

Tyre load fatigue verification of fibre-reinforced polymer bridges

Introduction

Fibre-reinforced polymer (FRP) bridge decks offer huge potential for lightweight, low-maintenance and low-carbon traffic bridges. Steel or concrete bridge decks are heavy and susceptible to corrosion, particularly from de-icing salts. FRP bridge decks are 20% - 40% the weight of concrete decks, which facilitates rapid construction and smaller foundations, and are also corrosion resistant, which ensures lower maintenance over a longer design life. While FRP decks have been used in several pilot projects worldwide over the last 30 years, their full potential for both new and replacement bridges has not yet been fully utilised.

New FRP design standards and fatigue testing

The at-scale adoption of FRP bridge decks will be facilitated by new design standards for FRP structures. The draft European standard prEN 19101 will be converted to a full structural Eurocode in 2028 and covers the design and execution of FRP bridges. This standard specifies fatigue testing of FRP decks to assess their resistance against local tyre load effects. Several previous FRP decking systems have suffered local damage as a result of such local tyre loading, which in those cases required costly rehabilitation schemes. Hence, it is crucial that the fatigue testing specified in the standard gives adequate assurance of the long-term FRP deck performance under traffic loads. However, currently there are major gaps including accurate definition of the tyre patch load, variable-amplitude loading, stress reversals and the influence of manufacturing variability.

Project aims

This project aims to address these gaps by conducting a comprehensive fatigue testing campaign on several FRP decking systems. The testing will be performed at University College London's state-of-the-art bridge fatigue testing facilities in East London. The testing approach will be underpinned by field monitoring data obtained from the West Mill FRP bridge in Oxfordshire, UK, which is Europe's oldest all-FRP traffic bridge. The field tests will record the local response of the FRP bridge deck to real traffic loading, via strain gauges installed at critical locations. The laboratory tests will subject sub-panels of different FRP decking systems to high-cycle fatigue loading, accurately reproducing the local effects of vehicle tyres.

Impact

The outcome of this project will be an updated local fatigue assessment methodology that can inform address the gaps in prEN19101 and give confidence in bridge designers and owners that FRP decking systems are adequately design against local fatigue. This will pave the way for the at-scale adoption of FRP bridge deck technology.