Department of Civil Engineering and Engineering Mechanics
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Excitation Mechanisms and Mitigation Measures for Railway-Induced Ground Vibration

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Ground-borne noise and vibration due to railway traffic are important environmental issues. These vibrations are mostly due to dynamic train loads generated by wheel and rail unevenness, impact excitation due to rail joints and wheel flats, and parametric excitation due to sleeper periodicity. These loads are transferred to the track, its supporting structure (ballast, subgrade, slab or tunnel) and the soil, where vibrations propagate as elastic waves and excite the foundations of nearby buildings. In the frequency range between 1 and 80 Hz, building vibration is perceived as mechanical vibration of the human body, whereas between 16 and 250 Hz, ground-borne vibrations can cause re-radiated or structure-borne noise by vibrating walls and floors. Problems of ground-borne noise and vibration due to railway traffic have gained considerable attention recently due to increased need for public transport, development of high speed lines, the desired shift of freight transport by road to rail, and increased public sensitivity.

This presentation will focus on excitation mechanisms and mitigation measures for ground vibrations induced by railway traffic. The first part of the presentation will discuss the generation of ground and building vibration due to a train pass-by. In order to highlight the relevant physical phenomena, a distinction is made between ground and building response due to the static and dynamic train loads. It is shown how, in most cases, the static load component gives rise to evanescent waves, generally unimportant except in the near vicinity of the track, while the dynamic load component generates waves which propagate in the soil away from the track. The second part of the presentation will discuss mitigation measures for railway induced building vibration. A selection of commonly adopted mitigation measures will be considered, including measures at the source (floating slab track), on the transmission path (stiff wave barrier in the soil), and at the receiver (base isolation of a building). The presentation will conclude with a number of open points requiring further research.

Dr. Geert Lombaert (PhD K.U.Leuven, 2001) is Professor at the Structural Mechanics Section of the Department of Civil Engineering of K.U.Leuven (http://bwk.kuleuven.be/bwm/), where he teaches Strength of Materials, Structural Mechanics, Matrix Analysis of Structures, and Wave Propagation and Vibrations in the Built Environment. His research interests include environmental vibrations due to traffic and construction activities, structural health monitoring, dynamic force identification, inverse problems, uncertainty quantification, and shape and topology optimization. He has been involved in many national projects and projects of the EU 6th and 7th Framework Programme and is co-promoter of the Centre of Excellence on Optimization in Engineering at K.U.Leuven (OPTEC, www.kuleuven.be/optec/). The work presented in the seminar has been performed within the frame of the recently finalized EU FP7 project RIVAS (Railway Induced Vibration Abatement Solutions, January 2011 – December 2013) where he was leader of Work Package 4: “Vibration Mitigation Measures on the Transmission Path”.