3. Fibre orientation in connection with single fibre pull-out tests (DIC and μ-CT)

Description

Investigation on the pull-out behaviour of steel fibres depending on the fibre orientation. The study focuses on characterizing the pull-out performance of steel fibres relative to the fibre orientation, and evaluating the extent and development of general and localized damage at the fibre and fibre-matrix interface using Digital-image correlation and X-ray micro-tomography.

Aim and objectives

The aim of this project is to characterize the pull-out performance of single steel fibres depending on the fibre orientation and embedded length, and understand the local damage mechanisms at the fibre and fibre-matrix interface. The following objectives are defined:
1- Summarize and categorize the existing literature on pull-out performance of steel fibres, focusing on the influence of fibre orientation and embedded length.
2- Optimize the operation of the existing standard test-setup for the execution of fibre pull-out testing, in combination with DIC measurements.
3- Characterize the pull-out performance of commercial fibres depending on the fibre orientation and embedded length, combining standard measuring techniques with Digital Image Correlation analysis.
4- Evaluate the local damage at the fibre-matrix interface using x-ray tomography.

Methodology

In order to fulfil the abovementioned aim and objectives, the study will comprise the following tasks:
1- Literature review: Identification, classification and summary of scientific literature
2- Macro-scale experimental study: Pull-out testing on standard test-rig at 119
3- Micro-scale experimental study: Scanning of tested specimens inside CT-scanner
4- Analysis of results: Descriptive statistics of the experimental data, DIC image analysis (Aramis), and exploration of x-ray scans (tutorials will be provided).

Minimum requirements

The project is oriented to MSc education level, preferably a group of 2 students. The students are expected to be able to work independently on theoretical, organizational and practical level (introduction to tasks will be provided). The specific requirements for accessing this project are:
1- Proficient English level on a technical basis, and understanding of scientific and technical literature
2- Intermediate-level programming skills (e.g. Matlab) and intermediate-advanced informatics skills (text processing, excel etc.)
3- Intermediate-level on statistics (exploratory statistics at BSc/MSc level)
4- Basic understanding of electronics and mechanical components
5- Advanced understanding of concrete technology and mechanics of materials

Remarks on experimental project: Students will need to have a reasonably free schedule, and will have to prioritize project activities over other obligations. Extra ECTS may be added to the project upon agreement.

Recommended literature (background)

Bentur, A., Mindess, S., 2006. Fibre Reinforced Cementitious Composites, Second Edition, Second. ed. CRC Press.
Neville, A.M., 2012. Properties of Concrete, IV. ed. Prentice Hall, Harlow, UK.
Mehta, P.K., Mehta, P.K., Monteiro, P.J.M., 2006. Concrete: microstructure, properties, and materials, III. ed. McGraw-Hill, Berkeley, Califormia.
Bozik, Simon. 2016. "Single Fiber Pullout of Steel Fibers from Concrete, Enkelt Fiber Tilbagetrækningen Af Stålfibre Fra Beton."