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Lab and field studies into effectiveness of flat steel plate – Rubber pad systems as tyre substitutes for local loading of cellular GFRP bridge decking

W.M. Sebastian, M. Ralph, M. Poulton, J. Goacher



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1 Lab and Field Studies into Effectiveness of Flat Steel Plate – Rubber Pad Systems 2 as Tyre Substitutes for Local Loading of Cellular GFRP Bridge Decking

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4 W.M. Sebastian ^{1, a}, M. Ralph ¹, M. Poulton ¹, J. Goacher ¹

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6 ¹ *Department of Civil Engineering, University of Bristol, University Walk, Bristol BS8 1TR, UK*

7 8 9 **ABSTRACT**

10 The current preferred approach to assessing the local tyre load fatigue performance of cellular
11 FRP bridge decks entails cyclic loading of the decks using flat, rectangular steel plates faced with
12 rubber pads. Significantly, the plate-pad details are taken from standards developed for concrete
13 and steel decks. For this approach to succeed with FRP decking, the local load *distribution* on the
14 deck from the plate-pad system must mimic that from a tyre. To that end, this paper presents
15 contact pressure distributions (CPDs, recorded using an electronic mat pressure sensor) exerted
16 on a FRP deck at different loads by plate-pad systems in lab tests and by lorry tyres at different
17 inflation pressures in field tests. The field data reveal that as the tyre load increased, the tyre-
18 deck contact patch evolved from a circle to an ellipse and then to a square, causing the contact
19 load profile to morph from a triangle to a trapezium. This changing geometry of the tyre-deck
20 CPD led to distinctly nonlinear variations, with the tyre load, of the local surface strains recorded
21 from the deck. Empirical definitions of these tyre-deck load profiles are proposed, based partly
22 on use of the field data in FE analysis. Across the spectrum of realistic tyre loads and inflation
23 pressures investigated, the plate-pad systems deviated significantly (less so for cork pads than
24 rubber pads) from the tyre on the CPDs and on the local strain responses from the deck. In
25 closing, the paper identifies the need to also quantify fibre waviness, in a move towards fatigue
26 performance prediction for FRP decks.

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28 **KEYWORDS** : Tyre, bridge deck, FRP, field tests, fatigue, contact pressure, inflation pressure.

29 ^a Corresponding Author, Email Address : Wendel.Sebastian@bristol.ac.uk

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