Tremie concreting, betong för igjutning av pålar och slitsmurar

EFFC/DFI Best Practice Guide to Tremie Concrete for Deep Foundations

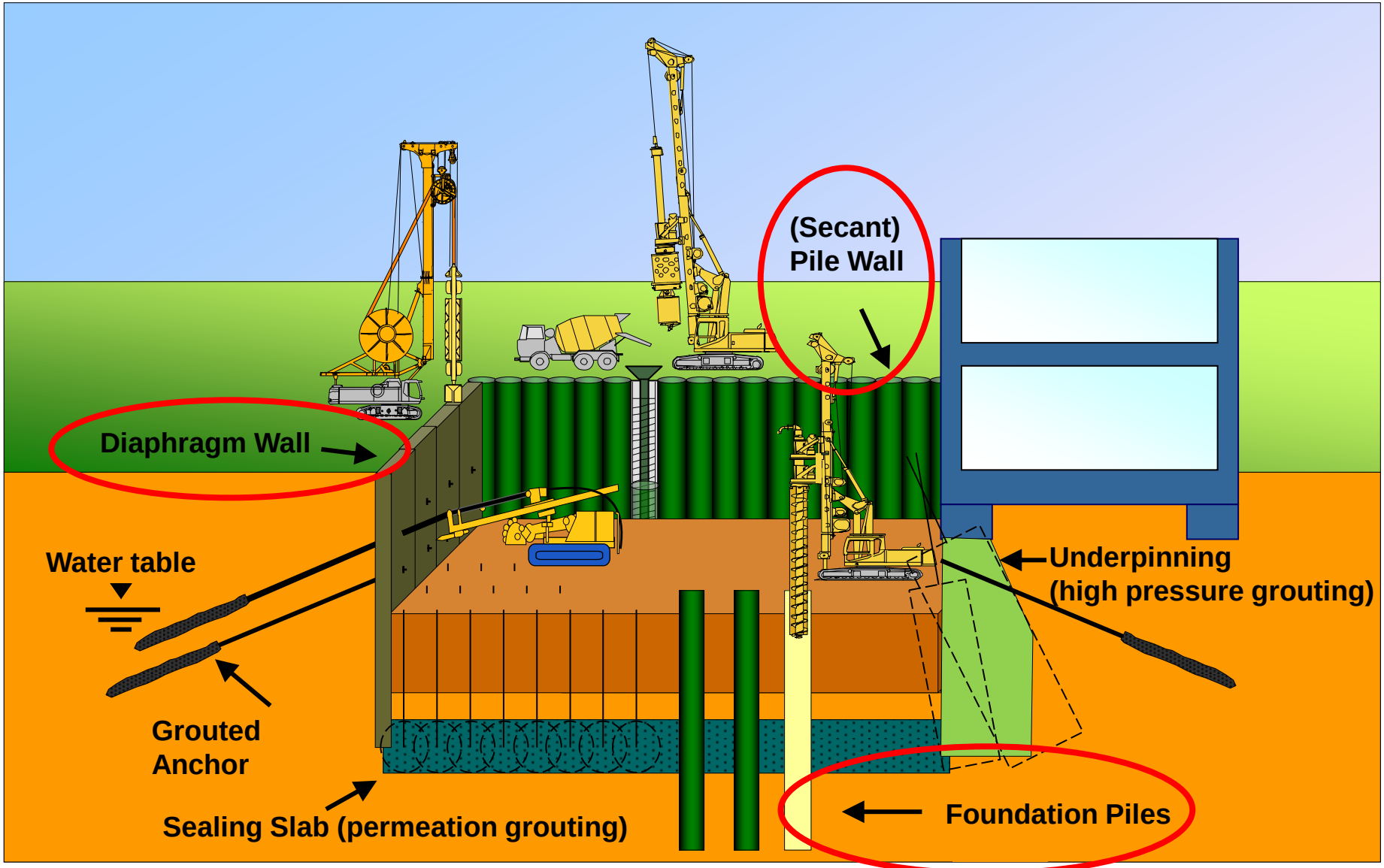
Karsten Beckhaus, BAUER Spezialtiefbau

BAUER

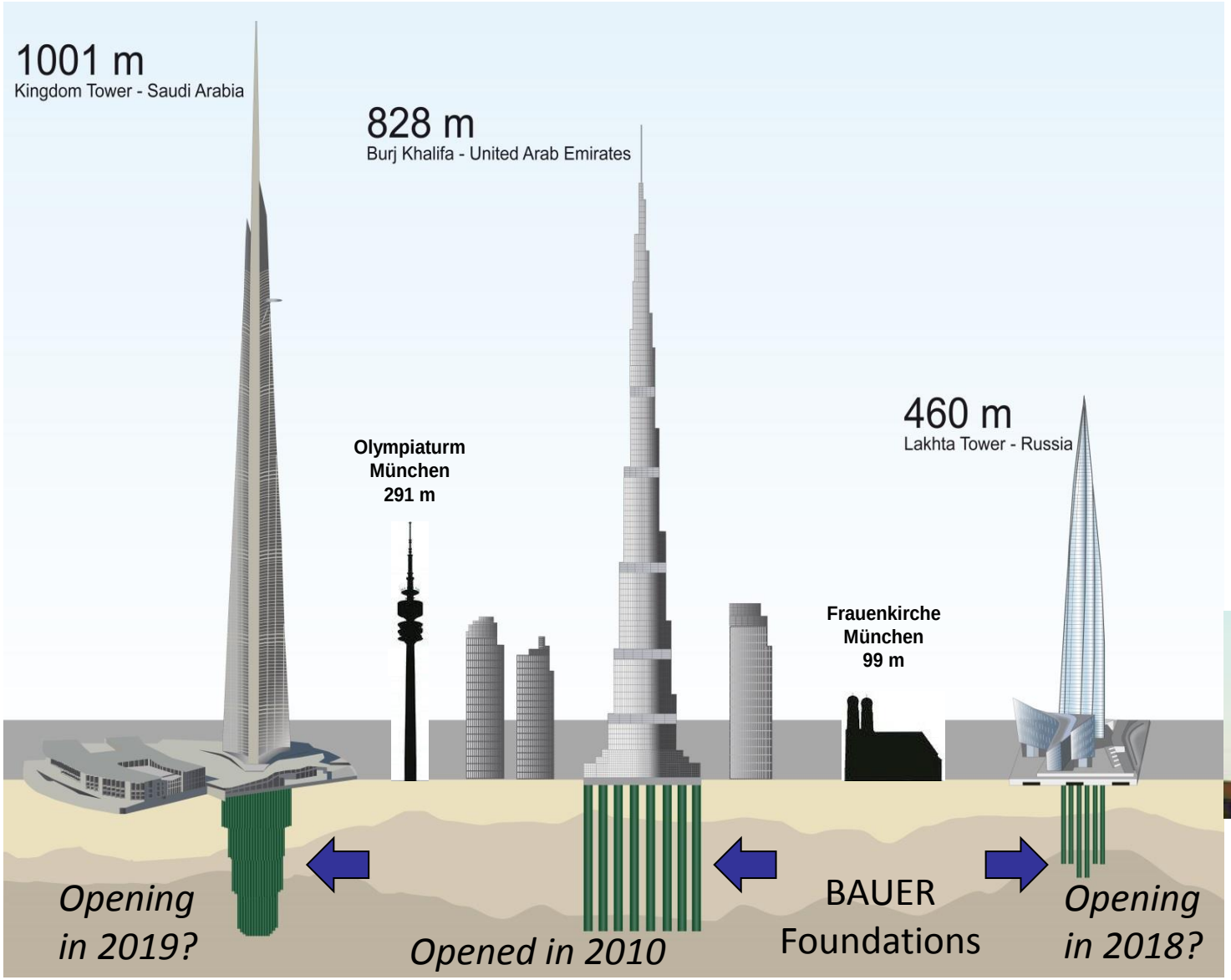
Begeistert für Fortschritt
passion for progress

BAUER specialist foundation's products

A look into an excavation pit:



Tall, taller, the tallest …

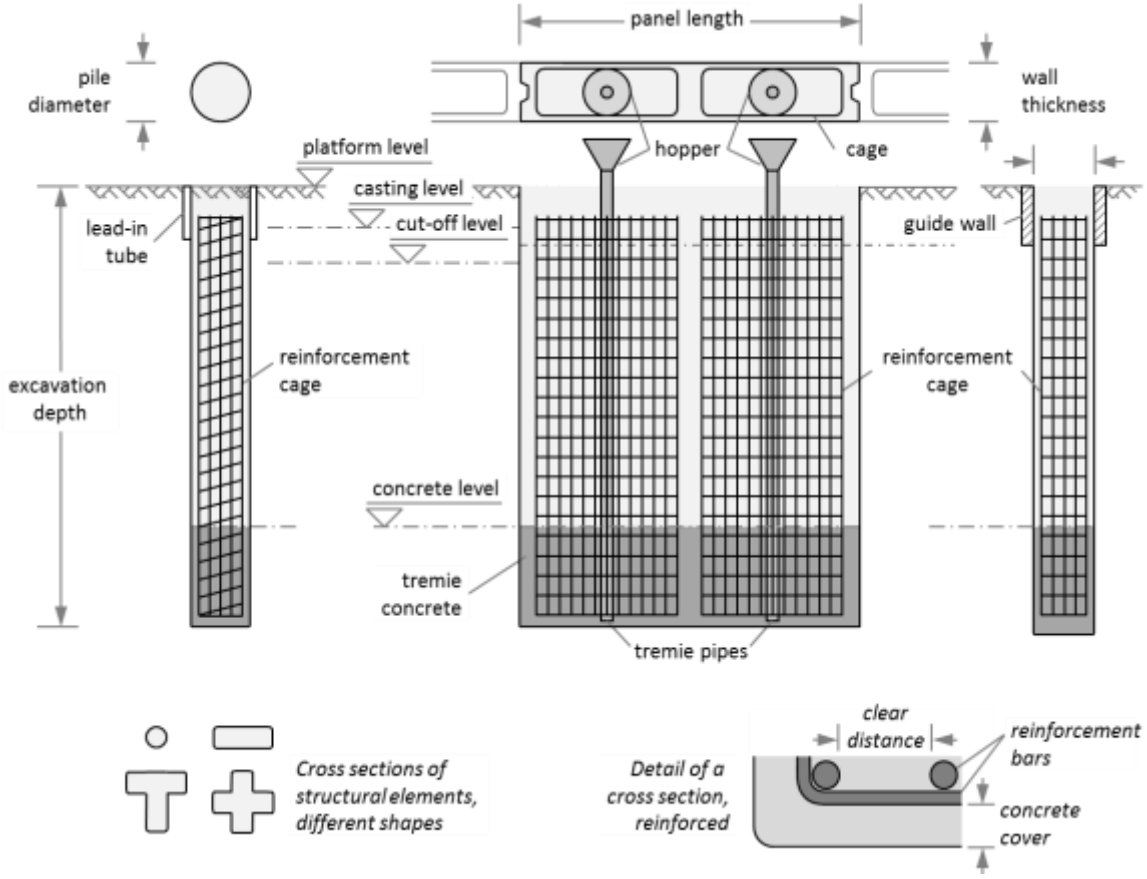


Kingdom Tower – Construction Site

- <u>270 Bored Piles</u>
- lengths from 49 to 109 m
- Diameter of 1.5 and 1.8 m

MISSION

Concrete for “Challenging” Deep Foundations



European Federation of Foundation Contractors

Scope and Objectives

- EFFC is the umbrella Federation of 16 National Federations across Europe.
- 370 Specialist Foundation Contractors
- Promotes the common interests of Members
- Achieves the highest professional standing
- Improves standards of workmanship, technical competence, safety and innovation
- Expresses Member's views within the European Commission, authorities, professional institutions, other Federations (eg FIEC)

By joint EFFC/DFI Concrete Task Group

The Guide

Background

- Increased incidence of concrete related problems in the completed piles and walls
- In 2014, joint EFFC/DFI Task Group set up
- R&D required with Universities in Europe and US
- High interest from Sponsors (suppliers, contractors, clients and consultants)
- Euro 150,000 received from Sponsors including DFI and EFFC

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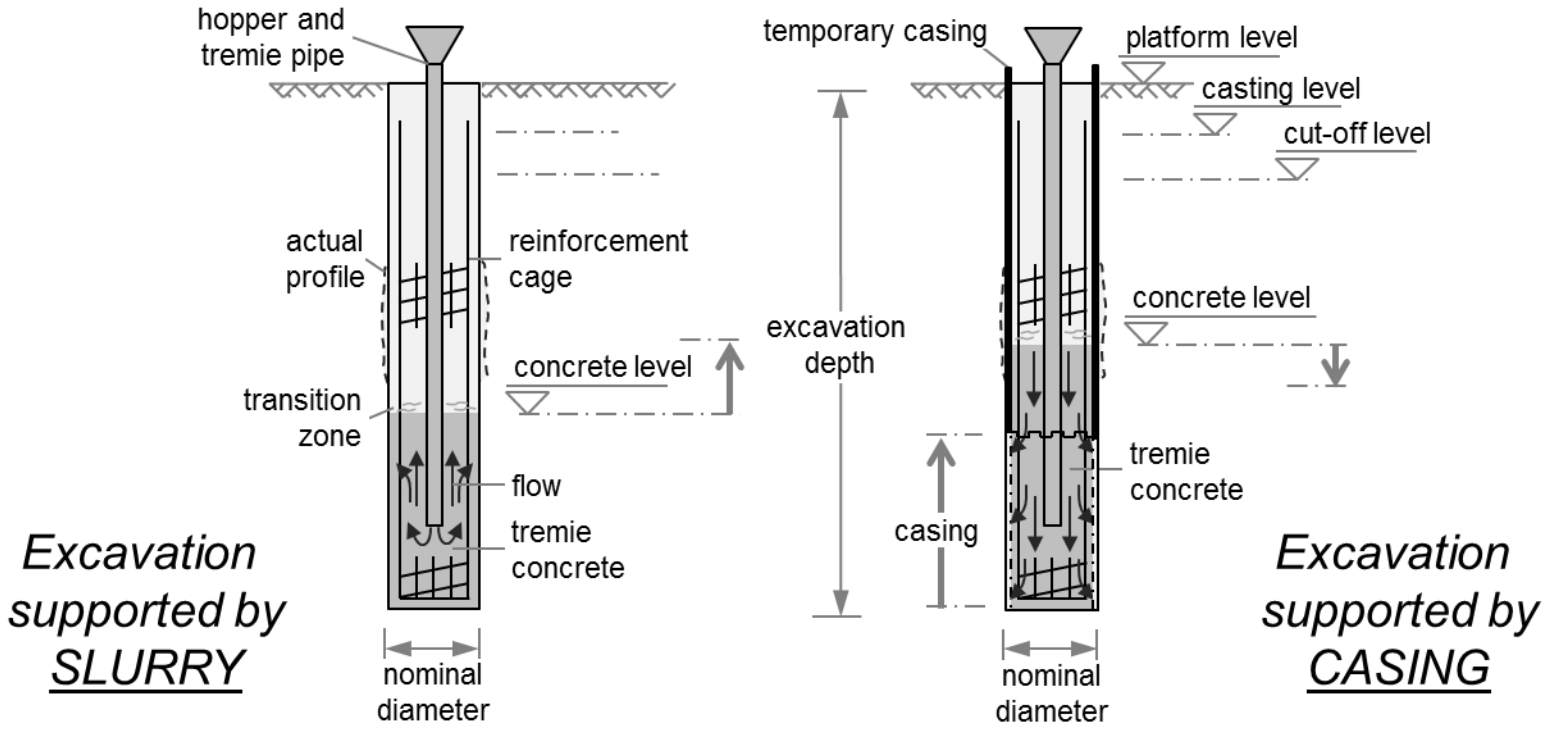
The Guide

Purpose and Scope

- Gives guidance on structural design related to concreting, on the characteristic performance of fresh concrete and its placement using tremie methods
- Presents current best practice in Europe and US
- Getting the mix right can only be done as a team:
  specialist contractor for execution,
  designer for durability and structural needs, and
  concrete supplier for an economic and practical mix
- The Guide is an addition to existing Codes, NOT a substitute

Mission

Concrete must allow for “modern” Design and Execution



Mission

All must prevent from avoidable defects and anomalies

Requirements in European Norms

Integrity of Bored Piles: EN 1536 / EN 206 (Annex D)

Placement condition	Cement content [kg/m³]	Water-cement ratio [-]	Slump [mm]	Flow diameter [mm]
Dry	≥ 325	≤ 0.60 and in compliance with provisions valid for specified exposure classes	150 ± 30	500 ± 30
submerged under water,	≥ 375		180 ± 30	560 ± 30
under a stabilizing fluid			200 ± 30	600 ± 30

These ranges – lower AND upper limits – can be good enough but may be not

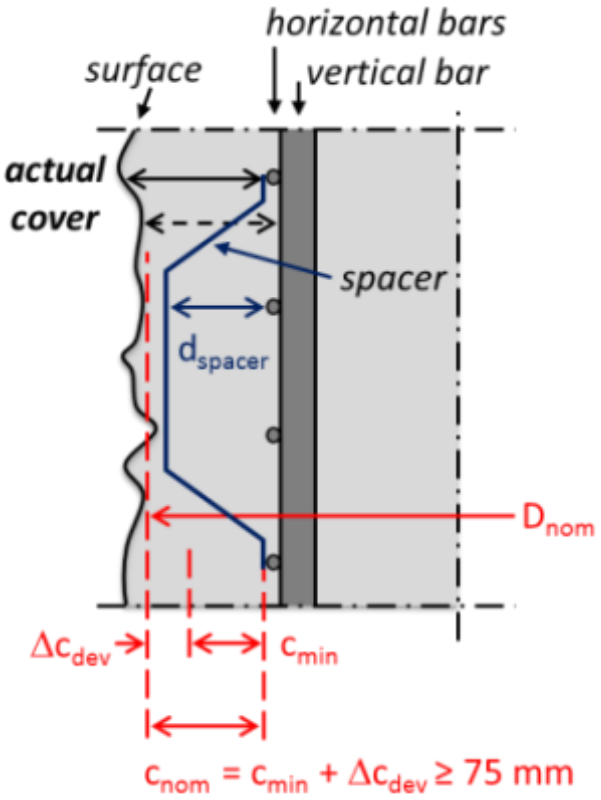
- *Consistence can not be transferred to rheological parameters, at least not to "flow"*

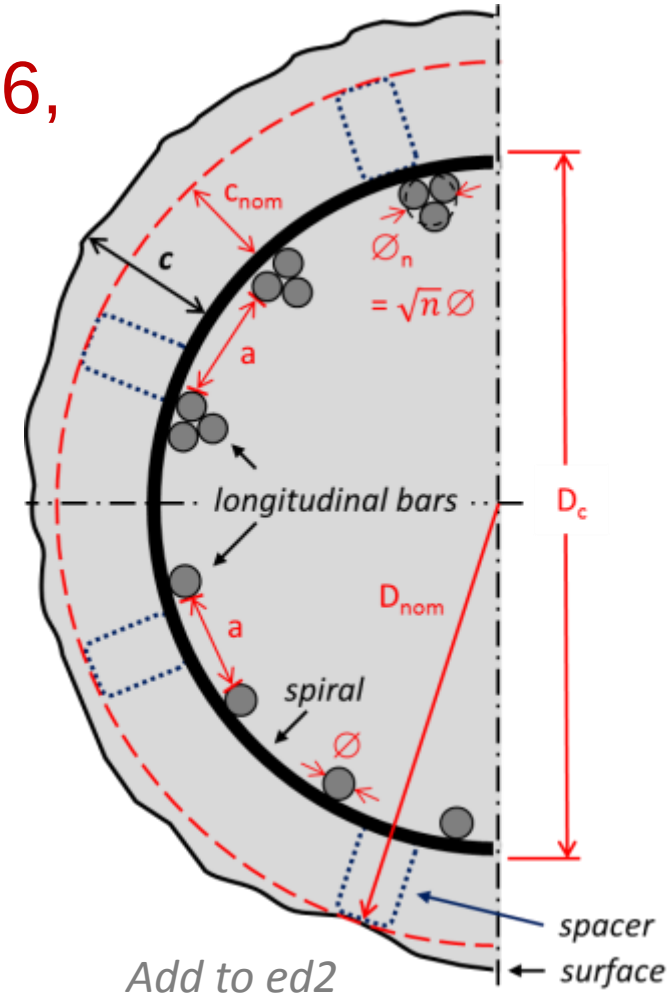
High cement contents are obviously meant to increase fines for better stability

- *Cement replacement would be better in order to ease the flow of concrete*

EFFC/DFI TREMIE GUIDE

Concrete Cover according to EN 1536, with $c_{min} + \Delta c_{dev}$





Add to ed2

Modern Concrete Technology

More options, lower w/c + admixture → more complex

Modern Concrete Technology

vs. present Standard Regulations

Old „3c Concrete“

New „5c Concrete“

principle

good workability at sufficient stability

((ignored))

application rule

Consistence Slump/Spread

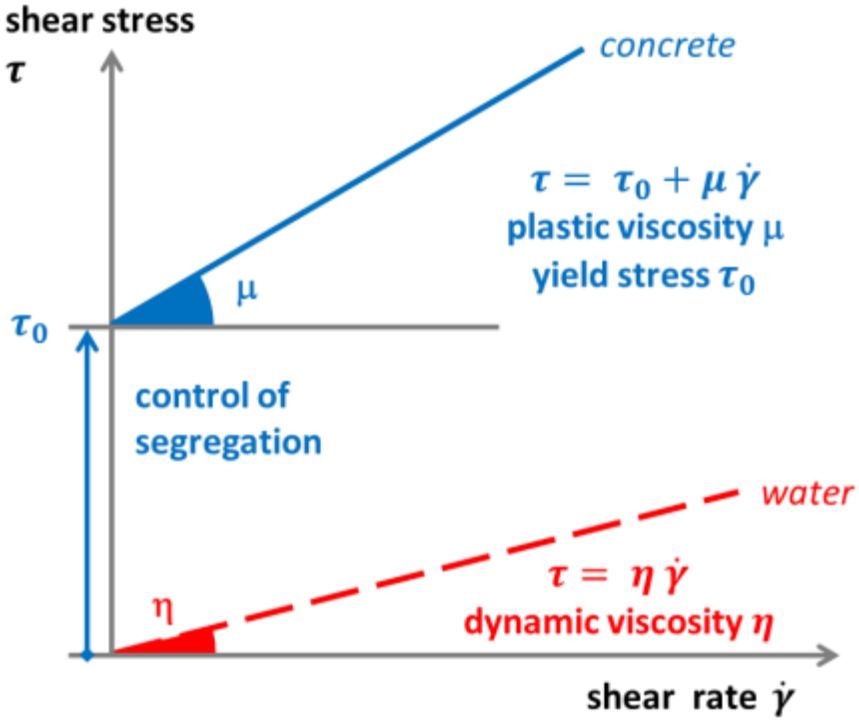
Consistence Slump/Spread

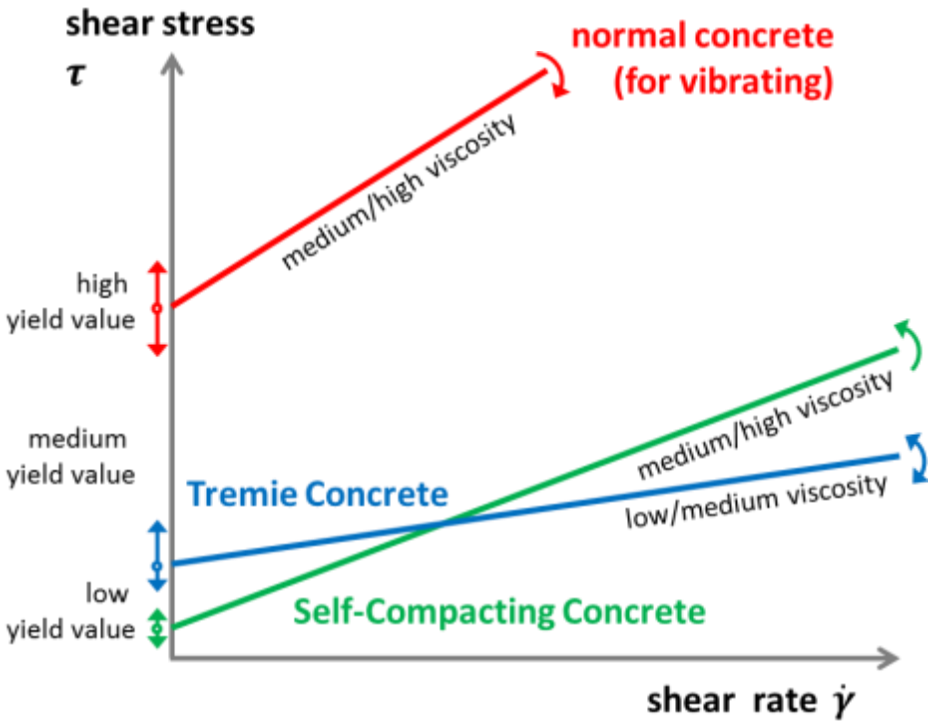
***Minimum** value to ensure good viscosity*

***Maximum** value to ensure high cohesion*

Need for Performance based QA/QC

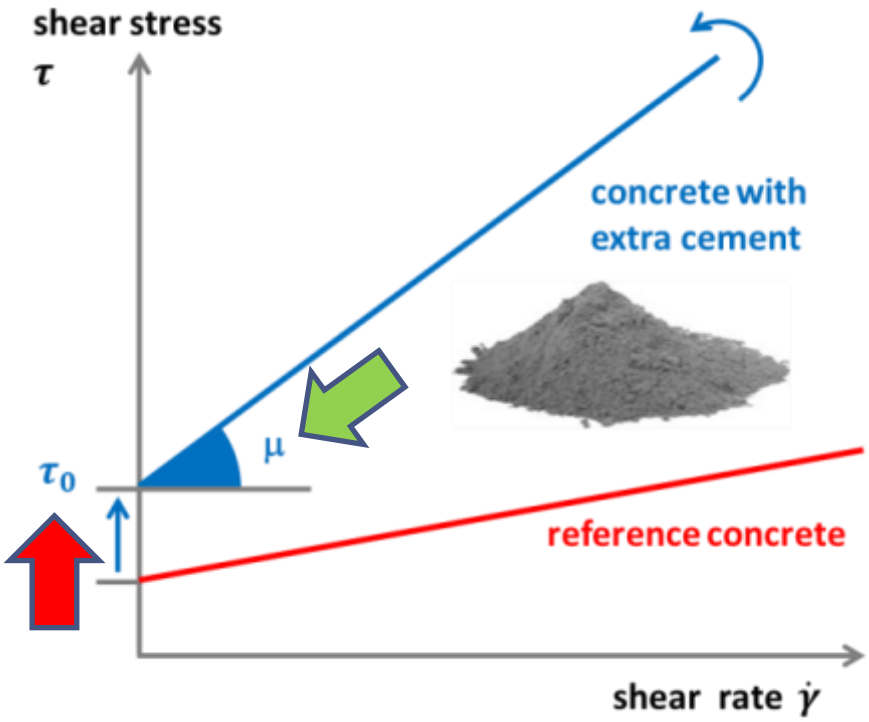
Characterisation and Comparison by Concrete Rheology



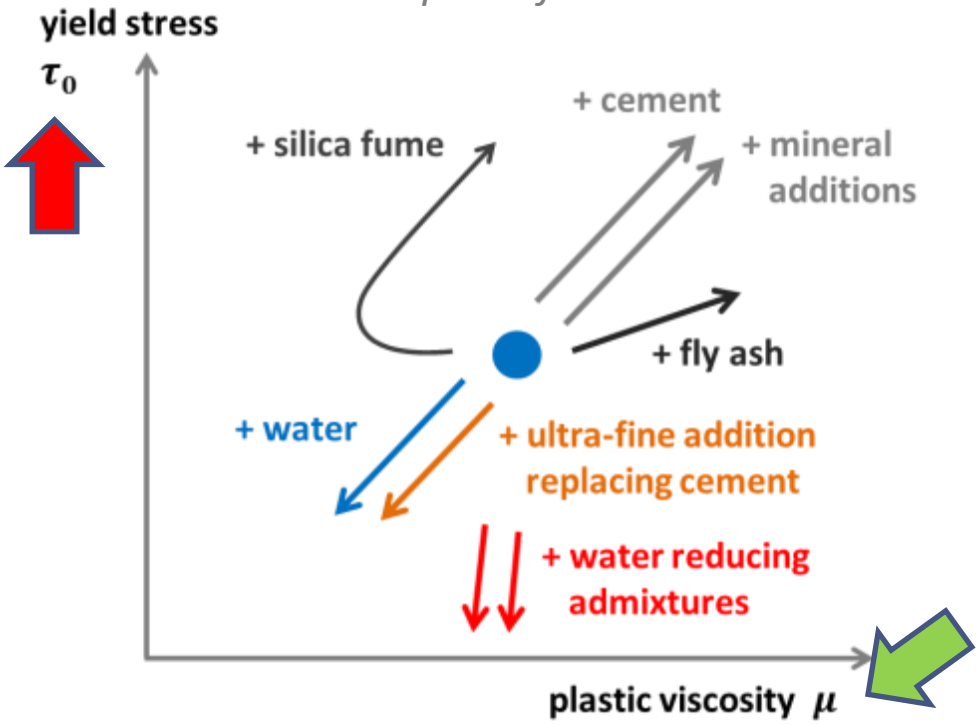


Need for Performance based QA/QC

Effect of Concrete Mix Design on Rheological Behaviour

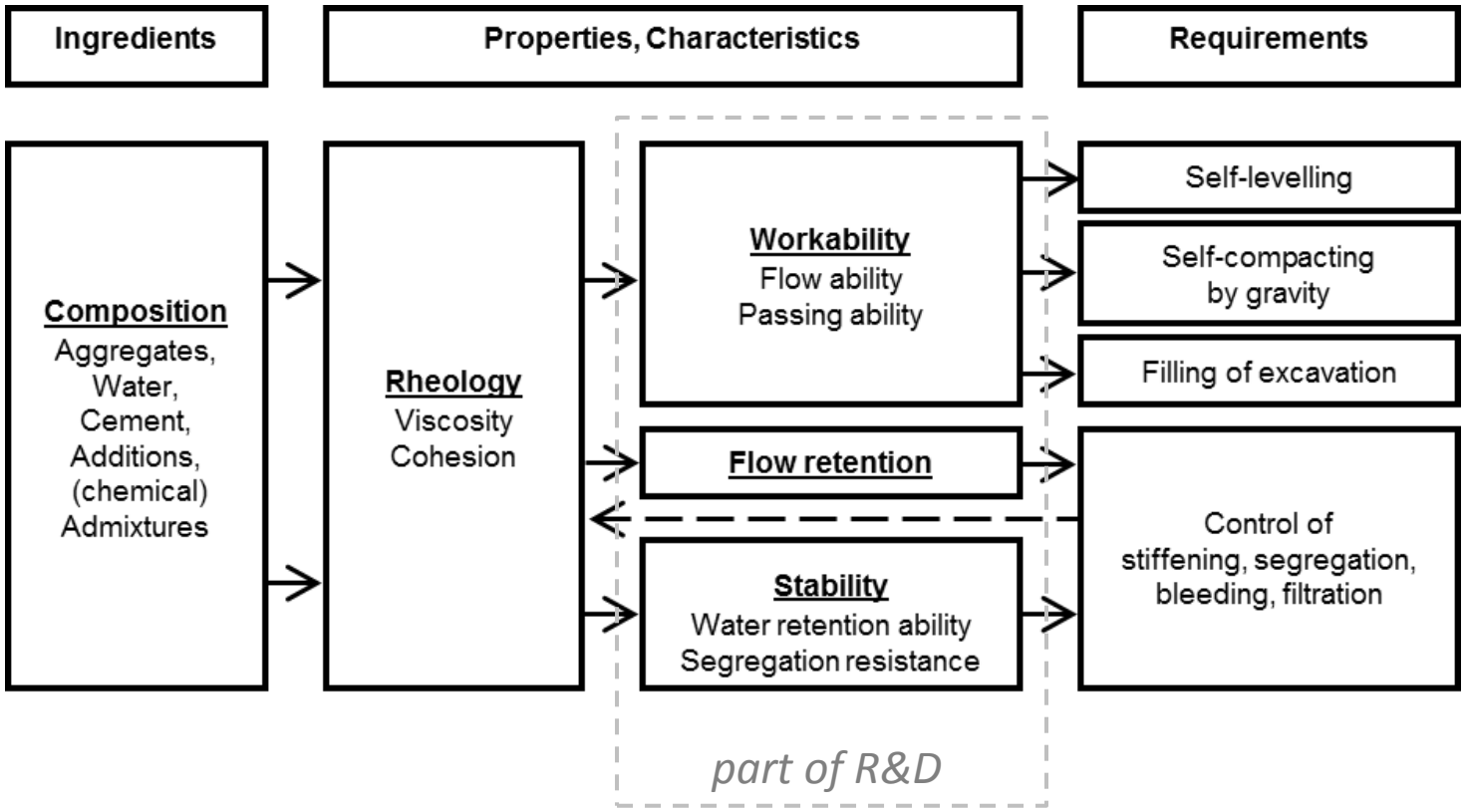


part of R&D



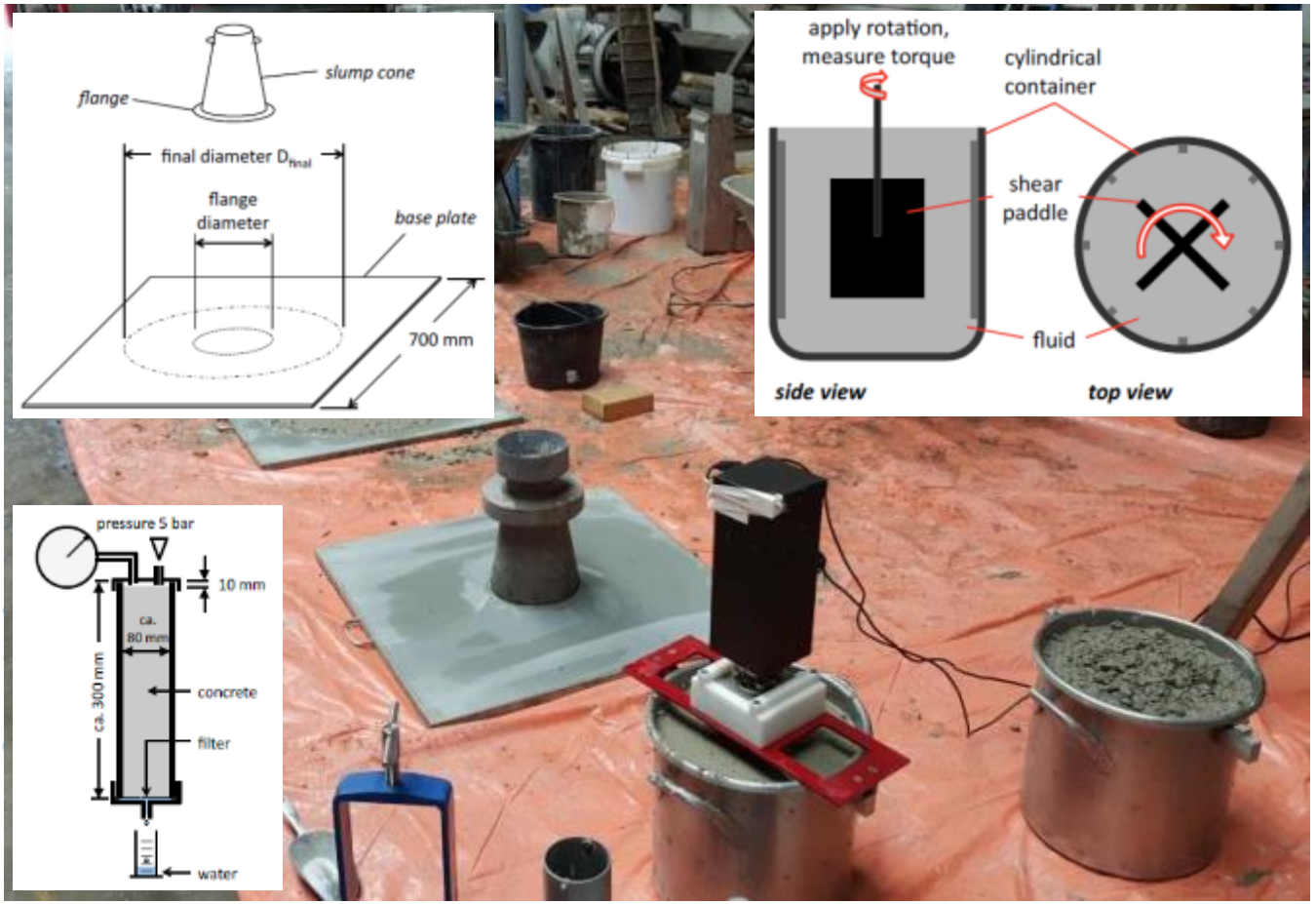
EFFC/DFI TREMIE GUIDE

Dependencies as seen by the Concrete Task Group



EFFC/DFI Research Program

Fresh concrete testing schedule



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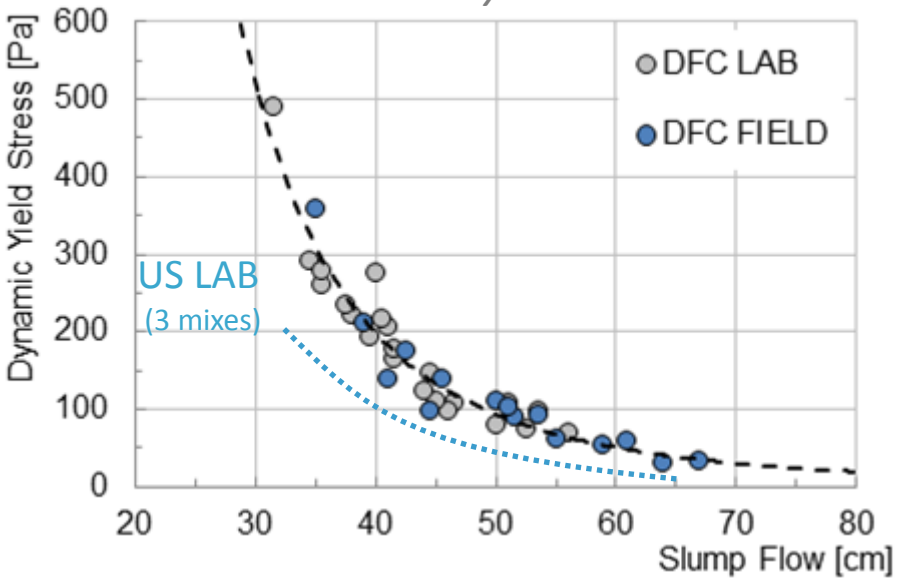
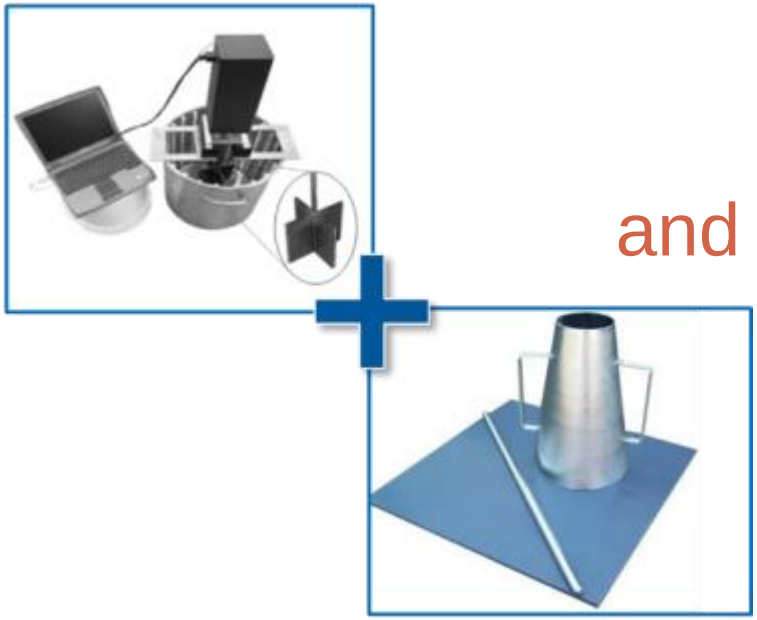
Initial Results on Yield Stress, derived from …

device-specific values
to be assessed by UNIs



rotational rheometer



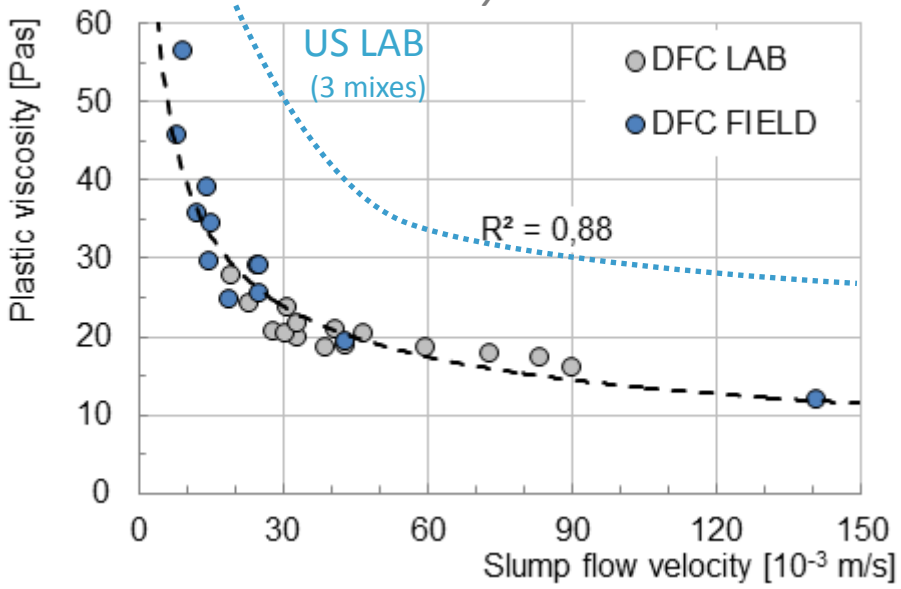
and

slump flow

EFFC/DFI RESEARCH PROGRAM

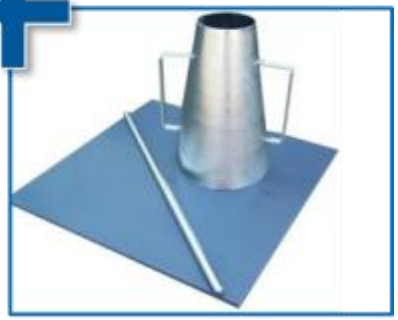
Initial Results on Viscosity, derived from …

device-specific values
to be assessed by UNIs



rotational rheometer

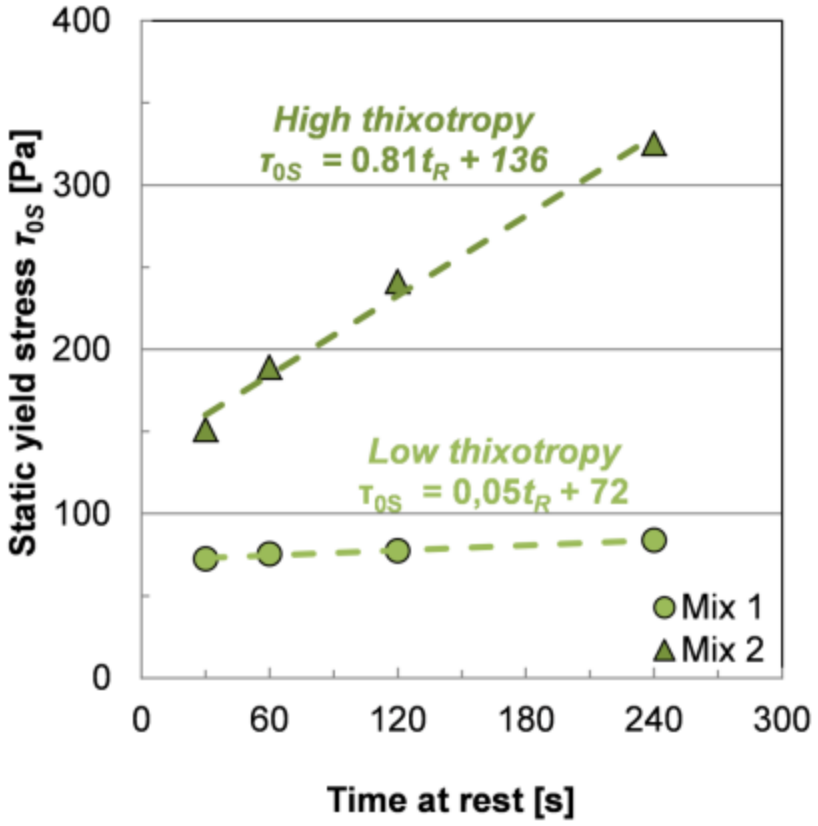
and



slump flow

EFFC/DFI RESEARCH PROGRAM

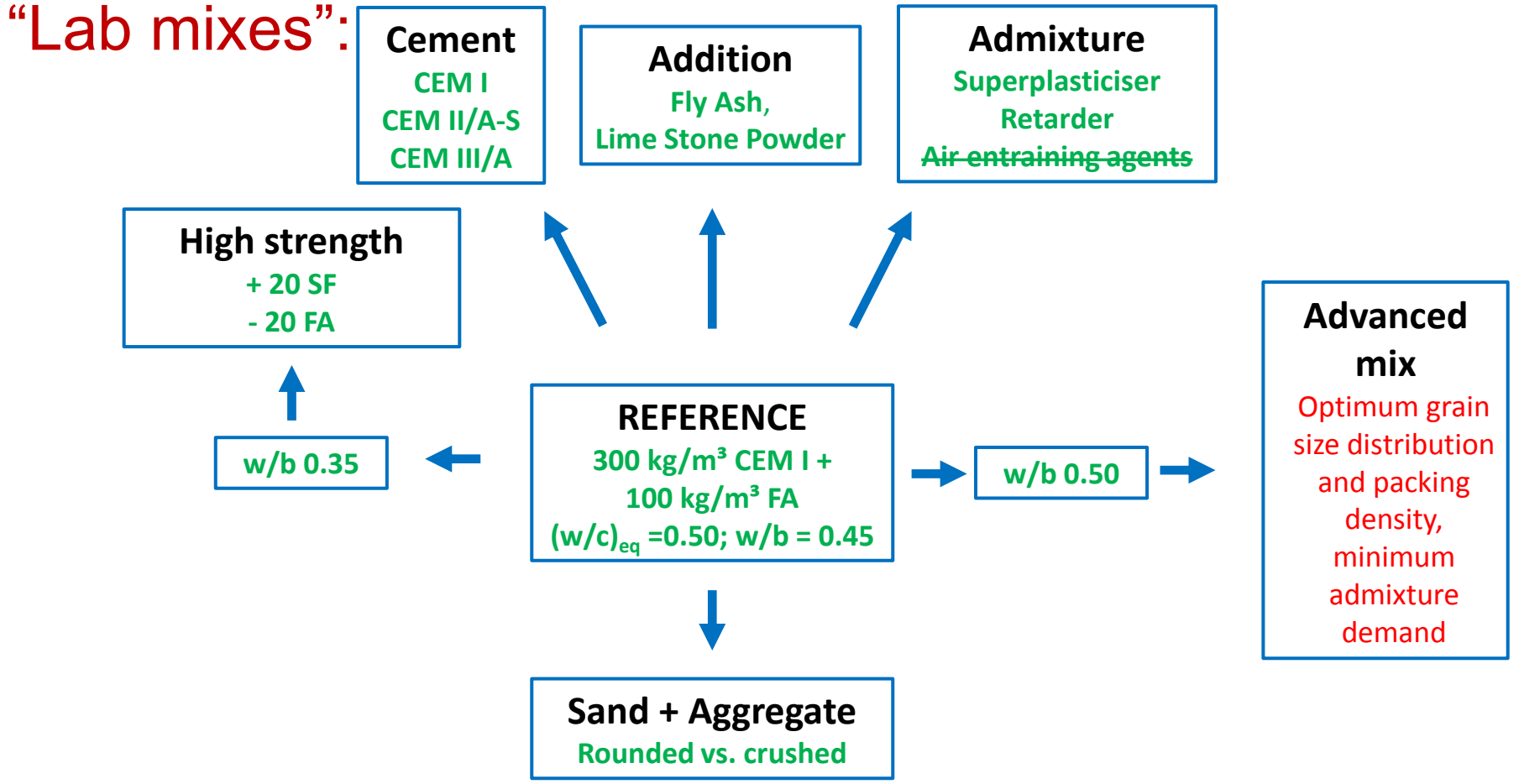
Thixotropy of Deep Foundation Concrete



0 min at rest

10 min at rest

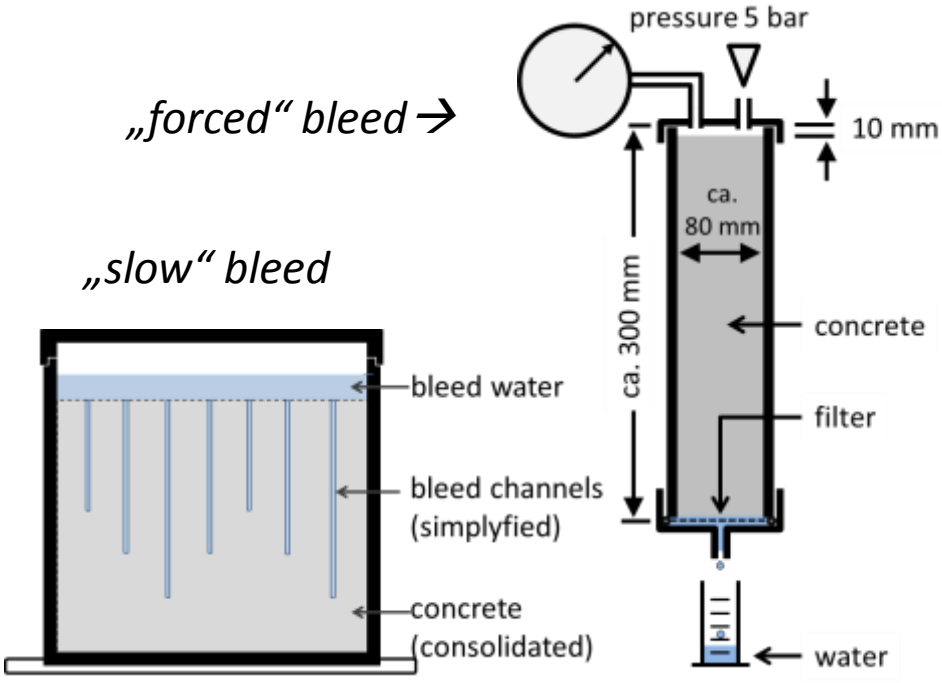
EFFC/DFI RESEARCH PROGRAM



EFFC/DFI RESEARCH PROGRAM

Stability of Deep Foundation Concrete: Forced Bleeding

- BAUER Filtration Test: 1.5 l of fresh concrete subject to 5 bar for 5 minutes: recommended limit: 22 ml



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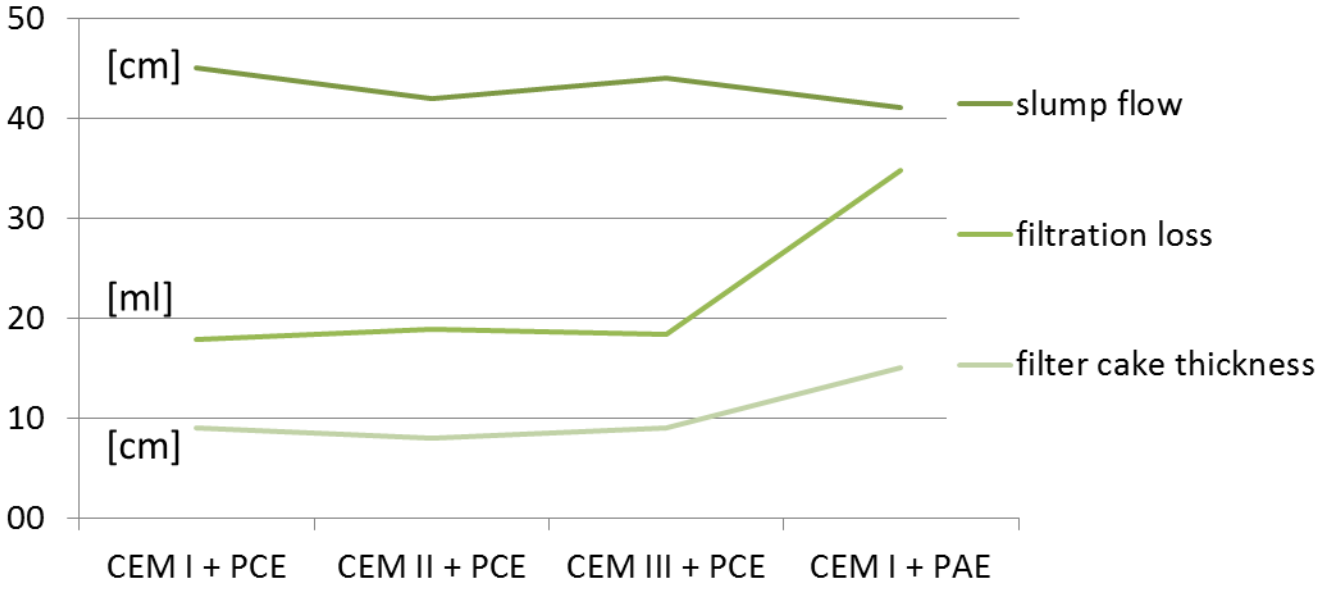


Extra Information:
FILTER CAKE THICKNESS

LOOKOUT

New Performance Specifications and Requirements

- Better Understanding of “Concrete Rheology”
- Appropriate Design, i.e. Concrete Cover & Clearance
- Agreed Best Practice of Execution
- Mutual Adaption to “Challenging Conditions”
- Guide #1: Option for Specific Testing
- Guide #2: Validated Concrete Testing Methods and related Acceptance Criteria for Workability & Stability, incl. outlook to assistance of Numerical Modelling (computational simulations)
- Norms 2020^{+}: Revised Concrete and Execution Standards

Karsten Beckhaus (CM), Bauer Spezialtiefbau, Contractor

Bartho Admiraal, Volker Staal en Funderingen, Contractor

Andrew Bell, Skanska, Contractor

Björn Böhle, Keller Grundbau, Contractor

Michel Boutz, SGS INTRON, Consultant

Dan Brown, Dan Brown & Associates, Consultant

Sabine Darson-Balleur, Soletanche Bachy, Contractor

Thomas Eisenhut, POYRY, Consultant

Peter Faust, Malcolm Drilling, Contractor

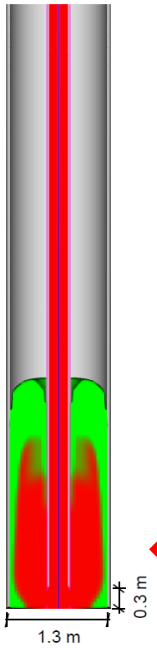
Raffaella Granata, TREVI S.p.A., Contractor

Chris Harnan, Ceecom, Consultant

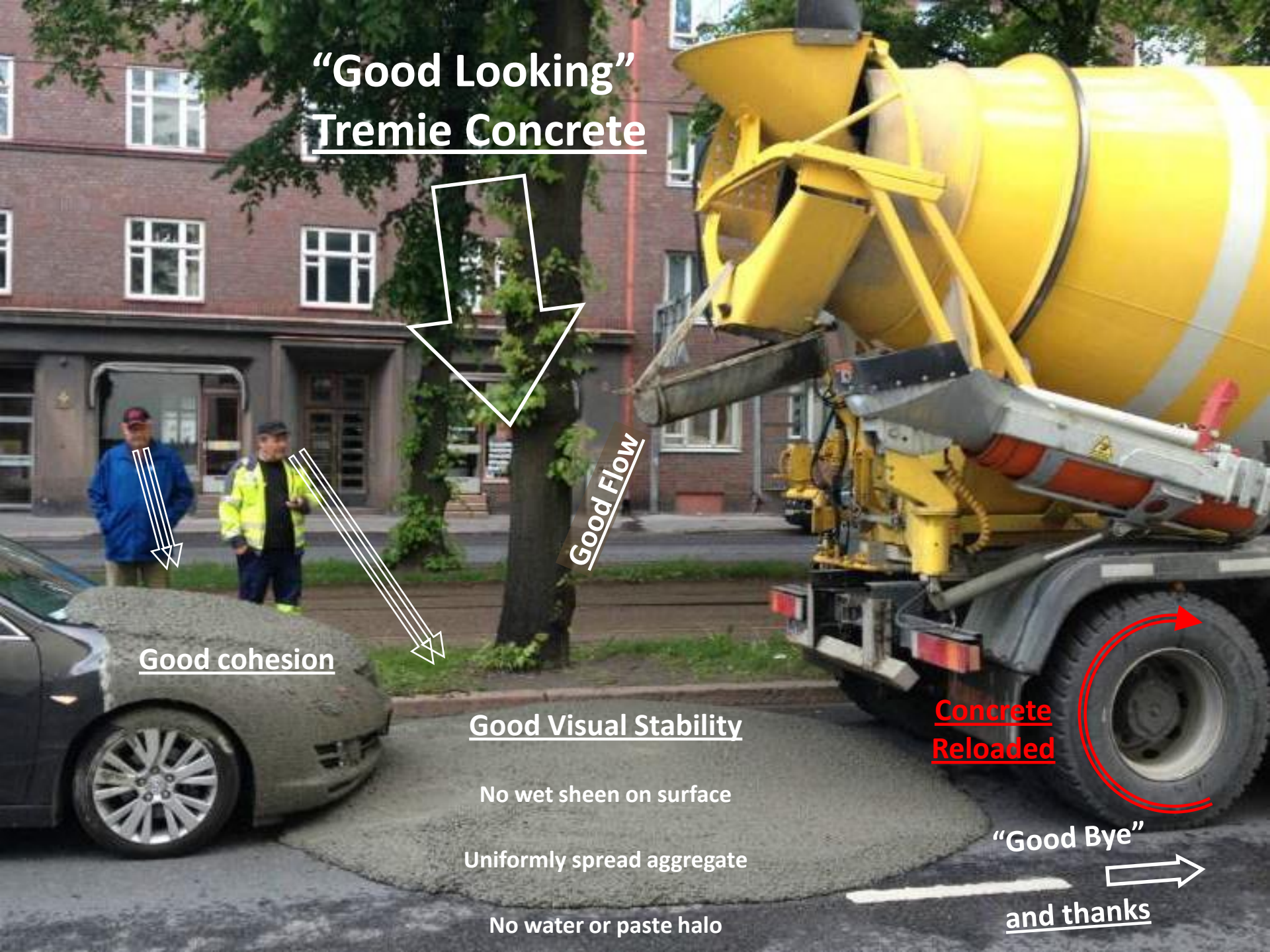
Duncan Moore, Implenia, Contractor

Duncan Nicholson, ARUP, Consultant

Alexander Rostert, Züblin, Contractor



- **Edition1 is free** to download from EFFC and DFI websites.
- **Edition2 due in 2018** with R&D results, conclusions, and acceptance criteria, **and a special feature**


"Good Looking"
Tremie Concrete
Good Flow
Good cohesion
Good Visual Stability
No wet sheen on surface
Uniformly spread aggregate
No water or paste halo
Concrete Reloaded
"Good Bye"
and thanks