Abstract

INFLUENCE OF SUSTAINED STRESS AND HEATING CONDITIONS ON THE OCCURRENCE OF FIRE-INDUCED CONCRETE SPALLING

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Experimental research of propensity to spalling of concrete samples under compressive load and radiant heating was conducted. The samples with dimensions 300×300×220 mm were cast in two groups: one group of samples included 1.6 kg/m^3 of polypropylene fibres in the mix and the other one did not. The samples were simultaneously exposed to two types of external actions: radiant heating and sustained mechanical compressive loading. The influence of different heating regimes involving parametric temperature-time curves described in Eurocode, the level of sustained mechanical compressive loading and the inclusion of polypropylene fibres in the concrete mix on the propensity of concrete samples to spalling were studied in the research.

Heating regimes were varied by changing the opening factor in the procedure defined by Eurocode from $O = 0.0415\ m^{1/2}$ up to the maximum allowed value of $O = 0.2\ m^{1/2}$.

Levels of sustained mechanical loading were varied from 19% to 53% of the ultimate compressive strain of concrete. The level of loading was controlled by the glued strain gauges on the exposed to heat faces of concrete samples.

The analysis of experimental results showed that sustained mechanical compressive loading enhances the propensity of concrete samples to spalling at the same heating regimes. The increased rate of heating changes not only the type of spalling from one-time to progressive, but also requires less energy for a spalling event to occur. As a result of the analysis, a diagram which summarizes the conditions of heating rates and loading levels was created.

Apart from that, the inclusion of 1.6 kg/m^3 of polypropylene fibres in the mix was proved to be an effective measure in the mitigation of propensity of concrete samples to heat-induced spalling.