Three Dimensional Simulation of Concrete Material Enriched with PP Fibres Under Fire Conditions

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ABSTRACT

The inclusion of polypropylene fibres (PP) in concrete material to prevent spalling at elevated temperatures is largely recognized [1] as an adequate measure and many experimental observations confirm the presence of these filaments is a possible solution to avoid catastrophic structural collapse during fire events [2].

Many factors have been identified as influencing spalling process [3] but the two main mechanisms are: i) heating rate and ii) pore pressures increment. PP fibres, vaporizing at given temperatures, increase connected void channels of the cement matrix with consequent porosity increment in concrete, reducing internal pressure.

In this work the complex mechanisms involving PP fibres in concrete have been evaluated through a three-dimensional numerical representation at a macro and meso scales using a thermo-hygro-mechanical formulation. The variation of hygral diffusivity for different percentages of PP fibres in temperature has been evaluated via a mechanistic formulation [4] taking into account the micro thermal cracks occurring after channels formation [5].

Numerical results have been calibrated and validated against experimental data.

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