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Diagnostics and Explanation of the Current Status of the 40- Year Railway Viaduct

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Abstract : Besides designing new constructions, engineers all over the world must face another problem – maintenance, repairs, and assessment of the technical condition of existing bridges. To solve more complex issues, it is necessary to be familiar with the theory of finite element method and to have access to the software that provides sufficient tools which to enable create of sometimes significantly advanced numerical models. The paper includes a brief assessment of the technical condition, a description of the in situ non-destructive testing carried out and the FEM models created for global and local analysis. In situ testing was performed using strain gauges and displacement sensors. Numerical models were created using various software and numerical modeling techniques. Particularly noteworthy is the method of modeling riveted joints of the crossbeam of the viaduct. It is a simplified method that consists of the use of only basic numerical tools such as beam and shell finite elements, constraints, and simplified boundary conditions (fixed support and symmetry). The results of the numerical analyses were presented and discussed. It is clearly explained why the structure did not fail, despite the fact that the weld of the deck plate completely failed. A further research problem that was solved was to determine the cause of the rapid increase in values on the stress diagram in the cross-section of the transverse section. The problems were solved using the solely mentioned, simplified method of modeling riveted joints, which demonstrates that it is possible to solve such problems without access to sophisticated software that enables to performance of the advanced nonlinear analysis. Moreover, the obtained results are of great importance in the field of assessing the operation of bridge structures with an orthotropic plate.

Keywords : bridge, diagnostics, FEM simulations, failure, NDT, in situ testing
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