Effect of Extinguishing Method on the Behavior of RC Columns Subjected to Fire

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Abstract

Concrete is more durable against fire than other structural materials. However, high temperature has deteriorating effects on mechanical properties of concrete. Decreases of strength at higher temperatures can be associated with various reasons, such as micro-and macro-cracks on the concrete, the volume expansion in the aggregate, and the deterioration of the calcium silicate hydrate (C-S-H) gels in the cement paste.

The main objective of this research work is to study the effect of four different cooling schemes on the ultimate strength of 54 reinforced concrete columns subjected to fire. The tested columns are of different surface area to volume ratios (with three different cross sections; circular, square and rectangular). Four cooling schemes were used; three of them are uniform cooling schemes with different rates (rapid, slow and intermediate) while the fourth cooling scheme was non-uniform. Two different fire temperatures and durations were considered (300°C for 3 Hours & 600°C for 6 Hours). Non Destructive tests (Core & Ultrasonic Pulse Velocity tests) were used to estimate the deterioration extent of fire on concrete properties. A mathematical model was developed to estimate the ultimate strength of RC columns subjected to fire in order to decide if the R.C. columns need repair and strengthening after fire or not. Results of the model and the obtained experimental results were compared together to evaluate the accuracy of the proposed model.

Key words: Concrete; RC Columns; Ultimate Strength; High Temperature; Fire Duration; Cooling Scheme; Surface area to volume ratio.

Ain-shams university - 2018, September