Books

FRACTURE AND FATIGUE IN WOOD, by L. Smith, E. Landis, and M. Gong 2003. John Wiley and Sons Chichester, England 229 pp. (ISBN 0-471-48708-2) Hardcover $130.

Fracture and Fatigue in Wood is divided into 9 chapters. In the Introduction, the authors make a clear case why fracture mechanics is a viable concept for wood. Physical and mechanical properties are discussed in Chapter 2. This chapter gives background to readers not deeply familiar with wood as a material and briefly addresses areas of wood science, ranging from the microstructure of wood to its physical and mechanical properties. The mechanical behavior of wood is discussed in Chapter 3. Elastic and inelastic behavior of wood and time-dependent properties at various scales are explained in a concise manner. This chapter is a good starting point for a deeper discussion of fracture mechanics. The principles of fracture mechanics are explained in Chapter 4. This chapter starts with the classical Griffith theory defined for elastic bodies and continues with the discussion of linear elastic fracture mechanics where basic concepts based on strain energy are introduced. This includes stress intensity factor, energy release rate, and fracture modes. The discussion continues with nonlinear fracture mechanics, J-Integrals, and a concept of continuum damage mechanics. All of the above concepts, which are described in a clear and concise way, deal with homogenous, isotropic elastic solids and fracture.

Failure phenomena in wood are addressed in Chapter 5. The authors make a case for removing the traditional distinction between small-clear specimens and full-size members when applying fracture mechanics to wood. Typical fracture modes applicable to wood are described, and the values of fracture toughness for several species are listed in the accompanying tables. Experiments that are used to determine values of fracture toughness for various fracture modes are presented, and their applicability to wood is discussed. Nonlinear fracture mechanics and experiments to measure the specific fracture energy are introduced and analyzed in the light of linear fracture mechanics.

Chapter 6, which deals with fatigue in wood, reviews major work and explains general concepts of fatigue and failure mechanisms. Particularly valuable is the discussion on various testing techniques and relations between wood structure and failure modes that are well demonstrated using microscopic images of failure surfaces.

Chapter 7 introduces the concepts of statistical fracture models starting with the discussion of the Weibull theory and continuing with nonlinear fracture mechanics modeling. Discrete models including finite element models and models that consider wood anatomy are compared with experimental data.

Empirical, phenomenological, and mechanics-based modeling of fatigue in wood is discussed in Chapter 8. Most of the models described are empirical in nature, reflecting the dominance of these models as compared to mechanics-based models that are more difficult to formulate.

The last chapter focuses on examples that include connections, slotted plates in tension, notched beams, and other wood-engineering problems. These examples are used to demonstrate the practical applicability of the concepts discussed in the book and represent a

Wood and Fiber Science, 37(2), 2005, pp. 367–368

strong point of the text. Those who are skeptical (including this reviewer) about the applicability of the fracture mechanics approach to wood design will read this chapter with great interest and will find evidence that fracture-mechanics approaches can be used for elegant solutions of design problems associated with stress concentrations.

The book is well organized and well written, contains extensive references at the end of each chapter, giving the reader ample opportunity to study particular problems of interest in greater depth. In my opinion, this book will become a classic text used by wood scientists and engineers for years to come.

Bo Kasal

Associate Professor
North Carolina State University
Raleigh, NC 27695