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PROBABILISTIC FATIGUE ASSESSMENT OF RIVETED RAILWAY BRIDGE CONNECTIONS USING STOCHASTIC FEA

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Summary: This study relies on a stochastic finite element approach for evaluating the fatigue behaviour of riveted steel connections, with a strong emphasis on a double-shear arrangement, typical of historical bridge details. Recognising the inherent variability in material features, geometry tolerances, and loading conditions, a probabilistic framework was put forward to account for these types of uncertainties in the finite element simulations. By incorporating random variables into the analysis, an S-N fatigue curve was generated for the double-shear riveted assembly, providing a more accurate picture of fatigue performance when compared with deterministic methods. The computational results are then compared to known experimental data on single and double-shear riveted connections and standardised design curves commonly used in design engineering practices. The results show that the proposed approach captures both mean trends and data dispersion more accurately, emphasising the relevance of uncertainty evaluation and quantification in performing combined assessments. Furthermore, the results show how the stochastic finite element method can help redefine design suggestions and maintenance plans for fatigue-prone structural components. Hence, this work provides an opportunity for understanding riveted connection performance, emphasising the importance of including probabilistic evaluations into fatigue studies to assure the safety and durability of existing railway infrastructure systems.