

This study examines the design parameters of high-speed railway bridges, focusing on critical locations like canals and road/railway crossings. It addresses concerns regarding structural safety and stability, especially for bridges with simple support, at elevated speeds. The analysis includes one-way and two-way loading scenarios under simply supported and elastically-supported conditions, using Euler-Bernoulli beam models. A non-dimensional framework facilitates systematic analysis of resonance and cancellation phenomena, reducing computation time. Surrogate models, employing neural networks, are developed to streamline computational efforts. Vibration absorbers, including resonators, inertial amplifiers, and negative-stiffness inertial amplifiers, are explored, with optimization conducted via genetic algorithms. Comparative studies reveal the effectiveness of inertial amplifiers in reducing vibration amplitudes, while negative-stiffness-based absorbers outperform inertial ones. Special attention is warranted in designing bridges to mitigate resonance and cancellation speeds associated with specific train load configurations, with optimization of vibration absorber parameters offering potential solutions to minimize induced vibrations.