

Numerical modelling of cracking in fibre reinforced concretes (FRC)

Pierre Rossi, Jean-Louis Tailhan

*Paris-East University, French Institute of Science and Technology for
Transport, Development and Networks (IFSTTAR)*

- **Presentation of the numerical modelling devoted to FRCs**

- **Example of application of the modelling:**

Shear behaviour of a mix reinforced concrete beam – Rebars + Steel fibres

Physical assumptions related to the model

3 steps in the cracking process in tension (Rossi et al., 1987, 1990, 1992)



1. **Microcracks creation: heterogeneity of the matrix**

2. **Localization process: Microcracks**  **Macrocrack (tensile strength)**
Mesocracks

Material behaviour: No fibre acting

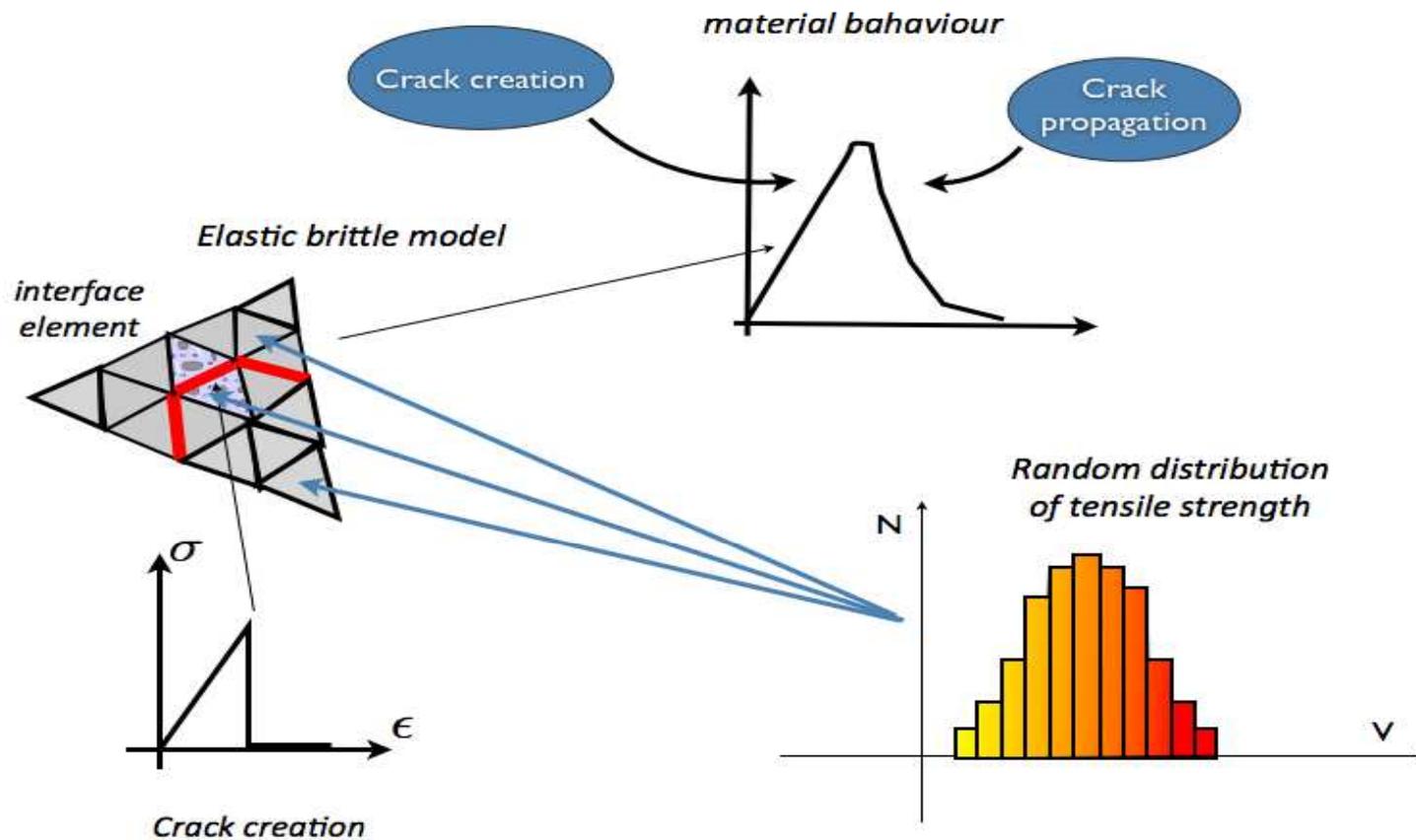
3. **Macrocrack propagation: Post-cracking behaviour governed by the fibres acting**

Structural behaviour

The model: Probabilistic discrete cracking model

Matrix behaviour

(Rossi et al, 1987, 1992 – Tailhan et al. 2010)

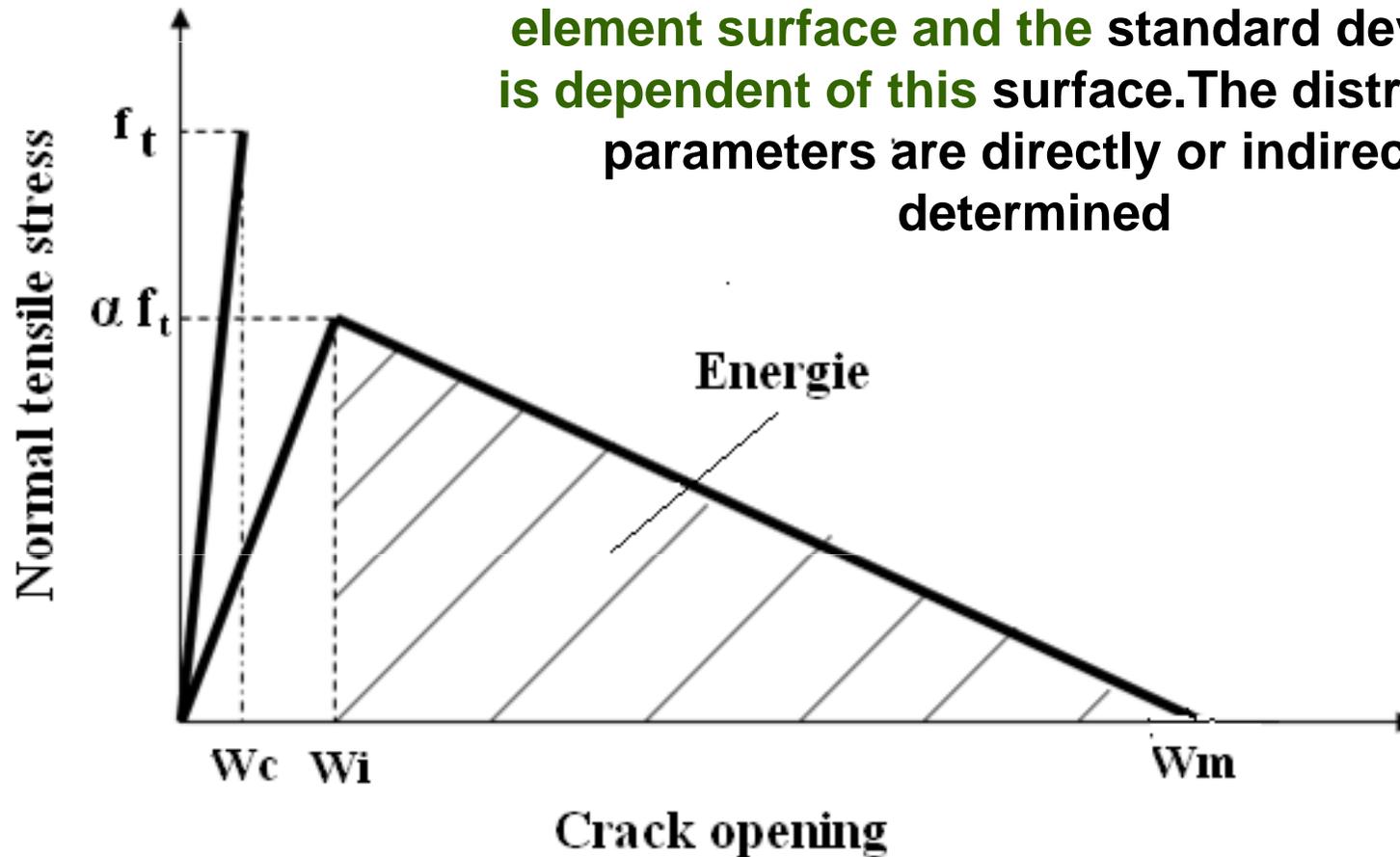


(After J.L. Tailhan)

The model: Probabilistic discrete cracking model

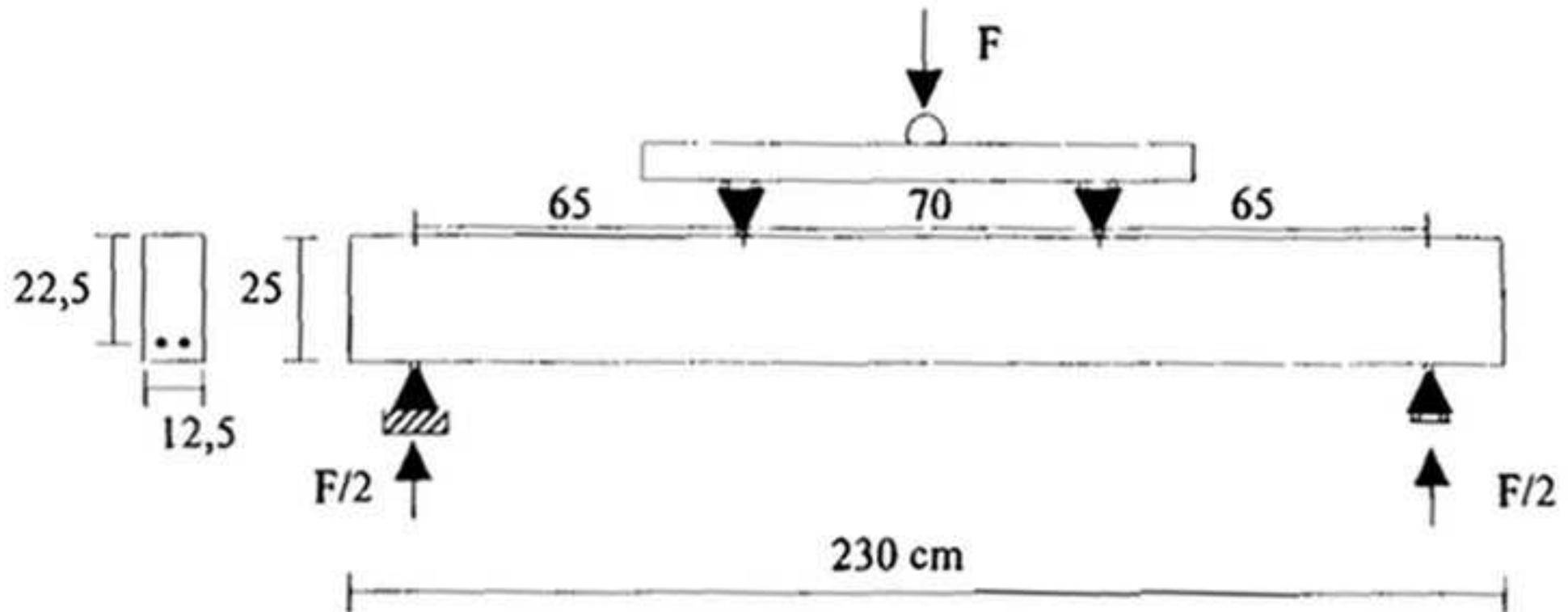
Post-cracking behaviour

Log-normal distribution of the Energy: the mean value is independent of the interface element surface and the standard deviation is dependent of this surface. The distribution parameters are directly or indirectly determined

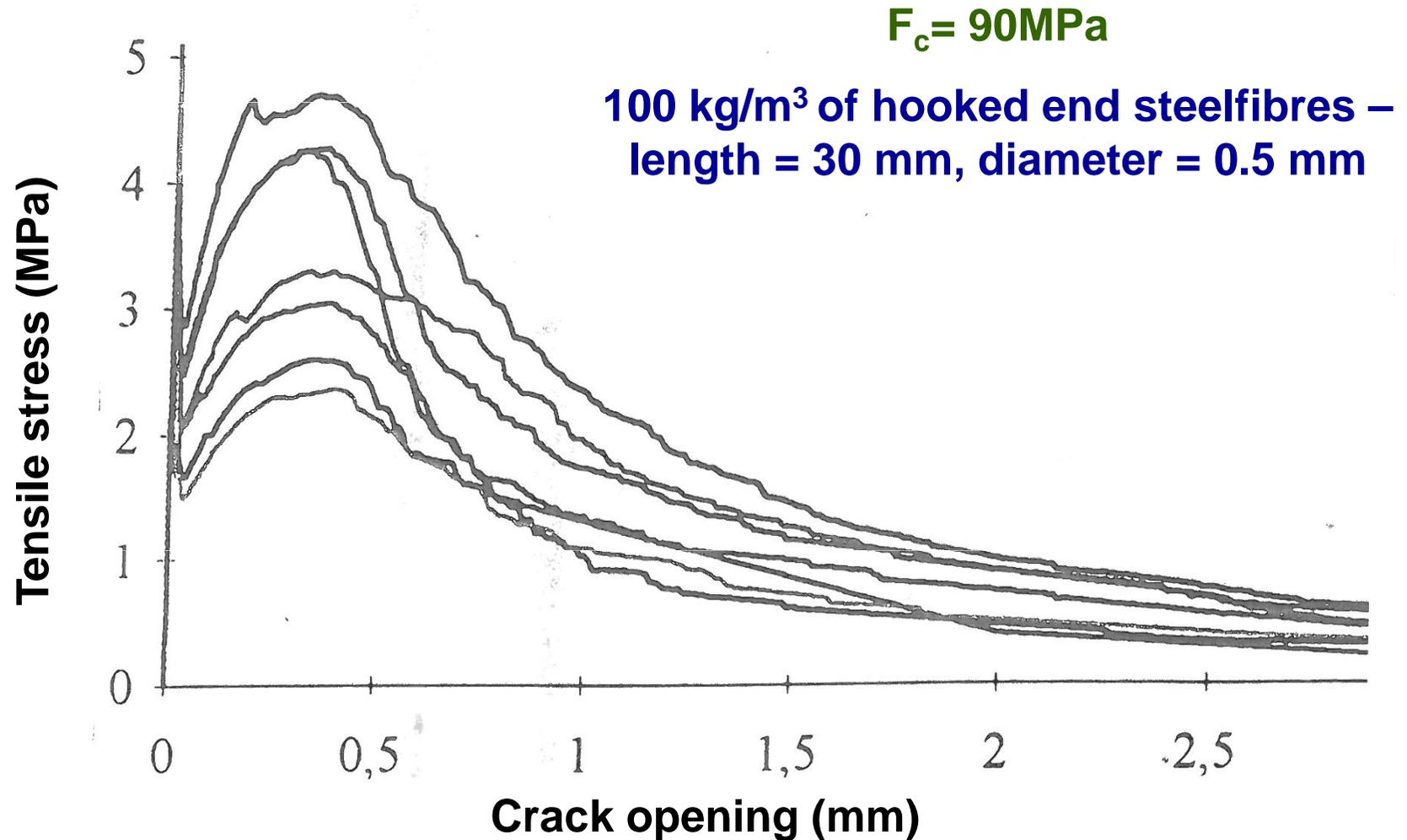


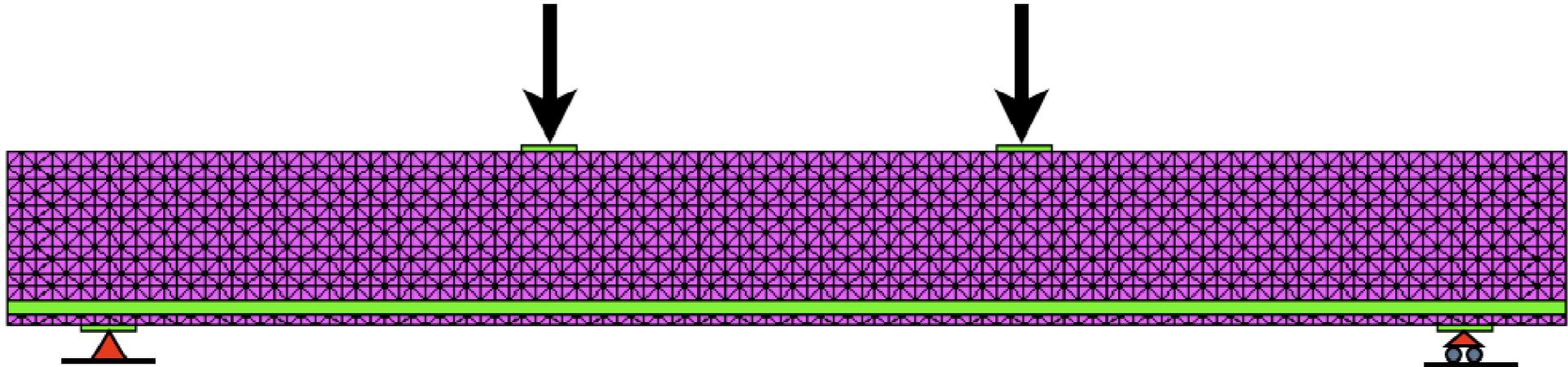
First validation of the model

**Shear behaviour of mix-reinforced concrete beam
(rebars + steel fibres) – Casanova et al. 1997**



Post-cracking tension behaviour of the SFRC





Matrix behaviour

Mean tensile strength: 5.6 MPa

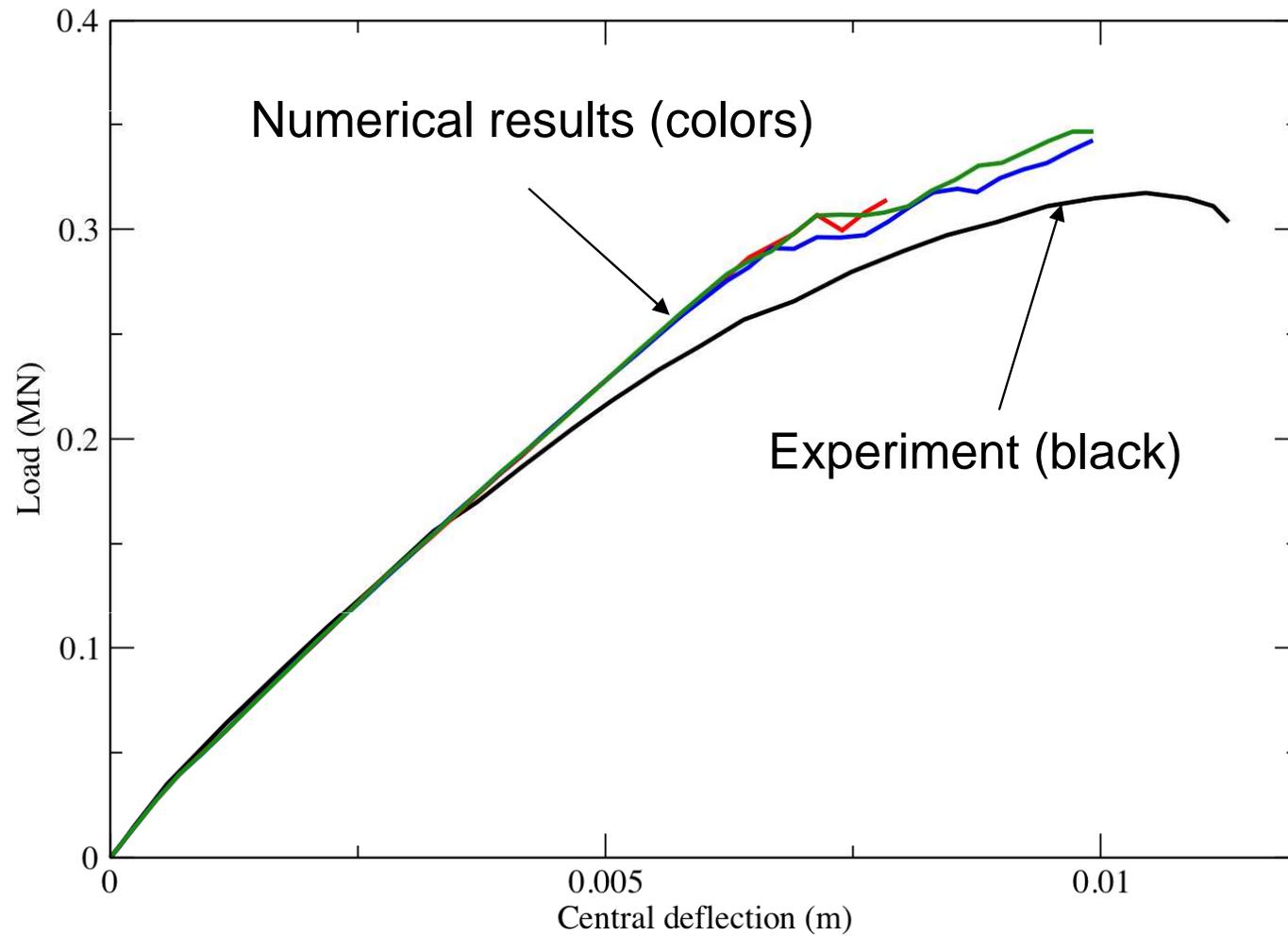
Standard deviation: 0.5 MPa

Post-cracking behaviour

Mean Energy: 3.45 MPa.m

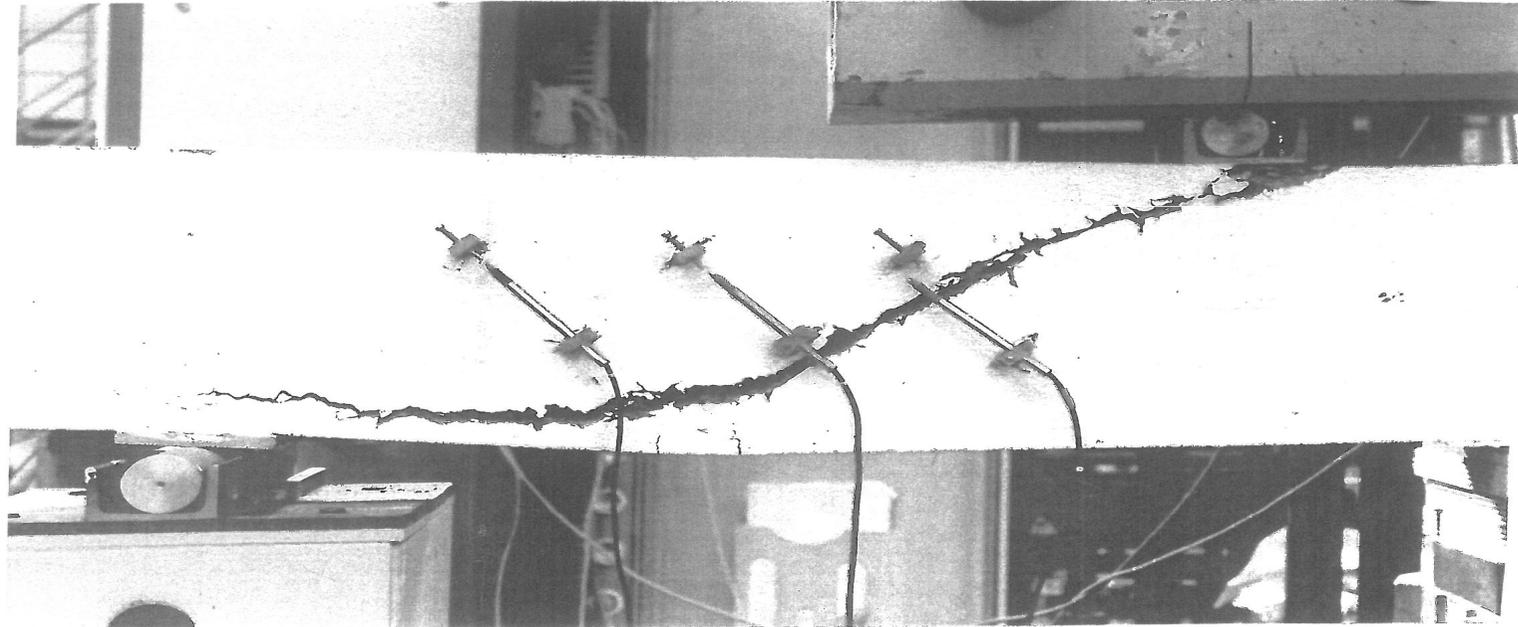
Standard deviation: 0.4 MPa.m

Global behaviour of the beam

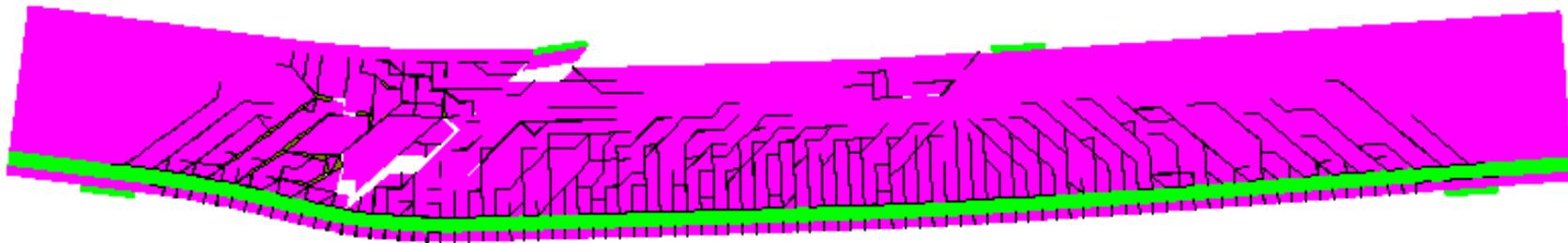


First validation of the model - Shear behaviour of mix-reinforced concrete beam

Cracks pattern



Experiment



Simulation

Conclusions

New numerical modelling of cracking of FRC concrete structures

- Microcracking step (**material behaviour**) is taken into account by considering a **perfect brittle behaviour** of the matrix which the material parameters are probalized by using a **weibull distribution function**



The cracks creation is modelled by using interface elements

- The macrocrack propagation is controlled by the fibres (**post-cracking behaviour**): use of a **damage model**



The tensile stress at the level of the interface elements is a linear decreasing function of the opening displacement related to the element.

The post-cracking energy is a probalized parameter (log-normal distribution function)

Conclusions (following)

First simulation of the shear behaviour of a mix-reinforced (**rebars + steel fibres**) beam



The comparison between experience and simulations is **promising** in term of **global mechanical behaviour** and of **cracking process**