Simulation of Steel Fibre Reinforced Concrete Behaviour Using Discrete Crack Approach

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The recent wide spread use of steel Fibre Reinforced Concrete (FRC) is mainly due to its numerous advantages compared to Normal Concrete (NC), namely by the possibility of changing the quasi-brittle behaviour of plain concrete structures to a behaviour of enhanced ductility, as a direct result of the addition of steel fibres. This work aims at developing a finite element formulation to specifically address the simulation of the behaviour of FRC members up to failure.

For this purpose, an embedded discrete strong discontinuity approach [1, 2] is adopted and steel fibres are explicitly introduced in the finite element mesh. In other words, the steel fibres are considered as discrete elements, embedded in concrete matrix, which increase the stiffness of the bulk finite elements. In this approach, new nodes (tips of fibre-elements) are introduced in the finite element mesh without increasing the global number of degrees of freedom. This is due to the fact that displacements at the new nodes are obtained from the displacements measured at the usual degrees of freedom. In this work the fibres are assumed to be perfectly bonded to the bulk.

This kind of approach provides a simple and efficient way to assess the influence of the steel fibres in the development of the crack pattern and the structural behaviour of the concrete elements. The proposed approach is validated using both numerical and experimental results. Finally, results are discussed and some conclusions are drawn.

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