Technical Note No. 24

CORROSION

Introduction

Any corrosion of metals used for external cladding may affect the appearance and eventually structural integrity of the facade. This Technical Note presents the basic theory of corrosion, indicates the conditions under which it may occur and the means by which its occurrence and consequences may be minimised.

Corrosion mechanism

Most metals are only found in nature as minerals in which the metal is combined with other elements. Production of the pure metal requires processes in which energy is expended and the resulting metal is not in an inherently stable form. Given time it will react with chemicals in the environment to revert to stable compounds. This process is known as corrosion.

Direct reaction between metals and dry air results in the formation of an oxide film on the surface. As the film grows it prevents contact between the metal and air thus preventing further reaction. The destructive corrosion of metals in the natural environment normally occurs by an aqueous electrochemical mechanism.

When a metal is suspended in water some of the metal atoms dissolve to form ions and the metal develops an electrical potential as a result of the presence of electrons left behind. Different metals in the same solution will have different solubilities and generate different potentials. If they are connected by an external circuit an electric current will flow; in effect a battery will be created. Electrons will flow though the external circuit from the more negatively charged electrode (known as the anode) to the more positively charged electrode (known as the cathode). At the anode the metal will continue to go into solution to replace the lost electrons and maintain the potential. The excess electrons at the cathode may be used up by the formation of hydroxyl ions from dissolved air and water although other reactions can occur in some circumstances. In the solution, the metal ions can combine with the hydroxyl ions to form the metal hydroxide, which can react with further dissolved oxygen to form the oxide.

The same process can occur on a single piece of metal in water, with potential differences generated by slightly different environmental conditions or slightly different properties of different grains in the metal structure.

This process is used for beneficial purposes in batteries but is also the basic mechanism of metal corrosion. Corrosion protection involves interfering with this process in order to retain the component's appearance and mechanical properties.

Although both oxygen and water are required for electrochemical corrosion, air with a relative humidity greater than 70% contains sufficient moisture to facilitate the corrosion of steel. Corrosion may occur at lower relative humidities if hygroscopic salts are present. A potential difference is also required for corrosion to occur. The potential difference may result from different metals in contact, heterogeneity within a single metal, differences in environmental conditions or differences in stress level. The rate of corrosion will depend on the availability of water and oxygen, the