

Progetto INTERREG A.C.C.I.D.E.N.T.
"Advanced Cementitious Composites In DEsign and coNstruction of safe Tunnel"



ADVANCED CEMENTITIOUS COMPOSITES UNDER DYNAMIC LOADING AND FIRE

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Year	Name of Tunnel	Country	Length (m)	Deaths	Number Injured	Vehicles Burnt	Accident Type
1994	Hugouenot	South Africa	6111	31	28	1	Bus Engine Problem
1995	Pfaender	Germany	6719	53	4	4	Collision
1996	I. Femmine	Italy	148	5	10	20	Collision
1996	Channel Tunnel	England	50000	-	34	-	Truck fire
1999	Mont Blanc	Italy	11600	39	-	26	Fire due to a leak
1999	Tauren	Austria	6400	12	-	40	Collision
2001	Gotthard	Switzerland	16918	11	65	23	Collision
2003	M. Berici	Italy	-	6	50	-	Overturning
2005	Frejus	Italy	12895	2	20	4	Fire due to a oil spill

Goals:

- 1- New class of structural materials for extreme conditions (high temperature and shock)
- 2- Construction and/or rehabilitation of tunnels designed for extreme conditions

Material level

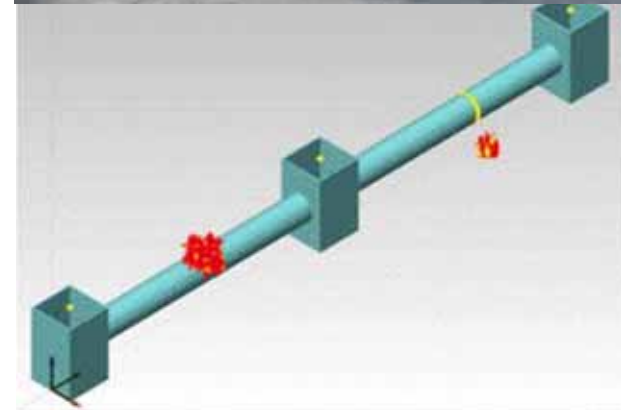
New types of cementitious composites reinforced by fibre randomly distributed and/or textile are developed and characterized both in a static and dynamic field considering fire condition, blast condition and their interaction.

Meso-structural level

A slab, interacting with soil, thermally damaged and subjected to a plane shock wave will be tested.

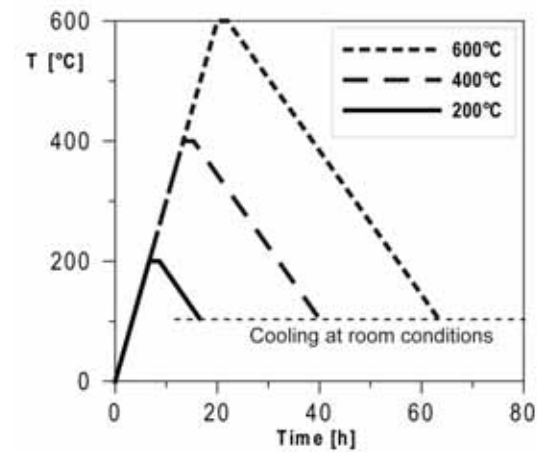
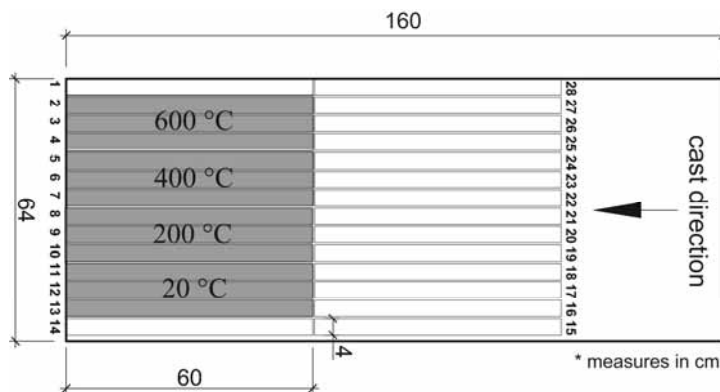
Macro-structural level

At this level two different tests, fire and blasting test, will be carried out on cylindrical plain concrete tube (diameter = 1m; thickness = 0.08m; length = 25m), embedded in a soil at a depth of 2.30 meters (see Figure), already existing at the training campus of the Lombardia Fire-brigade in Bovisio Masciago (Milan).

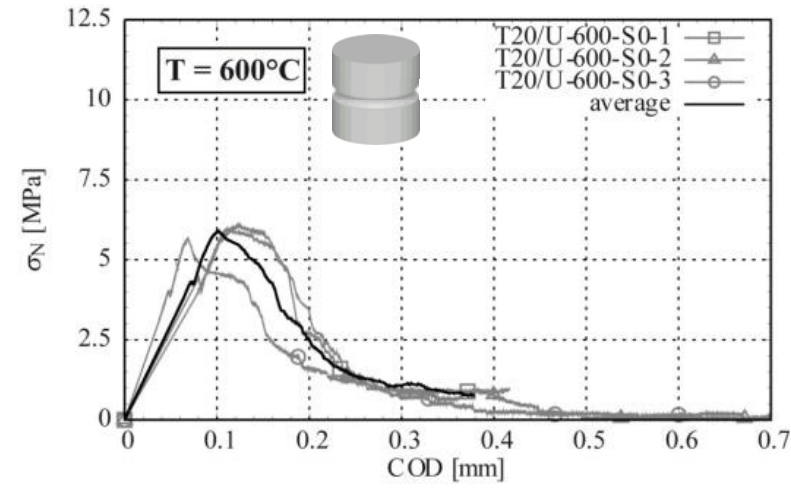
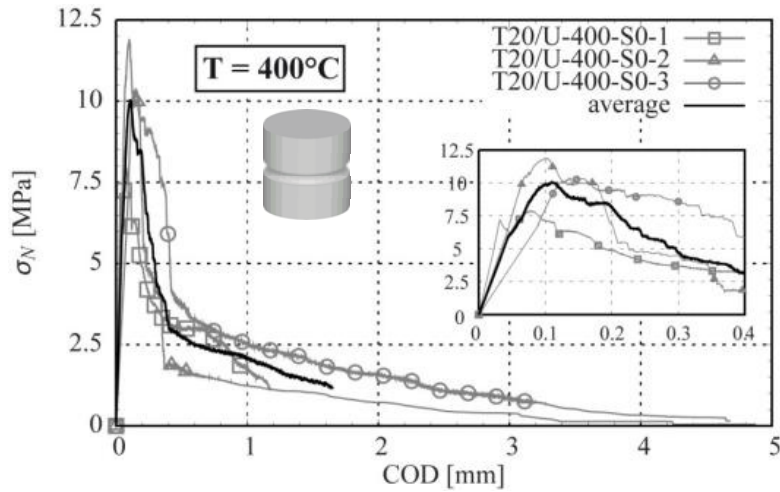
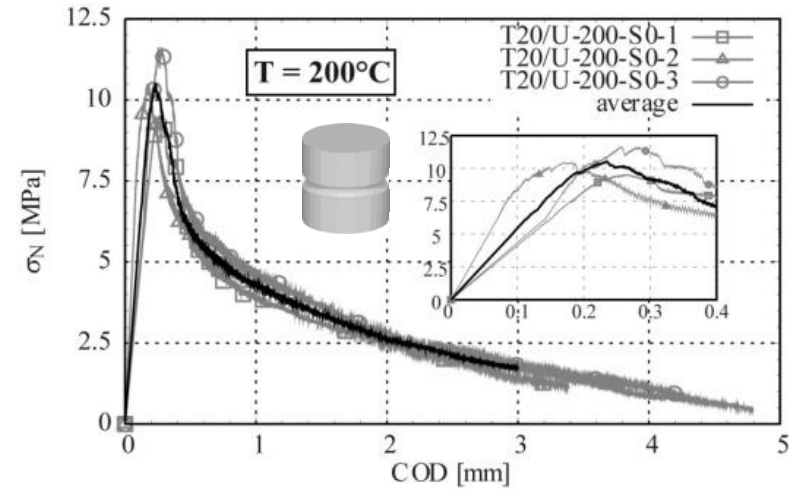
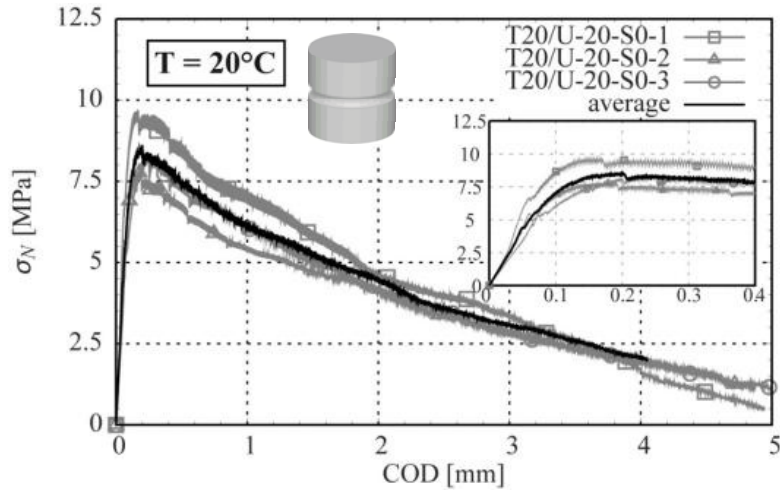


EXPERIMENTAL PROGRAM : MANUFACTURING

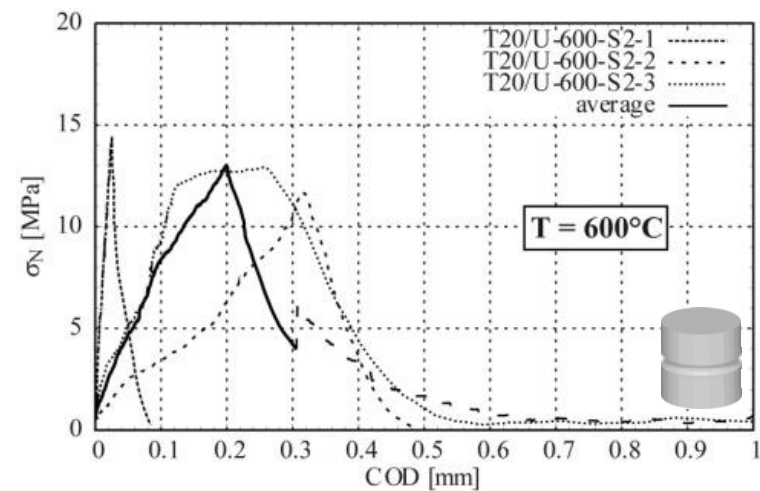
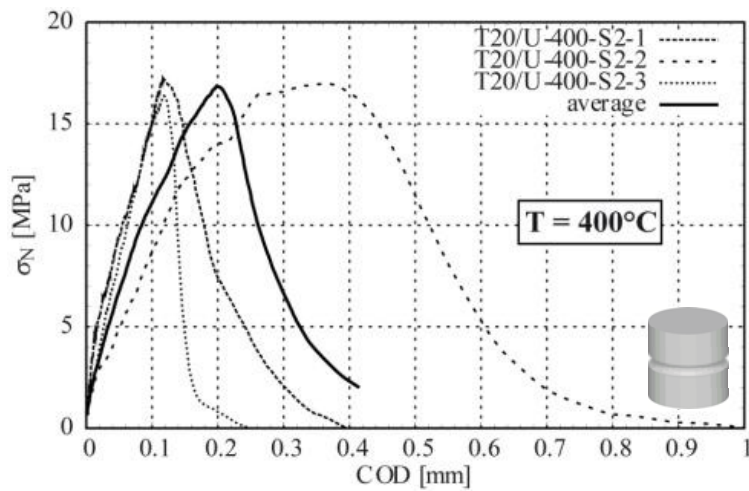
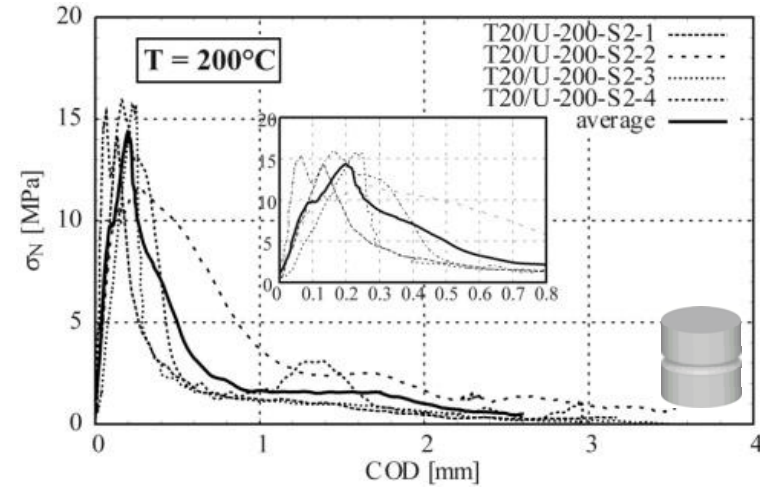
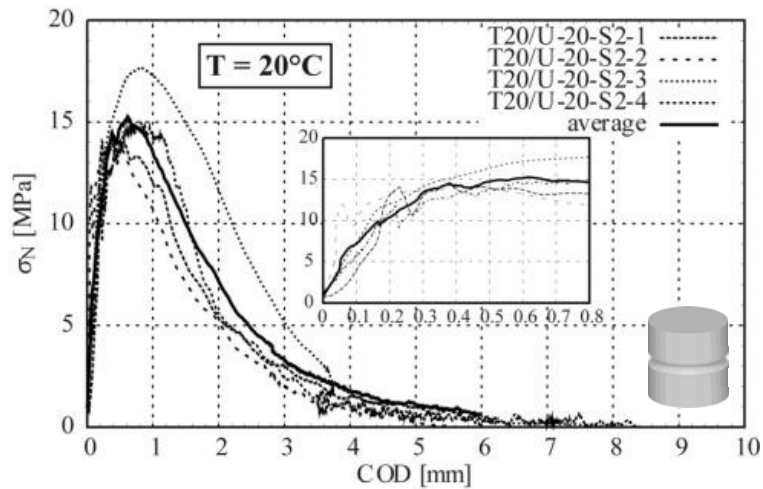
Component	Dosage (kg/m ³)
Cement type I 52.5	600
Slag	500
Water	200
Super Plasticizer	33 (l/m ³)
Sand 0-2 mm	983
Steel fibres ($l_f=13\text{mm}$; $d_f=0.16\text{mm}$)	100



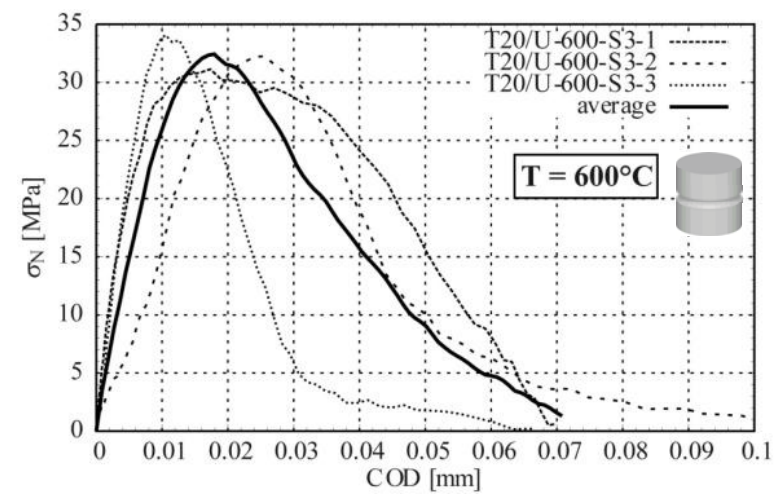
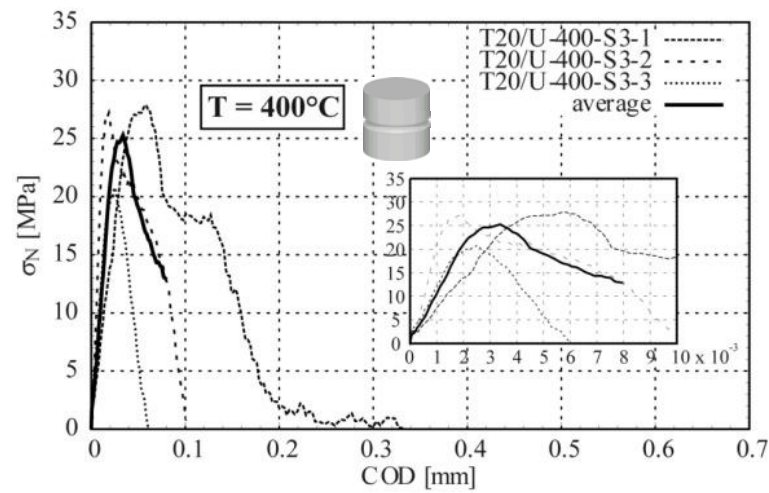
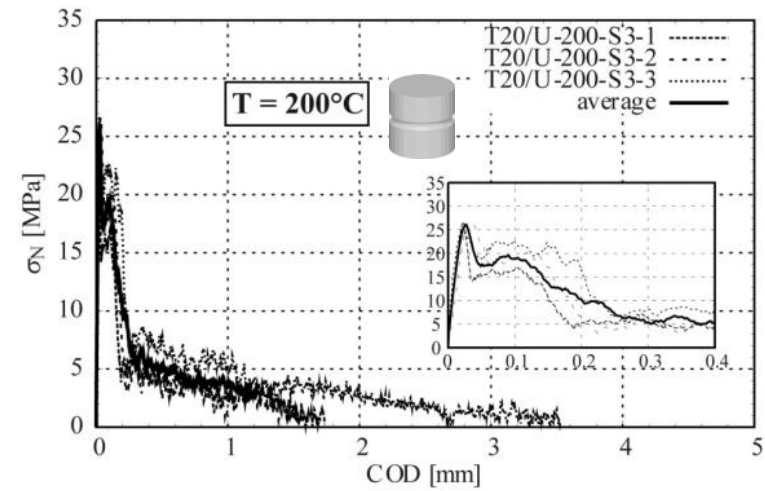
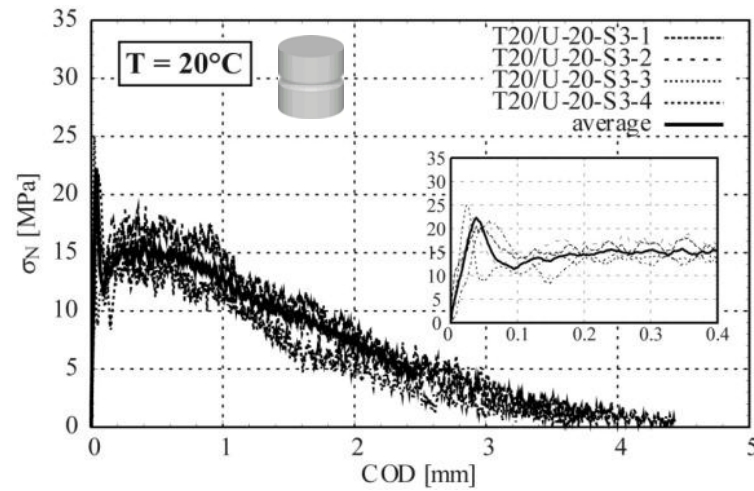
EXPERIMENTAL PROGRAM: NOTCHED CYLINDER (d=20mm)

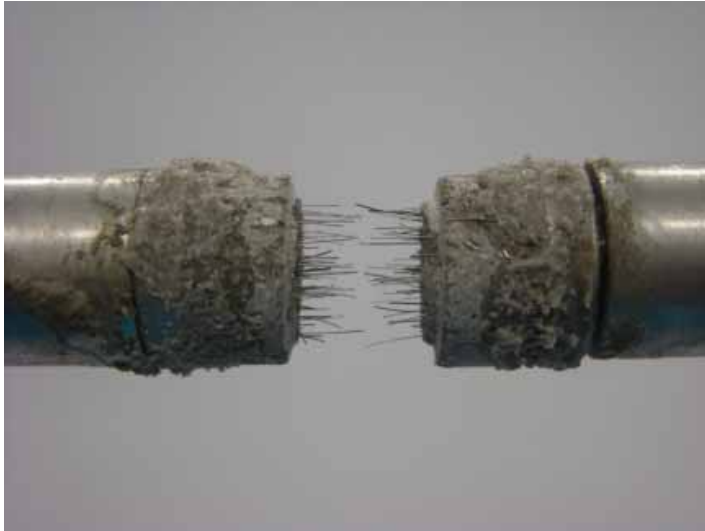


EXPERIMENTAL PROGRAM: $\dot{\epsilon} = 1 \text{ s}^{-1}$ Temp. = variable



EXPERIMENTAL PROGRAM: $\dot{\epsilon} = 150 \text{ s}^{-1}$ Temp. = variable





T = 20 °C



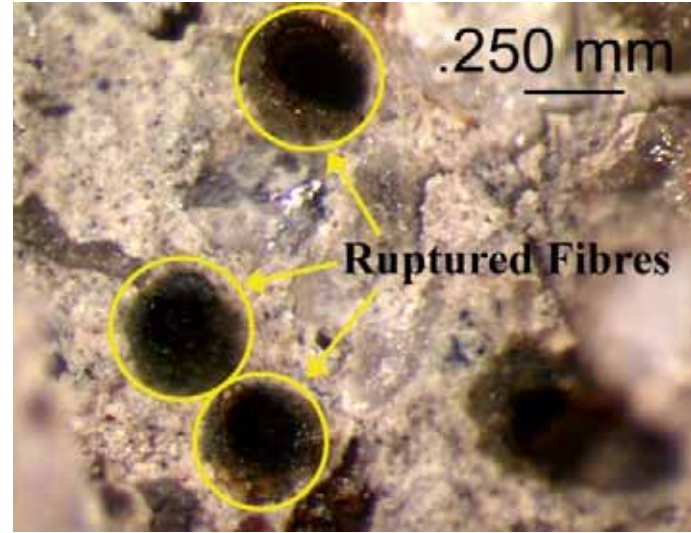
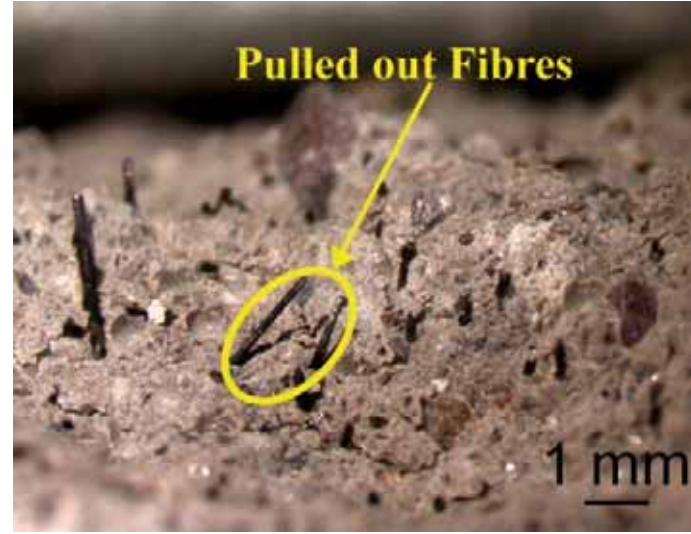
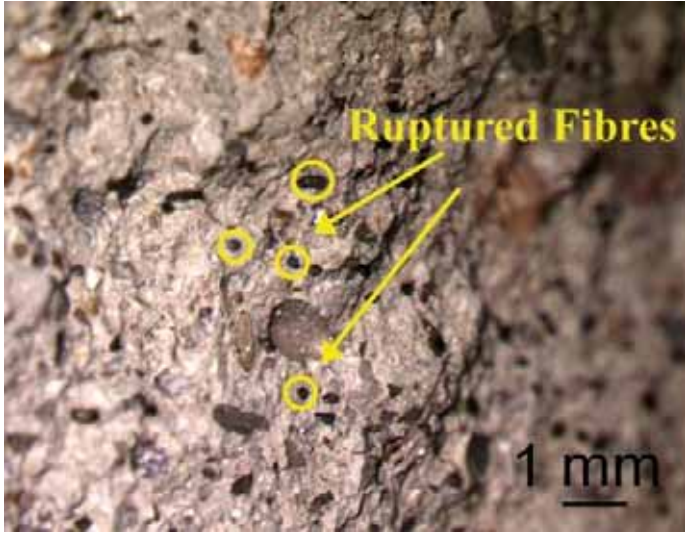
T = 200 °C



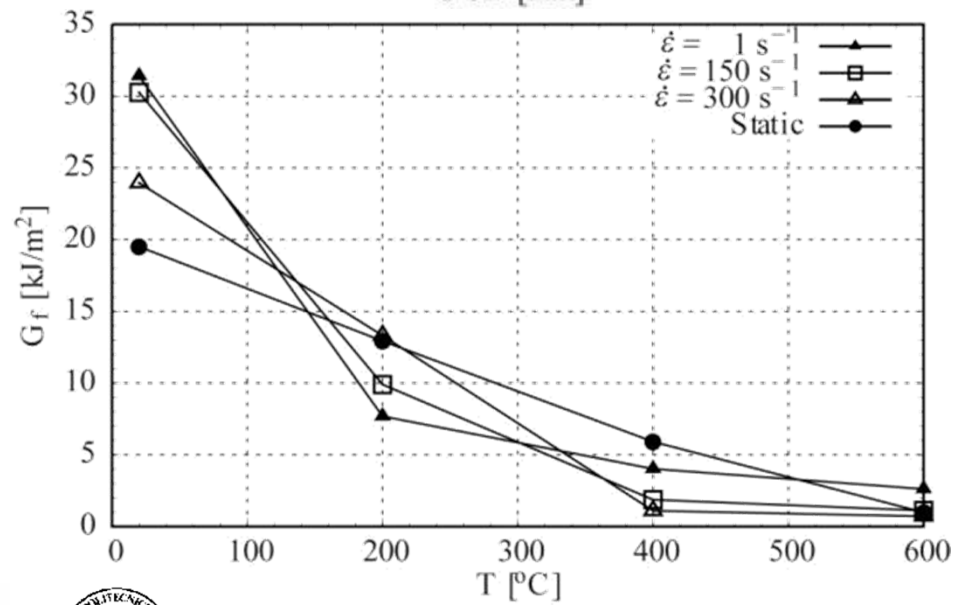
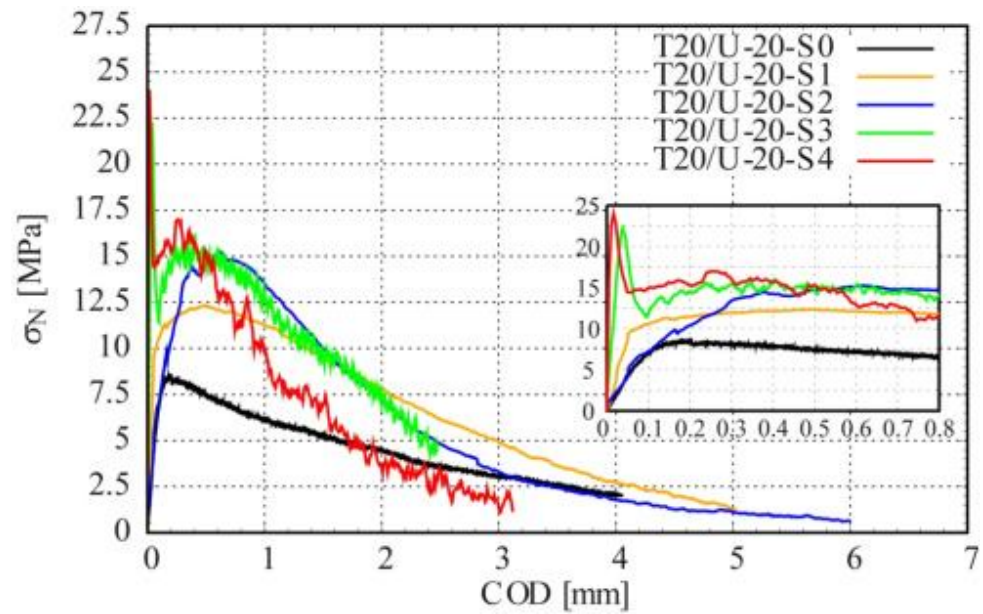
T = 400 °C



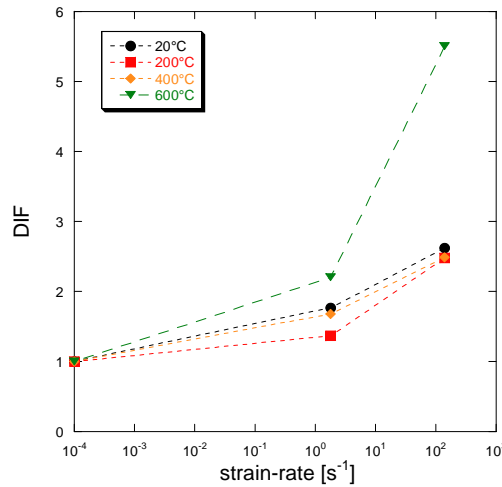
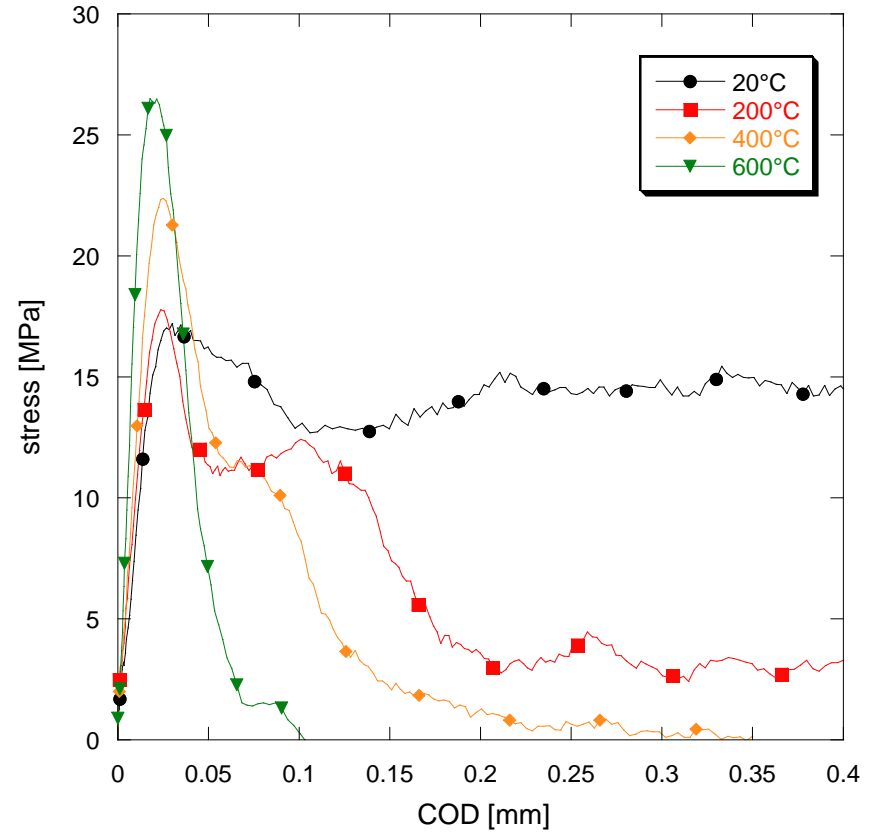
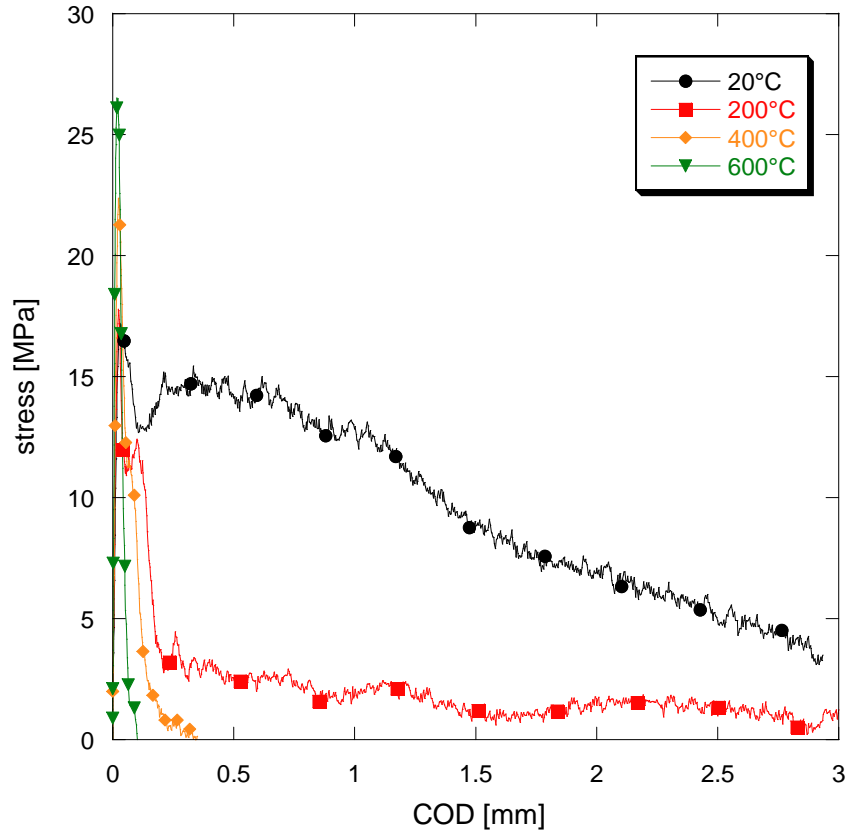
T = 600 °C



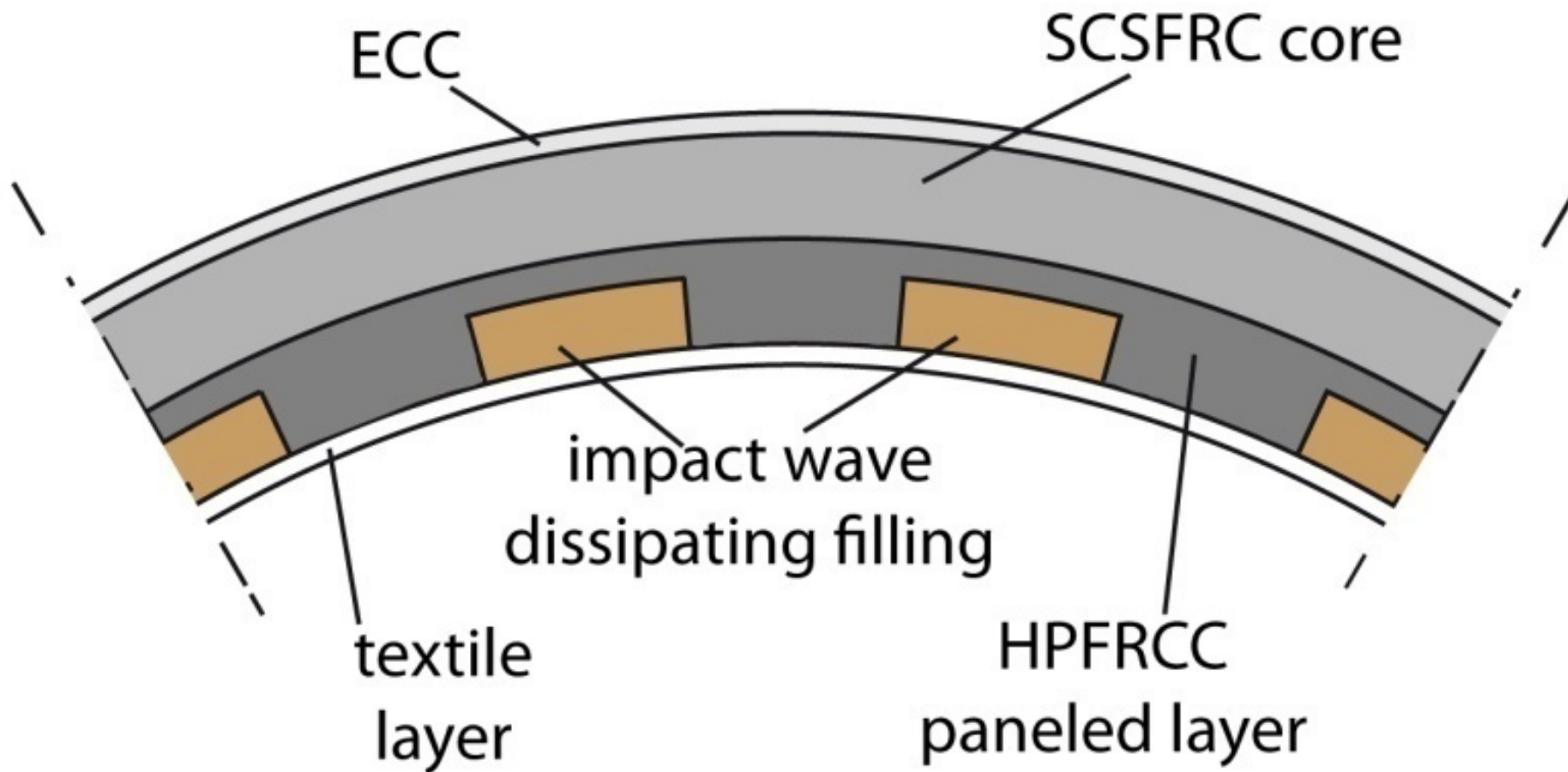
EXPERIMENTAL PROGRAM : SYNOPSIS



EXPERIMENTAL PROGRAM : SYNOPSIS



CONCLUSIONS AND FUTURE PERSPECTIVES



- The material shows an impressive response at high temperature and at high strain rates thus, it is considered the reference in the framework of the ACCIDENT research project.

Thank you for your kind attention

