DIGEST DG 527

EFFECTS OF CHEMICAL, PHYSICAL AND MECHANICAL PROCESSES ON CONCRETE

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This Digest provides an overview of the physical and chemical degradation processes that can affect concrete buildings and infrastructure. It outlines the main considerations in designing, specifying and executing durable concrete in order to ensure that it continues to perform in aggressive environments without premature deterioration or unplanned maintenance. The Digest will interest developers, asset owners, engineers and specifiers who wish to gain a broad understanding of the factors controlling the performance of concrete structures in aggressive environments.

A concrete structure performing well

INTRODUCTION

Concrete is the primary bulk construction material in the world and its use is likely to grow. It is widely used because it is so highly adaptable. There are no viable alternative products for many of its applications and Portland and blended Portland cements are currently the only economic binders for concretes that meet the performance and durability requirements under the wide range of conditions to which concrete is exposed. Whatever the exposure environment, proper design and execution of concrete construction can ensure that concrete continues to perform over its intended service life without premature deterioration or unplanned maintenance.

This Digest provides an overview of the degradation processes that can affect concrete structures and elements and which, under certain environmental conditions, can lead to potentially expensive repair work and a larger-than-anticipated maintenance burden. The type and extent of deterioration depend on factors in the environment surrounding the structure (eg the presence of aggressive agents, water, temperature, humidity, wind strength and direction) as well as the design, materials specification and execution of the construction process. This Digest also briefly describes several service environments where concrete is not expected to deteriorate.

The deterioration processes are summarised in Figure 1 and include:

1. chemical processes that can lead to deterioration of the concrete itself (eg sulfate attack) or to corrosion of the reinforcement (eg carbonation and chloride ingress)
2. physical/mechanical processes (eg freeze–thaw action and abrasion)
3. early-age processes (eg thermal effects and plastic shrinkage), which can lead to cracking and accelerated deterioration through other mechanisms.

A guidance document on the diagnosis of deterioration in concrete structures, including investigation, access, sampling and the use of test results in predicting the behaviour of a structure, is published by the Concrete Society[1]; this provides a useful and practical complementary document to this Digest.