# ABSTRACT

## Durability of steel fibre reinforced concrete

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Durability is one of the most important aspects of concrete due to its fundamental incidence in the serviceability life of structures. The structures must be able to resist, a part from the actions of loads that support, the physical and chemical aggressions to which they are exposed because of its location and function. In this respect, cracking plays a key role in the durability of concrete structures.

Cracking in concrete has been accepted as a natural fact. There is only one reason why cracks take place in concrete: there are tensions that exceed concrete tensile strength at a certain moment. Due to this fact it is necessary to establish measures in order to maintain the cracks under the limits that imply a risk for the durability of structural elements. In this context, fibres are presented as a solution to this phenomenon. Steel fibres, in particular, are use with two main objectives: reduce crack width and reach a ductile behaviour after cracking. The addition of steel fibres in concrete contributes to a better control of cracking because it increases residual strength, ductility and improves its mechanic properties. Nevertheless, in the majority of cases it is also necessary the presence of traditional reinforcement, this means a concrete with a reinforcement formed by the combination of bars and steel fibres.

The present survey analyses the contribution of steel fibres to durability of structural elements reinforced with bars. With this objective, the survey has been structured in four main parts. The first part consists of a state of the art on steel fibre reinforced concrete, including a historical evolution of fibre reinforced concrete as a construction material, from its origins to its consolidation. Moreover, general aspects such as mechanic properties, applications and normative are revised.

In the second part, a review about durability of steel fibre reinforced concrete against impact, durability in marine environments and against ice-thaw cycles is done to focus, later on, on the key role played by cracking in the behaviour of the structures against the aggressions just mentioned that could reduce its serviceability life. A part from revising the causes that generate cracking and its formation process in traditional reinforced concrete, the effect of adding fibres to this material is described as well as how the fibres work reducing crack width. There are also included several methods of determining cracking, for both concrete with traditional reinforcement and steel fibre reinforced concrete.

The third part consists of two chapters that correspond to the description of the experimental campaign and the analysis of the results obtained in the laboratory. In the first one, the geometry and the materials of the tested elements are defined and it is also presented the experimental campaign carried out in the Laboratory of Structure Technology in the Universidad Politécnica de Cataluña, describing in detail the preparation process as well as the tests done. In the second chapter, the results obtained in the experimental campaign are presented and analysed, including a paragraph in which the additional cost of adding fibres in concrete is valued.

Finally, in the fourth part, in order to deepen in the analysis of the results a non-linear section analysis program is used. This program, AESS (Análisis Evolutivo de Secciones Simétricas) developed at Universidad Politécnica de Cataluña, is used to reproduce the tests carried out in the experimental campaign. The main goal is to compare the results registered in the laboratory and the results obtained with the program (using two different models of constitutive equation for the fibre reinforced concrete, one indirect and the other direct).