ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
Faculté ENAC
IS-BETON
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Poster n° 339

Structural Behavior of Tension Members in Ultra High Performance Concrete

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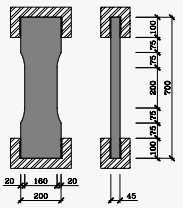
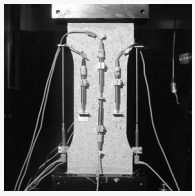
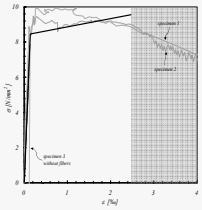
Improvements in the concrete mix design, along with the addition of metallic fibers, have lead to a new high performance cement material known as Ultra High Performance Concrete. A Compression resistance about 150 - 250 MPa and a reliable tension resistance can be achieved.
The high performance concrete 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 study on the tensile behavior of UHPC has been conducted. Material tests and tests on structural members with reinforcement bars have been performed. A schematic representation of the material behavior allows a general description of the behavior of structural members in tension.

Material Behavior

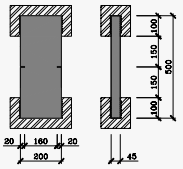
Distributed Deformation

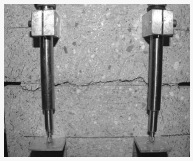


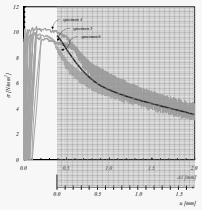




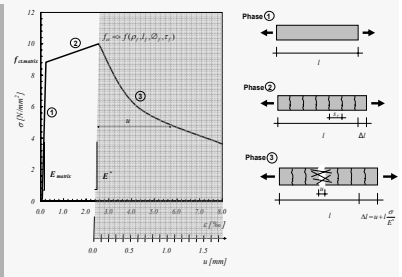
Crack Opening







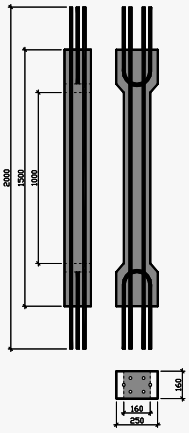
Tensile behavior of an UHPC element



Measured characteristic values:
$f_{ct,Matrix}$ = 8.9 MPa
f_{ct} = 9.7 MPa
E = 60 GPa

Testing of Tension Members

Test Setup for tension tests on structural members

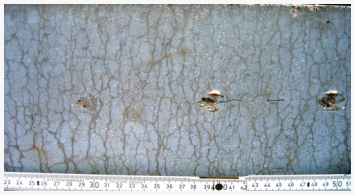


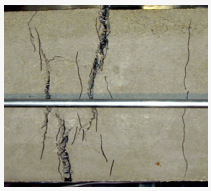
Test Parameters

	Criterion	Chosen [mm²]	ρ [%]	A_s [mm²]	Fs [kN]
T1	$F_s = 0$	-	-	-	-
T2	$F_s \approx F_c$	4Ø12	1.0%	452	251
T3	$F_s > F_c$	4Ø16	2.5%	804	447
T4	$F_s >> F_c$	4Ø20	4.1%	1256	698
T5	F_p	4Ø15.2	-	600	1062

Opened Cross Section

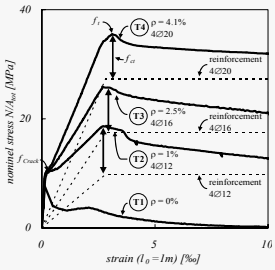
Cracking Behavior

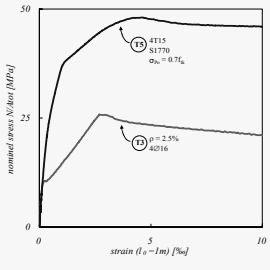




Tension Behavior

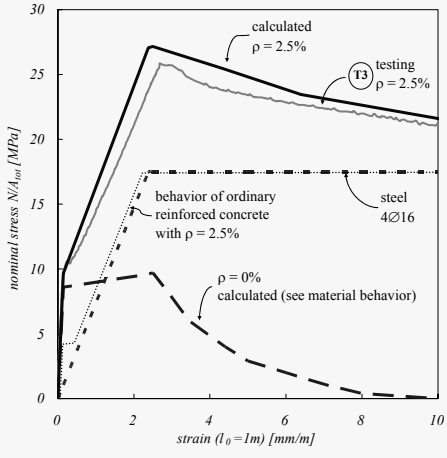
Results of the tension tests on structural members





	Reinforcement [mm²]	F_s [kN]	f_{Crack} [MPa]	f_t [MPa]	$f_{ct}=f_t - F_s/A$ [MPa]	s_{Crack} [mm]	$s_{Crack,fine}$ [mm]
T1	-	-	7.8(?)	-			12.5
T2	4Ø12	251	10.5	18.6	9	40	12.5
T3	4Ø16	447	10.9	25.9	8.6	50	12.5
T4	4Ø20	698	11.2	35.5	8.4	60	12.5
T5	4Ø15.2	1062	38.5	48.0	6.72		12.5

Model for tension tests on structural members



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Literature

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http://is-beton.epfl.ch/Person/Jungwirt/