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S. Aguib, A. Nour, B. Benkoussas, I. Tawfiq, T. Djedid, N. Chikh

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S. Aguib[a,*], A. Nour[a], B. Benkoussas[b], I. Tawfiq[c], T. Djedid[a], N. Chikh[a]
[a] *Dynamic of Engines and Vibroacoustic Laboratory, F.S.I., M.B. Boumerdes University, Algeria*
[b] *Ecole Nationale Polytechnique, Departement de genie mecanique, 10 rue des freres Oudek, El Harrach, Alger*
[c] *Laboratoire QUARTZ(EA7393), Supmeca, 3 rue de Fernand Hainaut, 93407 Saint- Ouen Cedex, France*

Abstract

In this work the static behavior of magnetorheological elastomer (MRE) sandwich beams is studied in flexion with transverse shear. The beam is formed by two aluminum skins bonded to a core of elastomeric silicone oil and loaded with iron particles at 30%. The rigidity of the beam is given by the addition of a usual stiffness matrix of two aluminum skins and an MRE complex stiffness matrix. The latter is a function of the magnetorheological properties of the MRE. The results show the influence of MRE adaptive stiffness and the loss factor in the static behavior of the sandwich studied. The structure proposed can be directly applied to civil engineering, for example, building foundations, mechanical engineering and aircraft wings.

Keywords: sandwich beam, static behavior, complex rigidity, MRE.

1. Introduction

Magnetorheological elastomers (MRE) belong to a new group of functional materials called smart materials. The terms smart materials, intelligent materials, and the less frequently used adaptive materials, were introduced in the 1980s, when certain materials included in the group were already known. Until today there has been no accepted universal definition of smart material, nor does it appear in the encyclopedia devoted to these materials, published in 2002 [1, 2]. Interest in magnetorheological elastomers (MRE) has recently increased because of their potential for application in various smart systems. MREs are smart materials, similar to magnetorheological fluids (MRF), in which the fluid component is replaced by a cross-linked material like rubber or silicone. Shearing of MRE in the presence of a magnetic field displaces the particles from the position of a minimum energy state, which requires additional work that increases monotonically as the strength of the magnetic field increases. Therefore the shear modulus depends on the magnetic field and is a characteristic feature of MREs [3, 4]. Changes of the modulus in the magnetic field also depend on the content of ferromagnetic particles in the elastomer matrix.

During the last few decades, research work has focused on the study of mechanical structures made of magnetorheological elastomer (beams, plates and shells). Demchuk and Kusmin [5] experimentally