Technical Advice Note

The Corrosion of Steel in Concrete

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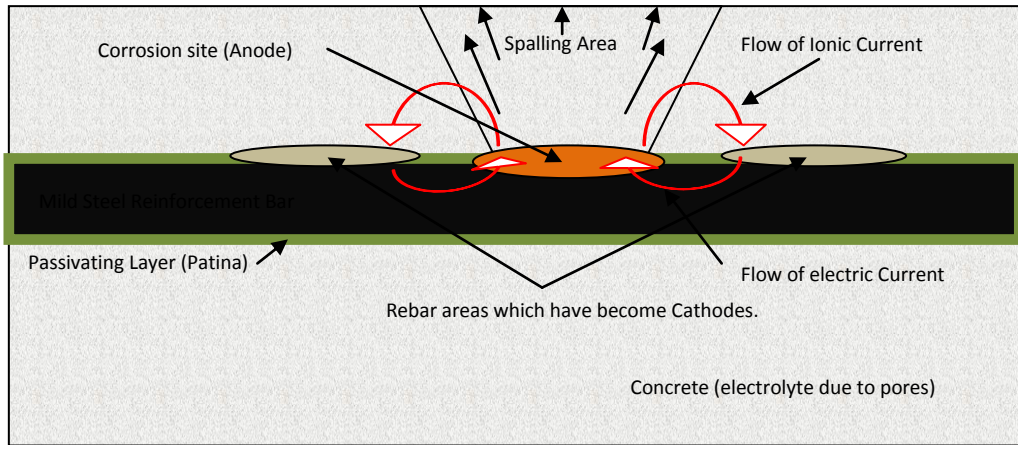
The corrosion (rusting) of steel occurs as a result of electric currents between two different points on the steel surface which are at different potentials and when the steel is in an electrolyte environment. The process is both electrical and chemical (Electrochemical).

An electrolyte environment is where the steel has both oxygen and water present. So the atmosphere is an electrolyte and due the pore water in concrete the concrete itself can also act like an electrolyte

Steel is made from iron ore. Iron atoms have 26 electrons of which 3 are loosely attached and can easily escape. It is when these electrons escape allowing the reduced iron atom to combine with oxygen and water that the corrosion process begins. The process dissolves the iron to form positive ions into a permeable mass of oxides termed corrosion (rust) Fe203H20).

Steel surfaces have both anodic (positive +) and cathodic (negative-) areas. Steel corrodes when in an electrolyte, anodic areas sacrifice ions (any atom deficient by 2 electrons) by the movement of an electrical charge to a cathodic area. These corrosion sites are termed the anodes of the corrosion cell.



These corrosion cells increase in volume as the rust occupies a greater volume than the parent steel. This expansion creates huge explosive pressures on the surrounding concrete causing the concrete around the cell to crack and spall away from the surface.

When concrete is first poured a chemical reaction called the hydration process occurs. During this process a protective layer (patina) is formed around the steel. This passivating layer is durable and self repairing and can last for hundreds of years providing the high alkalinity of the concrete is maintained.

However from the moment the concrete is poured it is under attack and is greatly influenced by environmental conditions, salts such as Sulpher dioxide (S02) and other pollutants in the atmosphere and naturally occurring chemicals such as carbon dioxide (C02) or combinations of chemicals can have a significant affect on the rate of corrosion . The presence of Chlorides reduces the alkalinity of the concrete neutralising the passivating layer leaving the steel more susceptible to corrosion.

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