STABILITY OF A RECTANGULAR MAGNETOELASTIC BLOCK UNDER A TRANSVERSE MAGNETIC FIELD

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Magnetorheological elastomers (MRE's) are metal particle impregnated rubbers whose mechanical properties can be changed by the application of external magnetic fields. The recently discovered MRE materials are finding an increasing number of applications in aerospace, automotive, civil and electrical engineering fields as vibration damping devices, variable stiffness mounts and so on.

Of interest here is the stability of a rectangular block subjected to a uniform magnetic field in the direction of its minor (x) axis. The two y=const. faces of the block are frictionless and kept parallel to each other. This boundary value problem is motivated by the problem of a cantilever beam subjected to a transverse magnetic field. The solution is based on a novel variational approach recently proposed by the authors, for which the energy extremum corresponds to a local minimum.

The constitutive equation is based on experiments using a particular magnetorheological elastomer. The exact, finite strain continuum problem for the rectangular block is solved analytically. The corresponding results for beams are extracted asymptotically while the continuum analysis of the problem provides the critical thickness of the block above which no buckling is possible.