continuous, and match joints with adjacent paving. Cracks will tend to develop from adjacent pavement joints, especially if the pavements are not isolated from each other. Try to place joints at 90° off re-entrant corners, although this doesn't always alleviate the cracking potential at these corners. Attempt to have regular joint spacing within the pattern.

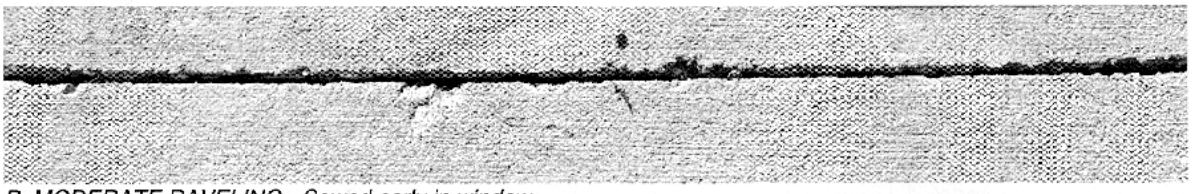
Joint Timing

The final critical piece of the jointing process is timing. For tooled or stripped joints, they are in place while the concrete is plastic and timing is not a concern. For sawed joints, however, timing is everything. Wet cut sawing should happen between 4 and 12 hours after finishing operations are complete, depending on the ambient temperatures and how quickly the concrete is setting. Early-entry sawing should

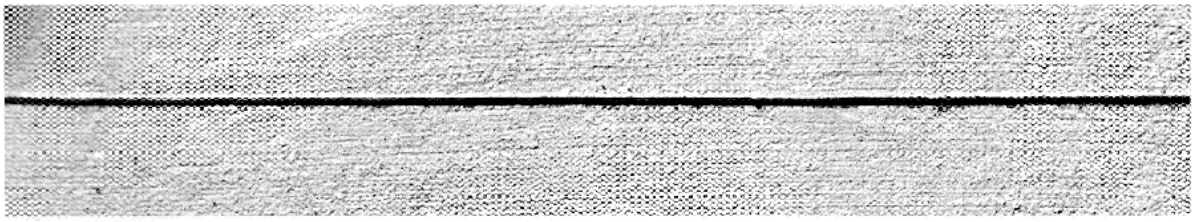
begin 1-4 hours after the conclusion of finishing operations. The appropriate time to saw really is a bit of an art. Saw too early, and raveling in the joints can occur. Saw too late, and cracks will have already formed, even if sometimes they cannot be seen yet. The window for sawing also determines the depth. As we mentioned in the joint depth section above, if the early-entry window has passed, the joint depth needs to be deeper. Missing the jointing window is a very common cause of drying shrinkage cracking in concrete.



A. UNACCEPTABLE RAVELING - Sawed too early



B. MODERATE RAVELING - Sawed early in window



C. NO RAVELING - Sawed later in window

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3636 West River Drive, Davenport, IA 52802