Early-age-crack control: a case story

Early-Age-Crack Control: A Case Story

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Summary

Increased demands to achieve durable concrete structures with increasingly longer service life requires more detailed investigations and knowledge of e.g. potential chloride ingress or risk of cracking in the concrete due to heat generation during hardening and/or shrinkage. In the last 10-20 years concrete mixes have moved towards more dense concrete to obtain high resistance to chloride ingress. As the concrete becomes more dense the concrete mechanical properties change and often the risk of cracking increases, which consequently can reduce the durability of the structure. In other words durable concrete can under improper use cause non-durable structures.

By means of computer simulations of the hydration temperature and the temperature induced stresses it is possible to predict the risk of cracking and to determine appropriate measures to reduce the risk of cracking. It is possible during planning of massive concrete castings to minimise the preventive measures required to reduce the risk of early age cracking such as cooling.

This paper will be based on three case stories from the Great Belt Link and The Oresund Link projects in Denmark, which demonstrates that the potential crack risk can be simulated quite accurately. Based on three dimensional simulations the importance of the static boundary conditions are discussed and it will be demonstrated that under certain circumstances it is impossible to avoid early age cracking due to the effect of autogeneous shrinkage.

Conclusions

Based upon the presented case stories we find that the following statements can be raised.

1. 3D dimensional analyses will be required in the future. A lot of assumptions regarding static boundary conditions can calculated instead of being assumed.

2. Single cooling pipes does not have to be modelled in relation to evaluation of global effects. This approach is equivalent to concrete design where the single reinforcement bar is often not modelled.

3. Prediction of potential crack risk can be calculated very accurate if all information is known. It is very important before any calculations are started or required as documentation, that acceptance criteria and input parameters are agreed.

4. To avoid the problems mentioned in 3 a guide or code of practice in relation to computer simulations of early age crack risk is needed.

5. By performing preliminary evaluations of the crack risk, cost can be reduced e.g. by avoiding expansion joints in some structures.