# Evaluating Concrete Repair Options

First ask why the repair is needed; then look for root causes

By George W. Seegebrecht

When we have to repair deteriorated or damaged concrete, many questions come to mind. First why is the repair needed? Is there a cracking problem or corrosion damage? Do we need a patch repair, or some type of structural enhancement or retrofit?

Then the project itself lends information: How fast must we complete the repair? How should the repair material perform and the finished surface appear? What preparation is needed to promote bond? Which repair materials should we choose from the wide variety now available? Under what service conditions must these repair materials perform? The number of factors that influence a repair can be quite daunting.

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**Aggressive concrete-removal methods are more prone to leaving a bruised concrete substrate. Such removal methods will most likely require follow-up with a less aggressive step, such as sandblasting or high-pressure water blast.**

## Why repair?

The first step must always be an objective look at why a repair is needed. Cracking concrete, visible corrosion staining, spalling, crumbling, and eroding are obvious signs. Those signs, however, may be just symptoms, and repairing symptoms alone can result in being called back to do the job over.

Asking "why" is a start to evaluating the problem. Is it a materials problem? Were inferior or inappropriate materials used in a too-aggressive environment? Were high quality materials used but installed improperly? If so, to ensure a successful replacement you could use a similar material with more careful attention to good workmanship. Sometimes the proper material is used and properly installed, but the design is inadequate. For example, the designer may have designed an exterior slab with a slope inadequate to permit proper drainage, or specified a mix with inadequate strength or durability for a given service condition.

## Define the scope

Once we know that a concrete problem is a design, materials, or workmanship problem, we then continue our evaluation by determining the extent and severity of concrete distress. Accurately defining the scope of the repair increases the probability of a successful, cost-effective project and avoids damaging the contractor's reputation due to unforeseen amounts of concrete removal and repair materials (see "Minimizing Cost Overruns in Repair Projects" on page 48). Reasonably assessing the root cause, extent of repair, and severity also improves the likelihood of a successful repair in terms of longevity and durability.

An evaluation must estimate reasonably the cause of the distress—how deeply it affects the concrete and how widespread the problem is within the structure. The evaluation should also consider the quality of the concrete that will remain once the deteriorated concrete has been removed. If the underlying concrete will remain poor in quality, it may not be economically feasible

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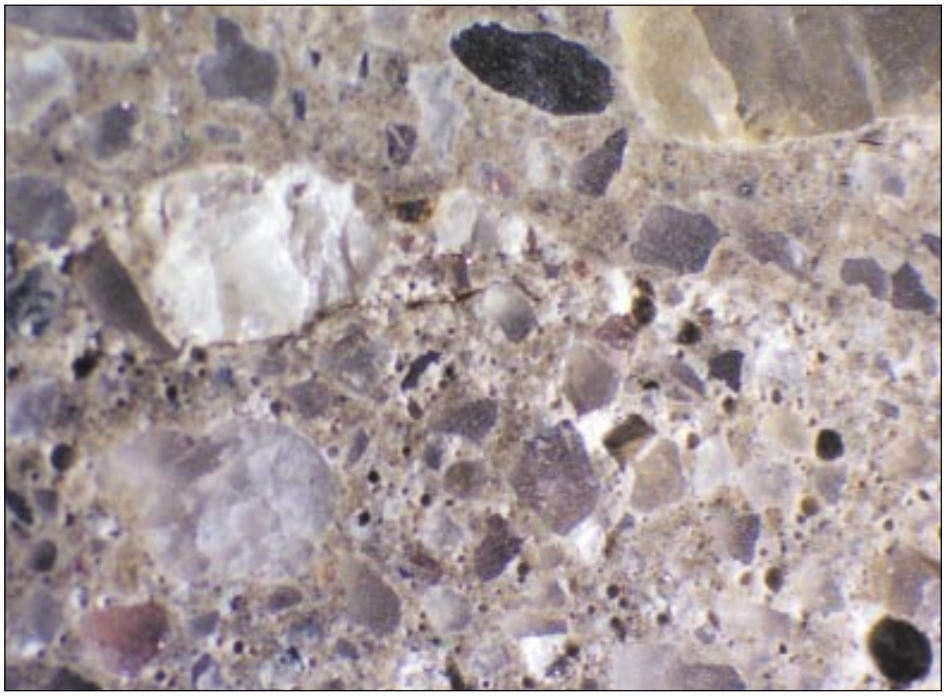


**Note in this photo that the "bruised" layer just beneath the substrate surface may appear acceptable, but the failure plane just beneath the surface can result in debonding of the repair at the depth of the bruising.**

to perform a repair that will provide a proper service life. This "repair opportunity" becomes an economic decision-making process: Rather than continuing the repair, should the affected member or structure be completely removed and replaced? Or should the repair continue with special considerations, such as strengthening the members or reducing the service loads? It's necessary to understand the underlying cause and extent of the deterioration before deciding how to proceed with any repair.

## Substrate condition

Knowing the cause, extent, and severity of a concrete problem, we then turn our attention to the condition of the substrate. Consider the repair of an exterior slab with surface delaminations caused by overfinishing. The objective is to remove the delaminated surface deeply enough to provide a sound concrete surface. Determining the average thickness of the delamination is an important first step. But the removal may have to extend slightly deeper to reveal a sound substrate that must then be roughened and cleaned so the overlay will bond properly.

First we must consider the various surface preparation methods that will yield the desired surface profile and condition in the most expedient way. Typical methods are pneumatic chipping hammer, hydro removal, pneumatic scabbler, and rotary milling machine. Rapid removal methods, such as large chipping hammers, are attractive, but an experienced contractor realizes that their speed may come at a price. Aggressive mechanical removal methods can damage the underlying sound concrete substrate, creating a need for a secondary, less aggressive pass to remove the new cracking. These new cracks are sometimes referred to as *bruising*. Unfortunately, the term *bruising* can imply a less-than-critical condition—one that could be overlooked. But if bruising is extensive, the repair contractor can apply a perfectly good overlay or repair material to a substrate that already has a failure zone in place just millimeters below the surface. The result is throwing good money after bad—creating a situation where the repair is sure to fail in the near future, with loss of time, money, and reputation for all involved. (See "Surface Preparation for Overlays," *Concrete International,* May 1998, for a discussion of this problem.)

## Project parameters

A contractor conducting a repair analysis will also be influenced by the owner's requirements and the materials being considered for the repair. Sometimes an owner will establish a window of time during which the contractor must complete the project, including mobilization, demolition, surface preparation, material installation,

## A step-by-step approach

The International Concrete Repair Institute (ICRI) is an excellent source of information for repair contractors and engineers. An example of a step-by-step approach is ICRI Guideline No. 03732, *Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.* This publication deals specifically with sealers and coatings, but the decision-making process is similar for most repair evaluations.

Here are the four basic things to consider in the selection of a repair method:

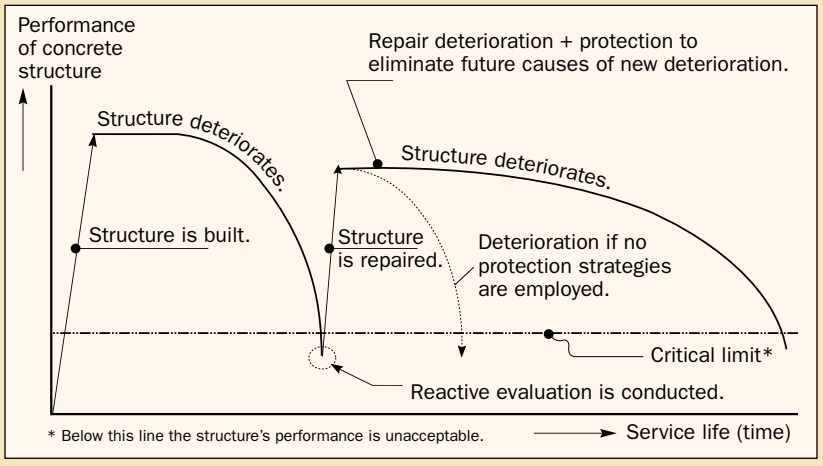
**1.** Knowing the substrate condition helps define the nature and volume of preparation.

**2.** The owner's need for uninterrupted use of the structure and concerns about operating environment or property damage may limit choices.

**3.** The properties and application requirements of the repair materials (manufacturer's recommendations) should be determined.

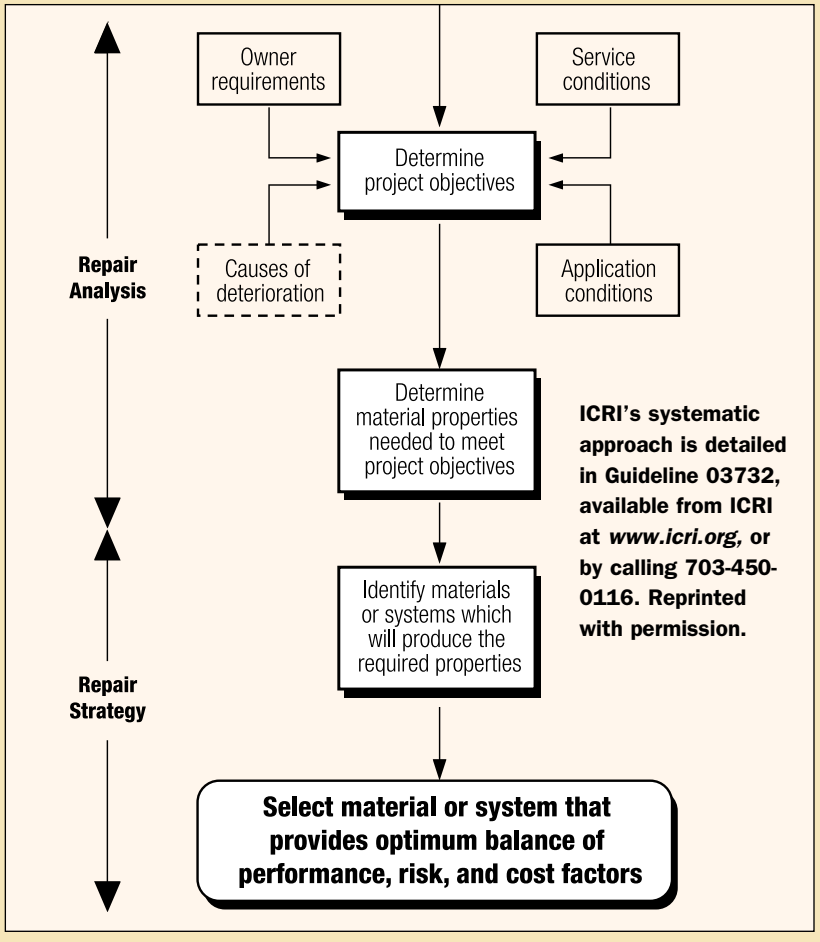
**4.** Site conditions during the repair (such as dust or wastewater generated, clearances, and power sources) will affect the decisions.

## Strategies to maintain performance




**An excellent source of information on the process of evaluation and repair is *Concrete Repair and Maintenance Illustrated* by Peter Emmons, reprinted with permission (available from the Hanley-Wood Bookstore at *www.worldofconcrete.com,* or by calling 800-323-3550).**

## Repair method selection process




**ICRI's systematic approach is detailed in Guideline 03732, available from ICRI at *www.icri.org,* or by calling 703-450-0116. Reprinted with permission.**

and material curing. Time restraints can have a huge impact on the means, methods, and materials selected by the contractor or specified by the engineer to complete the project on time, within budget, and in compliance with the desired performance criteria.

Examine each potential material to verify that it can perform within the project parameters. For example, curing time is an important issue in today's fast-paced construction schedules. Is a rapid-setting material needed? Are other items in line with the project needs, such as the temperature of both the substrate and the repair materials at the time of application? Temperature is of particular concern for paints, coatings, and membranes. Moisture conditions, sun exposure, relative humidity, vapor emission rate, and compatibility with adjacent materials may also play a role.

In closing, a word about the importance of mock-ups for complicated repairs. A mock-up at the beginning of a project allows the contractor to foresee problems with constructibility or compatibility of systems or materials. A mock-up allows everyone involved to view and agree on an approved finished appearance rather than individually interpreting a specification description. Also, due to changes in lighting, a small product sample or photograph of a repair can be misleading. A full-scale mock-up presents a valuable opportunity for the project participants to work together. What may appear straightforward on the drawings may not be possible to build in the field, and a mock-up provides an opportunity to fine-tune a detail that may later cause great frustration. This process also may help develop shortcuts to reduce time and increase profits on a repair project. ■

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