Restraint cracking – combined reinforcement

Master's project in Structural Engineering, for the Master Program Structural Engineering and Building Performance Design

Background

Concrete has a low tensile strength and tensile strain capacity and cracking is initiated at a tensile strain of about 0.1 mm/m which can be compared to the drying shrinkage of concrete of about 0.5 to 0.8 mm/m. Hence, cracks are almost unavoidable and reinforcement is needed to control the behaviour after cracking and to limit crack widths. Cracking may be caused by external applied forces, imposed deformations, by shrinkage or thermal strains which are externally and/or internally restrained, or by a combination of these. When cracking is caused by an external applied force the crack width, if sufficient amount of reinforcement is added, will depend on the applied force. However, if cracking is caused by an imposed deformation the force in the member depends on the actual stiffness and the crack width on the number of cracked formed. However, most codes do not distinguish between these two cases. Furthermore, for structures having both fibre- and bar reinforcement there exist almost no guidelines exists for structural engineers.

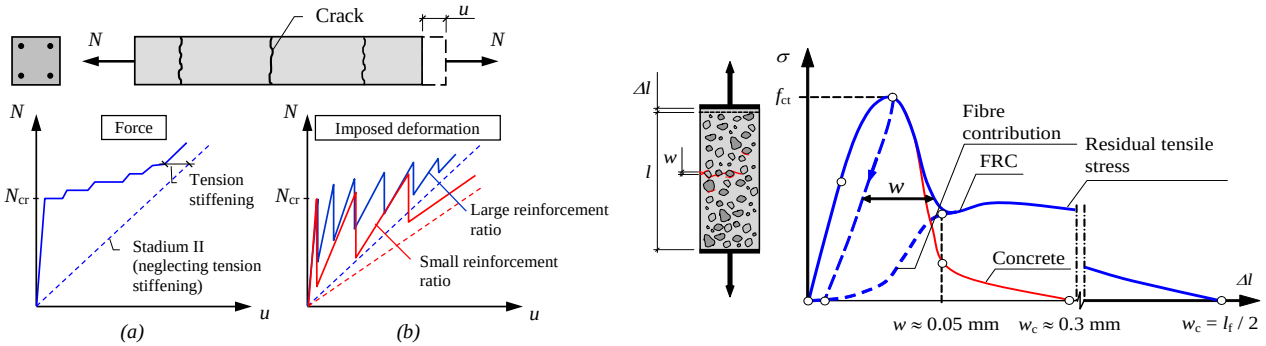

Figure 1. Cracking in reinforced concrete member subjected to load (a) and imposed deformation (b) and cracking process in plain and fibre-reinforced concrete.

Purpose/Method

This master thesis proposal aims to investigate the cracking behaviour, crack spacing and width, when fibre reinforcement is combined with conventional reinforcement. The cracking process will be assessed by numerical modelling, both analytical models and non-linear finite element. Different approaches will be assessed and compared.

Thesis setup information

The master thesis will be carried at Chalmers University of Technology (Structural Engineering) together with Thomas Concrete Group. This Master Thesis work will be part of an ongoing project and is suitable for students interested in restraint cracking and numerical modelling with the finite element method (FEM).

Supervisors

Ingemar Löfgren, Adj. Professor, Chalmers, Ingemar.lofgren@thomasconcretegroup.com
Carlos Gil Berrocal, PhD student, Chalmers, carlos.gil@chalmers.se