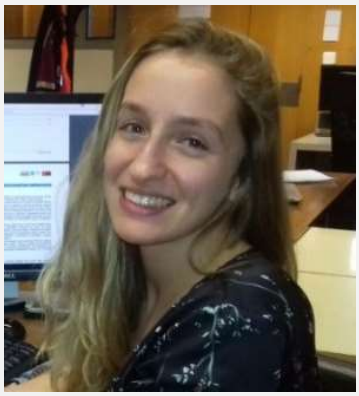
CERIS Civil Engineering Research and Innovation for Sustainability

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



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Summary

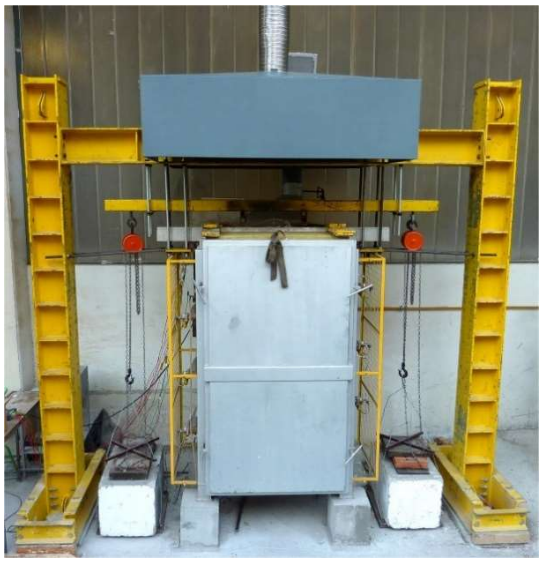
This thesis is focused on the fire behaviour of reinforced concrete (RC) structural elements strengthened with advanced carbon-fibre-reinforced-polymer (CFRP) systems and on the development of appropriate fire protection solutions. In this study the following advanced CFRP systems will be considered: (i) flexural strengthening with near surface mounted (NSM) CFRP strips, either prestressed or bent in the ends (conferring improved anchorage and thermal protection); and (ii) shear strengthening with CFRP bars embedded through the section (ETS). For both strengthening systems the effectiveness of using cement-based adhesives, less susceptible to thermal degradation than the more conventional epoxy ones, and different fire protection schemes will be evaluated. The research to be developed, includes an experimental programme with the following main tasks: (i) material characterization tests on the constituent materials; (ii) CFRP-concrete bond tests at elevated temperatures; (iii) fire resistance tests on loaded RC slabs flexurally strengthened with advanced-CFRP systems comprising different fire protection schemes; and (iv) fire resistance tests on loaded RC beams shear strengthened with CFRP rods applied according to the ETS technique.

The experimental campaign will be complemented with a numerical study to be developed using commercial finite element (FE) software; the temperature-dependent constitutive relations of all materials and interfaces determined from the experiments will be implemented in the FE models. After validation with experimental data, the models will be used to obtain a further understanding of the experimental results, to optimize the fire protection schemes and to provide fire design recommendations.

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.