Fibre Reinforcement in Load Carrying Concrete Structures Laboratory and Field Investigations compared with Theory and Finite Element Analysis

PhD Åse Lyslo Døssland, Multiconsult
Prof Dr ing Terje Kanstad, NTNU

Abstract

Fibre reinforcement can provide an alternative to conventional steel bars in order to improve the efficiency and working conditions on construction sites and in the prefabrication industry. Through the fibres ability to bridge cracks they improve the structural behaviour of the concrete by increased shear, moment and punching resistance, increased dowel effect, reduced crack spacing and crack widths, increased flexural stiffness and increased ductility in compression. A main reason for limited use of FRC in load-carrying structures seems to be the lack of accepted design guidelines.

The principal aim of this research project is to improve the current knowledge of the mechanical and structural behaviour of fibre reinforced concrete, focusing on practical applications. An experimental study is carried out where the following parameters are investigated: fibre volume, fibre length, steel versus synthetic fibres, size effect, influence of conventional reinforcement, self compacting versus vibrator compacted concrete, casting process and type of structural element.

Most of the test series were evaluated through calculations and finite element analysis (FEA) and compared with available design rules. Generally the agreement was good, both with discrete and smeared crack approach. This shows that FEA is an appropriate tool to determine the contribution of fibres to the load bearing capacity. Moreover, the results of the test series implied that the theoretical framework that exists today describes the behaviour of fibre reinforced structures relatively well, and that the design rules which are developed is satisfactory.