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NASA TECH BRIEF

Marshall Space Flight Center

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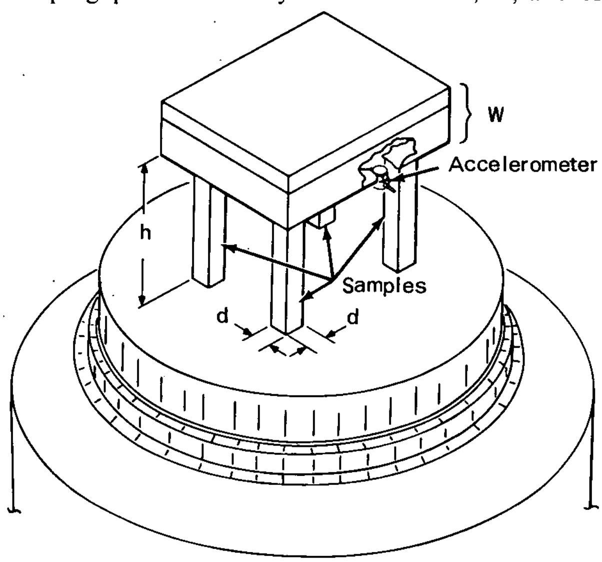
Experimental Determination of Damping Parameters of Viscoelastic Materials

The damping parameters of viscoelastic material can be characterized using easily constructed samples and readily available vibration test equipment. The damping parameters—dynamic modulus, E′, and loss modulus of elasticity, E″—are determined by a tuned-resonance method requiring the measurement of maximum transmissibility, T_m, and the frequency at T_m.



Test Rig on Vibration Exciter

Four identical square-sectioned columnar samples of the damping material are mounted on a vibration exciter with dental cement, and a support weight is cemented on top of them. The dimensions of the samples and the weight are selected such that the system is tuned to the desired resonant-frequency range for an estimated value of E′.

One accelerometer is cemented to the underside of the weight, and another is cemented to the vibration exciter in order to measure acceleration input. The input accelerometer is used to control the exciter, and an input of 0.3 km/sec^2 is maintained. A plot of the accelerometer's output response versus frequency is then obtained. The value of T_m is derived from the peak in the plot, according to the following:

$$T_m = g_r/g_i = g_r$$

where g_r is the acceleration response and g_i is the acceleration input.

The ratio of observed frequency (ω) at T_m to the undamped natural frequency (ω_n) of the system is determined from a graph, and the value of ω_n is calculated from the observed value of ω. The dynamic modulus of elasticity can then be calculated using the value of ω_n.

The loss tangent, tan ψ, is determined from a second graph, where ψ is the phase angle between E′ and E″. The complex modulus of elasticity, E*, is then calculated based on the following:

$$E^* = E' + jE''$$

where $E'' = E' \tan \psi$.

Note:

Requests for further information may be directed to:

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(continued overleaf)

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No patent action is contemplated by NASA.

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