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## **The Journal of Adhesion**

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### **A review of: “Structural Adhesive Joints in Engineering, by Robert D. Adams and William C. Wake, Elsevier Applied Science Publishers, London and New York, 1984, 309 pp. \$64.75”**

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## Book Review

**STRUCTURAL ADHESIVE JOINTS IN ENGINEERING**, by Robert D. Adams and William C. Wake, Elsevier Applied Science Publishers, London and New York, 1984, 309 pp. \$64.75.

In the preface, the authors state "The intention of this book is that it should contain everything an engineer needs to know to be able to design and produce adhesively bonded joints which are required to carry significant loads." The authors have generally met this goal although they correctly point out many areas where additional research is required before all aspects of adhesive bonding are thoroughly understood. The chapters in this book include: nature and magnitude of stresses in adhesive joints, standard mechanical test procedures, general properties of polymeric adhesives, factors influencing the choice of adhesives, surface preparation, and service life.

The first chapter introduces the subject of adhesion and discusses the advantages and disadvantages of adhesive bonds. The major portion of Chapter 2 is devoted to describing the stresses in lap joints. It contains an excellent review of the classical approaches to stress analysis of lap joints as well as a summary of recent work using finite element computer analysis techniques. The computerized techniques have allowed studies of joint end effects (adherend contour and adhesive spew fillets), stress variations within the adhesive, and elasto-plastic adhesives. Stresses in tubular joints and butt joints are then discussed and the chapter concludes with a short summary of the use of joints in design (including T-joints and corner joints).

One rather serious omission in the book is the lack of discussion of the singular stresses that exist in many bondlines. For example, in the discussion of stresses in butt joints, the stresses are shown to increase very rapidly as the bond edge is approached (Fig. 66). However, the authors rationalize falsely that the stresses are not singular;

stating "the stress concentration is difficult to determine because of the high stress gradients, but from the gradient of the displacement curve, the  $\sigma_z$  stress concentration was calculated to be at least 2.5." The magnitude of the energy release rate (or stress intensity factor) at the bond edge may be more important than bond stresses in the evaluation of joint strength. Therefore, this aspect should be discussed. Standard test procedures, (destructive and non-destructive) as listed by ASTM, BSI and other official bodies are summarized in Chapter 3. Limitations of these tests are discussed. The conclusion for complex bonded joints is very aptly stated: "Ultimately, the only real test of suitability is to build (and test) a representative sample of these joints for each candidate adhesive and surface treatment."

Chapter 4 contains a discussion of the properties of polymeric adhesives and gives the reader a good insight into the complex behavior of adhesives. Time (load rate) and temperature dependence of adhesives are discussed. In addition, a good collection of typical mechanical property data for adhesives is presented.

The next two chapters contain the information that is required in selecting an adhesive system and a surface preparation technique. The theory of adhesion is discussed. Then the types of adhesives (strengths and weaknesses of each), factors to be considered in selecting an adhesive and surface preparation techniques are outlined.

In Chapter 8 the effects of sustained load, moisture, temperature, and cyclic load parameters (amplitude and frequency) on the service life of a bonded joint are discussed. One interesting observation of the authors is that when bonded joints are held unloaded or loaded for periods of time subjected to known, steady temperature and humidity, or subjected to a sinusoidally varying load at a steady state, bond strength decreases at a far greater rate than under normal service conditions.

The book is very well organized and easy to read. It covers the most important aspects of adhesion. Except for the discussion of stress analysis of adhesive joints, the material generally represented the current state-of-the-art in bonding. It is an excellent text for beginners in the field of adhesion and contains much information for practitioners.

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