Institute for Sustainability and Innovation in Structural Engineering

VÍTOR CUNHA

Supervisors: Joaquim Barros / J. Sena-Cruz

BOND-SLIP MECHANISMS IN STEEL FIBRE REINFORCED SELF COMPACTING CONCRETE

INTRODUCTION: In fibre reinforced composites materials, fibre and matrix are bonded together through a weak interface. The study of this interfacial behaviour is important for understanding the mechanical behaviour of such composites. Moreover, with the outcome of new composites materials with improved mechanical properties and advanced cement matrices, such in the case of steel fibre reinforced self-compacting concrete (SFRSCC), the study of the fibre/matrix interface assumes a new interest.

Scope: Assess the pullout behaviour of steel fibres from a SFRSCC medium and ascertain the local bond stress-slip relationship. For these purposes an experimental set-up was defined, which allows the **accurate acquirement of the pullout load versus end-slip relationship**, and an analytical model is implemented to **obtain the local bond law** by a back-analysis procedure. These laws will be used in future work to model the fibre/matrix interface behaviour in structural elements of SFRSCC.

Assessment of the fibre pullout behaviour: The pullout tests were performed on a servo-hydraulic Lloyd LR30K machine with a capacity of 30 kN. The test setup is depicted in Fig. 1. The influence of the ***fiber type*** (smooth, hooked), ***embedded length*** (10, 20 and 30 mm) and ***orientation angle*** (0, 30 and 60º) on the pullout behavior of SFRSCC was studied.

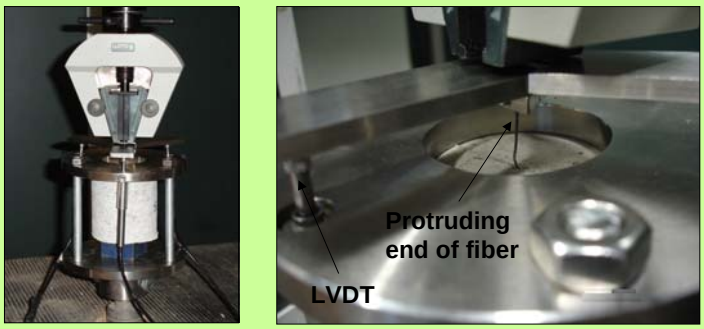

Fig.1 - Test setup.

The local bond phenomena of the fiber-matrix interface was modeled by a ***second order differential equation***. The analytical pullout load-slip relationship was determined using an energy approach. The local bond differential equation was obtained numerically using the ***Runge-Kutta-Nystrom*** method.

The parameters of the local bond stress-slip law that best fitted the experimental pullout load-slip curves of the smooth series were obtained by ***back-analysis***. In Fig. 2(a) is depicted the local bond law used and some parameters obtained in the back-analysis. In Fig. 2(b) are represented some analytical and experimental curves.

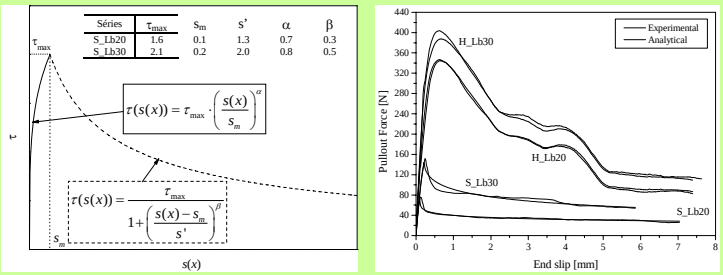

Fig.2 - (a) Local bond law (b) Analytical simulation.

Future work: The response of SFRSCC structural elements will be simulated using a ***mesoscopic model***. For this purpose **particle packing models** will be used on a meso-level to assess the final distribution state of the aggregates and fibres in a certain structural element. In a second step, the location and orientation of the fibres will be inserted in a three dimensional ***finite element mesh*** (see Fig. 3)***.*** A multi-fixed smeared crack model will be used to simulate the fracture process of plain concrete, whereas for modelling the fibre contribution will be used the bond-slip laws previously assessed.

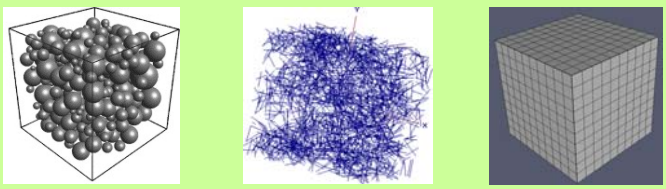

Fig.3 - Steps of the meso-level model.

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