NUMERICAL APPROACH TO THE EFFECT OF FIRE EXTINCTION PROCESSES ON THE SPALLING RISK AND RESIDUAL PROPERTIES OF HIGH STRENGTH CONRETES

Tai Ikumi Montserrat, Angel Guerrero

Polithecnic Universtiy of Catalonia, Materials Resistance and Structures in Engineering Department, Spain

The major aim of the presentation is settled in the domain of the analysis of the effect of a spectrum of cooling processes on the hygro-thermo-chemo-mechanical state of a structural element, manufactured with High-Strength concrete, during the development of a natural fire –more precisely, in its computational approach with the aid of HITECOSP software– with the particular objective of:

- Analyzing both phenomenologically and from a mechanistic point of view the effect of a spectrum of cooling processes on the hygro-thermo-chemo-mechanical state of a structural element, manufactured with High-Strength concrete, during the development of a natural fire.

To do so, although there are developed more than forty five hygro-thermo-chemo-mechanical analyses resulting from combinations of the parameters' values initially considered, two reference cases are selected where the extinguishing actions conditions are varied in order to cover the widest possible range of situations found by Fire-Fighting Services during a natural fire extinguishment: the type of cooling – either cooling the gases in the enclosure or the structural element's surface – and the cooling start instant and its rate.

This settling of objectives also includes the development of more than twenty Computational Fluid Dynamics simulations by means of Fire Dynamics Simulator software (FDS) in order to work out the evolution of temperature at surfaces during several extinguishing actions.

To conclude, the development of a heuristic analysis of the effect of cooling processes on the hygro-thermo-chemo-mechanical state of a square column, manufactured with High-Strength concrete, during the development of a natural fire in a High-Rise Building, is also included, being understood as an introductory extension of the abovementioned analyses to cases with bi-dimensional fluxes such as square columns, where Corner Thermal Spalling is often the most dangerous type.