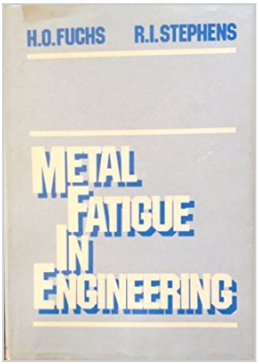

Metal Fatigue in Engineering

By H. O. Fuchs, R. I. Stephens

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Applied Optimal Design Mechanical and Structural Systems Edward J. Haug & Jasbir S. Arora This computer-aided design text presents and illustrates techniques for optimizing the design of a wide variety of mechanical and structural systems through the use of nonlinear programming and optimal control theory. A state space method is adopted that incorporates the system model as an integral part of the design formulations. Step-by-step numerical algorithms are given for each method of optimal design. Basic properties of the equations of mechanics are used to carry out design sensitivity analysis and optimization, with numerical efficiency and generality that is in most cases an order of magnitude faster in digital computation than applications using standard nonlinear programming methods. 1979 Optimum Design of Mechanical Elements, 2nd Ed. Ray C. Johnson The two basic optimization techniques, the method of optimal design (MOD) and automated optimal design (AOD), discussed in this valuable work can be applied to the optimal design of mechanical elements commonly found in machinery, mechanisms, mechanical assemblages, products, and structures. The many illustrative examples used to explicate these techniques include such topics as tensile bars, torsion bars, shafts in combined loading, helical and spur gears, helical springs, and hydrostatic journal bearings. The author covers curve fitting, equation simplification, material properties, and failure theories, as well as the effects of manufacturing errors on product performance and the need for a factor of safety in design work. 1980 Globally Optimal Design Douglass J. Wilde Here are new analytic optimization procedures effective where numerical methods either take too long or do not provide correct answers. This book uses mathematics sparingly, proving only results generated by examples. It defines simple design methods guaranteed to give the global, rather than any local, optimum through computations easy enough to be done on a manual calculator. The author confronts realistic situations: determining critical constraints; dealing with negative contributions; handling power function; tackling logarithmic and exponential nonlinearities; coping with standard sizes and indivisible components; and resolving conflicting objectives and logical restrictions. Special mathematical structures are exposed and used to solve design problems. 1978

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Editorial Review

From the Publisher
Presents methods proven successful in practice. Covers design procedures, such as safe-life, fail-safe, forecasting of service reliability, monitoring, and inspection; macroscopic and microscopic aspects of fatigue behavior; principles for determining fatigue crack growth and final fracture; scatter of data and statistical methods; environmental factors; and fatigue of joints and compounds. Contains design do's and don'ts and example problems.

From the Inside Flap
Drawing from the vast accumulation of research and design experience from 1860 to 1980, this book presents methods which have been proven successful in avoiding fatigue failure of metals. It achieves brevity by omitting interesting research results which have not yet led to practical applications. Data presented for many of the metals include not only traditional fatigue limits but also the more modern parameters derived from strain controlled tests and from crack propagation tests. Hard-to-find data information is provided on self (or residual) stresses produced by heat treating and shot peening, on crack propagation thresholds, and on the scatter found by investigators in their fatigue tests. The authors emphasize the importance of self-stresses and stress concentrations since these concepts provide a key to successful fatigue design. The methods for analysis and testing of products or components explained in this book range from the simplest to the most complex. They have all been used by practicing engineers. The advantages and disadvantages of the various methods are discussed so that engineers can make informed choices. "Dos and Don’ts in Design" follow most chapters. Example problems, in addition to more than 100 other problems and more than 300 references, enhance the book.

About the Author
About the authors H.O. FUCHS is Professor Emeritus of Mechanical Engineering at Stanford University. He received his education and early training in Germany and continued his career as a design and research engineer in the U.S. with General Motors and other companies. In 1945 he left GM to design suspensions and accessories for railway cars in Los Angeles and started a shot-peening business as a silent partner. In 1954 he joined the shot-peening business full time. Professor Fuchs has written many papers on fatigue design and is very active in the SAE Fatigue Design and Evaluation Committee, ASTM, ASME, and ASEE. He was honored by ASEE for innovations in teaching in 1974 and by ASME for design in 1980. R.I. STEPHENS is a Professor of Materials Engineering at The University of Iowa. He received a Ph.D. in Engineering Mechanics from the University of Wisconsin in 1965. His primary research interests and publications involve fatigue and fracture mechanics. Professor Stephens is a member of ASEE, ASTM Committee E-09 on fatigue, the ASTM Committee E-24 on fracture testing of metals and the SAE fatigue design and evaluation committee. He is coordinator of The Annual SAE-University of Iowa Fatigue Concepts in Design short course first offered with Professor Fuchs in 1970.

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