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Book Reviews

The Finite Element in Thermomechanics by Tai-Ran Hsu, Allen & Unwin, London, Sydney, 1986, p. xix–391, 60.00 Pounds.

REVIEWED BY J. H. LAU[1]

The finite element method is the principal means of solving boundary-value problems. Part of its advantage stems from its ability to take care of irregular boundary shapes, mixed material structures, and nonlinear problems. With the advance of computers and the rapid development of commercially available finite element codes, the finite element method has been employed with remarkable success in solving problems in virtually all areas of engineering and mathematical physics.

However, as with any popular method, many of the finite element analyses performed are not properly executed because of a limited understanding of the basic principles of the method and the fundamental equations of the boundary-value problem. This is especially true for nonlinear thermomechanical analyses. It is with this in mind that Professor Hsu has set out to write this book. In my opinion he has largely succeeded in his goal of bringing the subject matter closer to the uninitiated.

There are ten chapters of the book. Chapter 1 presents the fundamental principles of the finite element method. Chapter 2 is devoted to the derivation of the finite element formulation of heat conduction analysis.

Chapter 3 deals with the finite element formulation of thermoelastic-plastic analysis. Chapter 4 presents the derivation of the finite element algorithm for structures subject to creep. Chapter 5 deals with the elastic-plastic stress analysis with Fourier series for axisymmetric structures subjected to asymmetric loadings. Chapter 6 presents the finite element equations for stress wave propagation through structures, caused by dynamic loads such as impact or explosions. Chapter 7 presents specifically some of the unique techniques that could be used to predict the growth of cracks in structures under combined thermomechanical loads. Chapter 8 deals with the theory and the corresponding finite element formulation of finite strain plasticity. Chapter 9 presents the very important subject of coupled thermomechanics. The remaining chapter of the book, Chapter 10, is devoted to a description of the basic TEPSAC (Thermoelastic-plastic Stress Analysis with Creep) code and applications. Subject listing of the code is presented in Appendix 5. The user's guide for TEPSAC is given in Appendix 4.

TEPSAC is a two-dimensional plane stress/strain and three-dimensional axisymmetric code with very limited element types. Since the author's primary objective for constructing the code was to incorporate the thermoelastic-plastic-creep formulations into a finite element program, it has no automated mesh generation feature and its post processing of the results is virtually nonexisting. From an engineering applications point of view, TEPSAC is not as good as most of the commercially available nonlinear finite element codes. However, the strength of the book is the clear presentation of the fundamental equations of nonlinear thermomechanics and the adequate formulation of the corresponding finite element method. The book has a few topographical errors, but on the whole, it is a valuable addition to the literature. I recommend it to anyone who is interested in the applications of finite element method to thermomechanics problems. It is a useful reference book for engineers working in electronic packaging and interconnection.

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