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NASA TECH BRIEF

Finite Element Formulation for Linear Thermoviscoelastic Materials

The finite difference equations in time and finite element matrix equations in space have been developed for general linear thermoviscoelastic problems and presented in a report.

There have been numerous applications of the finite element technique mainly to elastic and plastic static problems, and to some steady-state dynamic problems. However, the extension of this technique to viscoelastic problems without using the elastic-viscoelastic correspondence principle has been accomplished only in a few relatively simple cases. It has been concluded that the elastic-viscoelastic correspondence principle can be evoked for rather special cases, i.e., when the material properties are independent of thermal changes. Since the properties of most viscoelastic materials are highly temperature-sensitive, it is concluded that the development of a general program should be based on the solution of integral equations in real time rather than the correspondence principle.

A brief statement of the thermoviscoelastic field equations is followed by the development of the finite difference equations in time and then by the finite element formulation in space. The equations are derived for a general three-dimensional body but are applicable with minor changes to one-and two-dimensional configurations. Some attention is given to the experimental determination of material properties and their use in analytical work. An expansion of the experimentally or analytically determined material property functions in terms of exponential series leads to recurrence matrix equations, eliminating the problem of calculating at each time-step the history of material response.

Note:

The following documentation may be obtained from:

The Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference: TR 32-1381 (N69-31925)
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Linear Thermoviscoelastic Materials

Patent status:

No patent action is contemplated by NASA.

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