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Finite Element (FE) Modeling of Tilton-Belmont Railroad Bridge in New Hampshire Under Typical Train Loading

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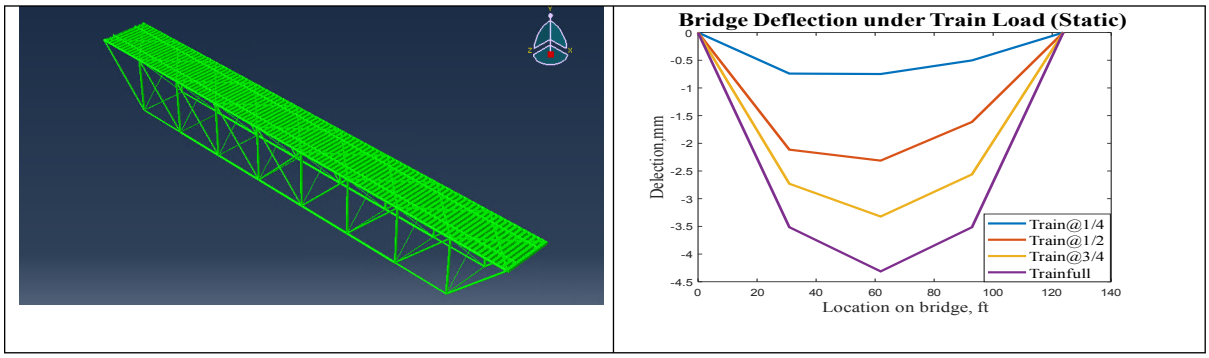
Abstract

Historic U.S. railroad bridges, dating back to the late 19th and early 20th centuries, are integral to the transportation infrastructure. To ensure their continued safe operation, the implementation of effective Structural Health Monitoring (SHM) techniques is imperative. This study focuses on the Tilton-Belmont Railroad Bridge, a noteworthy 1893 steel bridge in New Hampshire, chosen as a representative case study due to its historical significance and structural complexity. This single-span bridge accommodates both passenger and freight trains. The study's objectives encompass creating a finite element model of the Tilton-Belmont Bridge, conducting modal analyses to identify natural frequencies and mode shapes, and evaluating the bridge's response to freight train loading. The 3D finite element model was developed and utilized for modal analyses. Additionally, static analyses were performed, assessing vertical displacements under the influence of a standard 4-axle freight train configuration specified by the New Hampshire Department of Transportation. Preliminary findings reveal that the finite element model provides valuable insights into the bridge's structural behavior. Modal analyses unveil natural frequencies and mode shapes, while static analyses offer a comprehensive understanding of the bridge's response to freight train loading. Ongoing research aims to refine the model further. The first lateral, vertical, and twisting modes occur at natural frequencies of 1 Hz, 1.2 Hz, and 2 Hz, respectively. Similarly, the maximum static vertical displacement of 4.32 mm occurs at the bridge's midpoint when fully covered by a freight train.

This study significantly contributes to the preservation and assessment of historic railroad bridges, providing insights into their structural health through advanced analytical techniques. These findings are essential for maintaining these vital transportation assets, ensuring their continued safe and sustainable operation into the future.



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