Strength and durability of concrete subjected to various heating and cooling treatments

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Previous experimental studies on concrete under high temperatures have mainly concentrated on strength reduction of the concrete. Various experimental parameters have been examined such as maximum temperature, heating rate, types of gravels used, various binding materials and loading times (before, during and after the high temperature testing). There is very little research on durability properties of concrete after fire damage, even though the loss of durability of concrete can severely reduce the remaining service life of the structure. Poon et al. conducted an experimental study on the strength and durability performance of normal and high strength concrete, the main testing variables of their experimental study were not heating and cooling regimes but mix proportions of cement replacement materials [1].

The purpose of this study is to investigate the strength and durability performance of concrete subjected to various temperature scenarios. The test variables are heating rates (2 and 15˚C/min), holding times (2 and 4hrs), target temperatures and cooling regimes, which are slow cooling (1 ˚C/min), natural cooling inside the furnace, and water cooling. Thermal diffusivity, which is one of the fundamental thermal properties of concrete, is evaluated with a 4×8 cylinder. The unstressed residual compressive strength test and ultrasonic pulse velocity test (UPV) are performed to investigate the strength and stiffness properties of the concretes subjected to the temperature scenarios. The durability of the concrete is investigated by a rapid chloride permeability test (RCPT) and water permeability test (WPT). Additionally, the weight losses, color changes, and cracks of the specimens are also investigated.

References

[1] Poon, C.S., Azhar, S., Anson, M., and Wong, Y.L., “Comparison of the strength and durability performance of normal- and high-strength pozzolanic concretes at elevated temperatures”, Cement and Concrete Research, 31, 1219-1300, 2001.

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