RISK OF EARLY-AGE THERMAL CRACKING IN CONCRETE WALLS

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Durability of concrete structures can be partially compromised by the unexpected cracking occurring a short time after casting. As a matter of fact, past negative experiences and investigations demonstrated that, in a wide range of constructions, severe cracks can develop due to hygrothermal phenomena of concrete, such as shrinkage and thermal variations. In these cases, a thorough design of the structure and the construction phases is required in order to achieve a satisfactory long-term performance.

During concrete hardening, cement hydration produces heat that causes the temperature rise. Because of the lower temperature of surroundings, thermal gradients and, as a consequence, tensile stresses develop. Tensile stresses, combined to the low strength of concrete at early ages, could induce cracking. Concrete walls are particularly exposed to the risk of early-age cracking due to both their large size and low thickness.

A numerical study on the risk of early-age thermal cracking in thin concrete walls is presented in this paper. The main scope of the study is to determine the solutions that can be adopted in practice to minimize the risk of cracking. To this purpose, coupled flow-stress analyses are performed. Nonlinear heat transfer analyses aimed at studying the hardening process and thus determining the development of temperatures with time are carried out. These results are adopted as input data for structural analysis. The dependency of concrete both thermophysical and mechanical properties on the hardening state and temperatures is taken into account. The influence of different parameters such as the mix-composition, the type of formworks and the construction phases is evaluated. In order to model the different construction phases and keep, at the same time, the continuity of the global behaviour, phased analyses are performed.