ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
Faculté ENAC
IS-BETON - Prof. Dr. A. Muttoni
Dr. Jörg Jungwirth
cem suisse

Structural Behavior of Tensile Elements in Ultra High Performance Fiber Reinforced Concrete

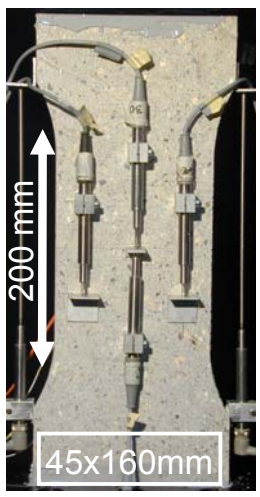
Keywords: ultra high performance concrete (UHPC), structural behavior, fiber concrete, tensile members, strain hardening in tension, ductility, reinforcement, fissuration, localisation

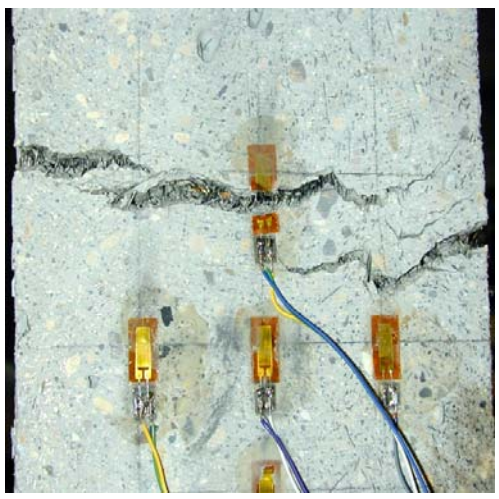
Context

Improvements in the concrete mix design, along with the addition of metallic fibers, have lead to a new high performance cement material known as Ultra High Performance Concrete. A Compression resistance about **150 - 250 MPa** and a reliable **tensile strength** (≈10MPa) can be achieved.
The high performance concrete project currently under way at the Structural Concrete Laboratory (IS-BETON) aims at examining **new concept and design approaches** to design statically efficient and economically viable structures using UHPC. In this scope a detailed investigation on the **tensile behavior of UHPC** has been conducted. Material tests and **tests on structural members** with and without reinforcement have been performed. A **model** has been developed to describe the behavior of structural members including the bond behavior with reinforcement.

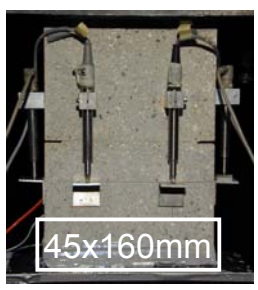
Experimental investigation

tensile behavior (constant section)

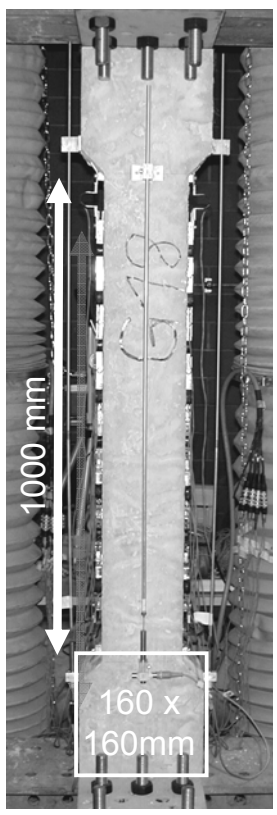


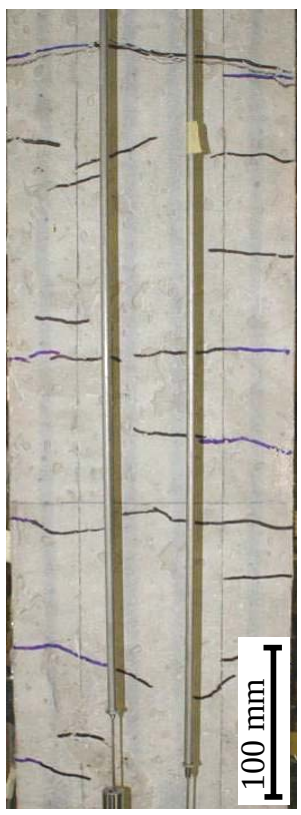


crack opening (notched)



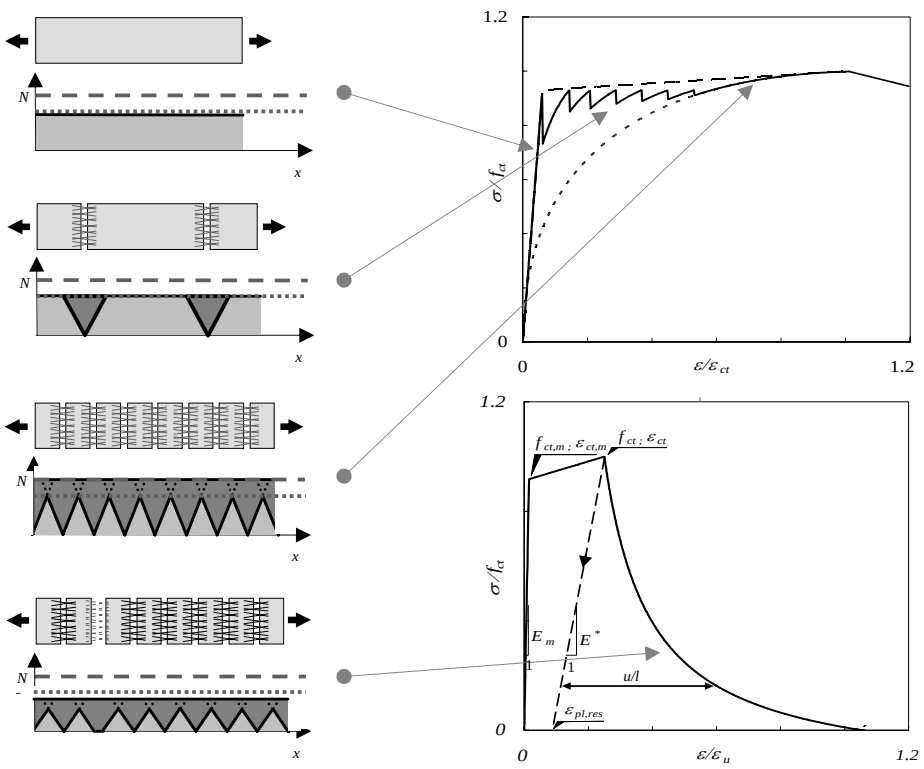
Tests on structural elements, crack pattern with makro and mesocracks





Results

Strain hardening behavior of the UHPC in tension due to the pullout resistance of the bridging fibers.
The structural behavior of UHPC can be described with a bi-linear law for the hardening phase and semi-empirical crack opening law.
Size affect has an important influence on the post failure behavior.



Interaction with the reinforcement leads to a complex multi-cracking with meso- and makrocracks.
The deformation capacity of the UHPC leads to a participation of the UHPC to the stiffness and resistance of the tie element.
Even if the added fibers lead to a more ductile behavior of the UHPC, the localization of the cracking in interaction with reinforcement can cause a brittle behavior of tie elements.