



## Limited Concrete Repairs Produce Limited Results

by Terri Chalaire, P.E.

Recently, we have seen an increase in buildings having limited or “lick and stick” concrete repairs performed. Lick and stick repairs are repairs where only limited amounts of concrete are excavated and do not remove all of the contaminated concrete to ensure a long-lasting and durable repair. Building owners and managers who hire contractors to, or sometimes have maintenance personnel, perform lick and stick repairs are usually attempting to save money and reduce the inconvenience, mess, and headache of a repair project. Are these goals being achieved?

In order to evaluate the merit, or lack thereof, of lick and stick repairs, the purpose of the repair must be understood. Is the purpose of a repair

to have it reoccur in short order? Is the purpose of the repair to have a problem in the area directly adjacent in the near future? No. Unfortunately, this is what is happening when limited repairs are performed. Limited repairs result in ongoing repairs year after year. The inconvenience and mess is ongoing. The costs are ongoing. The building as a whole is never completely restored. The building is in a constant state of partial disrepair. Are limited concrete repairs saving time and money? The answer is—no.

When considering a concrete repair project, owners and managers need to recognize the symptoms of the problem and what they mean. They also need to understand the problem to determine the appropriate course of repair for a long-lasting and durable solution.

### Symptoms

Some of the first indications of a problem are a visual observation of cracked, spalled, and delaminated concrete on columns, beams, and slabs. Another indication of possible problems is an observation of hollow-sounding floor coverings such as tile and stucco.

Cracked, spalled, and delaminated concrete indicates expansion of embedded steel reinforcing bars due to corrosion of the steel. The steel reinforcing bars most likely had surface rust during the original construction; however, this rust was removed by the alkalinity of the original concrete. Exposure of the concrete surfaces over time has allowed chloride contaminants into the

concrete reducing its alkalinity, which caused the rebar corrosion. The rust requires more volume than the base metal it is replacing and consequently pops out the concrete, causing a spall.

Delaminated stucco and floor tile produces a hollow sound when tapped and sometimes covers up potential concrete problems. Sometimes the problem is only delaminated stucco or floor tile. Sometimes the problem is spalled and damaged concrete underneath.

### Problems

There are two types of problems when spalled and cracked concrete is observed. One is the chemical problem of chloride contaminated concrete causing corrosion of the steel reinforcing bars. The other problem is the mechanical problem of the corroded steel bars.

The chemical problem is that the concrete has become contaminated with chlorides due to exposure over time. Chloride contaminated concrete has a reduced pH and is laden with negatively-charged ions. New or non-contaminated concrete is normally positively charged with an effective high pH. This high pH is what normally protects embedded steel bars. The steel bars in these two different environments creates a galvanic current. Negatively-charged electrons try to flow from areas of negative charge to areas of positive charge. The steel bars act as sacrificial conductors for the electrons. More electron flow results in more corrosion of the steel bars. The amount, speed, and duration of this electron flow depends on the level of resistance in the concrete. This corrosion is known as galvanic corrosion.



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The chloride contamination in concrete does not hurt or damage the concrete. It lowers the pH, making it less alkaline, facilitating the corrosion of the steel rebar. Corrosion damages steel bars by consuming the steel and converting it into rust. This rusting of the steel bars causes the mechanical problems.

The capacity of steel bars to resist tension loads is set by the diameter of the bar. Rust on steel bars consumes the base metal and causes a loss of cross sectional area. This is observed when rust scale is removed from bars and they are visibly thinned. This loss of cross sectional area results in a reduction of the bar's load capacity, and therefore, the slab, beam, or column design capacity.

Tension loads in steel bars are locally transferred to the concrete via raised ridges on the bars and at the bar surfaces. Rust on steel bars is a bond breaker that causes a loss of structural load transfer between the bar and the concrete. This loss of load transfer causes loads to either react further along the bar, or if close to a splice or bar end, the load is relaxed, causing a redistribution of loads in the concrete that usually causes cracks. This results in localized relaxation of slabs, and in extreme cases, a sag that is visually noticeable.

**Solution**

Concrete spall repairs require removal and replacement of existing concrete. Generally, proper repairs are performed following the International Concrete Repair Institute (ICRI) guidelines. These guidelines address

both the chemical and mechanical problems.

The first problem is the chemical problem. Concrete should be removed to expose the rusted bars and remove the surrounding contaminated concrete. During concrete repairs, the measure for adequate removal of contaminated concrete is the visual appearance of the steel bars exposed. Steel bars embedded in normal, uncontaminated concrete do not rust. In fact normal, uncontaminated concrete will remove any surface rust remaining from original construction. Steel bars embedded in normal, uncontaminated concrete will show a white powder-coated gray color when exposed. The standard is to remove contaminated concrete along steel bars until at least two to three inches of good bar surface area is exposed.

Removal and replacement of concrete during repairs is similar to new construction. New construction requires concrete "cover" to protect steel bars from external exposure. Code required and industry standard cover depths protect steel for long amounts of time. Long-lasting repairs require removal of contaminated concrete to extend into areas of uncontaminated concrete so the new concrete placed will provide "cover" protection from both external exposures and internal exposures to adjacent areas not being repaired.

We have seen contractors attempt to create this cover protection by treating the surrounding contaminated concrete by chemical methods. The idea is to restore

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the chemical conditions in the contaminated concrete as if it were uncontaminated concrete. These chemical treatments have a wide variety of results. The standards for long-lasting and durable concrete repairs do not call for chemical treatment alone, but require removal of a sufficient amount of concrete at the damaged areas. Limited, or lick and stick, repairs do not remove enough contaminated concrete. They also do not address the mechanical problems with the concrete. After chemical treatment only, rusted bars are not completely exposed and are left remaining in areas of contaminated concrete. Limited removal results in limited results. Also, and most importantly, addressing only the chemical problem when spalls are present leaves a structurally unsafe condition.

The second problem is the mechanical problem. This cannot be addressed by chemical means. At repair areas, concrete needs to be removed until "clean" bars are exposed at the extent of the repair areas. This removal is not only to provide the chemical protection discussed above, but it is also required to resolve the mechanical problems. Concrete removal to where clean bars are exposed gives a visual indicator that the steel bars at that point are structurally sound and able to carry their full-load capacity. Also, within the repair area, concrete needs to be removed all the way around the circumference of the rusted steel bars. The rust scale needs to be removed from


the bars, and then the bars need to be inspected for loss of cross sectional area (thinned bars). These bars require repair by one of several methods to restore loss of capacity. Because the bars were repaired, when new concrete is placed, the bond will be restored between the bars and the concrete. This will restore the transfer of the tension loads between the bars and the concrete and restore a safe structural condition.

### Conclusions

In the big picture, it is typically the areas with spalled concrete that show where the loss of cross sectional area of the bar is significant enough to require a bar repair, meaning there is a structural problem. Performing limited lick and stick repairs with chemical treatments and patches does not remove enough concrete to expose and repair corroded rebar or to restore the bond of the rebar to the surrounding concrete. They also do not remove all of the contaminated concrete, which will cause more problems later. Any cost savings now will be lost when repairs in the same location will need to be repeated in the very near future.

Schedule and budget constraints often make limited repairs appealing, taking less time and money now; however, they will not be long-lasting,

**An engineering survey should be performed to get a handle on the estimated extent of the building's problems. A repair project using the proper method can be scheduled and budgeted for. This will reduce future repair costs.**



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and most importantly, typically do not yield structurally safe results and could possibly result in liability for the association.

There are ways to minimize costs without performing limited lick and stick repairs. An engineering survey should be performed to get a handle on the estimated extent of the building's problems. A repair project using the proper method can be scheduled and budgeted for. This will reduce future repair costs. Engineering surveys and repair projects should be performed every few years, and surveys and repair projects can become predictable expenses.

Cracked only concrete can be repaired by gravity fed or injected epoxy to stiffen and strengthen slabs and reduce future corrosion damage to embedded bars that cross the cracks. To reduce the chemical problems in areas not being repaired, the addition of penetrating corrosion inhibitors into the concrete can reduce the corrosion electrolysis process and delay spalls in some cases. Buyer beware! Some of these corrosion inhibitors are new and not time tested. Product claims and warranties should be investigated. References should be checked. Also, there is no chemical treatment to resolve the mechanical problems that result in a structurally unsafe condition.

Remember... Limited concrete repairs produce limited results.

Terri Chalaire, PE is the owner of Chalaire & Associates, Inc. For more information, visit [www.chalaireandassociates.com](http://www.chalaireandassociates.com).



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