Applications of Structural Fire Engineering
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Self-Compacting Concrete at High Temperature: a Critical Survey and Recent Test Results

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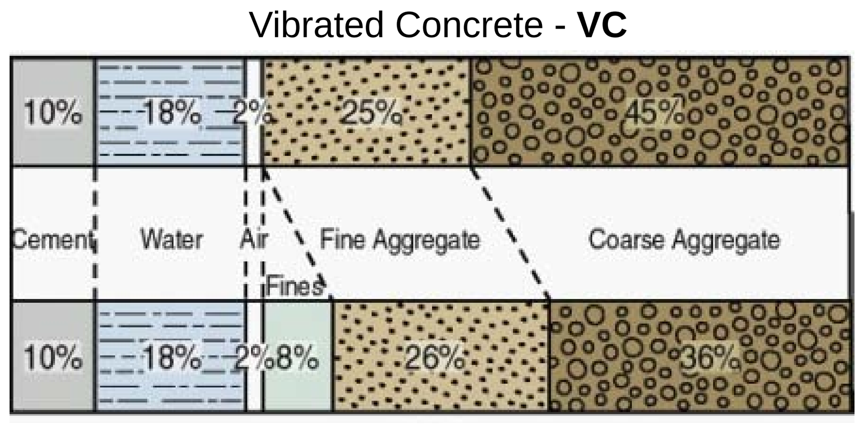
Financial Support: CTG-Italcementi (Liaison Engineer: Stefano Cangiano)

SCC (Self-Compacting Concrete): any concrete, where an appropriate mix-design brings in extreme fluidity (measured by flow rather than slump). There is no need for vibrators to compact the concrete, and the placement is definitely easier. These concretes are characterized by a more uniform and homogeneous microstructure, a higher content of very fine aggregates and a more dispersed and closed porosity. **Now, the questions are:**

Vibrated Concrete - **VC**

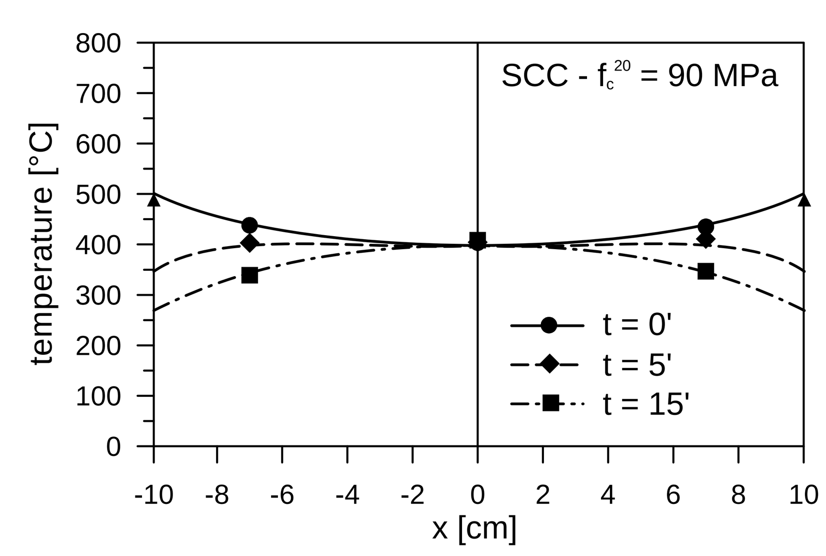


Self-Compacting Concrete - **SCC**

- **Is SCC more affected than Vibrated Concrete by high temperature and fire?**
- **Do the available test results (2004-2007) provide reliable information?**

To answer these questions, a research project was carried out at Politecnico di Milano, on 3 Self-Compacting Concretes (f_c^{20} = 50, 80 and 90 MPa), in "hot" and "residual conditions", with reference to 4 temperature levels (T = 0, 200, 400 and 600°C).

pre-heating in the furnace



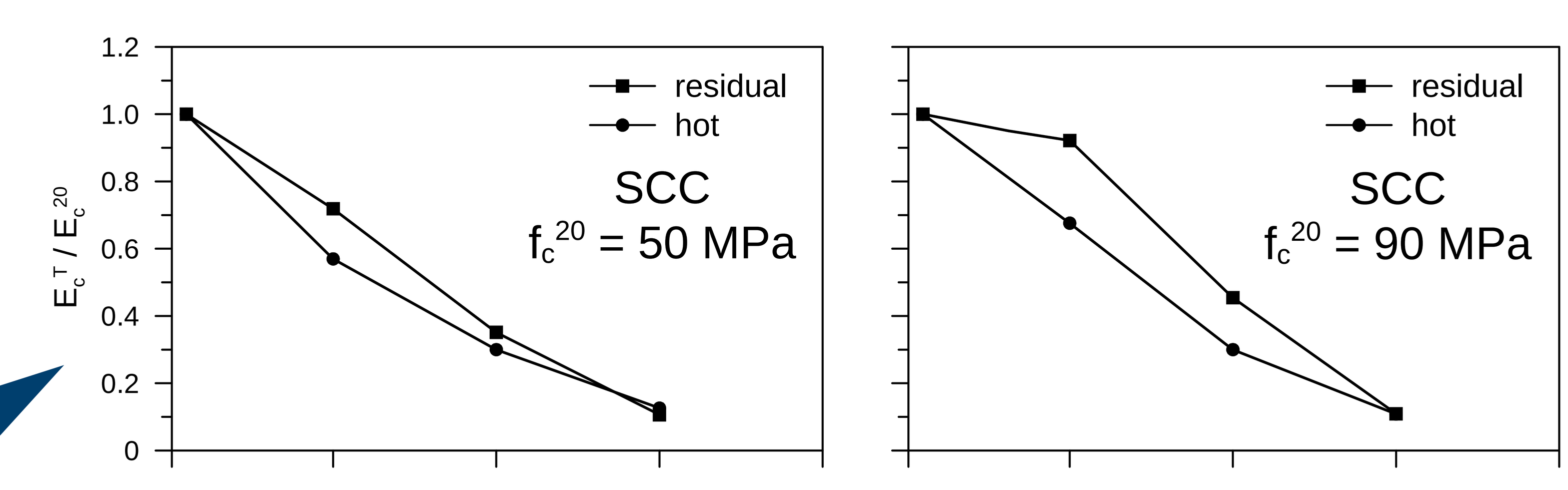
temperature profiles in a typical test (T = 400°C)

testing of pre-heated specimens

Hot tests: the specimens are tested while at high temperature.

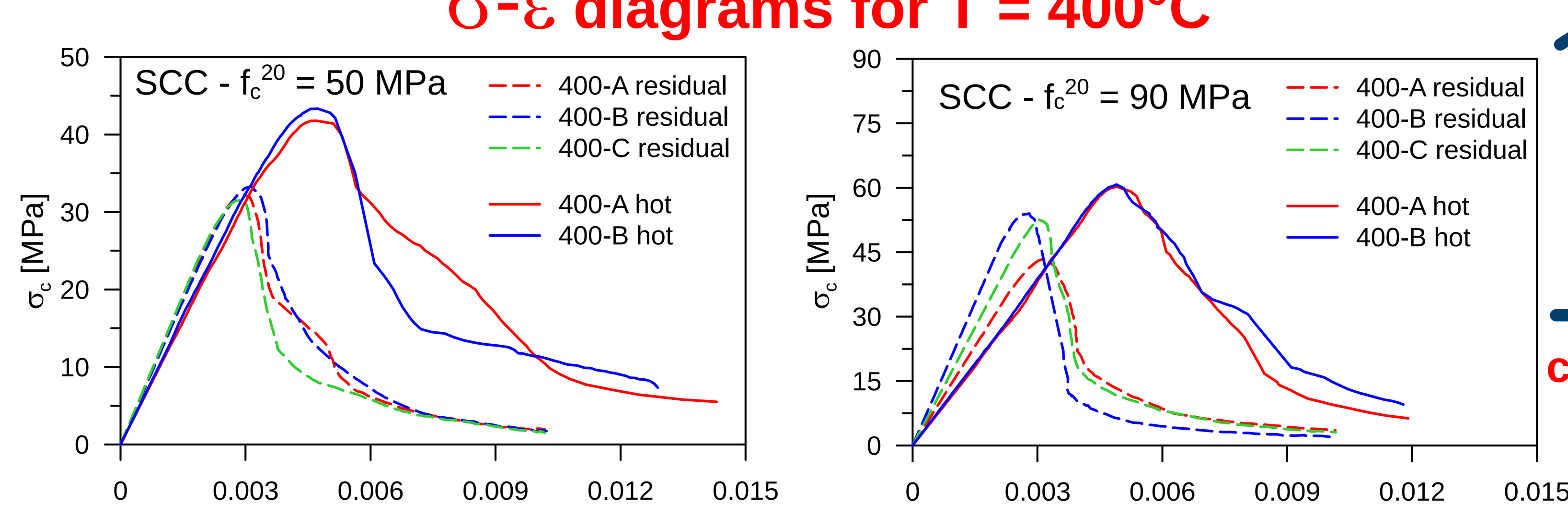
Residual tests: the specimens are tested after cooling from the reference temperature to 20°C.

Compression tests were carried out, in order to measure the stress-strain curves, the elastic modulus and the compressive strength at the different thermal levels.

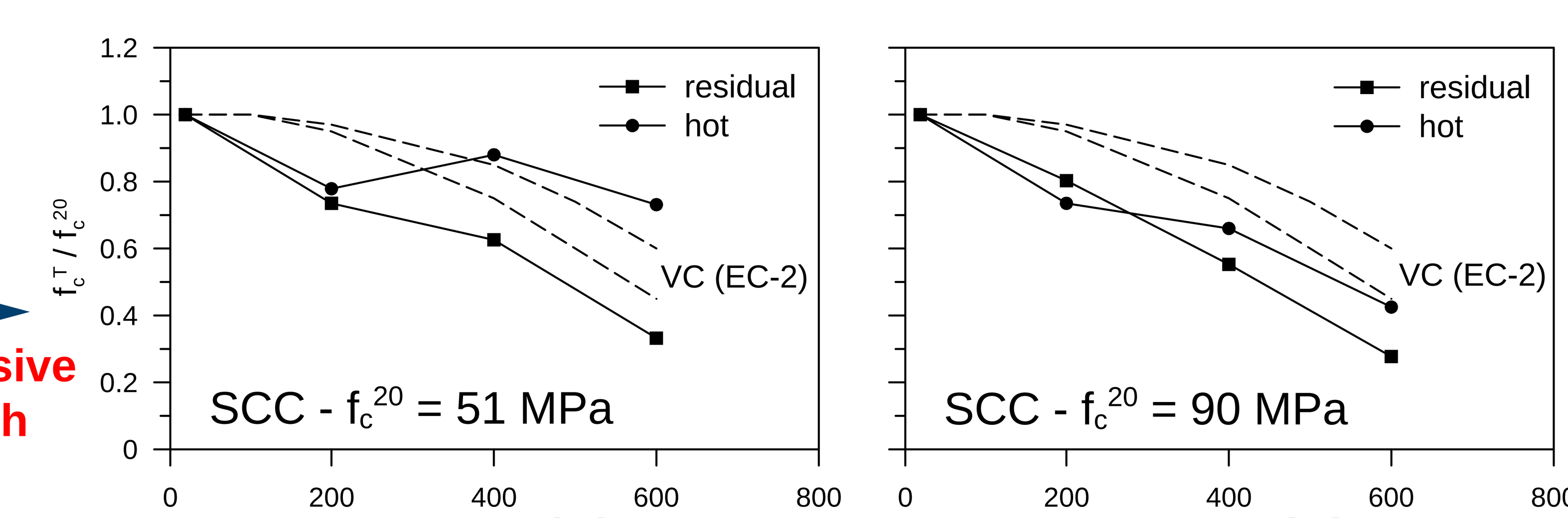


elastic modulus

σ-ε diagrams for T = 400°C

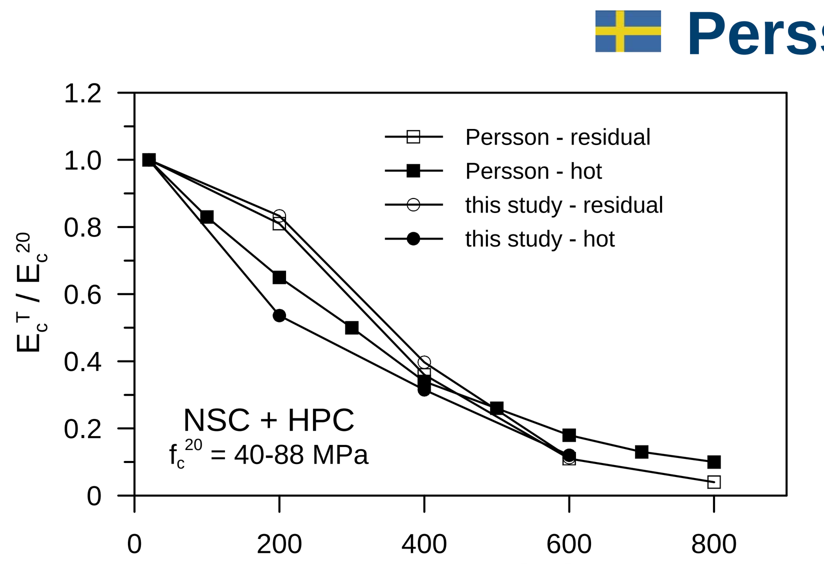


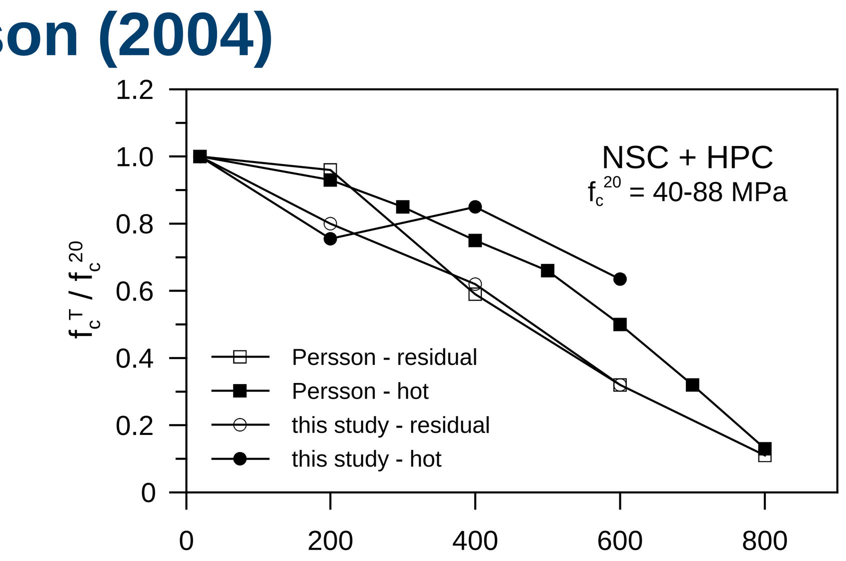
compressive strength



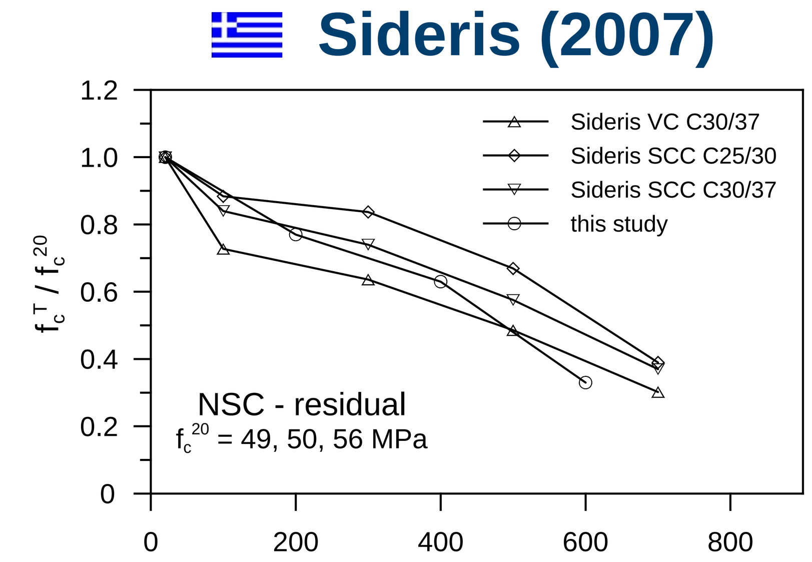
Comparison with available literature

Persson (2004)

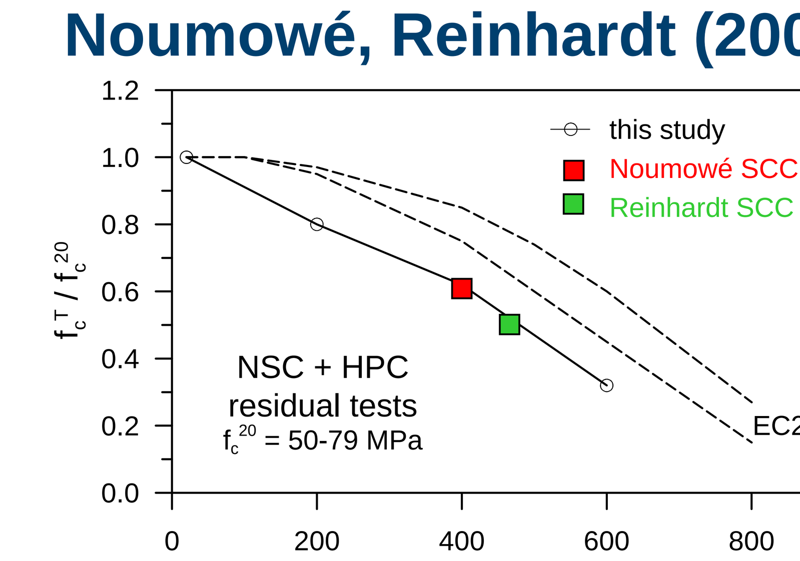




Sideris (2007)



Noumowé, Reinhardt (2006)



- **Hot and residual stress-strain curves in compression:** both at high temperature and after cooling, the behaviour in the pre-peak phase is very linear, while the softening is very steep at 200 and 400°C.
- **Hot and residual mechanical properties in compression:** below 80 MPa the hot strength of SCC agrees with EC-2 envelopes for ordinary VC, while above 90 MPa SCC is slightly more temperature-sensitive. In SCC at high temperature there is a decrease around 200°C, as usually found in high-performance VCs. At high temperature, the elastic modulus is lower and more affected by the temperature than in residual conditions (LITS).
- The present study **confirms** the scanty results available in the literature.