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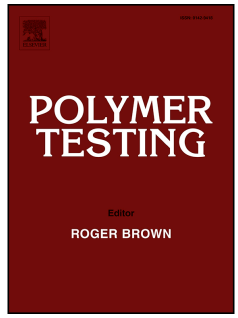

Impact simulation and experiment on rubber anti-vibration systems

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Impact simulation and experiment on rubber anti-vibration systems

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Abstract: There is very limited literature regarding impact analysis on solid rubber anti-vibration systems as the true damping characteristics of rubber materials are very complex and difficult to define. Viscoelastic approach is a usual method and has only achieved limited success. In this article, an integrated quasi-static and impact analysis with validation on an anti-vibration mount is presented. The Rayleigh damping has been introduced for rubber hysteresis. The impact responses from both simulation and experiment have been compared and have shown very good agreement in real time domain. In addition, it has been revealed that real geometry and elasticity of an impact object have to be included in simulation in order to obtain an accurate response. It has been shown that the proposed approach is reliable and can be used for an appropriate design stage to evaluate an impact/dynamic response of rubber anti-vibration systems. The key points to use this approach are also provided.

Keywords: Impact; rubber damping; rubber hysteresis; solid rubber model; dynamics

1. Introduction

Rubber springs are essential anti-vibration components for industrial applications. Rubber components are widely used in order to minimize vibration levers generated from dynamic environment. However, the real time-domain analysis for rubber structures under dynamic loading are not well covered, especially for solid rubber components. There are many papers dealing with quasi-static behaviour of rubber material using hyperelastic models.

Luo et al. [1-2] predicted the load-deflection response for anti-vibration components and subsequent lifespan of rubber components [3-5]. Pelc [6], Bolarinwa and Olatunbosun [7], and Ghoreishy [8] performed simulation on rubber tyres. Sharma [9] calculated responses on an anti-vibration rubber component using three hyperelastic models. It was found that the error for the stiffness varied about 3% to 40% between the test and the simulation and suggested to correct the errors based on the experiment data. Verron et al. [10] predicted the continuous volumetric change in rubber including the damage into a hyperelastic model based on the strain energy density. Lillbacka et al. [11] evaluated strain of rubber components using several hyperelastic models and indicated that most of models gave good prediction up to 100% strain.

For many dynamic analyses, real rubber components have been converted into simple individual elements in engineering applications. Magalini et al. [12] simplified rubber components as lumped springs and dashpot elements using concentrated parameters in a

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