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Semi-Analytical Approaches to Vibrations Induced by Moving Loads with the focus on the critical velocity and instability of the moving system

given by

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With the evolution of the computational power, there is a tendency to overlook analytical and semi-analytical solutions, despite their inherent advantages. One should, however, be aware of the fact, that these solutions provide the necessary insight into the relevant physical phenomena that are accompanied by quick and highly precise results. With the help of dimensionless parameters one can understand general tendencies for a specific group of possible combination of real parameters, and, as the physical model usually requires substantial simplifications, this also means that the results obtained are reduced to essential ones that can be simply analysed.

The objective of this presentation is to fill the gap in available semi-analytical solutions related to wave propagation induced by moving loads, with practical applications of high-speed rails. Two important aspects will be dealt with: the critical velocity and the instability of the moving system. The structures that will be considered are composed of a beam and a supporting medium. The beam will be simplified in conformity with the Euler-Bernoulli theory. The supporting structure will be considered as two-parameter viscoelastic foundation that will gradually increase its complexity via finite depth viscoelastic continuum without shear resistance, with partial shear resistance up to the full two-dimensional plane strain model. The moving object will contemplate a moving force as well as a moving mass and one- or two-mass oscillators.

Solution methods are based on moving coordinates, Laplace and Fourier transforms, and methods of contour integration. New closed-form formulas are presented for the critical velocity and for the full beam deflection shapes respecting the influence of non-homogeneous initial conditions. Proximity of moving objects is also analysed. Presentation is based on the following publications and includes also new results, so far published only in conference proceedings.

The lecture will be held on Thursday, June 27, 2019 at 2:00 PM in the building of the Institute of Theoretical and Applied Mechanics, Prosecká 76, 190 00, Prague 9.

- Z. Dimitrovová, "Semi-analytical approaches to vibrations induced by moving loads with the focus on the critical velocity and instability of the moving system", Chapter 4 in Ground Vibration from High Speed Railways, V.V. Krylov (Ed), ICE Publishing, Thomas Telford Ltd. (in press)
- Z. Dimitrovová, "Semi-analytical solution for a problem of a uniformly moving oscillator on an infinite beam on a two-parameter visco-elastic foundation", Journal of Sound and Vibration (JSV), 438, pp. 257-290, 2019.
- Z. Dimitrovová, "Complete semi-analytical solution for a uniformly moving mass on a beam on a twoparameter visco-elastic foundation with non-homogeneous initial conditions", International Journal of Mechanical Sciences (IJMS), 144, pp. 283-311, 2018.
- Z. Dimitrovová, "Analysis of the critical velocity of a load moving on a beam supported by a finite depth foundation", International Journal of Solids and Structures (IJSS), 122–123, pp. 128-147, September 2017.
- Z. Dimitrovová, "New semi-analytical solution for a uniformly moving mass on a beam on a twoparameter visco-elastic foundation", International Journal of Mechanical Sciences (IJMS), 127, pp. 142–162, July 2017.
- Z. Dimitrovová, "Critical velocity of a uniformly moving load on a beam supported by a finite depth foundation", Journal of Sound and Vibration (JSV), 366, pp. 325–342, 2016.