



arcoBridge – Low cost FRP Bridges for mainstream applications

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Abstract

Arup are developing arcoBridge, a new modular glass fibre reinforced polymer (GFRP) footbridge designed with a view to accessing the UK rail market. The bridge's unique modular and post-tensioned design has several advantages over existing steel, concrete and composite designs. Compared to Steel and Concrete, the lightweight bridges require smaller cranes and can be transported to sites with difficult access without costly haul roads. Arup's initial costs are lower than other GFRP options due to the smaller tooling, QA and workshop size requirements.

The bridge has been designed with a design-for-manufacture philosophy. Working in sympathy with the materials has led to a number of novel design features for a GFRP bridge. These include the incorporation of a post-tensioning system and a patented shear joint design. These features create a stress-state dominated by compression, thus simplifying the design process considerably.

In this paper an overview of the on-going design and testing work is presented, as Arup work towards delivering a 15m span prototype in September 2015. It includes a description of arcoBridge's novel design features and the laboratory testing that has been performed as validation to date. Further, the paper explains a novel technique, involving full scale factory testing of the first bridge built by each supplier to enable the GFRP structure to be supplied conforming to Eurocode reliability. This is possible even without a published code for this material.

Keywords: Composites, GFRP, Footbridges, Post-tensioning, Eurocode

List of symbols

α	First-order reliability method sensitivity coefficient
β	Reliability index
σ_d	Design value of the compressive failure strength of the laminate
V	Coefficient of variation of the failure strength, σ_d

1 Introduction

The UK rail market is currently undergoing a period of significant investment. The electrification of many local and intercity rail lines

means that many new and replacement bridges are required.

To date, the initial-costs of FRP structures has been perceived as too expensive for standard use.