Finite element analysis of temperature in hardening concrete using isothermal calorimetric data

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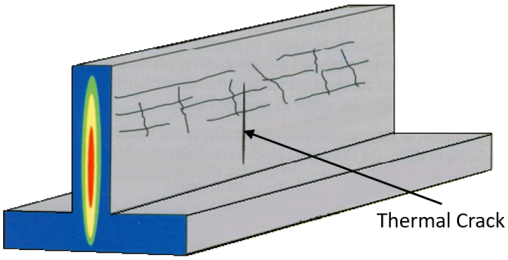
The risk of thermal cracks are of concern for massive concrete structures, mostly associated with dams, bridge piers and other structures with large volume placements. The consequence of thermal cracks in concrete can be severely reduced service lifetime.

Background

It is of importance to analyse how the heat in concrete develops to avoid thermal cracking. In order to predict how the temperature in concrete develops, simulation-programs are used which can estimate the temperatures for complex geometries.



Thermal crack in hardening concrete

Many of the simulation-programs are based on mathematical calculations called "Finite element method". In order for these programs to be reliable it is of high importance that the characteristic heat development of the concrete is established with high accuracy.

Until now, the heat development is typically described using parameters evaluated from so-called semi-adiabatic experiments. However, a more sophisticated method to describe heat development is to use data from so-called isothermal calorimetry.

Objective and method

An algorithm was developed which estimates the heat with use of isothermal calorimetry. The algorithm was successfully implemented to the program HACON which is now one of the first programs to support isothermal measurements for simulation of temperatures in hardening concrete. The new version of this program was evaluated in this dissertation with an experimental setup which was built as a cylindrical concrete structure.

Result

HACON using the conventional as well as the new algorithm resembles the behaviour observed in the experiment. However, the results were slightly different and the question whether the new method that was implemented is more accurate than the method that is usually used, remains to be investigated.

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