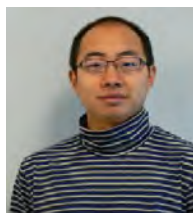




## Experimental Study on Mechanical Behaviour of FRP-to-steel Adhesively-bonded Joints after Hygrothermal Aging

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### Summary

The research presented in this paper is experimentally studying mechanical behaviours of the hygrothermal aged adhesively-bonded joint between FRP sandwich bridge decks and steel girders. Generally, there are three typical stress states in the adhesively-bonded joint: shear and tensile stress, and combinations of both. To realize these stress states in the adhesively-bonded joint, a specific loading device was developed to provide six different loading angles, which were 0° (tension), 18°, 36°, 54°, 72° and 90° (shear). Before experiments, adhesive joints were aged in a hot/wet environmental condition for four months. Subsequently, experiments were conducted under the six angle loading conditions. Failure modes of adhesive-bonded joints were investigated, which indicates that, for the shear loading, the failure mode is the cohesive failure in the adhesive layer. For the tensile and combined loading conditions, the failure mode is the combination of fibre breaking and FRP delamination. Depending on the failure loads of six angle loading conditions, a tensile/shear failure criterion of the hygrothermal aged adhesive-bonded joint was obtained.

**Keywords:** FRP deck; steel girder; composite bridge; adhesively-bonded joint; tensile and shear combined loading; hygrothermal aging.

### 1. Introduction

Fibre Reinforced Polymer (FRP) bridge decks are increasingly implemented in practice for rehabilitation of existing bridges and also for new bridge constructions, which is due to their remarkable advantages of FRP decks: lightweight of bridge superstructures, the ease of installation, minimum traffic disturbing, large tolerance for environmental corrosion, long service life time, as well as low maintenance cost. Current commercially available FRP decks can be classified into two categories according to the types of assembly and construction: sandwich panels and multi-cellular type panels [2], as shown in Figure 1.



(a) Sandwich (ECOSAFE) (b) Cellular (DuraSpan)  
Fig. 1: FRP bridge decks

To be cost-effective, FRP decks are commonly supported by longitudinal main girders made of either steel, prestressed concrete or FRP composites [3-5]. As shown in Figure 2, between FRP decks and steel girders, adhesive bonding technique is usually employed as a preferable connection method, since it can reduce

construction time, save weight by eliminating fasteners, introduce more uniform load transfer and provide better long-term performance. Unfortunately the technical background and researches on the adhesively-bonded joints between FRP bridge decks and longitudinal main girders have not