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Numerical Study on the Dynamic fracture propagation in Fibre-Reinforced Concrete

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The industrial use of FRC in structural applications, particularly the use of steel fibres, has increased considerably during the last decades. However, in order to optimise the design with fibre reinforced material and spread its applications, a complete understanding and modelling of the material behaviour is still lacking.

The object of this work is to simulate the dynamic fracture propagation in FRC (fibre reinforced concrete) beams loaded in a three-point bend configuration. The proposed model has the following main characteristics: a) a single cohesive crack is allowed to propagate in the middle section. The opening of this crack is governed by a rate-dependent cohesive law proposed in [1]; b) the fibres around the fracture plane are explicitly represented through truss elements, see Fig. 1. The fibre behaviour is depicted by an equivalent constitutive law, which is obtained from an analytical load-slip curve.

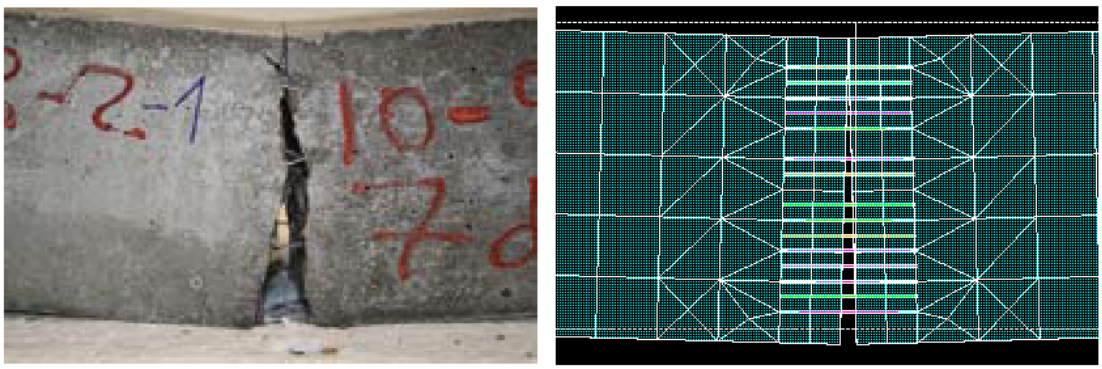

Fig. 1 Fibres shown to sew the main crack in a three-point-bend beam (left) and the numerical representation through truss elements sharing nodes with the solid elements near the middle section.

The proposed methodology is implemented in the commercial software ANSYS using contact/target elements for the cohesive fracture. The obtained load-displacement curves are compared with their experimental counterparts [2], two examples are shown in Fig. 2. The good agreement testifies to the model's feasibility.

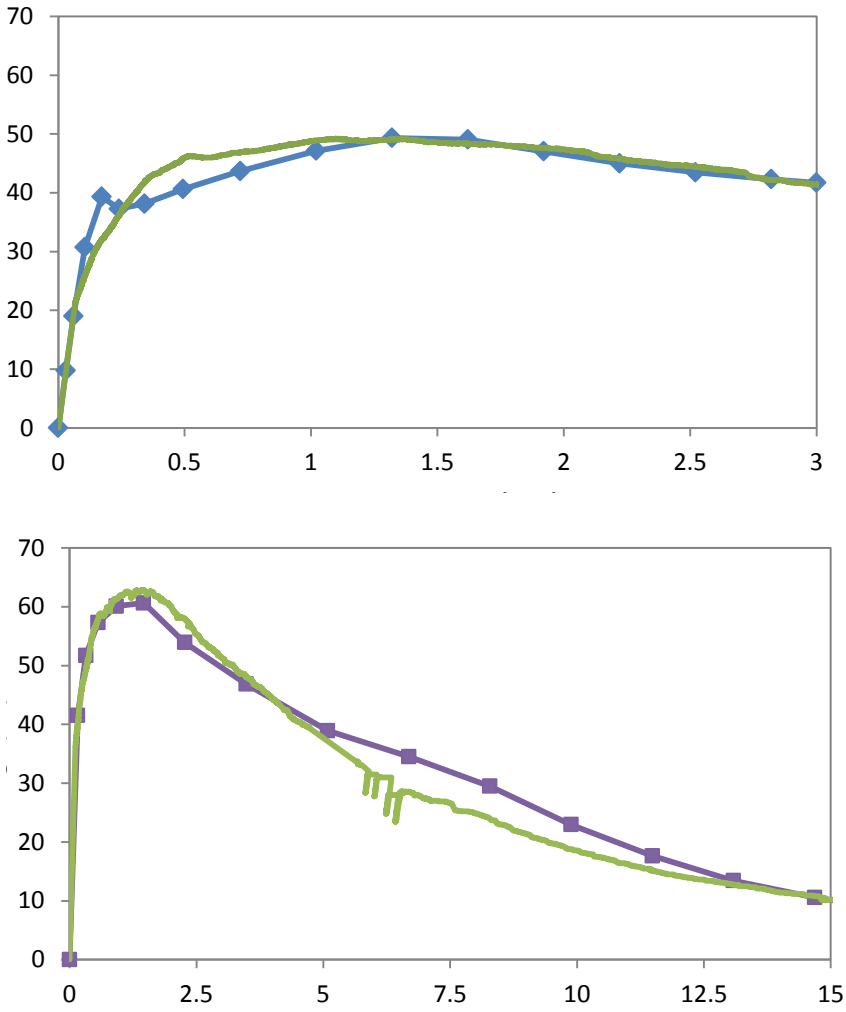

Fig. 2 Load-displacement curves for a TPB beam reinforced with 199 fibres (top) and 354 fibres (bottom) at the middle section, where the vertical axis is the load in **kN**, the horizontal axis is the loading-line displacement in **mm**; the solid lines represent experimental measurements, whereas the lines with square symbols are their numerical counterparts.

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