OC 22. Real Traffic-Informed Fatigue Assessment of Metallic Railway Bridges with Support from Digital Twin Technology

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Abstract

Ageing Metallic Railway Bridges (MRBs) remain in widespread use despite being exposed to traffic loads and adverse conditions, which are quite different to their original design assumptions, as well as materials that are now mostly no longer in use. While facing these challenges which put these structures vulnerable to degradation, they continue to serve an important role in delivering the significant socioeconomic benefits associated with railway infrastructure.To ensure their continued safe operation, it is critical to maintain their structural integrity and longevity by effectively managing important hazards to durability, particularly fatigue. Fatigue effects, in particular, can be controlled by more precisely characterising current traffic volume and its evolution, along with appropriate fatigue evaluation and monitoring strategies. Rather than depending solely on normative reference loads, this study introduces an approach attempting to enhance fatigue assessment and monitoring using a Bridge Digital Twin (BDT) demonstrator. The proposed BDT incorporates real traffic data derived from Weigh-in-Motion (WIM) system and enhanced by Machine Learning (ML) techniques for improved traffic characterisation and trend analysis. This study illustrates the value of applying real traffic data over standard fatigue load models in effectively characterising fatigue states of ageing MRBs. Furthermore, the BDT approach allows for a more dynamic and comprehensive fatigue assessment process, raising conventional standards of MRBs evaluation.

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