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PII: S0263-8223(17)32928-8
DOI: https://doi.org/10.1016/j.compstruct.2017.12.051
Reference: COST 9208

To appear in: *Composite Structures*

Received Date: 10 September 2017
Revised Date: 28 November 2017
Accepted Date: 20 December 2017

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Abstract

A numerical model for evaluating the performance of fiber-reinforced polymer (FRP) strengthened reinforced concrete (RC) slabs under fire conditions is presented. The numerical model utilizes a macroscopic finite element based approach to trace thermo-mechanical response of FRP-strengthened RC slabs from linear elastic stage to collapse under fire conditions. The model accounts for temperature dependent properties of concrete, steel, FRP, and fire insulation as well as for temperature induced degradation of bond between concrete and FRP. The model is validated by comparing predicted response of FRP strengthened RC slabs with measured temperatures and deflections in fire tests. A case study is also presented to compare fire performance of RC slabs with and without FRP strengthening, as well as with different insulation and bond configurations. Results from the analysis indicate that a FRP strengthened RC slab, without any fire insulation, yields lower fire resistance as compared to conventional RC slab. Also, temperature induced bond degradation significantly influences fire performance of an FRP strengthened RC slab and neglecting bond degradation may lead to un-conservative estimation of fire resistance.

Keywords: Fiber reinforced polymers (FRP), Fire resistance, FRP strengthened slab, Numerical model, Reinforced concrete (RC) slab

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