



Concrete Repair Q & A

by Bill Scannell and Ali Sohangpurwala

You can see some cracking, rusting steel, crumbling concrete or some other signs of an apparent problem with the concrete around your building. Evidence of this type of damage may be prevalent on your balconies, or building facade or in your parking garage. These outward signs are but symptoms of a more serious internal problems—corrosion of steel or other metals inside the concrete or a self-destructive mechanism occurring within the concrete itself. Thousands of property owners have experienced similar problems and numerous questions have been raised. In hopes of shedding some light on the subject, some of the most frequently asked questions are discussed below.

Q. What is the difference between repair and rehabilitation?

A. Repair techniques are used to restore the structural integrity and shape of a concrete element. For example, a balcony slab can be repaired so that it does not have any damaged concrete or unsafe indentations. Repair techniques generally include removal of damaged concrete and placement of new concrete in its place. Repair methods, however, do little to address the cause of deterioration. Therefore, in the case of reinforcing steel corrosion, simple repairs typically fail prematurely since nothing is done to mitigate or stop the primary deterioration mechanism.

Rehabilitation methods, in addition to restoring structural integrity and shape, mitigate or stop the process responsible for the damage. Because rehabilitation includes addressing the cause of the problem itself, the repairs last significantly longer.

Q. We recently completed repairs of concrete damage on our building so why has the problem shown up again?

A. Assuming the repairs were installed correctly, they probably did not include provisions for stopping the underlying problem of corrosion and could have even inadvertently accelerated corrosion. The real question is “how long should I expect the repairs to last?” Again, this is totally dependent on whether or not the original cause of the problem is properly addressed.

Q. What types of corrosion protection systems are presently available for balconies and parking garages?

A. There are numerous types of corrosion protection measures that can be used. They vary from the simplest (sealers and corrosion inhibiting chemicals) to the most sophisticated (cathodic protection and electrochemical chloride extraction). Other corrosion protection technologies include several different types of membranes, cementitious overlays, specialty concretes, and various kinds of reinforcement coatings. The cost of such systems varies from less than \$1 to

\$10 or more dollars per square foot of affected surface area. Each of the corrosion mitigation systems is capable of controlling a certain level of corrosion activity, just as specific dosages of medicine are required to cure different degrees of sickness.

Q. How do I determine which type of repair and corrosion protection system to use?

A. Selecting a corrosion control system and compatible repair is complex. The level of present and anticipated future corrosion activity is controlled by the source and amount of chlorides, carbonation of the concrete, presence or lack of sufficient concrete cover over the steel, contact between dissimilar metals such as aluminum and steel in concrete, etc. This is further compounded by the presence of alkali silica reactive aggregate, freeze-thaw damage, non-corrosion induced cracking of the concrete, ingress of moisture and chloride ions through deficient joints and seals, etc. The association’s available budget and the owners desire regarding the longevity of the rehabilitation are also of prime importance. Thus, relevant information from the owners and results obtained from a concrete and corrosion condition survey are required in order to properly match a corrosion control system and compatible repair scheme to the existing problem.

What is cathodic protection? Do we need to install a cathodic protection system?

A. Cathodic protection of steel in concrete is simply a means of fighting fire with fire, or in this case, electricity with electricity. The corrosion process generates very small electric currents. With cathodic protection, a source of external current is used to counteract the corrosion current. If sufficient countercurrent is applied, corrosion stops.

Cathodic protection is not always needed nor is it necessarily applicable on every structure. As discussed above, to select and design a proper repair and protection scheme it is imperative that the cause, or causes, of the distress are properly diagnosed and fully understood, and that the extent of damage is determined. Therefore, the first step is to have a concrete and corrosion condition survey conducted. With the results of a thorough condition survey at hand, the corrosion engineer must analyze the data and make a determination on the type of repair and protection method to use. If cathodic protection is chosen then another determination must be made in order to choose the most appropriate system for the conditions encountered.

Cathodic protection systems can be grouped into two basic types; impressed current systems and galvanic, or sacrificial anode, systems. In both types of systems, a small amount of current flows from an anode material, through the concrete and to the reinforcing steel. If the system is properly designed, the current will be of sufficient magnitude and direction so as to oppose the natural flow of current resulting from the corrosion process.

The type of anode is one of the most critical components of a cathodic protection system. Your particular application may preclude the use of some of the available anodes and cathodic protection systems. Important factors in selecting a specific system include:

- the type of surface to be protected (top surface, soffit, vertical, etc.) and its geometry
- concrete cover over reinforcing steel
- the environment in and around the structure
- structural considerations, such as whether the structure can support the additional dead load resulting from some cathodic protection systems.

Q. Do different corrosion problems require different rehabilitation strategies?

A. Yes, just as different cancers require different treatments, different corrosion problems require different corrosion protection solutions.

For example:

- A cathodic protection system would be needed to stop corrosion if a concrete slab contained admixed chloride ions and exhibited a high level of damage.
- An element with insufficient concrete cover over the steel and carbonation of the concrete may require increasing the cover by placement of an overlay and/or coating of the reinforcing steel.
- If damage is limited to cracking and corrosion of steel is occurring in cracked areas only, simple sealing of the cracks may be the best solution.

Q. Should we conduct the same repair on all of our balconies?

A. If the amount and/or predominant cause of damage is significantly different in one section or on one side of the building versus another, different repair and corrosion mitigation systems may be used on the same structure to control the overall cost.

Q. Is it ever cheaper to replace a balcony rather than repair and install a corrosion protection system?

A. Yes, when damage on a balcony exceeds a certain threshold, complete replacement is more cost effective than repair and installation of a corrosion protection system.

Q. Our balconies are currently in good shape. Can we avoid a major repair project down the road?

A. The answer to this question is dependent on what the current level of corrosion activity is and what the future propensity for corrosion is. In the case of reinforcing steel, if the corrosion process has not yet started, or if it has only just begun, certain preventive steps can be taken to delay the problem or to avoid it all together. The idea here would be to prevent salts and moisture from ever entering the concrete or to prevent future accumulation of these elements in the concrete. However, once the corrosion process has reached maturity, a suitable repair and corrosion protection strategy is needed and the options available for effectively dealing with the problem are fewer and, more often than not, more costly.

Q. Since our condominium is located on the ocean front, are we bound to have concrete corrosion problems?

A. Unfortunately, most reinforced concrete buildings situated on the ocean front are likely to suffer corrosion induced damage at some point in time.

Q. Do we have to immediately repair the damage or can we wait some time prior to starting construction?

A. Depending on the severity of the damage, repairs can often be delayed or phased over several years.

Q. Do hollow sounding tiles mean that I have deteriorated concrete under my tiles?

A. Not necessarily. Hollow sounds under tile can also be caused by voids in the grout used to place the tile.

Q. Are there any circumstances where I can safely use carpet on my balcony?

A. Yes, if corrosion has not yet begun and the salt content in the concrete is low enough, the surface of the balcony can be adequately waterproofed so that a carpet will not have any adverse effect. Another example where carpet can be safely used is in conjunction with certain cathodic protection systems. Since cathodic protection systems are installed to stop corrosion, in many instances, the otherwise detrimental affects of carpet are negated by the cathodic protection system.

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