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Structural fire behaviour: a necessary component of structural optimization

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PERFORMANCE ENHANCEMENT OF STRUCTURES THROUGH THE USE OF FIBRE-REINFORCED POLYMER (FRP) COMPOSITES

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ABSTRACT

Due to their various advantages including excellent corrosion resistance and high strength-to-weight ratios, fibre-reinforced polymer (FRP) composites have been widely used as bonded external reinforcement to enhance the performance of concrete, masonry, metallic and timber structures. In addition, FRP composites have attracted increasing attention for use in the construction of high-performance new structures. In particular, the combined use of FRP composites with one or more traditional materials to create hybrid structural systems is a promising direction for new structures in coastal/marine and other severe environments. This presentation will provide a summary of recent research advances in both areas at The Hong Kong Polytechnic University (PolyU).

In the area of strengthening and retrofit of reinforced concrete (RC) structures with externally bonded FRP reinforcement, the following topics will first be covered: (1) suppression of debonding failures; (2) fire resistance and reliability-based design; (3) computational models for FRP-confined concrete and FRP-confined RC columns; (6) Seismic retrofit. Some fundamental issues in the strengthening of steel members with externally-bonded carbon FRP plates/sheets are then discussed. Finally, strengthening of RC beams with near-surface mounted carbon FRP (CFRP) strips, a more recent alternative technique to externally bonded FRP reinforcement, is examined.

In the area of new construction, this presentation will be focused on structural members based on concrete-filled FRP confining tubes manufactured using the filament winding process. These FRP tubes have fibres oriented close to the hoop direction, so their main functions are to confine the concrete, enhance the shear resistance, protect the column against corrosion, and serve as the stay-in-place formwork. Particular attention will be paid to hybrid FRP-concrete-steel double-skin tubular columns (DSTCs) which consist of a layer of concrete sandwiched between an outer FRP tube and an inner steel tube.

The presentation will conclude with an outline of some future opportunities and challenges in the structural use of FRP composites in construction. For example, the use of FRP reinforcement in new structures made of sea-sand seawater concrete should be an interesting area to explore.

KEYWORDS

FRP composites, strengthening, debonding, confinement, new construction, hybrid structures.



