The Institution of Structural Engineers

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# 2012/13 Undergraduate Research Grant Scheme

**Project title:** Structural Interaction Between Wearing Surface and Cellular GFRP Bridge Decking

**University:** University of Bristol

**Supervisor:** Wendel Sebastian

**Student:** tba

**Aims of research:**
Uncertainties exist over the in-service performance of the surfacings laid onto cellular glass fibre reinforced polymer (GFRP) bridge decks. This is one important consideration which inhibits widespread use of these light, modular, corrosion-resistant decks. This project will address that concern by performing tests to elucidate the localised load responses of surfaced GFRP decks. Two aims will be good correlation between bi-axial strains recorded from the tests and FE-predicted strains for the specimens, and inference of the role of surfacing-to-deck interaction (bond) in the surfacing's load response. This understanding will help underpin recommendations aimed at maximising surfacing integrity on such decks.

**Description of method:**
The following three-pronged approach will be employed, namely :

1. Polymer concrete surfacing will be cast onto GFRP decking. Two different polymer concretes will be used, on alternate deck specimens. These surfaced deck specimens will be instrumented and tested to failure under code-specified tyre patch loading. A key focus will be the impact of defects in the surfacing-to-deck bond on the surfacing-deck system's load response. Such defects may arise from variable workmanship in practice. To that end, some specimens will be fabricated with the best possible surfacing-to-deck bond. In other specimens, bond defects will be introduced by laying greased polythene sheets on the deck before casting the surfacing. Defect lengths / locations, along with the locations of patch load application, will vary between specimens. Strain gauges will be used in both main directions on the surfacing and deck (including near but not at the surfacing-deck interface, to avoid further disturbance to bond), to quantify bi-axial response to failure local to the loads. GFRP-surfacing hybrid coupons will be fabricated and tested to establish relevant interfacial bond strengths and fracture energies. Individual material properties will be determined from separate coupon tests. Bristol undergraduates work in pairs on research projects, making for good progress with testing.

2. Nonlinear finite element (FE) models of the specimens will be developed using the measured material & interface properties.Test results (recorded bi-axial strains, observed failure modes) will be used to enhance / verify the FE models.

3. The verified FE modelling will be used to perform a parametric study whereby bond defect details and GFRP deck geometries beyond those tested as above are considered. Finally, the project's results will be formulated into a matrix that clearly illustrates the impact of load location and defect size / location on the failure behaviours of the surfacing-deck systems.

**Benefits to structural engineering:**
Project results will be translated into design and practical implementation (including bond testing) guidelines aimed at improving the in-service performance of surfacings on cellular GFRP decks. The insight into surfacing-to-deck interaction may be exploited by engineers to reduce (relative to the decks acting alone) the all-important stresses developed in the decks local to tyre loads, which will improve deck fatigue performance. Hence the project outputs can significantly enhance the cost-effectiveness of these light, modular, corrosion-resistant deck systems. A database of surfacing-to-GFRP bond parameters will be initiated using the test data, to provide a reference for future research on this topic.

**Proposed finish date:** May 13

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