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Impact of Drainage Defect on the Railway Track Surface Deflections; A Numerical Investigation

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Abstract : The railwaytransportation network in the UK is over 100 years old and is known as one of the oldest mass transit systems in the world. This aged track network requires frequent closure for maintenance. One of the main reasons for closure is inadequate drainage due to the leakage in the buried drainage pipes. The leaking water can cause localised subgrade weakness, which subsequently can lead to major ground/substructure failure.Different condition assessment methods are available to assess the railway substructure. However, the existing condition assessment methods are not able to detect any local ground weakness/damageand provide details of the damage (e.g. size and location). To tackle this issue, a hybrid back-analysis technique based on artificial neural network (ANN) and genetic algorithm (GA) has been developed to predict the substructurelayers' moduli and identify any soil weaknesses. At first, afinite element (FE) model of a railway track section under Falling Weight Deflection (FWD) testing was developed and validated against field trial. Then a drainage pipe and various scenarios of the local defect/ soil weakness around the buried pipe with various geometriesand physical properties were modelled. The impact of the soil local weaknesson the track surface deflection wasalso studied. The FE simulations results were used to generate a database for ANN training, and then a GA wasemployed as an optimisation tool to optimise and back-calculate layers' moduli and soil weakness moduli (ANN's input). The hybrid ANN-GA back-analysis technique is a computationally efficient method with no dependency on seed modulus values. The modelcan estimate substructures' layer moduli and the presence of any localised foundation weakness.

Keywords : finite element (FE) model, drainage defect, falling weight deflectometer (FWD), hybrid ANN-GA
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