

## Development, testing and construction of the hybrid FRP composite – concrete road bridge

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### Abstract

Fibre reinforced polymer (FRP) composites have become an integral part of the construction industry because of their versatility, high strength-to-weight ratio, enhanced durability, resistance to fatigue and corrosion, accelerated construction and lower maintenance and life-cycle costs. However, all-composite structural bridge systems have specific shortcomings such as high initial costs, low stiffness and the existence of brittle failure modes. To make the best use of materials and to overcome the above shortcomings, combinations of FRP and conventional materials have recently been investigated. The innovative hybrid idea of a “FRP composite – concrete” structural system for bridges is proposed. The objective of this paper is the description of the new bridge system itself and the presentation of research results related to its development, as well as a demonstrative bridge construction.

**Keywords:** FRP composites; bridge; hybrid structure; FEM analysis; testing; construction.

### 1 Introduction

The heavy traffic on major roads and the ageing of the highway infrastructure have led to an increasing demand for new technologies in bridge engineering. Due to their corrosion resistance, high strength and low self-weight, fibre-reinforced polymers (FRP's) offer promising options. FRP composites have become an integral part of the construction industry because of their versatility, high strength-to-weight ratio, enhanced durability, resistance to fatigue and corrosion, accelerated construction and lower maintenance and life-cycle costs. Advanced FRP composite materials are emerging for a wide range of civil

infrastructure applications. These include everything from bridge girders and decks, bridge repairs and strengthening, seismic retrofitting of marine waterfront structures, and sustainable energy-efficient housing.

First used in the 1950s for ships, FRP composites have undergone ongoing development to become highly valued in aerospace and military applications for their lightweight and high strength properties. Transport infrastructure applications began in the 1980s with research on the strengthening of bridges with carbon fibre-reinforced polymer (CFRP) and the construction of the first FRP road bridge in China. More recently, smaller pedestrian and road bridges, bridge decks