Durable and low-maintenance structural concrete infrastructures are long-term societal assets

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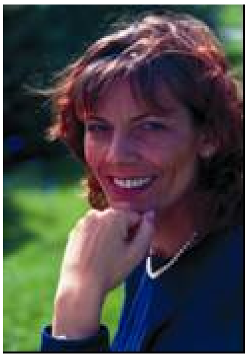

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Summary

The societal assets and the complexity of designing well performing, low maintenance, and durable concrete structures are presented in this paper. The multidisciplinary set of problems to be solved by the designer in order to ensure a truly long service life with minimal maintenance is highlighted. The descriptions of the individual measures required to achieve this goal are shown to be relatively simple and based on well-known methods, materials, and technology, however. The key aspects, benefits, and pitfalls of these measures are outlined with particular emphasize on construction materials, structural detailing, and the quality of workmanship during construction. References to selected recent and current durability design and assessment projects are provided in an individual section.

The paper also illustrates the lack of integration of service life orientated design in available codes and standards and in the current design practice. Moreover, the different perspectives and demands of the owner or the client, the contractor, and the designer concerning durability design and the resulting discrepancies are reviewed and put into a societal context. Thereby, the need for a new design paradigm for concrete structures is formulated, exemplified, and sustained.

Keywords: Durability, service life, concrete structures, reliability, design paradigm

1. Introduction

Service life performance of concrete structures pose multidisciplinary challenges on the designer and the contractor to master structural, materials, construction, and maintenance properties. The growing demand for environmental awareness, i.e. sustainability, is an additional element in support of durable designs. The demands for long service lives reflect on the owner through new challenges regarding the demands, which define the service life design basis and corresponding acceptance criteria. [1,2].

During the past years clients have asked for bridge, tunnel, and marine structures to be designed to satisfy a specified service life, this being typically 100 and 120 years, and in particular cases even 200 years. Normal codes and standards alone are not adequate as a design basis for these demands.

There is no generally agreed methodology available today on which basis such designs can be carried out and results can be verified. In fact, the present design methods do not consider the time factor on other effects than creep and shrinkage and their ULS and SLS effects. With respect to deterioration, concrete structures have some important characteristic properties, which differ fundamentally from structures made of other structural materials. The quality of the concrete and the designed durability performance of the structure are only assumed properties at the design stage. The true quality and performance characteristics of the structural concrete are determined through the actual execution process during construction.

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