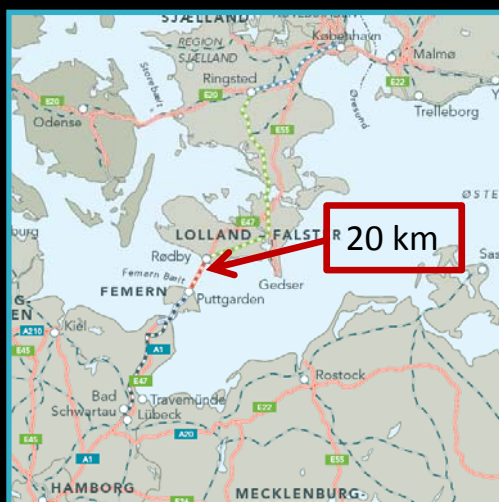




# CONCRETE CENTRE NEWSLETTER – March 2010

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# Fehmarnbelt Fixed Link Testing Program

Femern A/S, the Owner of the coming [Fehmarnbelt Fixed Link](#), has through an open tender process selected the Concrete Centre at Danish Technological Institute as its external concrete laboratory. As part of a testing program supporting the preparation of material requirements the Concrete Centre's HighTech Concrete Laboratory has produced 30 concrete blocks and a large number of small test specimens based on a series of possible mix designs for the construction. Fifteen large concrete blocks (400 litres – 2 x 1 x 0.2 m) each having different concrete composition have been placed partly submerged in the harbour in Rødbyhavn. They will be monitored at least until the end of the construction period, which is in expected to be in 2018.

For the production of the 15 concrete types, including 3 SCC mixes, the demands on batching accuracy have been very strict. Maximum 1 % weight deviation was allowed on any individual constituent. This requirement was met by the mixing plant at the Concrete Centre by implementing special procedures for moisture control of the aggregate. The mixing plant has 5 aggregate silos and 4 powder silos and a capacity of 250 litres concrete per batch.

An extensive testing program has been initiated comprising documentation of:

- Workability, density, and air content
- Setting time and bleeding
- Strength development (compressive and split tensile)
- Frost resistance and air void structure
- Chloride ingress resistance
- Microstructure (petrographic analysis)

The high batching accuracy achieved by using the mixing plant at the Concrete Centre ensures that conclusions regarding the fresh and hardened concrete properties are based on a sound foundation. The laboratory mixing plant has proven to be a valuable tool for documentation of concrete and constituent materials at the industrial scale.

The results from the testing program will be used in preparing the material requirements for the Fehmarnbelt Fixed Link construction.

For more information please contact Teamleader Claus Pade, [cpa@teknologisk.dk](mailto:cpa@teknologisk.dk), or phone +45 7220 2183

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Cores ( $\varnothing 100$  and  $\varnothing 150$  mm) are drilled from concrete blocks at 28 days of maturity.



Left: Casting of large concrete block at the DTI laboratory.

Right: Martin with the first concrete block.



Left: Self-compacting concrete in the mixer.

Right: Measuring the slump flow of SCC after determination of rheological parameters by the [4C-Rheometer](#).



# HighTech Concrete Laboratory

The HighTech Concrete Laboratory, established in 2007, provides industry access to exploring new opportunities within production of concrete, formwork and prototypes. The two primary units of the HighTech Concrete Laboratory are a full-scale automatic concrete mixing station and a digitally controlled robot cell. This equipment combined with the specialists of the Concrete Centre makes the laboratory able to provide unique possibilities for developing new and innovative solutions within concrete.

Using the robot cell at the [HighTech Concrete Laboratory](#) digital models are directly used to produce physical items in terms of formwork (negatives) or model prototypes (positives). When tailoring the solution for a specific challenge, a wide range of possibilities regarding finish/quality and cost is available. The concrete mixing station provides a unique opportunity to demonstrate the concrete products based on the unique formwork manufactured using the robot cell. In addition the facility offers the opportunity to develop and optimize concrete mix design and to study the rheology of self-compacting concrete, e.g. [formfilling](#) under very controlled large scale conditions.

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## “Concrete Things” – design to product

The facilities and expertise at the DTI HighTech Concrete Laboratory can help you realize your design ideas.

Targeting the furniture exhibition “The Cabinetmakers’ Autumn Exhibition” the Concrete Centre teamed up with [Komplot Design](#) to create the “Concrete Things”. The design was done digitally by Komplot and the drawings were transformed by experts at the Concrete Centre into milling programs for the 6-axis robot at the HighTech Concrete Laboratory. Using a lightweight foam material accurate masters of the “Concrete Things” were produced. Subsequently, the first units were cast using Self-Compacting Concrete into silicone matrices made from the masters.

The first six units produced were acquired by the Danish Art Foundation and placed in front of “Rigshospitalet – Copenhagen University Hospital”. The “Concrete Things” are now marketed by the Swedish company [Nola Industries AB](#).

For more information please contact Lars Nyholm Thrane, [lnth@teknologisk.dk](mailto:lnth@teknologisk.dk) or phone: +45 7220 2215

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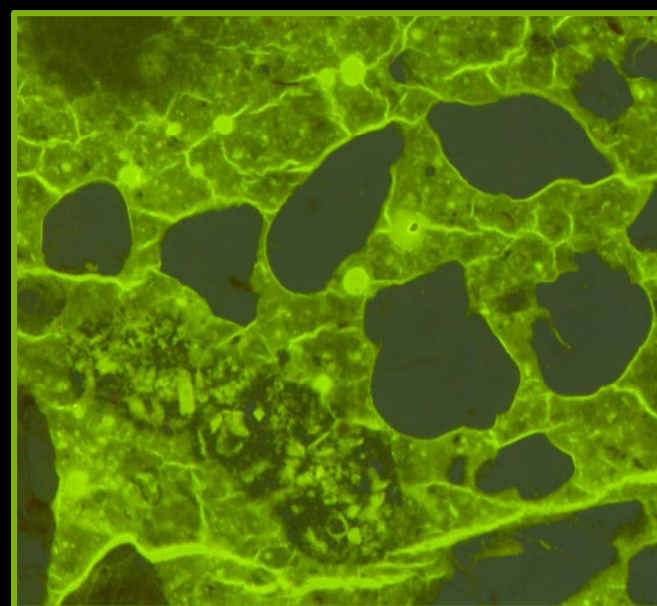
## High Quality Sample Preparation

Concrete microscopy requires high quality specimens in order to perform a reliable analysis. DTI has more than 30 years of experience in preparing concrete specimens (thin sections & polished sections) for optical microscopy and SEM-EDX analysis. One of our specialties when preparing the specimens is the use of yellow fluorescent epoxy in the impregnation process. The use of fluorescent epoxy allows us to study and quantify features which cannot otherwise be studied such as e.g. cracks <math><10 \mu\text{m}</math>, paste homogeneity and porosity of aggregate. The greatest advantage of using fluorescent epoxy is, though, that we are able to determine the w/c ratio of concrete.

DTI offers [petrographic analysis](#) including specimen preparation. However, if you prefer to perform the analysis yourself we offer to prepare your specimens. Send us the concrete sample and we will return the specimens. In case you intent to build up your own laboratory we do also offer [training courses](#) in sample preparation as well as assistance regarding choice of equipment etc.

For more information please contact Dr. Ulla Hjorth Jakobsen, [uhj@teknologisk.dk](mailto:uhj@teknologisk.dk), or phone: +45 7220 2198

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Did you know?: That concrete containing slag appears bluish green inside