

## **Overview of Danish Centre for Resource Saving Concrete**



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### **ABSTRACT**



The Danish Centre for Green Concrete aims to help the concrete industry face new environmental challenges and to help Society to solve environmental problems. The goal of the Centre is to reduce the environmental impact of concrete. To enable this, new technology is developed. The technology considers all phases of a concrete constructions life cycle, i.e. structural design, specification, manufacturing, maintenance, and it includes all aspects of performance.

**Key words:** CO<sub>2</sub>, residual products, green concrete, bridge, specification, life cycle screening, united business effort.

## **1. BACKGROUND**

The environment is in focus for both society, the industry as for the individual person. Aspects considered are e.g. CO<sub>2</sub> emissions, where Denmark has ratified ambitious targets in the Kyoto agreement, problems with landfilling of residual products, substances harmful to health and environment and the consumption of resources.

Concrete can contribute to the solution of some of the mentioned environmental problems. Because of the high volumes consumed – in Denmark 1.5 t per capita annually – even small environmental improvements result in large improvements for Society. Ways to improvement are e.g. to develop cement and concrete with reduced CO<sub>2</sub> emission, to use residual products from other industries, to improve durability and to design for a minimised need for heating energy.

Some of the mentioned solutions are being investigated in the Danish Centre for Resource Saving Concrete Structures – short name Centre for Green Concrete.

## **2. OBJECTIVES**

The goal of the Centre is to reduce the environmental impact of concrete. To enable this, new technology is developed. The technology considers all phases of a concrete construction's life cycle, i.e. structural design, specification, manufacturing, maintenance, and it includes all aspects

of performance, i.e. mechanical properties, fire resistance, workmanship, durability and thermodynamic properties

### **3. PARTICIPANTS, BUDGET AND TIME TABLE**

The Danish Centre for Green Concrete was established on July 1, 1998. Fulfilment of the objectives of the centre calls for different kinds of expertise. Therefore, the centre involves partners from all sectors related to concrete production. Participants are: The Concrete Centre, Danish Technological Institute, Aalborg Portland A/S, Unicon A/S, COWI A/S, MT Højgaard a/s, AB Sydsten, Technical University of Denmark, Aalborg University and the Danish Road Directorate.

The Ministry of Trade and Industry partly funds the centre through a so-called centre contract. The partners form a "centre without walls" with a formalised management structure and an agreed work programme, but with the work carried out by the partners at their own facilities. The centre has a budget of approximately DKK 22 million – one of the largest Danish concrete development projects ever. The centre will finalise the work December 2002.

### **4. ENVIRONMENTAL AND TECHNICAL GOALS**

The centre has defined a number of alternative environmental requirements with which green concrete structures must comply to. These goals are in accordance with Danish environmental strategies, e.g. the goal for CO<sub>2</sub>-emission is in accordance with the Danish obligations at the Kyoto agreement (21% reduction before 2012 compared to the 1990 level).

- CO<sub>2</sub> emissions shall be reduced by at least 30%.
- At least 20% of the concrete shall be residual products used as aggregate.
- Use of concrete industry's own residual products.
- Use of new types of residual products, previously landfilled or disposed of in other ways.
- CO<sub>2</sub> neutral waste-derived fuels shall replace at least 10% of the fossil fuels in cement production.

In addition to the environmental goals there are a number of environmental intentions. Most important are: to avoid the use of materials which contain substances on the Danish Environmental Protection Agency's list of unwanted materials, not to reduce the recycling ability of green concrete compared with conventional concrete and not to increase the content of hazardous substances in the waste water from concrete production, compared with waste water from production of existing concrete types.

The technical goals for the centre are to obtain the same technical properties for the green concrete compared to conventional concrete – or to determine in what way the properties differ. The compressive strength goals for the green concrete are:

- Aggressive environmental class (outdoor, horizontal): 28-day strength > 35 MPa and 56-day strength > 85% of the strength of a reference concrete.

- Passive environmental class (indoor): 28-day strength >12 MPa and 56-day strength > 85% of the strength of a reference concrete.

The compressive strength goals for the 28-day strength correspond to the minimum requirements in the Danish standard for concrete materials, DS 481. A reference concrete is defined as well-documented conventional concrete produced in large amounts.

## 5. CENTRE ACTIVITIES

Different ways of producing green concrete are being investigated. An overview of the investigated concrete types can be seen in /1/. Extensive investigations on durability, mechanical properties, fire resistance and workmanship are carried out for selected concrete types. A summary of the most important results are shown in /1/. More detailed information can be found in /2/ as regards durability and in /3/ as regards mechanical properties.

Green structural solutions and repair and maintenance of green concrete structures with focus on a bridge are being investigated on the basis of the result of among others the durability testing, /4/. Some of the green concrete types have been used in the construction of a bridge in Jutland, see /5/. Furthermore, an environmental screening of the bridge will be carried out.

Other activities for the remaining part of the centre is to prepare a guidance for the production and use of green concrete, to formulate a Danish Road Directorate special concrete specification for green concrete structures and to prepare material for education.

## 6. CONCLUSION

The results obtained by the Danish Centre for Green Concrete point to ways of significantly reducing the environmental impact of concrete by using "greener" cement, by using residual products and by optimising the operation and maintenance methods. The results indicate that the environmental targets set up will be achieved.

## REFERENCES

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