tion for linear aging viscoelastic materials is derived. Finally, a numerical solution for the integral equation is outlined, along with a program listing for this. Although it is indirectly explained in several parts of the chapter, a clear definition of viscoelasticity could be included at the beginning.

The use of rheological models, namely Kelvin and Maxwell models, is introduced in chapter II. Equations for creep and relaxation using these models are derived, and the concepts of relaxation time and retardation time are introduced by good illustrations. The need to use generalized models (chain of Kelvin and Maxwell models) is explained; equations for a standard Kelvin model (three-parameter system) are derived. Conversion of integral equations to a set of uncoupled differential equations is shown. A nonlinear Kelvin model is introduced at the end of the chapter.

In chapter 3, the response of the "standard" model to different loading conditions is discussed rather extensively. The concepts of stable viscoelastic materials and fading memory of non-aging materials are explained in this chapter. Finally, approximate solutions using reduced (effective) modulus are derived and several examples are worked out to illustrate the use of different moduli.

Chapter 4 extends the unidimensional theory discussed in previous chapters to three dimensions. Analogy is drawn with equations of elastic materials when formulating the relations for viscoelastic materials.

The theory of viscoelasticity which has been described in the first four chapters is applied to concrete and concrete structures in chapters 5 and 6. Chapter 5 starts with a good explanation of physical mechanisms of creep and shrinkage in concrete. The essential facts and definitions of creep and recovery are illustrated well in section 2. Some mathematical forms for expressing creep and shrinkage are introduced; practical forms of these expressions which are used in structural analysis, such as the Dischinger model and Bazant-Parrula model, are described. Finally, a brief review of code expressions and nonlinear viscoelasticity of concrete is given.

Chapter 6 deals with structural analysis methods of viscoelastic beams. Homogeneous and nonhomogeneous materials are considered. The flexibility method is employed in analysis and several examples are worked out. Approximate solutions using the reduced modulus method are derived. The chapter ends with a detailed example of stress redistribution in a reinforced concrete column; different solution techniques, using standard model and practical prediction formulas, are illustrated well in this example.

Analysis of viscoelastic materials using the finite element method (FEM) is introduced in chapter 7. The chapter starts with an excellent introduction to FEM; the use of FEM to solve truss elements is illustrated by means of some well-chosen solutions. The need to use rate-type equations when dealing with viscoelastic structures in FEM is explained and the corresponding formulas in 3-D are derived. An incremental approach to solve viscoelastic problems is described. A listing of FEM programs to solve viscoelastic trusses is given at the end of the chapter.

The concepts of stability and buckling as applied to viscoelastic structures are discussed in chapter 8. Following the practice of previous chapters, theory is introduced for elastic structures and then extended to viscoelastic cases. The chapter ends with a look at buckling of nonlinear viscoelastic structures and a brief review of code formulas.

Several reference listings given at the end of each chapter provide interested readers with a good source for further reading.

Though the style of the text is pleasing to the reader, the numerous grammatical and spelling errors could have been minimized. It also seems that too much theory and too little application has been included. In chapter 6, one of the main areas where time-dependent deformations of concrete structures are considered, the example given is for bridges (segmental and cantilever construction); more examples concerning this concept could have been included. A good knowledge of computer programming may be useful for solving certain examples in the book.

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Aerogels
Edited by J. Fricke
(Proceedings in Physics, Vol. 6, Springer-Verlag, 1986)

Aerogels remained a scientific curiosity for many years after their discovery more than 50 years ago. Recent increased interest, however, prompted the first International Symposium on Aerogels at Wurzburg in September 1985. This book contains the papers presented at that conference. The introduction by the editor, J. Fricke, is followed by the papers which are divided into four sections. These cover Production and General Aspects (eight papers), Energy Conservation and Thermal Properties (eight papers), Structural Aspects (five papers), and Applications (three papers).

For those not familiar with aerogels, the extensive introduction, aptly titled "Aerogels—a Fascinating Class of High-Performance Porous Solids," provides an excellent initiation. It also serves as a general overview for the more specific papers that follow. This introduction covers the history of aerogels: their discovery by Kistler in 1932; their preparation by supercritical drying, initially after solvent exchange from aqueous systems, and more recently from sol-gel materials; their properties; and some current applications.

The papers in the Production and General Aspects section illustrate the versatility of the supercritical drying process in that a large variety of gels can be converted to aerogels. These include multicomponent oxide, oxide-metal mixtures, and glass compositions in addition to silica, which is the most common.

Demand for silica aerogels in particular is such that a commercial operation has been set up by Henning in Lund, Sweden, and this is described. This demand was initiated by their particular suitability as Cerenkov counters, because of low refractive index; but commercial availability is now a large incentive for evaluation in a number of other applications.

Recently, the thermal properties of aerogels have become important for insulation applications. The section on Energy Conservation and Thermal Properties contains papers describing investigations of radiant heat transfer, thermal conductivity, and solar transmission all tied to potential use as super insulators. This seems to be a promising application but little mention is made of the cost, and this no doubt will be the major factor in future development.

The studies described in the Structural Aspects section were carried out on silica samples only. Electron micrographs showed extremely small particle size which correlated with the surface area, pore size and volume, and pore size distribution measurements. The optical transmission of thin sections and some mechanical and acoustic properties are also described.

Finally, the papers in the Applications section describe some of the noninsulative applications. Perhaps the most versatile use is in the catalyst field where the high surface area and variety of aerogel materials is of particular significance. Both fixed bed reactors with multicomponent oxides and fluidized beds with metal-metal oxide materials have been investigated with impressive results. Another interesting use was that of silica as a thickening agent for rather potent reagents such as red fuming nitric acid rocket fuel in addition to more mundane materials such as gasoline.

This book is highly recommended both as an introduction to aerogel science for the general reader and as a state-of-the-art review for those more familiar with the field.

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