Graduation Project

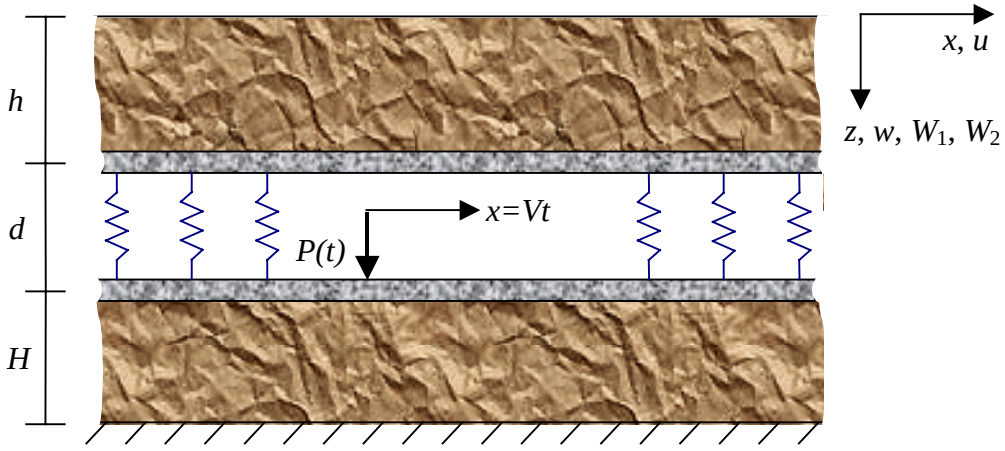
Vibration of a ground surface due to a train moving in a tunnel

The vibrations perturbed by a modern high-speed train can propagate in the ground and be perceptible at significant distances. As recently reported the level of these vibrations increases when a train runs at speeds close to the Rayleigh wave velocity in the track subsoil. In a soft (peat) subsoil this velocity is in the order of 200 km/h and can be simply exceeded by nowadays operated high-speed trains. Therefore, the research on soil vibration caused by a moving train is of indubitable practical importance.

Certain part of the train traffic takes place inside tunnels. In the past, building the railway tunnels was mostly motivated by an engineering necessity. Tunnels were built, for example, to pass trough a mountain, to arrange traffic under a river or to avoid a swampy soil. Nowadays, the tunnels are employed not only to satisfy purely engineering needs, but also to fulfil rapidly growing environmental requirements - they should provide the noise and the vibration level reduction.

One has to be aware, however, that moving in a tunnel, a high-speed train still may cause significant vibrations of the ground surface. How high is the level of these vibrations? How does it depend on the train speed? How wide is the vibration spectrum and whether it overlaps frequency ranges, unfavourable for the human being? These questions and many other ones should be carefully analysed by railroad engineers.

The objective of this project is to answer the above-formulated questions by employing a relatively simple two-dimensional model depicted in the Figure. The model consists of a visco-elastic layer, describing the ground and two elastically connected beams, representing the tunnel walls. The structure is perturbed by a moving load.



By carrying out the proposed project a student gets aquatinted with basic principles of elastodynamics, with possible ways of description of the dynamic soil-structure interaction and with creative ideas of the theory of wave excitation by a moving load.

In the sense of learning calculation tools, a student will be taught how to use MAPLE – an outstanding program for analytical calculations and how to write fast-calculating FORTRAN programs by using rapidly developing Visual Fortran package. All this comes together with a computer, software, a WWW connection and enthusiastic supervisor's support.

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