Evaluation of Different Procedures for the Determination of Damping Properties in Metal Foams to Improve FEM Modeling of Filled Structures

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Abstract

In many applications, the use of aluminum foam as a filling material has the aim to improve the vibrational behavior of structural components. Structures (like machine tool) are generally designed by means of Finite Elements Modeling (FEM) of the whole machine (basement, ram, spindle, etc.) to obtain the best vibrational behavior for the selected application, the desired material savings, etc. To take the virtual model as a starting point for the design phase, the dynamic material properties (i.e. Young modulus, damping ratio, etc.) must be known.

While well known standards have been developed for the measurement of the Young Modulus of metal foams, the determination of damping properties for such materials lacks a commonly accepted procedure suitable for a direct application in FEM software. In such software there are several ways to take into account damping. The most commonly used are: structural damping, composite modal damping and Rayleigh damping. These coefficients have different significance so a proper selection is done.

The aim of this work is to review the available procedures suitable for the determination of damping parameters in literature and standards for porous and dense materials and to evaluate their applicability to metal foams.

Preliminary experimental setup and characterization data obtained with the selected procedures are presented and compared with representative FEM models. The experimental dynamic measurement on a test structure are compared with the simulated ones in order to validate the chosen procedure.