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| Doctoral thesis: | Numerical study on early age thermal-shrinkage stresses in massive foundation slabs |
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## Abstract

Massive concrete slabs are special types of structures, in which the source of internal stresses during the construction process is the concrete itself. The origin of these stresses is related to the transformation of the concrete structure during hardening, which is accompanied by temperature and moisture variations. The resulted early-age volume changes may have a relevant influence on the arising stresses and consequently the risk of cracking. Therefore, the proper prediction of the early age effects in massive slabs is required to minimize both unfavorable stresses and the corresponding cracking risk. The analysis is additionally complicated with the fact that at early-ages concrete endures significant evolution of strength and elastic properties with the progress of cement hydration. Thus, the magnitude of early-age volume changes is simultaneously influenced by many relevant factors, such as concrete mix composition, curing conditions, construction technology, and structure dimensions.

This thesis is focused on basic strategies for thermo-mechanical FE modelling of foundation slabs at early ages. For the purpose of understanding and identification of the phenomena and all relevant factors, at first, the literature review regarding early age thermal-shrinkage effects was performed. Furthermore, for the investigation of the potential crucial factors influencing the massive foundation behavior, 10 cases of execution experiences were analyzed and discussed.

The applied methods for evaluation of early-age thermal-shrinkage stresses in massive foundation slabs, especially provided by the software DIANA FEA were described. As an alternative, the analytical methods were briefly introduced.

The main part of the thesis, implementing its major aims and hypotheses, refers to the case study of a massive foundation slab. The principal part of that study was a thermo-mechanical FE simulation of the massive foundation of the sluice Sülfeld-Süd in Germany, performed in DIANA FEA software. After a detailed description and motivation of provided assumptions in the process of modelling of the 2 m slab with the dimensions in the plan view: 26.5×41.5 m, the results of calculations were compared to corresponding measures provided by the monitoring system installed in the real structure. The data from sensors, i.e. temperature, strains and stresses arising in the structure during the construction process, allowed for validation of the numerical model. The investigation was extended with the application of analytical methods.

The subsequent part of the thesis was a parametric study for investigation on the methodology of modelling and the influence of the chosen technology-material factors on the early-age temperature and stress distribution in massive foundation slabs.

Finally, a discussion was made on the strategy of modelling including both the influence of input parameters and data on the obtained FE results and the selected technological and material factors on the early-age temperature and stress distribution in massive foundation slabs.

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