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Quality Control and Robustness of SCC, Part 1

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Peter Billberg PhD (Civil Eng.), is a Senior Researcher at the Swedish Cement and Concrete Research Institute. For over 15 years, Peter has focused on rheology and workability of fresh cementitious materials and various aspects of self-consolidating concrete (SCC). Such aspects include mix design, test methods, thixotropy, formwork pressure, robustness and training. Throughout 2007 and 2008, he worked as postdoctoral fellow with Professor Kamal H. Khayat at the Université de Sherbrooke (Canada). Peter's research interests currently focus on robustness of SCC mixtures and the influence of thixotropy on casting results. Peter is active in several international technical committees, serving as chair of RILEM TC 233-FPC (Formwork Pressure Generated by Fresh Concrete) and as secretary of ACI 238 Workability.

Fresh Property Responses of Powder-, VMA- and Combination type SCC to Varying Aggregate Moisture

Peter H Billberg

Swedish Cement and Concrete Research Institute

Outline

- **Parameters influencing SCC fresh properties**
- **Materials**
- **Test methods**
- **Evaluation methods**
- **Mixture designs**
- **Results**
- **Correlations**

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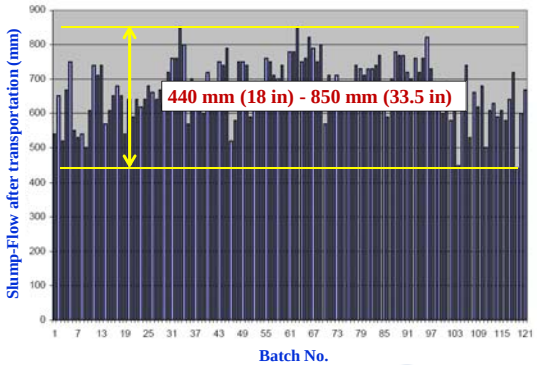
Slump Flow @ Construction Site



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Robustness

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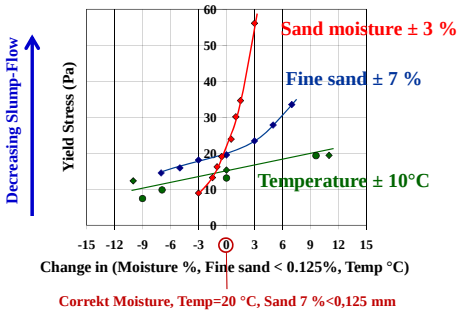
Response to varying parameters



P. Billberg, M. Westerholm (2008)

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Solid Materials

Cement:
CEM II/A-LL 42.5 R (app. 13% limestone)

Aggregate:
0-8 mm and 8-16 mm, glaciofluvial origin

Powder materials:
LP1: Crystalline limestone, $D_{0.5}$ = 40 microns
LP2: Crystalline limestone, $D_{0.5}$ = 25 microns

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Chemical Admixtures

Superplasticizers:
SP1: PCE, 35% solids
SP2: PCE, 30% solids
SP3: PCE, 35% solids
Configured also for stability (VMA?)

Viscosity Modifying Admixtures:
VMA1: Modified starch
VMA2: Microbial anionic polysaccharide
VMA3: High molecular weight ionic polymers
VMA4: Polysaccharide

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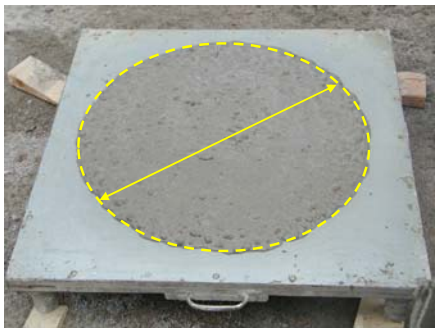
Slump Flow



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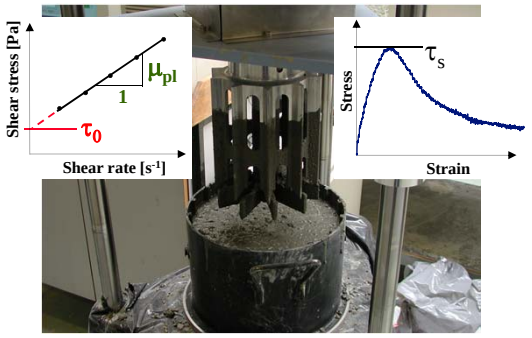
Viscometer ConTec 4



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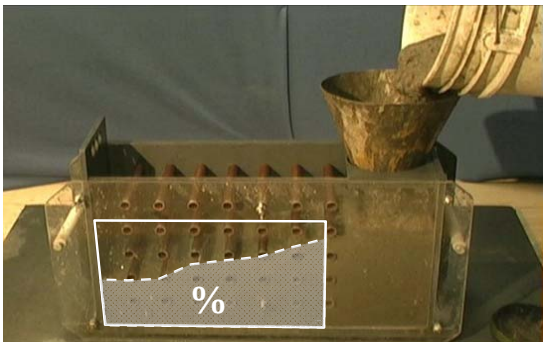
Filling Capacity



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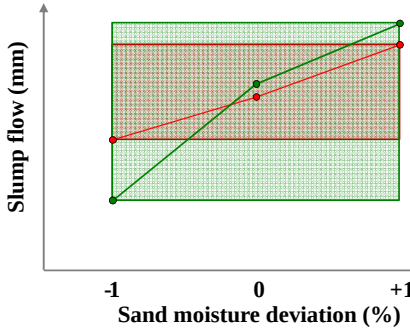
Slump Flow Area



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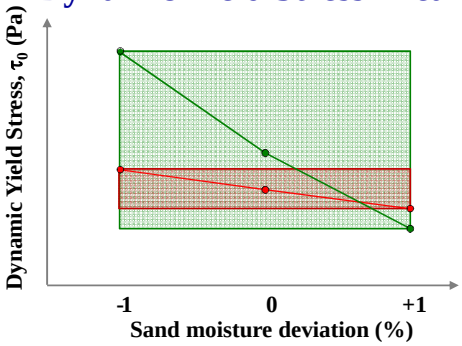
Dynamic Yield Stress Area



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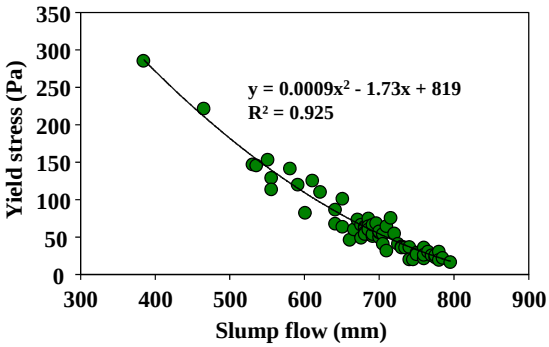
Correlation Slump Flow - Yield Stress



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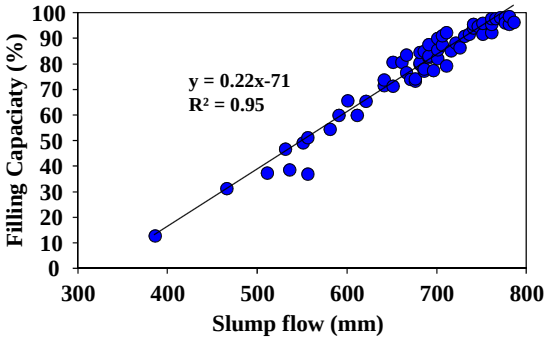
Correlation Slump Flow - FC



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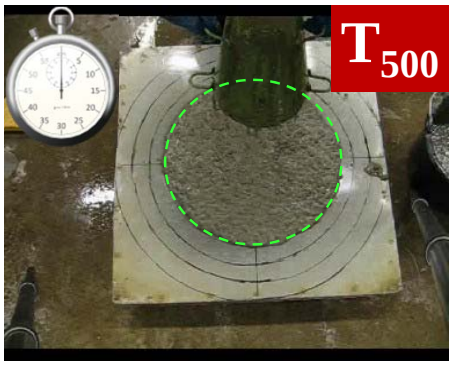

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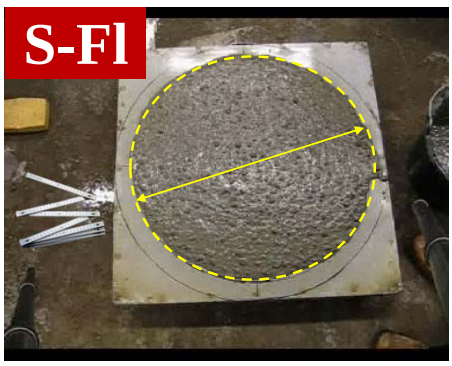

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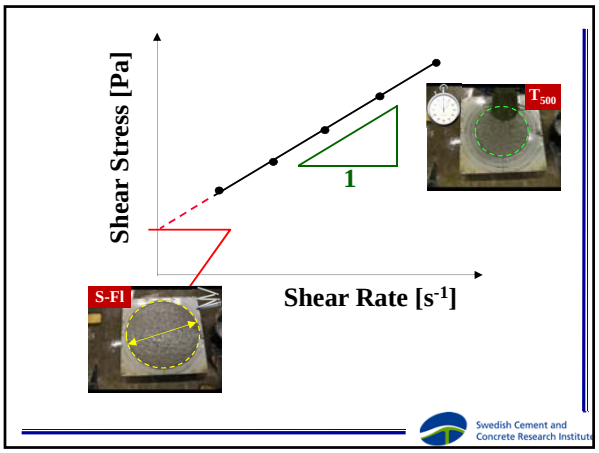
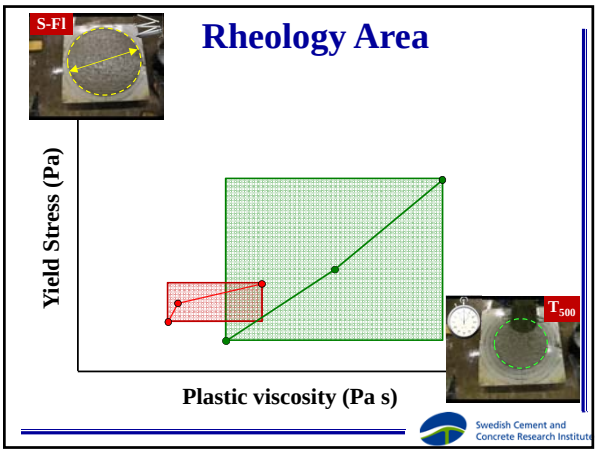
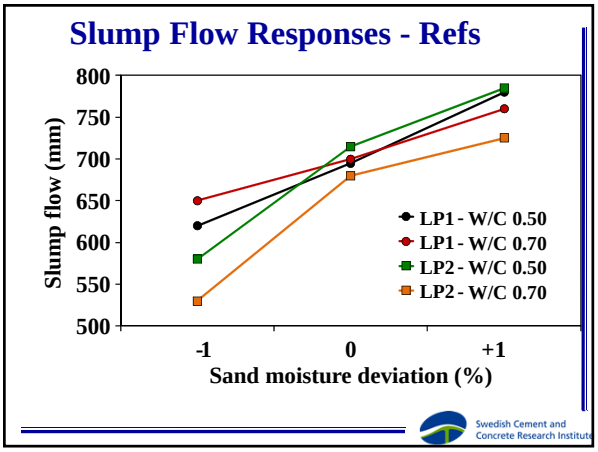
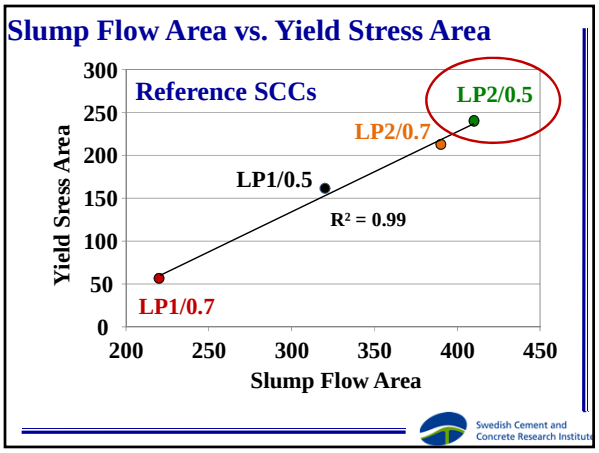




Mix Design - Reference Mixtures

Material	Kg/m³	
Cement	300	375
Water	210	188
W/C	0.7	0.5
Coarse Aggregate	30%	40%
SP Type	SP1	SP1
Powder Type	LP1/LP2	LP1/LP2
Powder weight	200	100





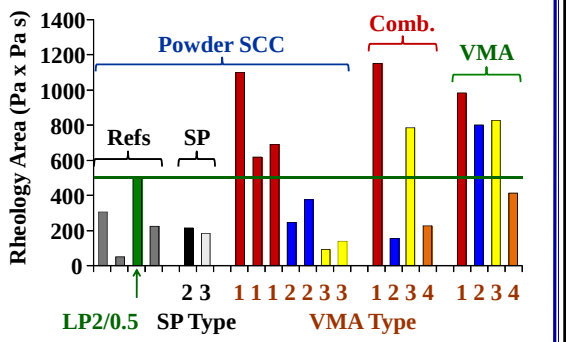
Powder/Comb./VMA Mixtures

Cement = 375, W/C = 0.5, Powder = LP2

	SCC Type		
	Powder	Comb.	VMA
LP2 weight	100	50	-
CA	40%	35%	30%
SP Type	1, 2, 3	SP1	SP1
VMA Type	1, 2, 3	1, 2, 3, 4	1, 2, 3, 4

↑ low, various, dosages

Rheology Area



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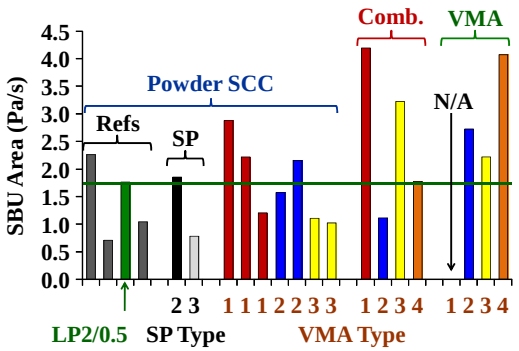
Structural Build-up, SBU, Area



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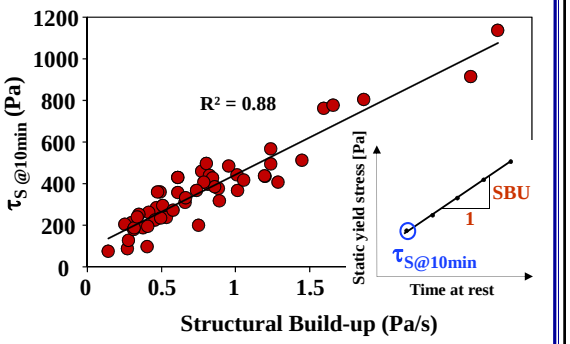
Correlation SBU – $\tau_{S@10min}$



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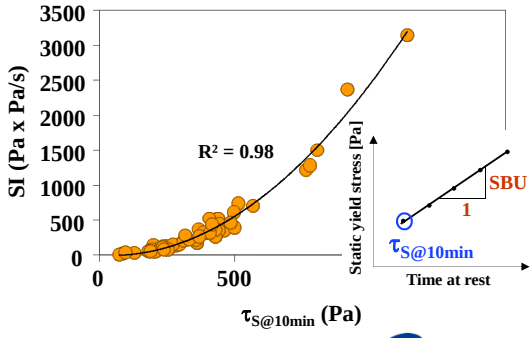
Correlation $\tau_{S@10min}$ - SI



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Conclusions

The more free water (higher W/C or coarser powder) the more robust the SCC becomes.

SP type important for robustness. SP2 and SP3 better than SP1 due to enhanced stabilizing ability.

Except for the SCCs with VMA1, the powder type SCC is generally more robust.

For the powder type SCC, VMA3 performed best (slump flow, yield stress, SBU, FC)

Strong correlations: slump flow vs. yield stress and FC, and initial static yield stress vs. SBU and SI

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Thank you!

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