Fire behaviour of reinforced concrete structures strengthened with advanced Carbon Fibre Reinforced Polymer (CFRP) systems

Summary

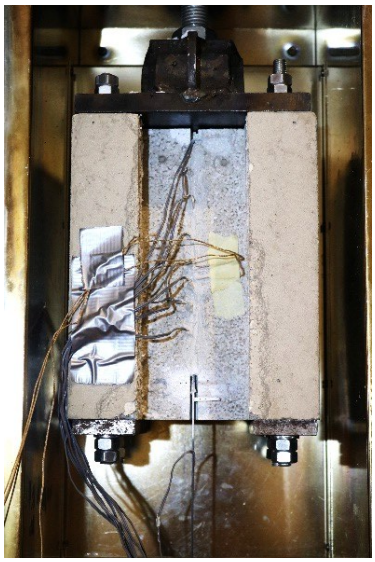
This thesis focuses on the effects of elevated temperature and fire exposure on the performance of advanced FRP strengthening systems. The first part of the study comprised experimental and numerical investigations about the bond behaviour of CFRP/steel-concrete at elevated temperatures. Bond tests were performed at elevated temperatures on near-surface mounted (NSM) and ETS systems. These tests confirmed the susceptibility of both techniques to elevated temperatures and provided in-depth knowledge about their temperature-dependent behaviour.

The second part of the study comprised experimental and numerical investigations on the fire behaviour of RC members strengthened in flexure with advanced CFRP systems, assessing the influence of (i) the strengthening technique (EBR vs. NSM vs. CREatE), (ii) the prestress level on the NSM system, and (iii) the fire protection geometry. The results highlighted the improved performance of NSM and CREatE systems compared to EBR, and showed that the fire resistance decreases with the prestress level and increases with the insulation of the anchorages.

The third part of the thesis assessed the fire behaviour of RC beams strengthened in shear according to the ETS technique. In the fire tests, without fire protection, the ETS systems lost their structural effectiveness after between 12 and 48 min of fire exposure, depending on the type of strengthening bar, CFRP and steel, respectively. Numerical simulations showed that, using U–shaped fire protection, it is possible to attain up to 140 min of fire resistance.

Keywords

Carbon fibre reinforced polymers (CFRP), fire behaviour, near surface mounted (NSM) CFRP strips, CFRP bars embedded through the section (ETS), experimental tests, numerical models, fire design recommendations.



CFRP-concrete bond test at elevated temperature.

Fire resistance test setup.

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