

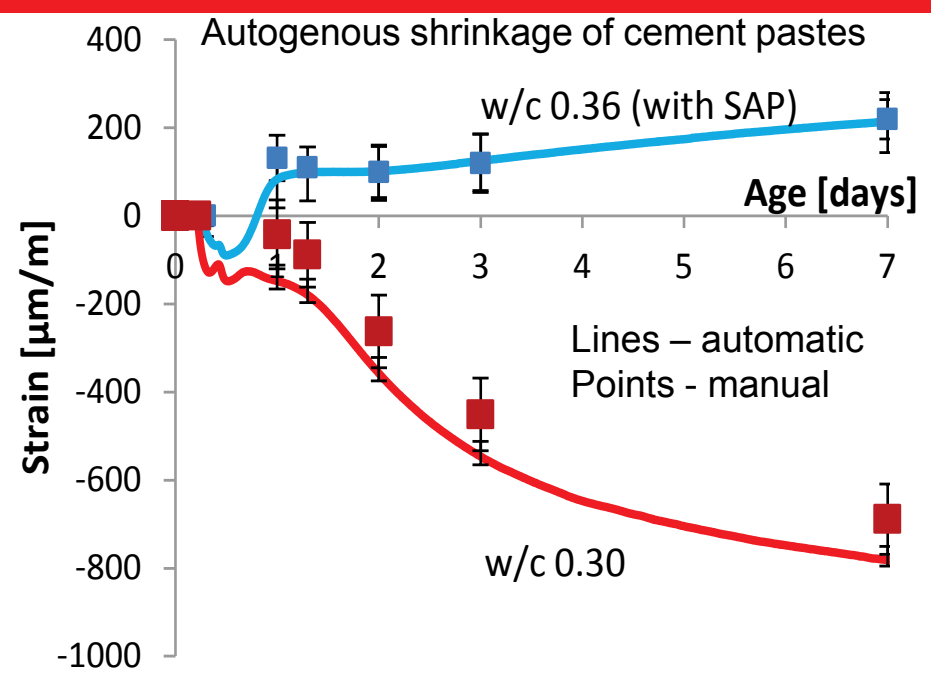
Autogenous shrinkage in HPC - Motivation

Autogenous shrinkage of cement paste is one of the major **causes of early-age cracking** of high performance concrete (HPC) [1]. Autogenous shrinkage becomes important with w/b lower than about 0.45 and increases with the decrease of w/b. Autogenous shrinkage further increases for higher amounts of SCM (e.g. silica fume). Contrary to drying shrinkage, autogenous shrinkage occurs without any loss of moisture from the concrete.

Measurements with corrugated tubes

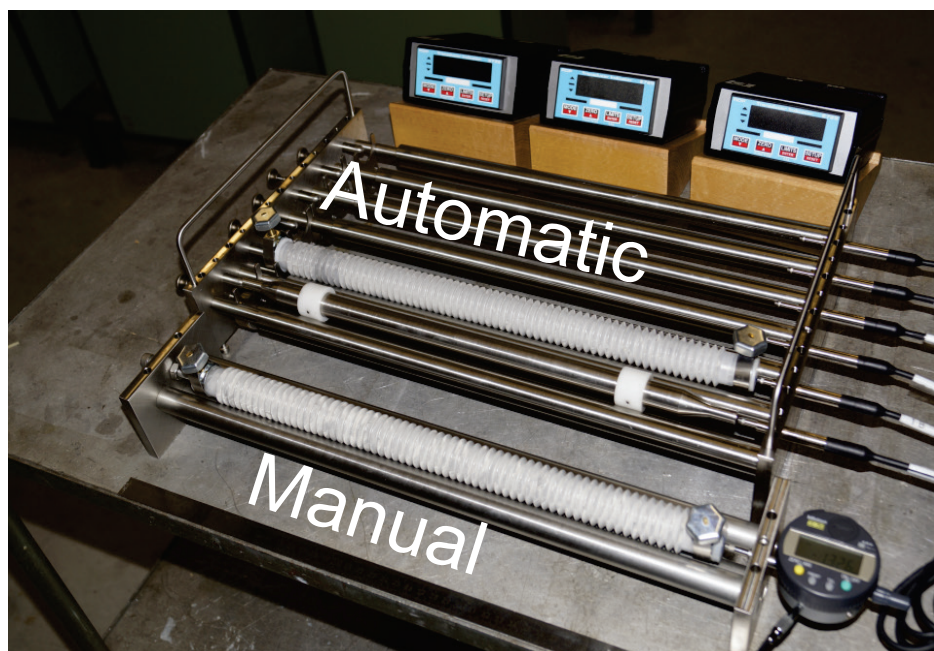
Measurements of linear autogenous shrinkage with **corrugated tubes** have been proposed by Jensen and Hansen [2]. A manual version of the method has been described in the standard ASTM C1698-09 [3]. Both **manual and automatic measurements** are available at the Concrete/Construction Chemistry Laboratory at Empa.

The tests require a very good temperature control (**isothermal conditions**), **no moisture loss** due to drying and **precise** length change measurements.



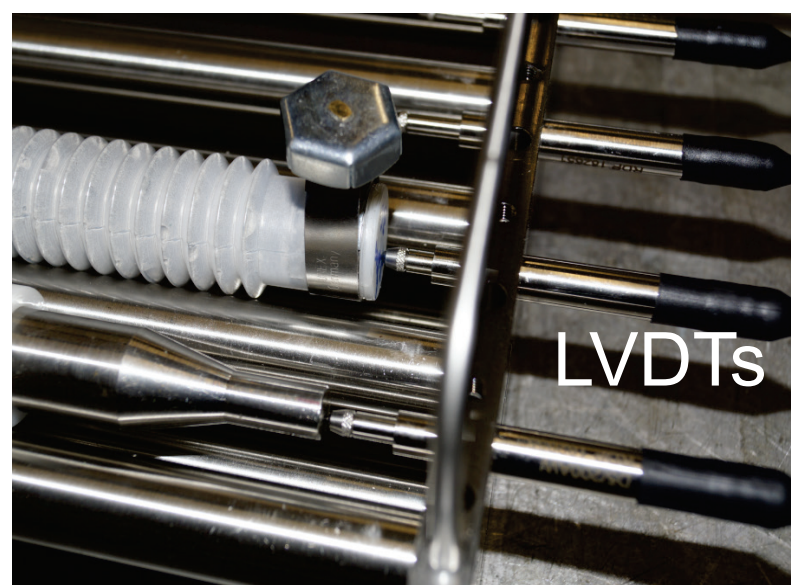
Manual measurements

- Standard ASTM C1698-09 [3]
- Measurements at chosen ages (1, 3, 7, 14, 28 d)
- **Allows measuring a large number** of samples in parallel (screening)
- Good accuracy



Automatic measurements

- Measurements in silicone oil bath
- Very good temperature control, ± 0.1 °C
- Mass loss (**drying**) of the samples **completely eliminated**
- Up to 12 samples measured in parallel
- Continuous evolution of autogenous shrinkage, also before setting
- **Very good accuracy**



References:

[1] P. Lura, O.M. Jensen, K. van Breugel, *Cem. Concr. Res.*, 33 (2003) 223-232.

[2] O.M. Jensen, P. Freiesleben Hansen, *Mater. Struct.*, 28 (1995) 406-409.

[3] ASTM C1698-09 Standard test method for autogenous strain of cement paste and mortar, 2009