Spray-Lock®
CONCRETE PROTECTION

The Problem:
Steel Corrosion and the Halo Effect in Reinforced Concrete

Steel corrosion in concrete is essentially an electrochemical reaction. Very much like a household battery, there is a positive side (cathode), a negative side (anode) and pathways that allow electrons and ions (metallic connection and electrolyte, respectively) to pass between the anode and cathode. Unlike a household battery, oxygen is required for the steel corrosion process. The natural permeability of concrete allows ions, moisture and oxygen to migrate in and out of it, turning concrete into the electrolyte needed by the steel corrosion process to form rust on rebar. When the steel in reinforced concrete corrodes, the three components required to initiate and sustain the steel corrosion reaction are:

1. **Steel rebar in concrete**
2. **Pathways for electron and ion movement (steel rebar and concrete, respectively)**
3. **Oxygen that enters through concrete capillaries and pores**

In addition, the onset of steel corrosion in concrete may be accelerated by chlorides that can enter the concrete from the batching/mixing process, deicing chemicals, and/or the environment. Anodic Ring Phenomena, also known as the "Halo Effect," is a special form of metal corrosion in which "new" corrosion sites develop immediately around repair areas.

Figure A displays the conventional concrete rebar corrosion process described above. Corrosion deposits (rust) become concentrated between the anode and cathode sites; pressure develops between the rebar and concrete, and eventually the concrete tensile strength is overcome and cracking develops. As corrosion deposits build up and/or structural loads continue to be applied, damage accelerates to the point of developing concrete delaminations or spalls. Traditional repair includes removing all damaged and weakened concrete to below the affected rebar, cleaning affected rebar of all corrosion deposits, adding additional reinforcement if required, and then filling with a cementitious patching material.

Figure A

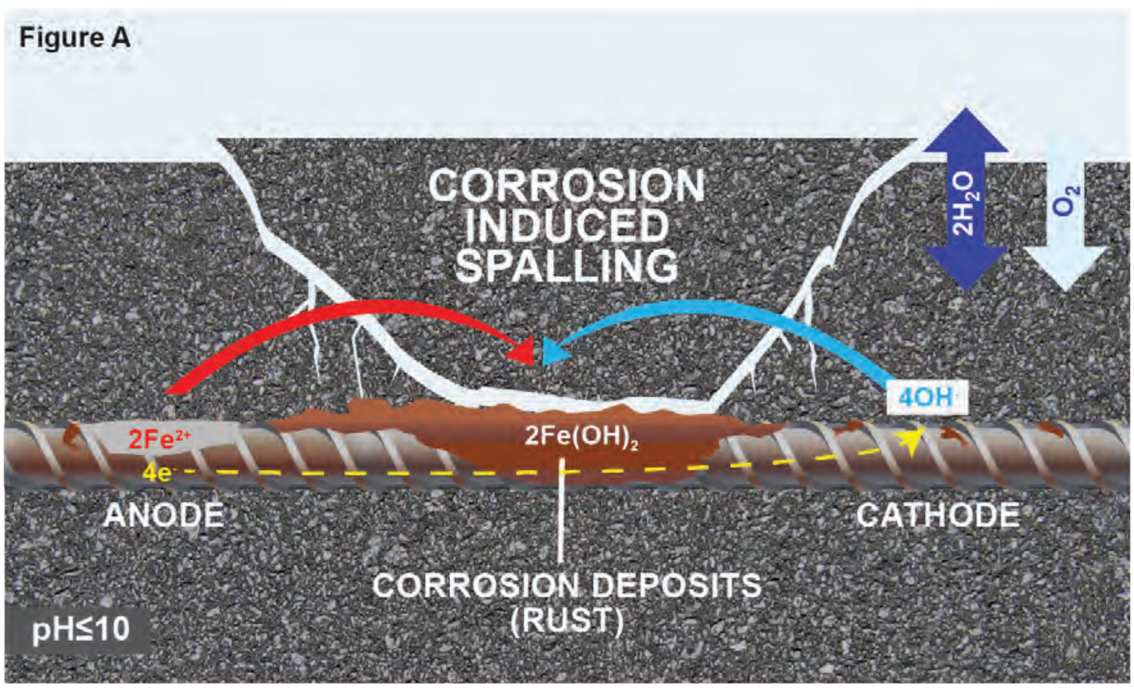


Figure B displays an example where the repair may or may not have added new rebar in the new concrete patch, while the old areas have the original rebar.

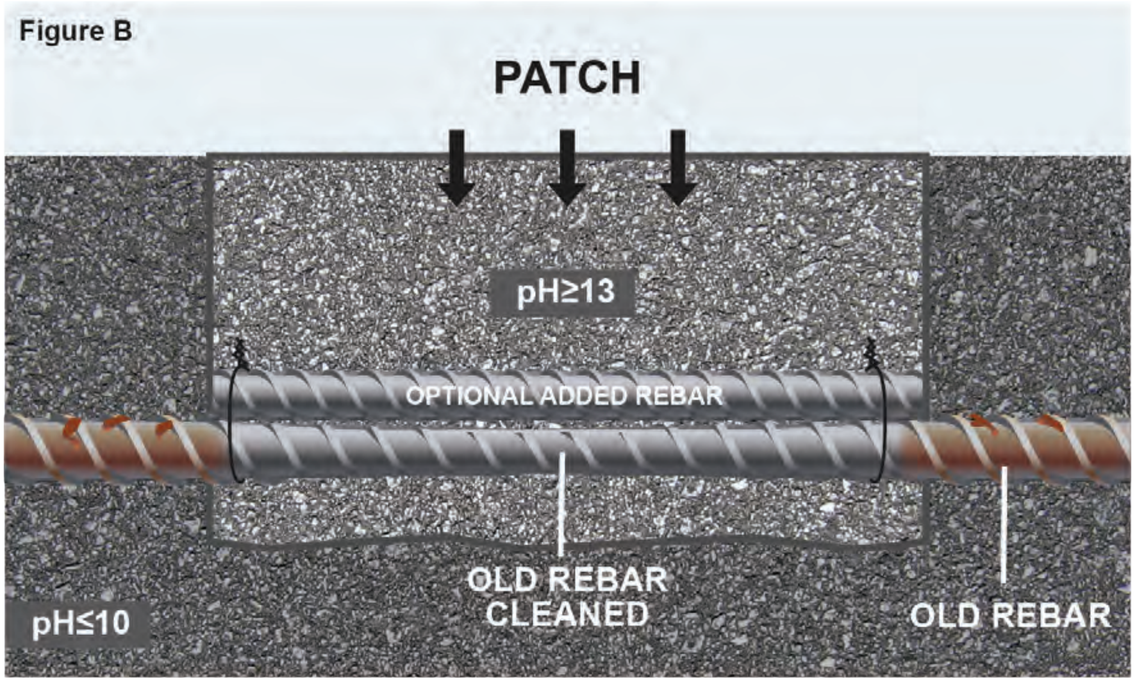
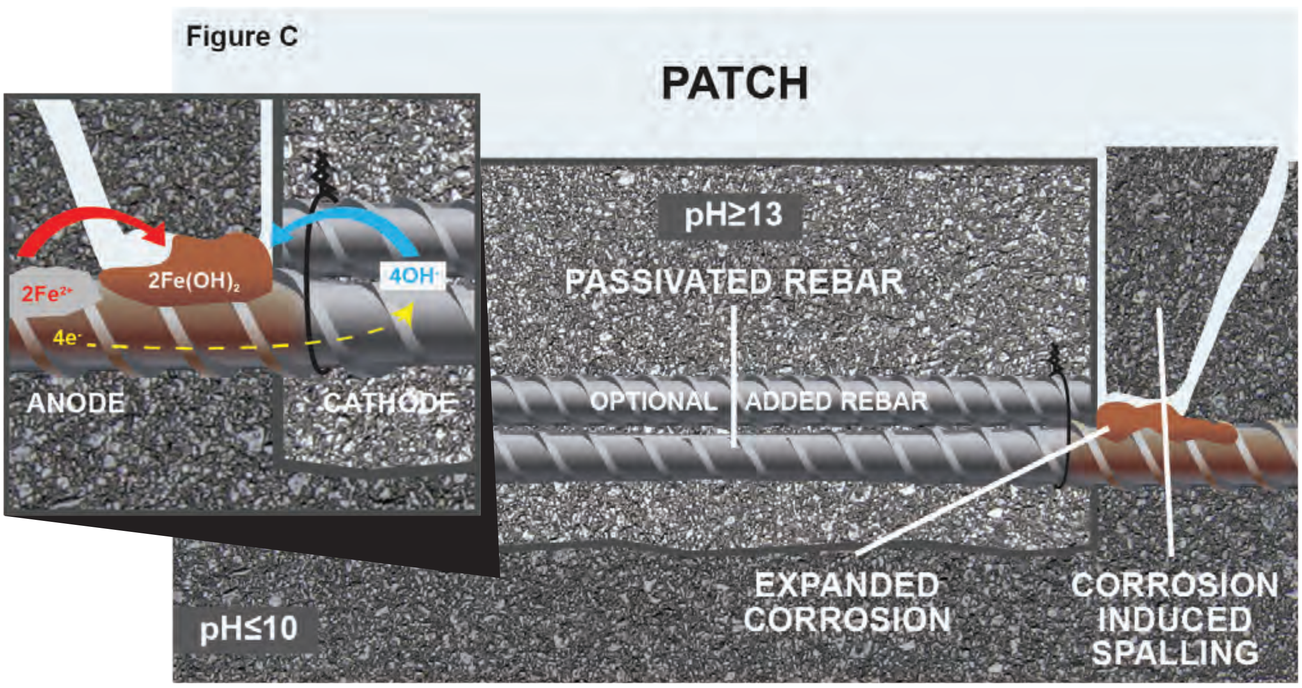


Figure C shows this situation after a period of time where, dependent on the conditions in and around the repair area, the corrosion process has been forced into the existing concrete rebar. What happens is that the existing and/or new rebar in the patch is passivated (turned into a cathode) by the high pH (~12 to 13) of the new concrete. Since the new rebar is electrically connected to the existing rebar in the older concrete (pH ≤ 10), the existing rebar turns into the anode of the corrosion process. Therefore, when corrosion deposits form between the anode of the old concrete and the cathode of the patch concrete, it appears that distressed areas were missed during the initial repair. Instead, the new repair is forcing new corrosion in the older concrete.



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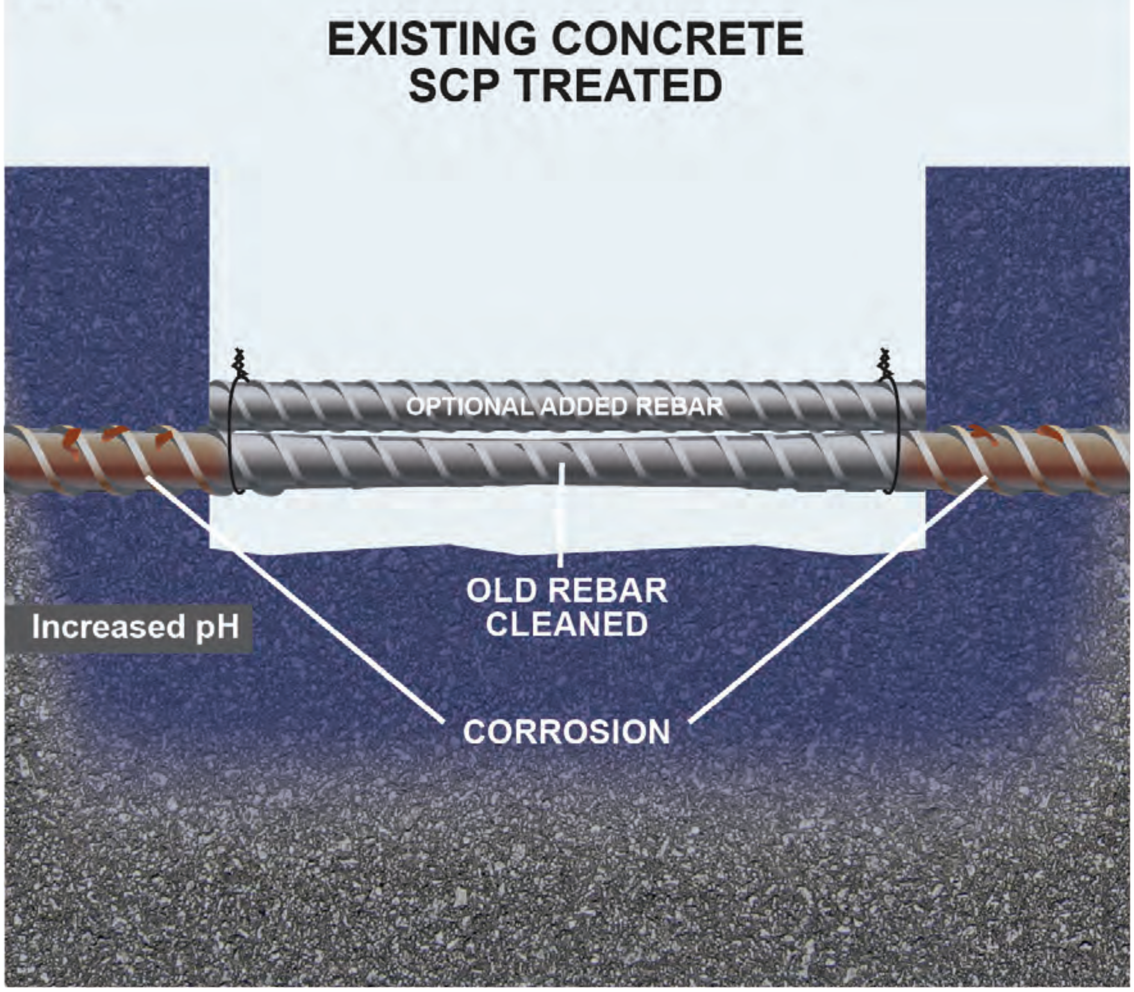
The Solution:
Addressing the Halo Effect with SCP Post-Placement Pozzolan Treatment

With conventional concrete repair methods like the one described, the Halo Effect is a common, unwanted side effect. Fortunately, Spray-Lock Concrete Protection (SCP) can help solve this problem by addressing the causes. Below, **Figure D** illustrates the first step of the SCP process. By raising the pH of existing concrete to a safe and healthy level comparable to new concrete, SCP helps passivate the existing rebar. The treatment also seals the accessible capillaries and pores so that water cannot penetrate and contribute to the deterioration of concrete and steel. While this sealing process does not make the concrete air proof, it does greatly reduce the amount of oxygen that can migrate into the concrete and contribute to the Halo Effect. Also, sealing the capillaries and pores will prevent additional chloride penetration into the concrete, while any existing chlorides will be encapsulated or purged by SCP so they cannot contribute to the Halo Effect. Once existing concrete is treated, repairs can be made to both the concrete and steel using traditional methods.

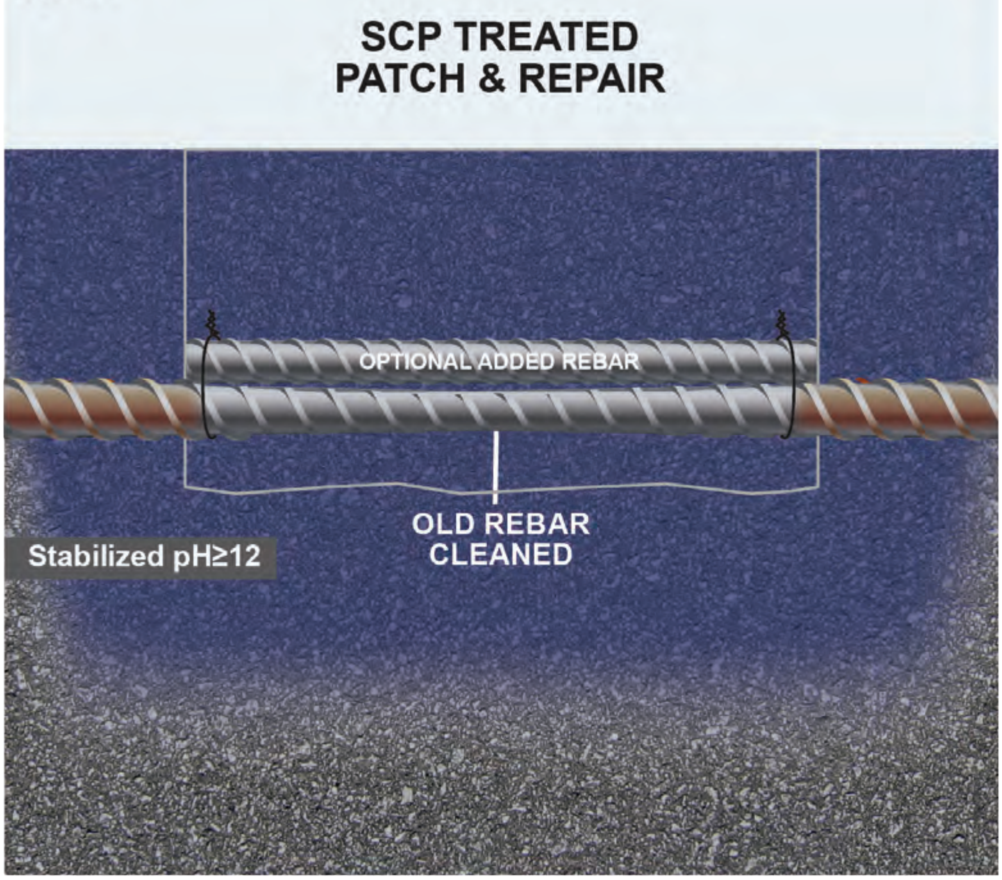
Figure D



Finally, as shown in **Figure E**, the cementitious repair or patch is then treated with SCP. Treating both the existing and new concrete effectively seals the concrete capillaries and pores from contaminants and moisture, stabilizes the pH at a level beneficial to the health of the steel rebar and increases the concrete resistivity such that the corrosion potential for the repaired reinforced concrete system is greatly reduced. Repairs made using this approach allow for greatly extended service life of the structure and repair treatments.

Note: *Treating a portion of a structure with SCP that is electrically connected to an untreated portion of the structure will help passivate that section's rebar, resulting in a form of the Halo Effect.*

Figure E



UP TO **92%** **REDUCTION** **of Drying Shrinkage** **(40-60% at 28 days typical)**

UP TO **99.8%** **REDUCTION** **of Water Permeability** **(at 72.5-psi Pressure)**

UP TO **20%** **INCREASE** **of Compressive Strength** **(9-16% at 28 days typical)**

UP TO **64%** **REDUCTION** **of Chloride Content** **(30-60% typical)**

UP TO **47%** **REDUCTION** **of Carbonation (Dusting)** **(20-40% typical)**

For sales, contact
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