Dynamic response of structures subjected to moving loads: Applications to high-speed railway lines

Dr. Zuzana Dimitrovová
Department of Civil Engineering
Universidade Nova de Lisboa, Portugal

Přednáška v rámci semináře katedry mechaniky ve středu 5. května 2010 od 12:45 hodin v B 366

Railway transportation is faster, safer, more comfortable and less pollutant, when compared with road traffic. Therefore the European railways are facing the challenge of tailoring the railway system for the 21st century in order to improve their competiveness with airway transport. This increases demands on creating new lines, on modernization of existing lines and on increasing the capacity of the whole railway network. As a consequence new issues related to the structural response of railway tracks subjected to moving vehicles are still arising. It is necessary to have an efficient computational tool giving quick response with sufficient accuracy to the arising questions. At this point it is necessary to evaluate the applicability of traditionally used simplified models which have a closed form solution. Simplified models have many advantages: (i) only the main results are available, so they are simple to analyze; (ii) the results preserve parameter dependence, allowing for direct sensitivity analysis; (iii) numerical evaluation can be carried out only in places of interest. Due to the simplifying assumptions, however, it must be stressed that the results obtained correspond only to an estimate of the structural response to a moving load. Therefore it is necessary to know to what extent these results can be utilized. This contribution is focusing on the train critical velocity.

Regarding simplified models, governing equations are obtained by Hamilton's principle. Shear distortion, rotary inertia and effect of axial force are accounted for. A visco-elastic foundation model is implemented. The linear elastic part is considered as continuous, discrete or piece-wise homogeneous. Material damping is introduced in the form of Rayleigh damping or by the damping ratio. The load is introduced as a time varying force moving at a constant velocity. Transversal vibrations induced by the load are solved by the normal-mode analysis. The solution is expressed in the form of an infinite sum of orthogonal natural modes multiplied by the generalized displacements. The natural frequencies are obtained numerically exploiting the concept of the global dynamic stiffness matrix. This ensures that the frequencies obtained are accurate. A general procedure for numerical implementation is presented and verified. Reflected waves at the extremities of the full beam are avoided by introduction of semi-infinite structural elements. The critical velocity in this study is defined as the velocity at which vertical displacements achieve very high values. It is obtained by extracting the maximum displacement while parametrically varying the load velocity.

*Přednáška **v češtině** se koná ve středu 5.5.2010 od 12:45 hodin v zasedací síni katedry (místnost B 366) v budově Stavební fakulty ČVUT v Praze, Thákurova 7, Dejvice. **Všichni zájemci jsou srdečně zváni.***

Podrobnější informace poskytne Prof. Milan Jirásek, tel. 224 354 481, Milan.Jirasek@fsv.cvut.cz .