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Experiences from Vertical Full Scale Castings with SCC

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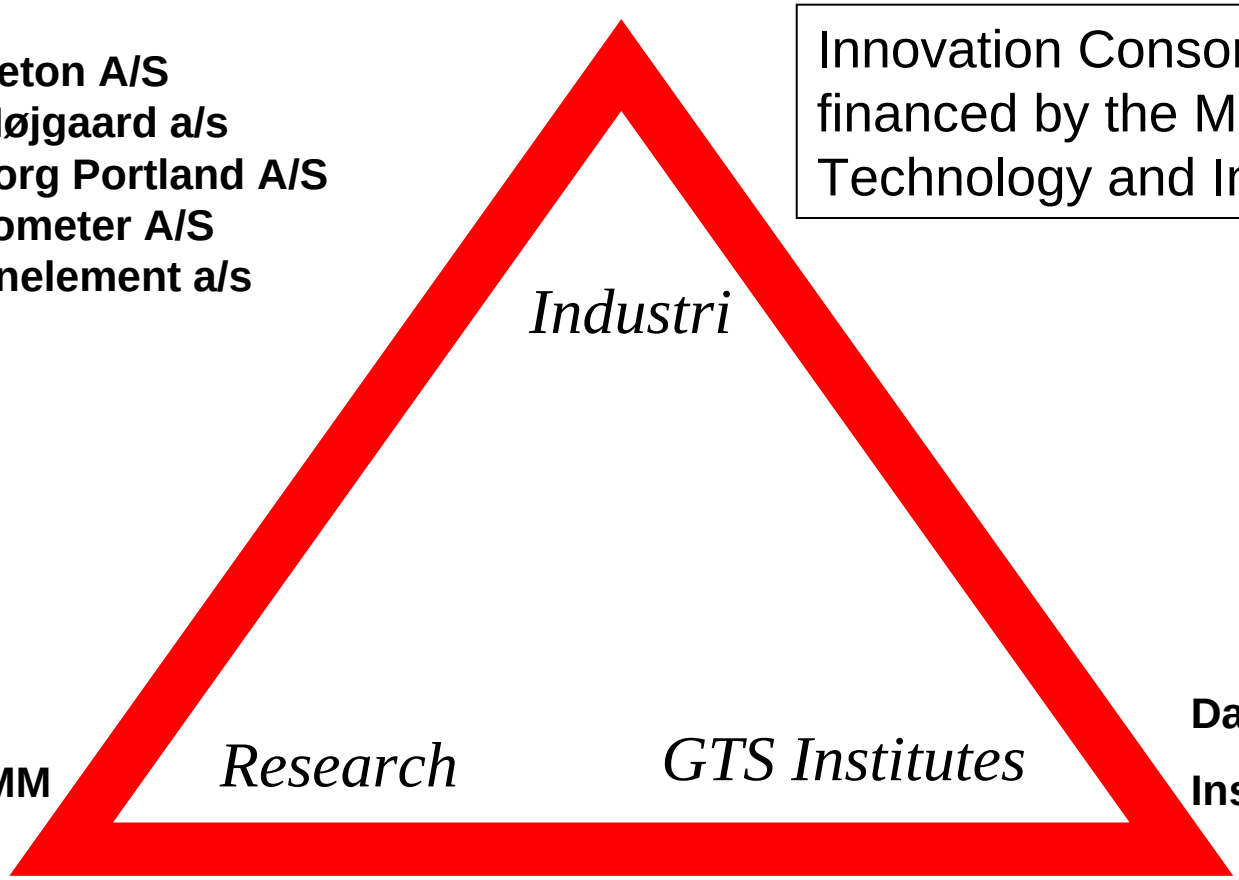
Nordic SCC Workshop 2006

SCC Consortium

4K Beton A/S
MT Højgaard a/s
Aalborg Portland A/S
Videometer A/S
Betonelement a/s

Innovation Consortium partly financed by the Ministry of Science Technology and Innovation



DTU/IMM

Danish Technological Institute, Concrete Centre

Overall objective:
<u>To improve the productivity and the working environment of the concrete industry</u>

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Outline

Introduction

Test setup

Results

- Form filling
- Segregation/Blocking
- Form pressure

Fresh state

- Surface finish
- Frost resistance
- Air void structure

Hardened state

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Introduction

The use of SCC in vertical castings is still much lower than the use of SCC use in horisontal castings such as floors.

The aim of the full scale wall castings is to obtain experience on i.e.

- the relation between the fresh concrete workability, casting technique and the form filling behavior
- form pressure
- surface finish
- air void structure and frost resistance

Test Setup

Wall ID	V1	V2	V3	V4	V5
Dimensions	H * W * L = 4m * 0.5m * 5m				
Concrete Type	A35	A35	A35	M30	M30

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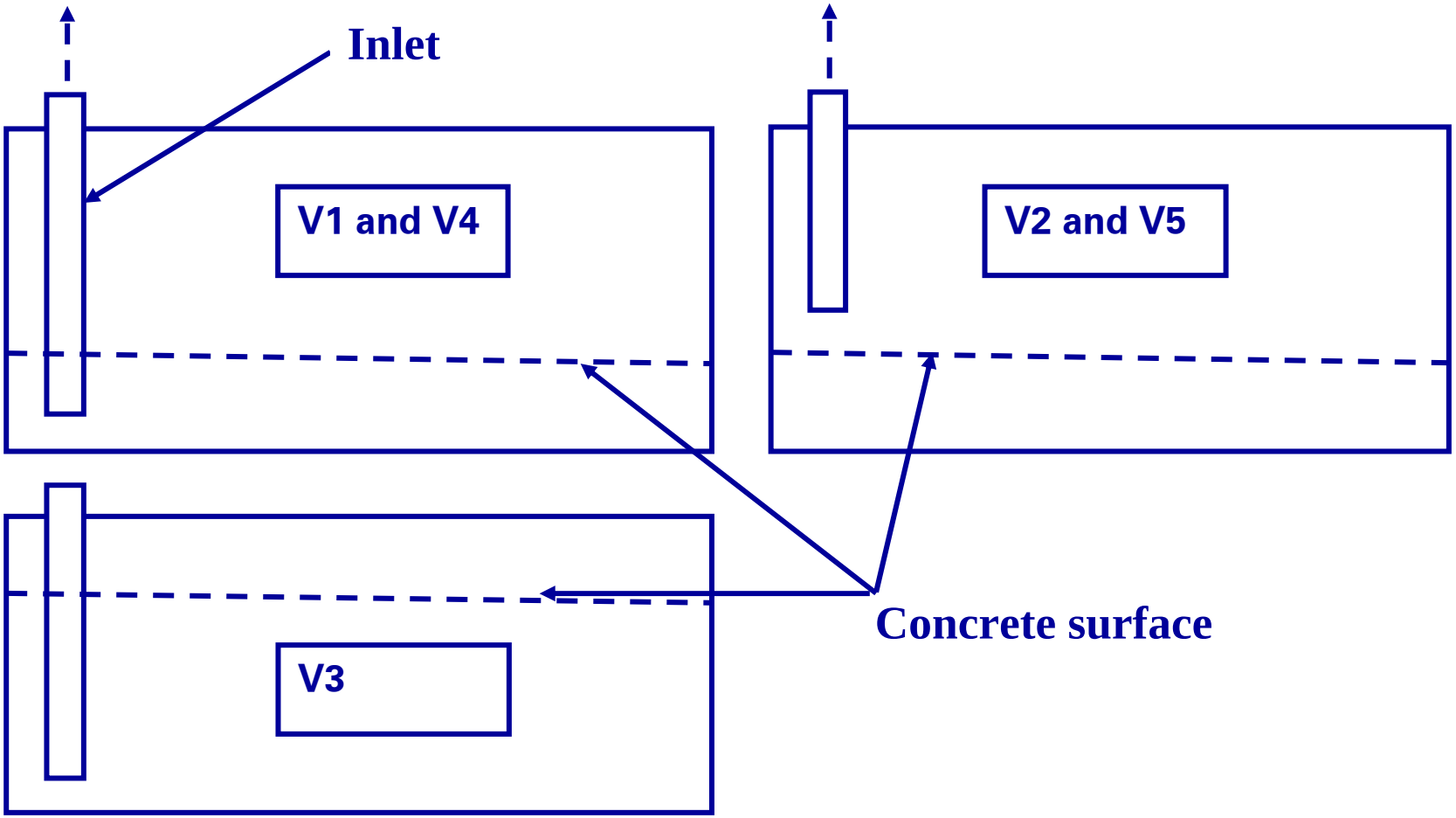
Test Setup



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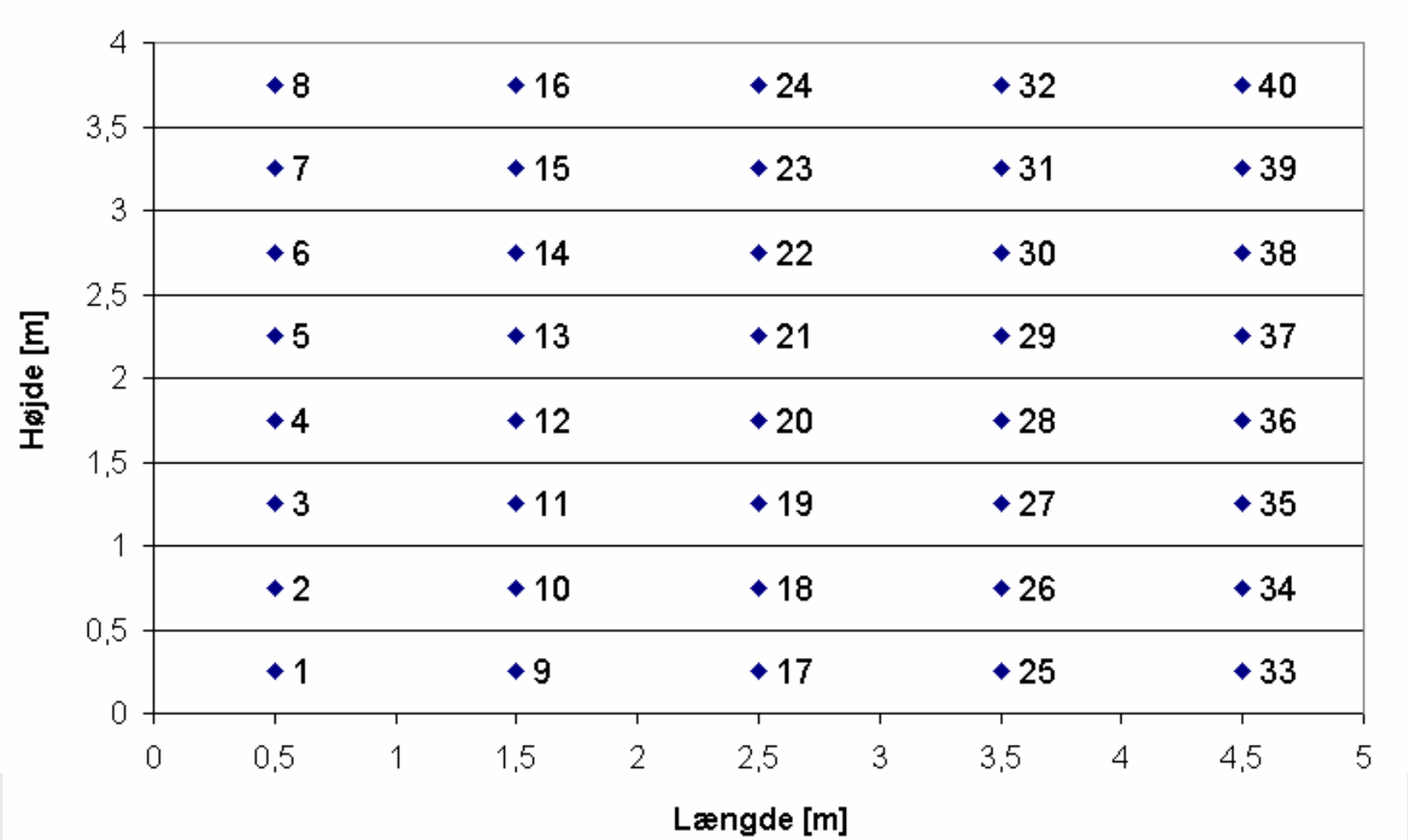
Test Setup



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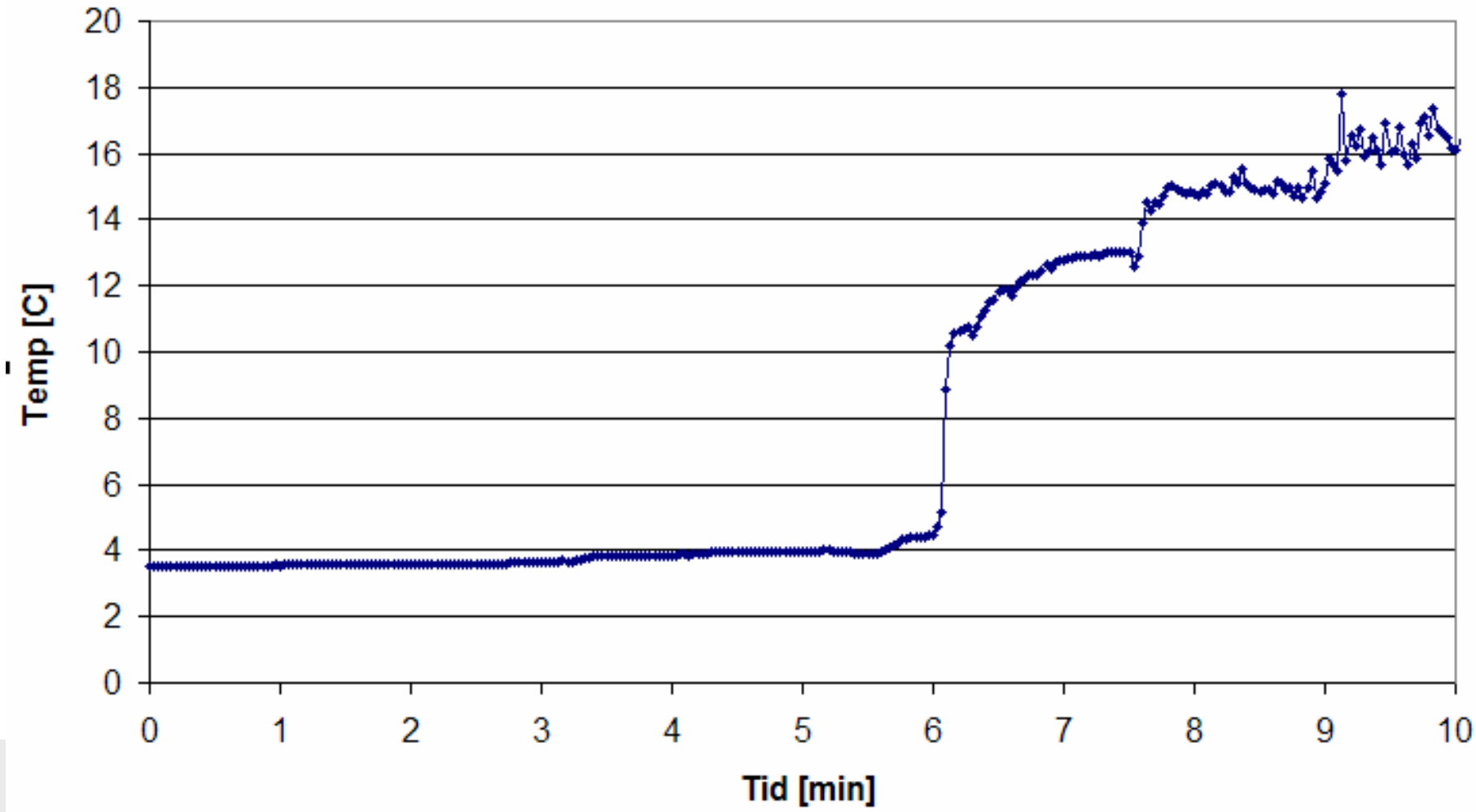
Test Setup



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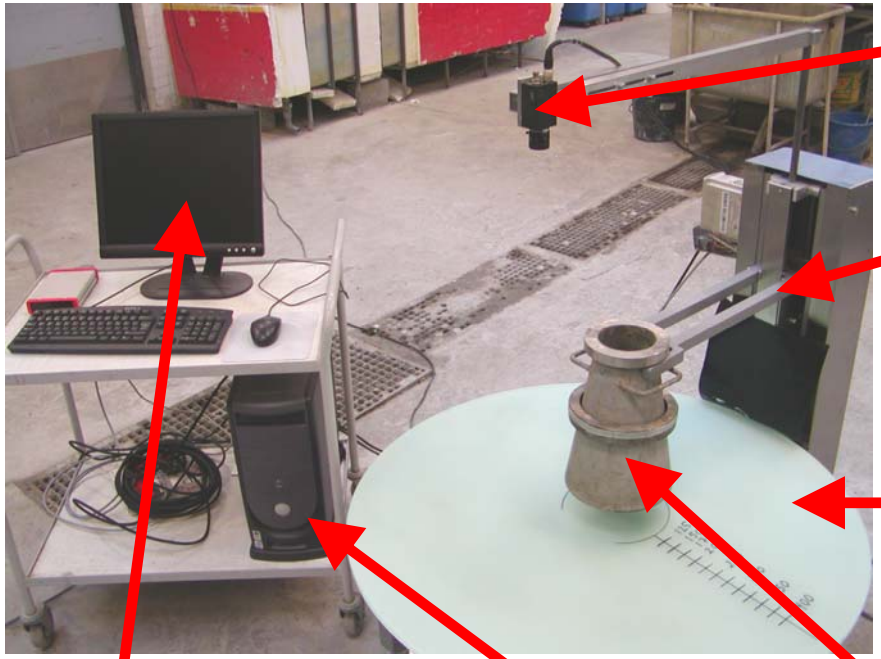
Test Setup

Slump Flow, Annex U i DS 2426	Compressive strength
Slump Flow, 4C Auto-slump	Heat development
J-ring	Finish
Air content	Macro analysis
Air void distribution: Air-Void-meter	Air void structure: EN 480-11
Form pressure	Frost Resistance: SS 13 72 44
Temperature	

4C Automatic Slump Flow



B/W Video camera

Lifting device – Ball screw ensures accurate lifting speed of 7 cm/s

Base plate in hardened sand blasted glass on adjustable rubber feet

Everything mounted on ”rollers”

Monitor – one click and the analysis will proceed automatically

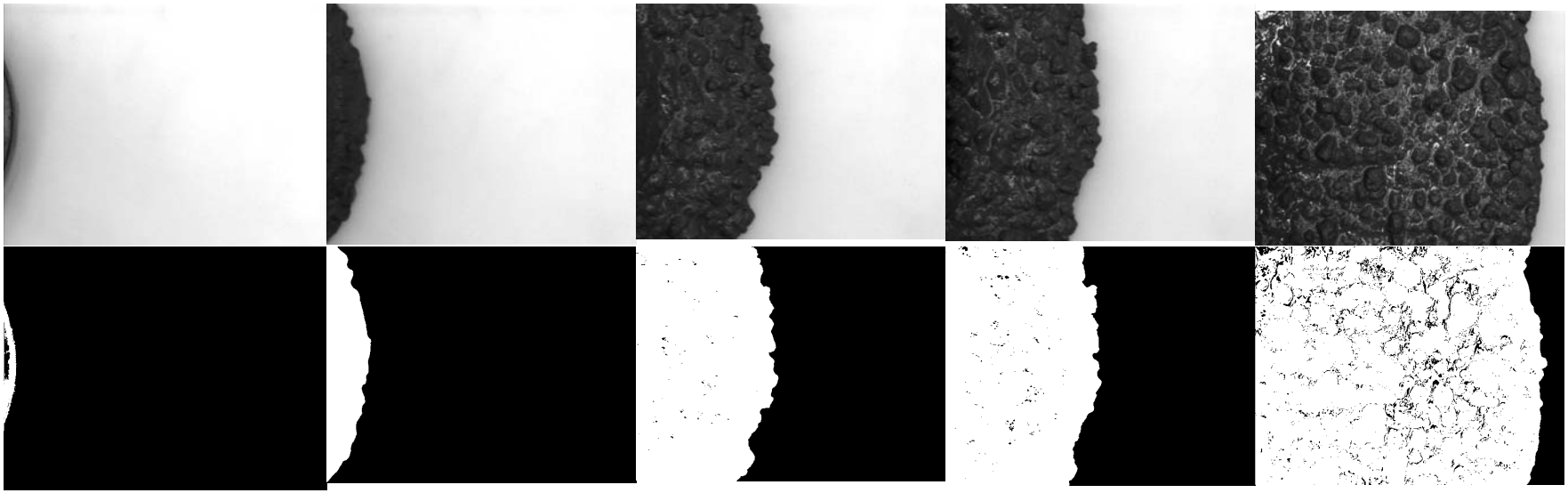
PC

Upright Abrams slump cone with weight ring

4C Automatic Slump Flow

Concept:

Raw image



Field of view 232 x 172mm – 640 x 480 pixels

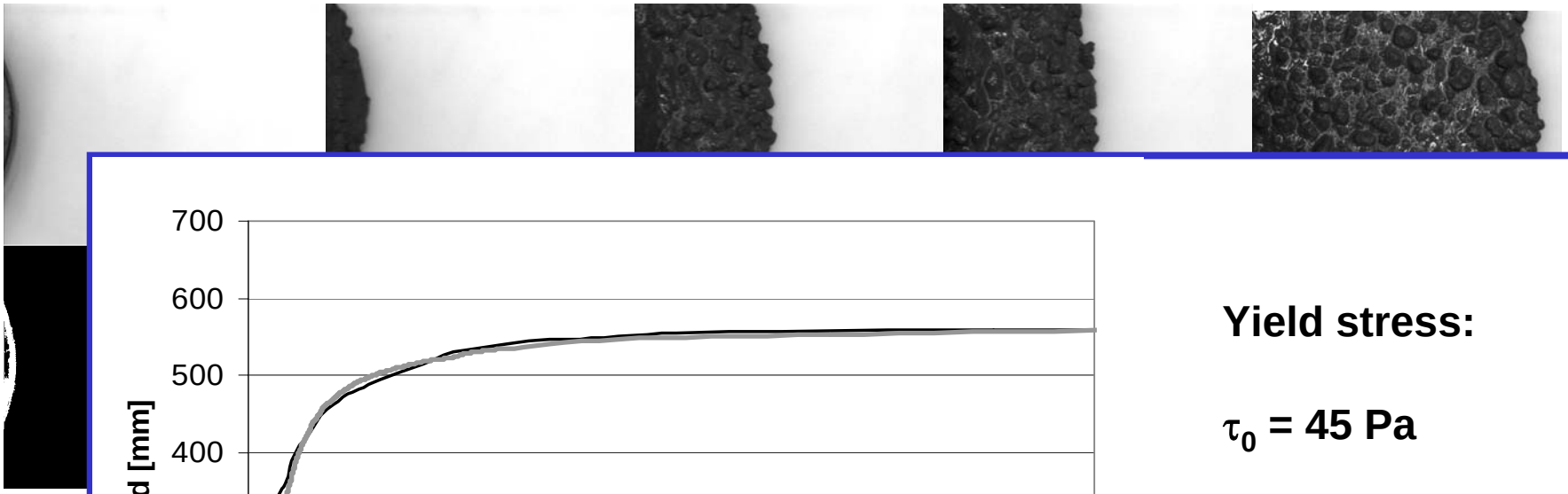
Binary image – only black and white pixels

Spread as a function of time is determined – 30 images per second

4C Automatic Slump Flow

Concept:

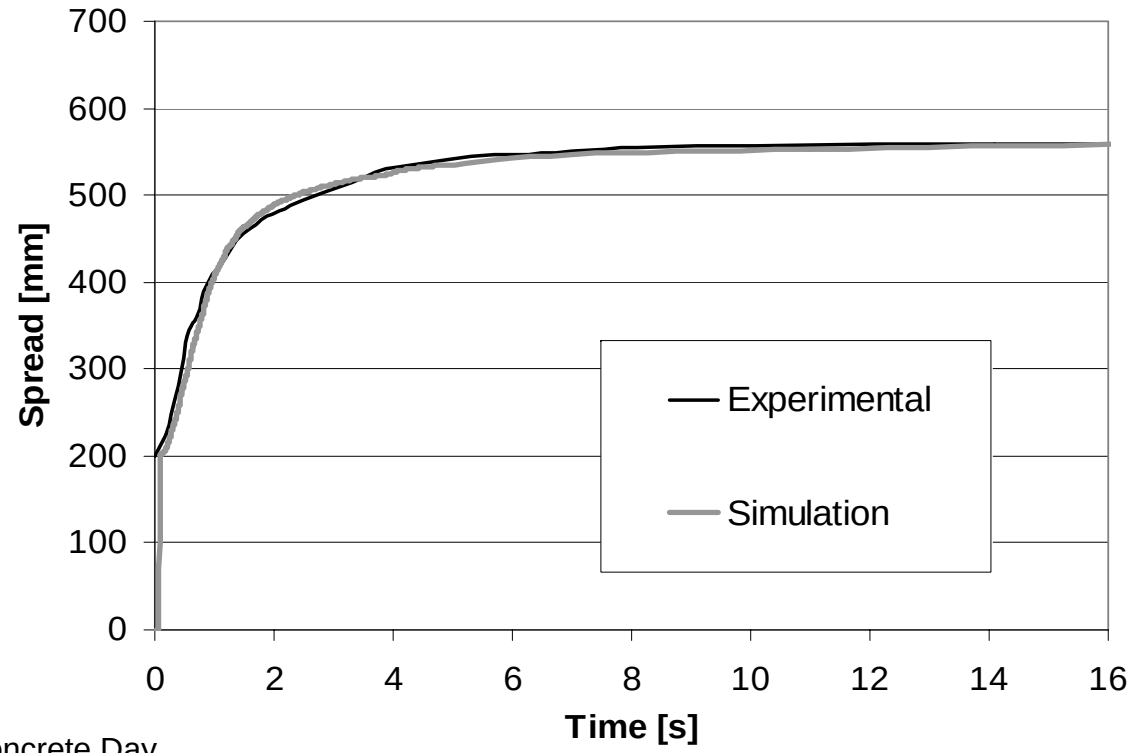
Raw image



Field

Spr

30 i



Yield stress:

τ_0 = 45 Pa

Plastic viscosity:

η_{pl} = 30 Pa s


J-Ring

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Results

	V1	V2	V3	V4	V5
Air [%]	5	6.6	5.1	8.5	7.1
SF [mm]	640	660	670	550	570
τ_0 [Pa]	20			60	45
η_{pl} [Pa·s]	60			34	34

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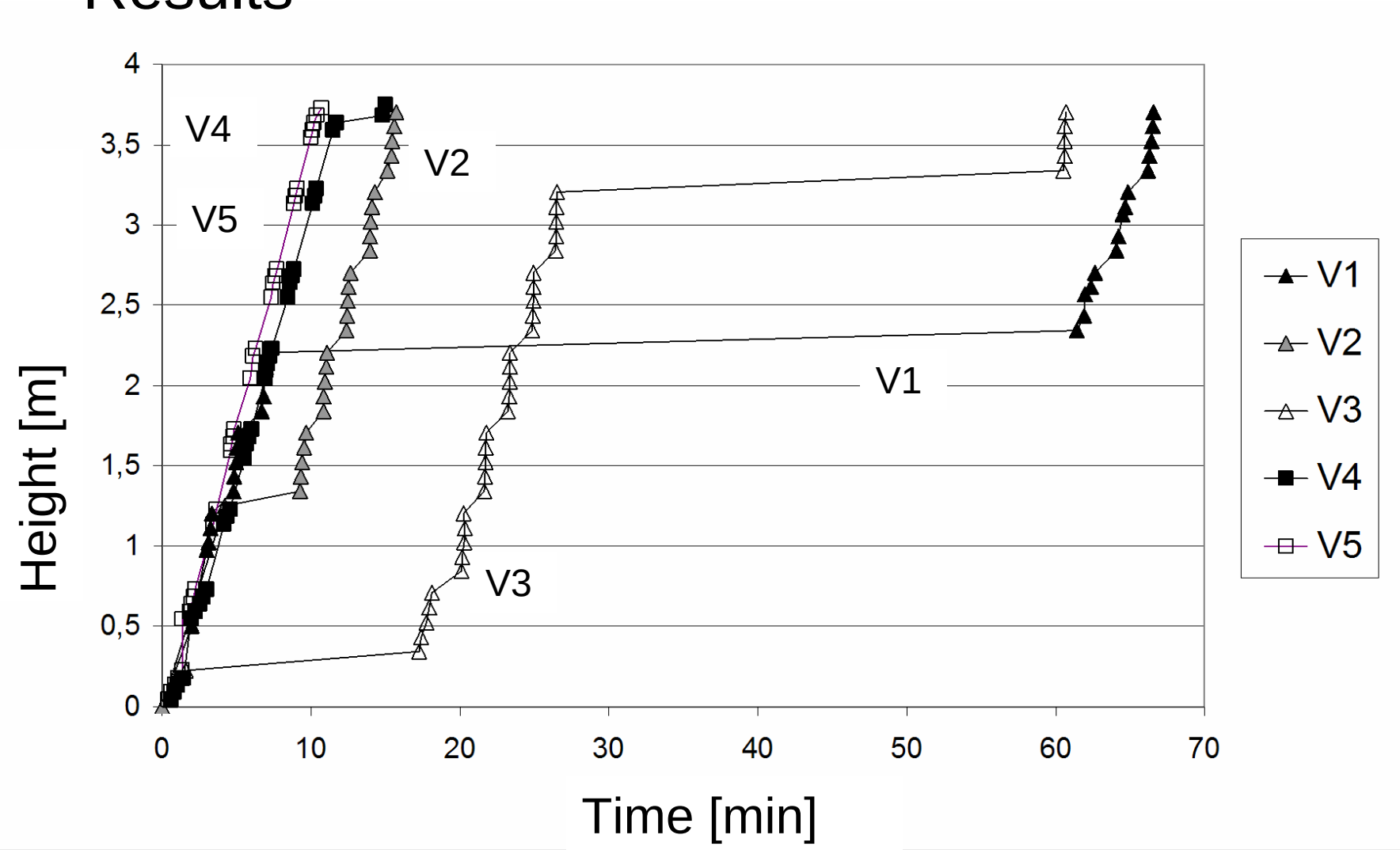
Results



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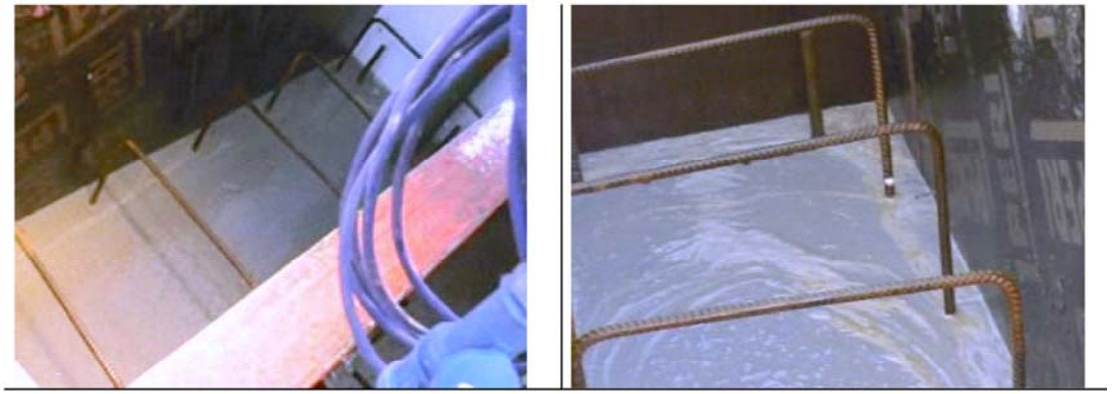
Results

Complete form filling was obtained. Depending on the rheological properties it was necessary to move the inlet to level the concrete surface.

Form geometry and reinforcement configuration do not prevent high casting rates of up to 25 m/hour. However, may have to lower due to e.g. finish and form pressure.

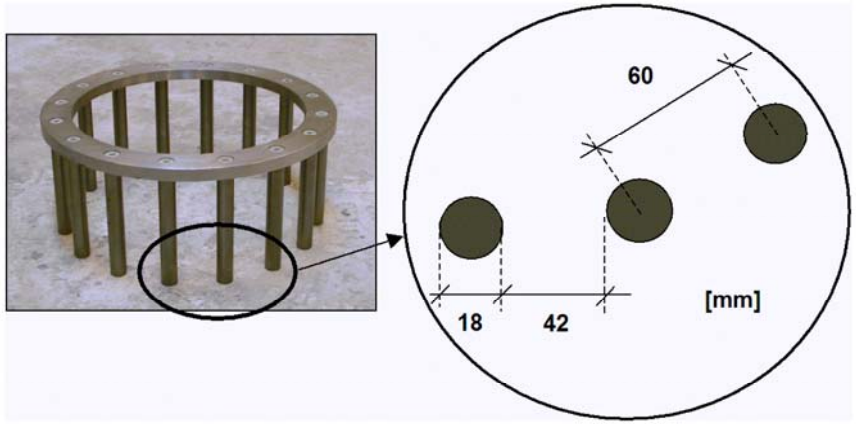
Results



V1(~ 2 cm)

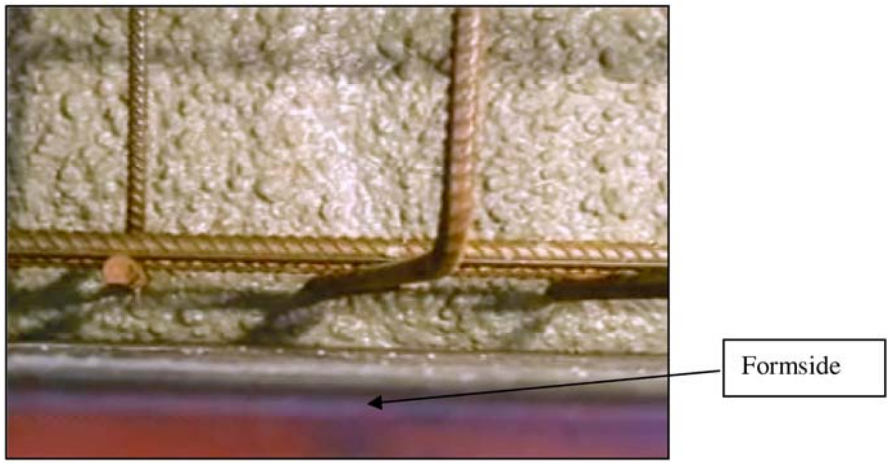
V4 (~ 10 cm)

Results



2.6

Blocking was not observed during form filling.



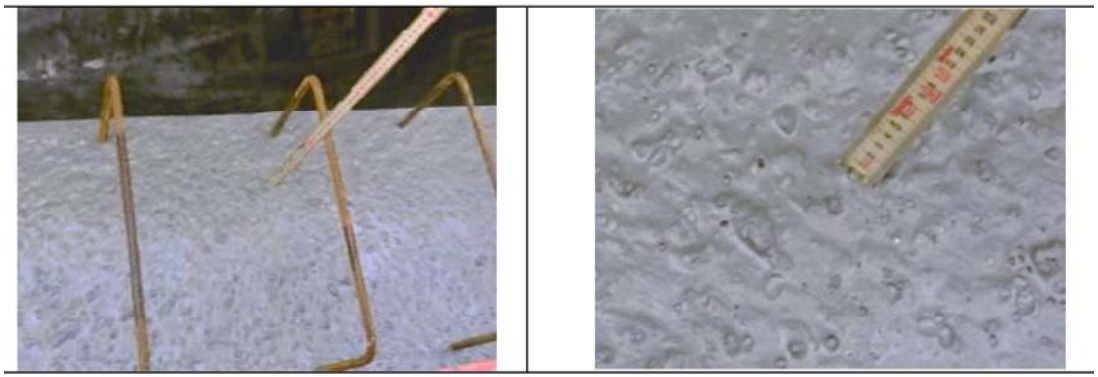
3.2

Res

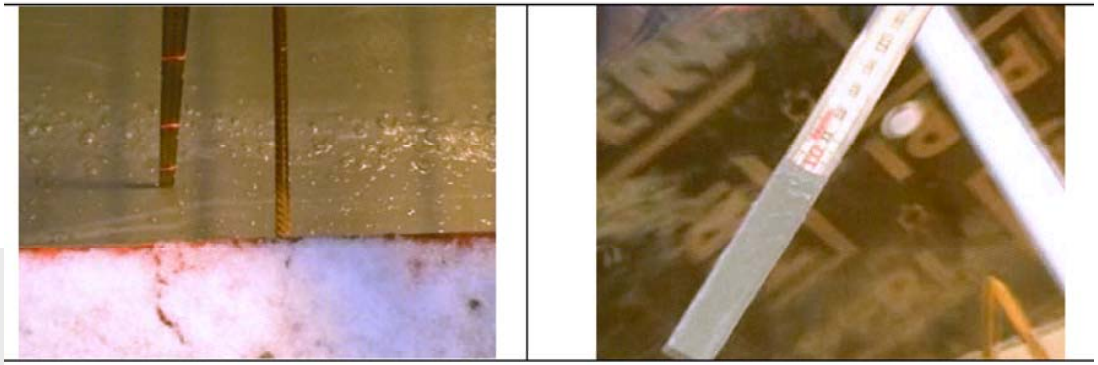
V4 (0 cm)

V1 (~ 5 cm)

V5 (0 cm)



V2 (~ 0 cm)



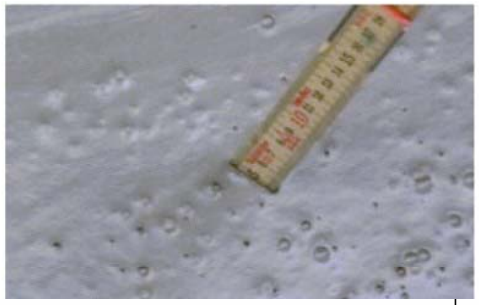
V3 (~ 10 cm)

Dynamic segretion very dependent on the casting technique and the rheological properties.

Res

V4 (0 cm

V5 (0 cm



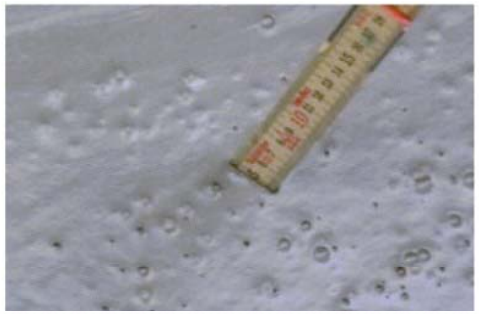
V3 (~ 10 cm)

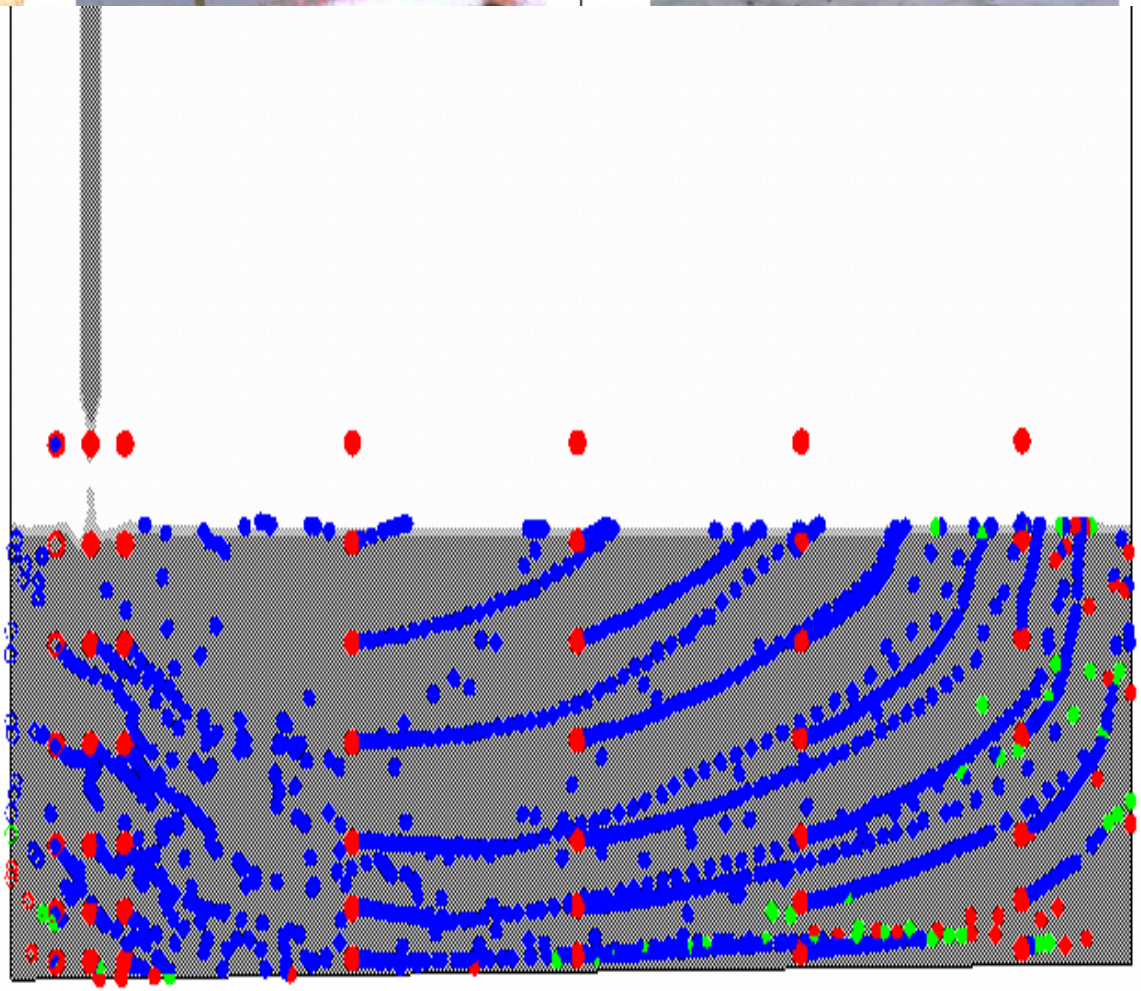
Dynamic segretion very dependent on the casting technique and the rheological properties.

Res

V4 (0 cm)

V5 (0 cm)



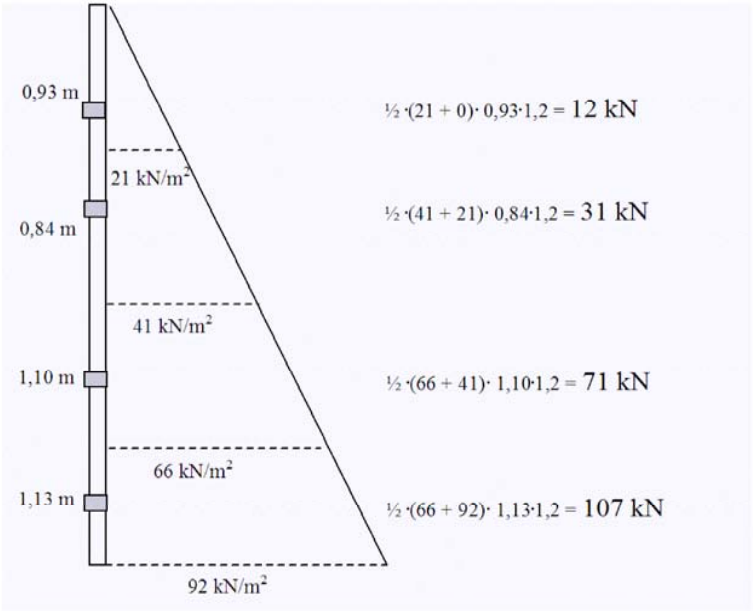


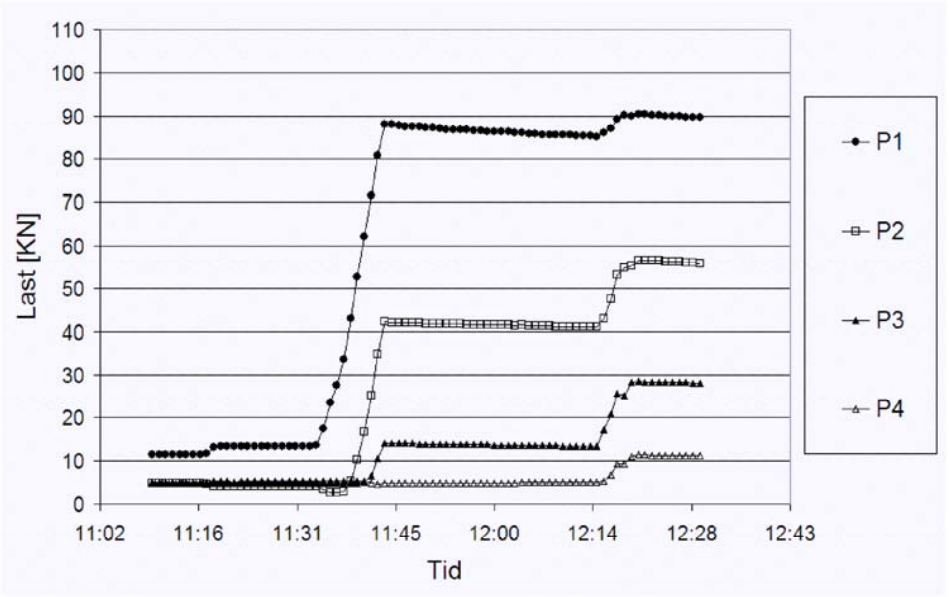
V3 (~ 10 cm)

Dynamic segregation very dependent on the casting technique and the rheological properties.

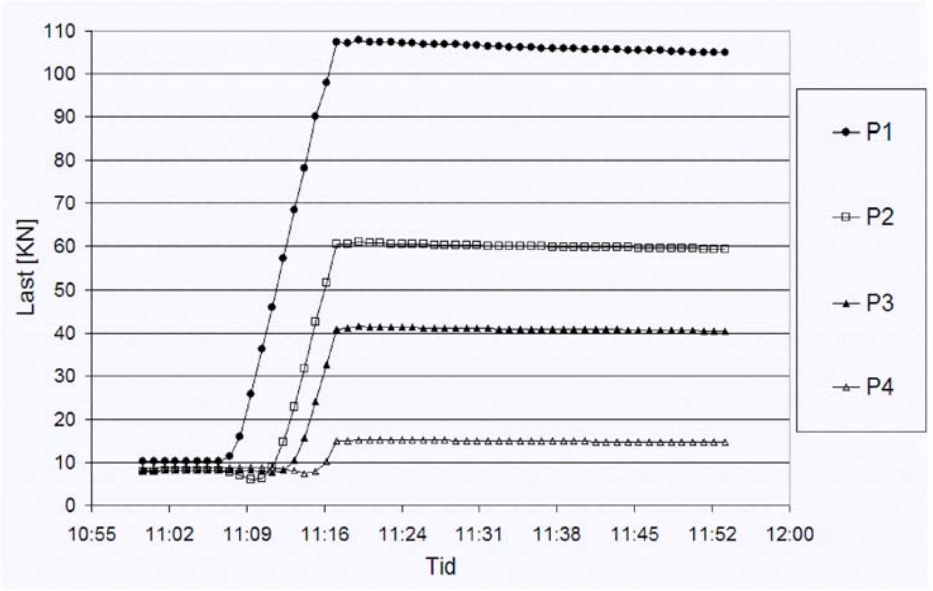
Results

Hydrostatic pressure is obtained (> 18 m/hour)





V3



V5

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Results

2 types of form oil:

- Bricon Unislip 9-12, mineral oil
- Emulfix LL, vegetable formolie

Visuel inspection showed no difference in surface finish.

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Results

Finish is evaluated by counting pores according to:

BPS-publikation 24: *Typiske beskrivelsesafsnit – indvendige betonoverflader til malebehandling og tapetopsætning* (2. udgave, 1989).

For each wall four sections are chosen of 1x1 m^2. The sections represent

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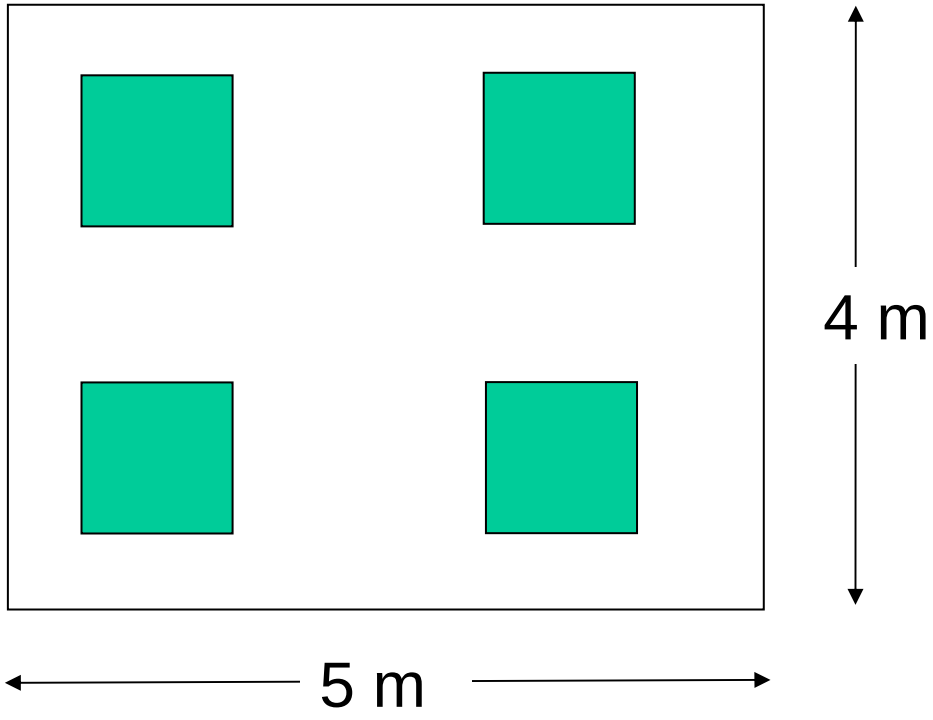
Results



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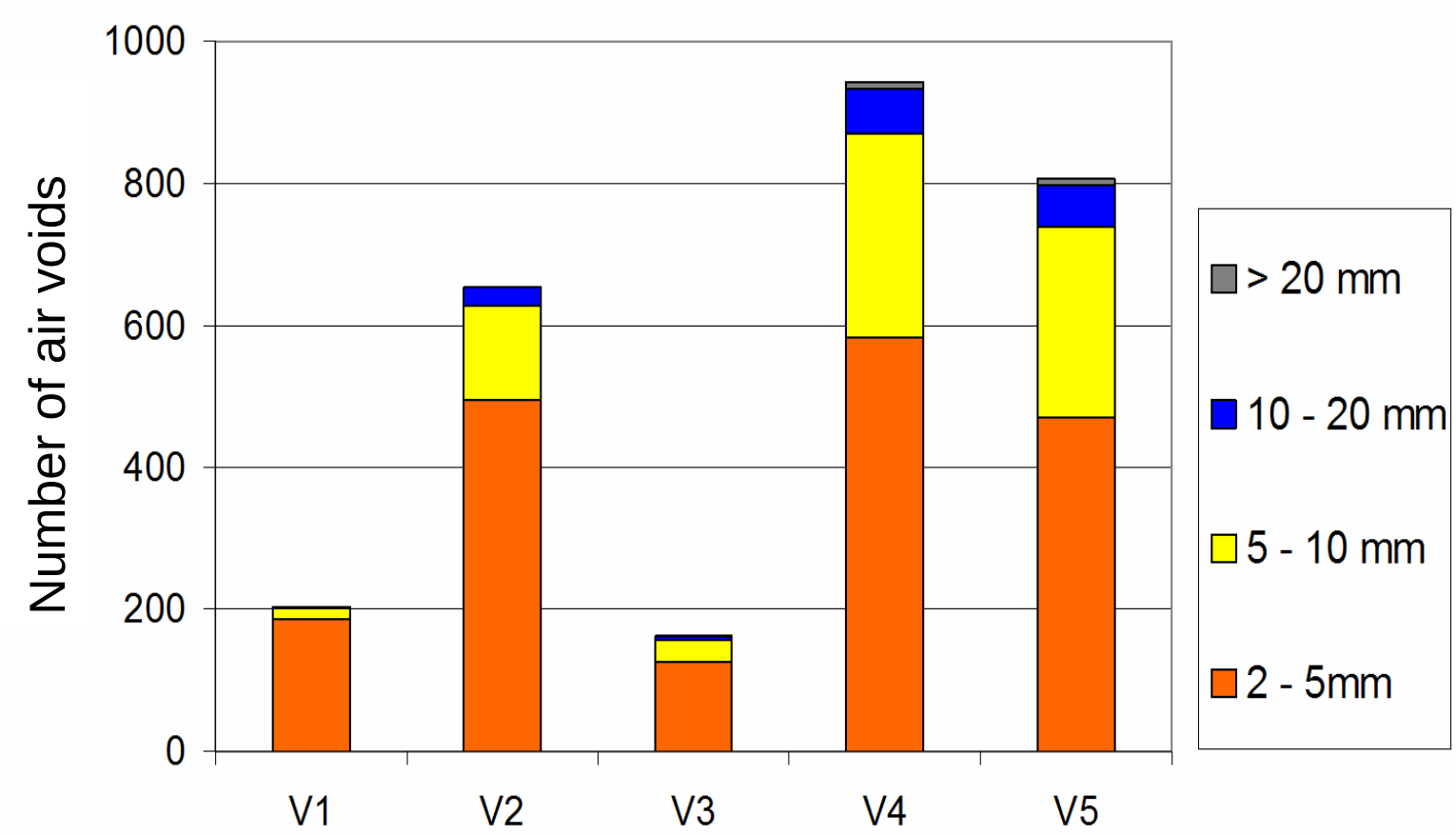
Results



The surface finish is very dependent on the casting technique and the rheological properties.

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Results

According to annex F in DS 2426 concrete in exposure class XF2, XF3 og XF4 (A, A and E in DS 481), which is exposed to a combination of salt and frost should obtain:

- Air void content in hardened concrete (DS/EN 480-11) > 3,5%
- Spacing factor is < 0.20.

It is observed that all the tested samples fulfil these requirements except for the three core samples in the bottom of V1 where the total air void content is 3.4%.

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Results

According to annex F in DS 2426 concrete in exposure class XF2, XF3 and XF4 (A, A and E in DS 481), should obtain the result *good* in a frost/thaw test (SS 13 72 44).

The results show that a satisfactory frost resistance is obtained.