

The Relevance of Microcracking

Q What is microcracking? As a small concrete contractor, should I be concerned about it?

A The term microcracking refers to very small cracks that form in concrete but are not visible to the naked eye. Some microcracking occurs as a natural part of the cement hydration process, but it also occurs as compressive loads are applied. Bond cracks form where the coarse aggregate and the cement meet. Those cracks propagate through the surrounding mortar as mortar cracks.

According to ACI 224R-01, "Control of Cracking in Concrete Structures," research in the 1970s and 1980s found that substantially smaller microcracks also form to allow concrete to compress. It's not always as rigid a material as we previously thought, thanks to the cement and mortar paste being "nonlinear softening materials."

You should understand something about microcracking for two reasons.

Microcracking can act as a starting point for the development of larger cracks."

First, how watertight a concrete structure is can be affected by the extent of microcracking. Water moving through these small channels obviously goes slowly, but the more microcracking there is, the less watertight the concrete element. That's particularly important where chloride ions in the water might reach reinforcing steel embedded in the concrete and cause corrosion problems.

The other reason to know about this phenomenon is that microcracking can act as a starting point for the development of larger cracks. If you develop a deep curiosity in this subject, a thorough explanation can

be found in ACI 446.1R-91, "Fracture Mechanics of Concrete." But the main point is that overloading or demolition activities can lead to compressive microcracking in concrete. That makes it easier for larger cracks to form and for repairs to fail.

ACI 546R-04, "Concrete Repair Guide," describes localized microcracking that can result from concrete removal activities. "Removal of concrete using impact tools may result in small-scale microcracking damage (termed bruising) to the surface of the concrete left in place. Unless this damaged layer is removed, a weakened plane may occur in the parent concrete below the repair material bondline." If so, it will only be a matter of time until the repair fails—not by separating from the base material, but due to a failure within the base material.

The repair guide explains that when "aggressive impact methods," such as a boom-mounted breaker, are used to remove concrete prior to a repair, "the concrete left in place should be prepared by using a secondary method, such as chipping, abrasive blasting, or high-pressure water jetting, to remove any remaining damaged surface material." It also notes that sawcutting around the area of concrete to be removed can limit microcracking due to removal operations. Section 2.7 provides an explanation of various concrete removal methods and a table comparing the features, considerations, and limitations of each.

Microcracking is also a concern when drilling hardened concrete, such as for dowels or anchors. The commentary provided with ACI 318-08, "Building Code Requirements for Structural Concrete," specifically notes that "drilling holes for post-

installed anchors can cause microcracking," explaining that this is a factor in the minimum edge distance requirements for installing anchors.

Finding old articles

Q How can I get an electronic copy of "Concrete Pavements Save Truck Fuel," from CONCRETE CONSTRUCTION, Vol. 35, No. 1, p. 67. I know it is an old issue—1990 I think—but is it available online? I could only find back issues to 2004 on the Web site.

A For this particular article, type this URL into your browser: <ftp://imgs.ebuild.com/woc/c900067.pdf>. I'll explain the method for finding the older articles, too, for future use.

Begin by going to the CONCRETE CONSTRUCTION homepage (www.concreteconstruction.net). Roll your mouse over the item that says "News & Articles" in the top navigation bar and a dropdown menu should appear. Select the first item, "News and past articles," and you'll end up on the search page. (If the dropdown menu doesn't appear, just click on "News & Articles," which will take you directly to the search page.)

At that point you enter a relevant word or two into the top box labeled "Keyword Search." For example, type in "truck, fuel"—notice that they are separated by a comma. Clicking on "Search" produces a list of possible matches. The article you're looking for was the fourth one down. Clicking on that link (www.concreteconstruction.net/industry-news.asp?sectionID=718&articleID=246726) brings up an abstract of the article that includes a link at the bottom to the PDF of the article.

I hope that explanation is something you can use in the future to streamline your retrieval. **CC**