

Finite element modelling of steel fibre or synthetic fibre reinforced concrete structures

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Abstract

Steel fibres or synthetic macro fibres can replace ordinary reinforcement in floors, slabs on grade and walls and have become more common the last decade for reasons due to economy and industrialisation within the construction industry. Also in load carrying structures, like beams and plates, fibres have been used in real construction projects, but in those cases only as partial replacement of the ordinary reinforcing steel. In the latter types of structural elements, the use of fibre reinforcement is still hampered by scepticism among consulting engineers and the lack of generally approved design rules. A major problem is still the uncertainty due to fibre distribution and orientation in the real structures, and convenient control and documentation rules.

The fibre types used in projects where the Department of structural engineering at NTNU has been involved are Dramix steel fibres of length 35 and 60 mm, and several types of synthetic macro fibres of length 40-50 mm. The test programmes contain standard 4-point bending tests, simply supported slabs with concentrated loads, different types of beams, and field testing. In addition single fibre pullout tests and creep tests on pre-cracked specimens are being developed.

Considering the post-cracking behaviour which is of crucial importance for fibre reinforced concrete, the material modelling is based on the theoretical stress resultant in the fibres crossing a crack. The residual stresses are linearly dependent on the fibre concentration and a fibre orientation factor. A major result comparing experimental and theoretical results is that the fibre contribution is strongly dependent on the casting process and the concrete consistency. In general the best experience is better by self-compacting concrete than by ordinary vibrated concrete.