Master's Dissertation at the Div. of Structural Mechanics

DYNAMICS OF HIGH-SPEED RAILROAD BRIDGES

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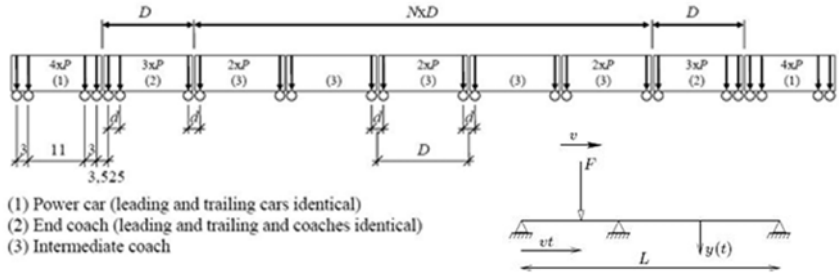

Background
The dynamic behavior of railway bridges is in most design codes traditionally analysed by following an approach of a so-called "single moving load" model which is a static load that, multiplied with a dynamic impact factor, represents the increase of a static load to a dynamic situation. This model does not take into account the possibility of resonance effects due to a periodic load, which may appear for train reaching speeds above 200 km/h. In 1995, due to several problems with high speed railway lines, in particular excessive high acceleration on bridges that could lead to ballast liquefaction, the European Rail Research Institute (ERRI), decided to establish a committee to study these phenomena. It resulted in new design codes for railways with train-speeds above 200 km/h, which included the necessity to take the effect from periodic load into account.
When calculating the dynamic effect of a railway bridge a general used method is "the travel point force technique". The method implies that by performing a discretisation of the structure, divide it into smaller parts, so called finite elements, an approximate model of the bridge is obtained. The trains are modelled as point forces moving over the bridge model. By solving the system of differential equations M*a +C*d + K*d = f at different time-steps, the bridge response is calculated.
Depending on the accuracy of the result the structure may be modelled in 1-,2- and 3-dimensions. A large advanced model normally produces a more precise result. Analysing large models of bridges is, however, time consuming and in an early stage of a project a simple model could significantly reduce the time needed to perform the analysis. To benefit from such a simplified model, it should provide sufficiently accurate results that have to be carefully interpreted.

Aim
The aim of the thesis is to develop a design tool for analysing the dynamic response of railway bridges subjected to high-speed trains. The design tool is intended to be used at an early stage in the design process to make estimation of the influence of various design variables