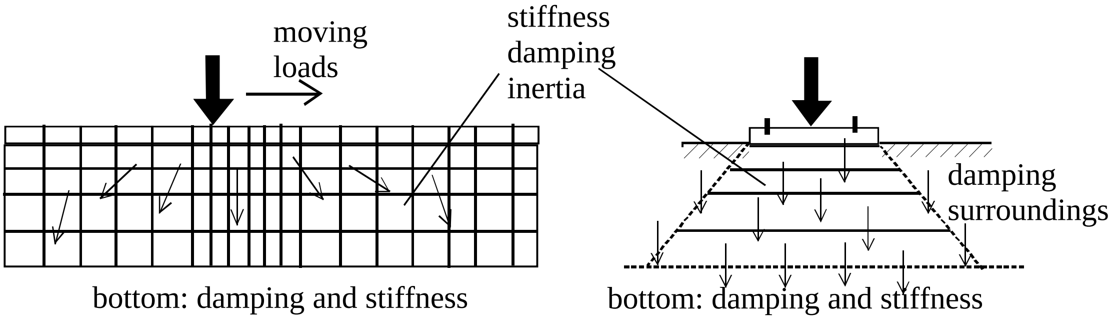
SPOOR

Dynamic **A**nalysis of **R**ail **T**rack **S**tructures

SPOOR: A 2-D state analysis of moving loads at a rail track on a layered half space

The analysis of structures subjected to fast moving loads is a subject of growing interest in railway and pavement engineering. The applications of transient analyses using finite element models, however, are still very limited. The faster a load moves the more elements we need to model the structure. Even at fast workstation and main frame computers a moderate accurate analysis requires days of computer time.
Many problems can be solved much more efficiently by application of a steady state analysis using a moving reference system. We will introduce an x-axis that travels together with the moving loads. Based upon this formulation we will develop finite element models which travel together with the moving loads.
Here we present a computer program, called SPOOR, that has been based upon these concepts. Such an analysis can be performed with the computer power and execution time necessary for the solution of a common static problem, thus at a normal PC. Especially in the design phase such an analysis is very attractive.

In SPOOR we model the moving load problem by a 2-D plane stress/strain model. with moving loads at the edge of the model . These loads move with a constant speed c along the x-axis. With respect to the y-axis (the depth) we take layers (and elements) with increasing thickness B. The top layer supports the rail, the bottom layer is either just a layer or a layer of springs and dashpots only.

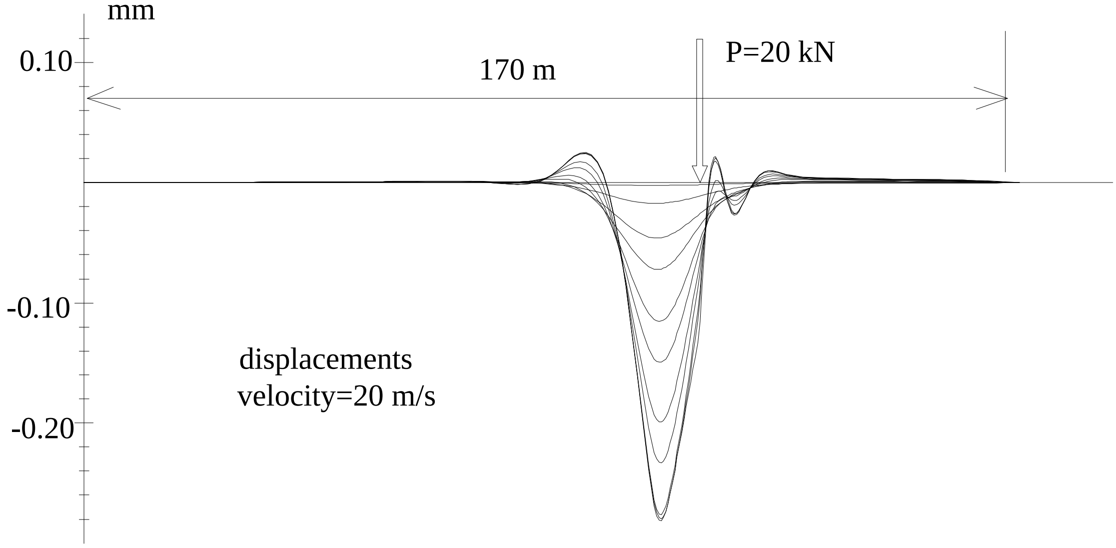


The analysis will be performed following the theory of linear elasticity; nonlinear properties are ignored. Because of the time dependent character of the problem we have to consider inertia properties and damping properties; the faster the train moves, the more important the dynamic properties are.

The structural components are a Timoshenko beam at the top of the half-plane (the rail) and a series of elastic layers. The thickness and the properties of the layers may vary with the depth. Energy dissipation is realized by damping properties of the layers and the surroundings.

The response to the moving loads is calculated by a steady state analysis. Finite element mesh and results are defined with respect to a moving reference system which travels together with the loads. Discretisation and analysis are carried out following the common procedures of the finite element method. techniques. The numerical integration procedure has been developed in such a way the both subsonic and supersonic speeds can be handled.

The postprocess capabilities are subdivided into print output, which lists upon request the results, and graphical output. The graphical output capabilities show rail forces, stresses and vertical displacements along the x-axis, and horizontal displacements and stresses about vertical cross sections.



Displacements under subsonic steady state load