# **Examensarbete** vid Byggnadsmekanik

# FINITE ELEMENT MODELLING OF A RUBBER BLOCK EXPOSED TO SHOCK LOADING

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The assignment designates from the fact that there is no accurate method to model rubber dampers exposed of shock load. In this master thesis, different kinds of constitutive models for rubber will be investigated.

After a theoretical examination of the material models in LS-DYNA, material tests were performed at Trelleborg Automotive. Simple shear tests were performed, where both purely elastic and dynamic tests were considered, since these tests are suited for calibration of both the Yeoh model and the Arruda & Boyce model. These two visco- hyperelastic models were the only ones that were found useful for this application and the possible material tests.

Shock tests were performed in order to evaluate the shock simulations in LS-DYNA. The achieved frequencies cover the range from about 9 Hz to 17 Hz. The shock accelerations were used as input in the FE simulations. The achieved accelerations and displacements were compared with the experimental ones.

The results from the simulations correspond quite well to the experimental tests. Especially the Yeoh model gives remarkably good results despite many approximations in the adaptation of the model. The response of the Arruda & Boyce model did,

*Rubber damper*

however, not fit very well for the lowest mass, for the two highest the response were similar to the one for the Yeoh model. Unfortunately, the rubber material depends more on the strain amplitude than the strain frequency at these relatively low frequencies. The frequency dependency can almost be neglected in this frequency range. This is a problem since the models depend only on the frequency and not the amplitude. This results in large deviations at the shock phase where the amplitude are considerable higher, due to too high damping, while the free vibration phase is better. If the interesting part is the shock phase it might be more suitable to use a purely hyperelastic model, the disadvantages is a large error at the free vibration phase. The free vibration phase is however better simulated with the visco-hyperelastic model.