Graduation Project

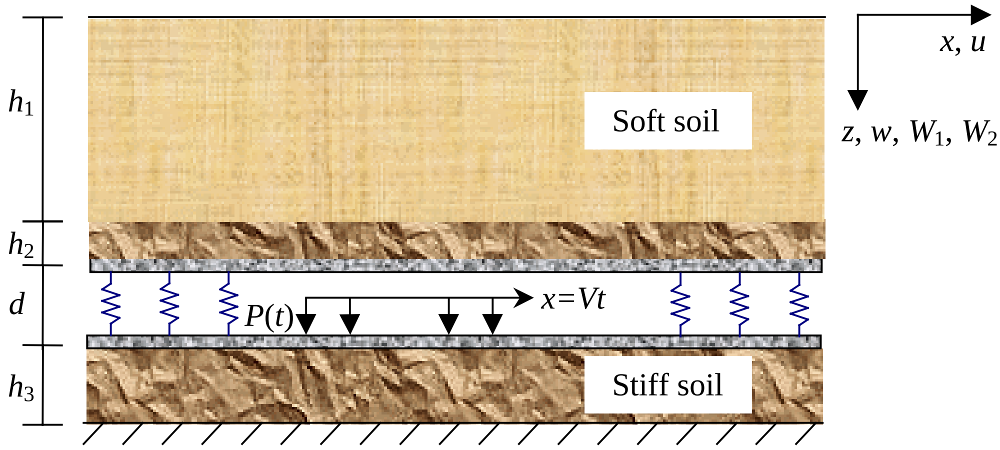
Response of a stratified soil to a high-speed train in a tunnel

To develop a successfully operating railway track for high-speed trains one has to solve a number of engineering problems. One of them is related to the soft soil that is widely spread over the Netherlands. The point is that the soil vibrations perturbed by a train when it moves over a soft soil are much more powerful than that arising in a stiff soil. Consequently, having built the track on a soft soil, one has to expect fast track deterioration, reduced comfort of passengers and a high level of vibration of buildings that are located aside the track.

There are a few ways that may help to overcome the “soft soil problem”. This project is concerned with one of these ways, namely with organisation of the train traffic in tunnels. Futuristically seen, this way is the most attractive, since having the traffic in a tunnel, we free the land from noisy, space consuming and often dirty tracks. Additionally, a solution of the “soft soil problem” comes almost automatically by building the tunnel below the soft soil layer.

Having the train traffic in the tunnels does not imply, however, that the buildings on the ground surface can not be disturbed by the traffic. One has to bear in mind that, even moving deep in the ground a high-speed train remains a powerful source of elastic waves and 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 aforementioned questions by employing a relatively simple two-dimensional model depicted in the Figure. The model consists of two visco-elastic layers and two elastically connected beams that representing the tunnel walls. The upper layer is chosen to be softer than the lower one, as it normally is in reality. The structure is perturbed by a set of moving loads that represent a high-speed train wagon.



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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