FINITE ELEMENT MODELLING OF THE LOOPLINE BRIDGE AND MODEL VALIDATION USING GROUND-BASED RADAR INTERFEROMETRY

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ABSTRACT

The structural health monitoring of bridges is crucial around the world today, however current monitoring methods are inefficient and occasionally inaccurate. Ground-based radar interferometry is a recently developed, innovative technology that can precisely measure the deflection of structures under operational conditions. This research investigates the procedure of using ground-based radar interferometry to develop and validate a finite element model of the Loopline Bridge in Dublin, Ireland.

A detailed description of the bridge is outlined and a three-dimensional finite element model was developed using RFEM, a commercial software package. The modelling approach was first validated against known theoretical solutions. The bridge model was then verified with section property calculations, experimental studies in the literature and deflection tests. The dynamic deflection at midspan of the Loopline Bridge was measured for two train crossing events using ground-based radar interferometry. A single train crossing event showed the deflection of the loaded side of the span with respect to the unloaded side. Additionally, a dual train crossing event demonstrated the twist in the deck from the train loads travelling in opposite directions on separate sides of the bridge. The same loading conditions were simulated in the finite element model and the resulting deflections were extracted. A comparison between both sets of deflection data was carried out and their correlation validated that the model accurately captures the behaviour of the real Loopline Bridge structure for both train loading scenarios.

The practical application of this finding is that this procedure could potentially be used to establish a reliable and efficient platform for the structural health monitoring of bridges that can rapidly assess damaged structures. Additional structural measurements such as vibrations, and more accurately measured and modelled loading conditions, could be introduced to further fine-tune the model and obtain more precise research findings.