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# Dynamic Analysis of a Swivel-Joist-Expansion-Joint by Truck Crossing Simulations

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## 1 Abstract

In a current research project at the University of the German Armed Forces in Munich, we are investigating the dynamic behavior of a swivel-joist-expansion-joint. The special feature of this construction results from the entire polymer-based damping support, which is positioned as connecting element between lamellas and their supporting traverse. These pre-stressed elastomer-components create a certain clamping effect between the adjacent superimposed components. This special application is used for isolation and shock reduction. The elastomers are investigated by dynamic mechanical thermal analysis (DMTA). Associated master curves for the description of the time, frequency and temperature dependent material behavior in the form of a generalized Maxwell model with corresponding Time Temperature Superposition Principle were derived from the obtained results. The load-dependent linearization of the frequency response distribution can be integrated into a finite-element-model (FEM) as a practical modeling approach. This allowed the approximation of the viscoelastic and temperature-dependent damping behavior for common engineering FE software. Finally, the results of the FE simulation of a truck crossing the swivel beam expansion joint are presented and compared with the measured signal from actual truck crossing experiments.

**Keywords:** Viscoelasticity, Prony-Series, Finite-Element-Analysis, Swivel-Joist-Expansion-Joint, Fourier-Transformation

## 2 Introduction

In highway network, bridges are of particular significance. Hence, the realistic modeling of the traffic loads as well as the bridges and its components such as the expansion joints is vital for an economic but reliable design. This paper is concerned with the appropriate modelling of the swivel joist-expansion joint w.r.t. its components and especially the sufficiently correct assignment of the stiffness and damping coefficients of the parts of the swivel joist-expansion joint in order to reach a sustainable and cost efficient design. Hence a linearization for viscoelastic polymer materials is deduced in this paper and applied for the example for this expansion joint.

## 3 FE-Modeling of the Swivel-Joist-Expansion-Joint

This chapter comprises details on the finite element modelling structure, the definition of the

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