THE DEVELOPMENT OF CONFIDENCE LIMITS FOR FATIGUE STRENGTH DATA[*†]

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Abstract

Over the past several years, extensive databases have been developed for the S-N behavior of various materials used in wind turbine blades, primarily fiberglass composites. These data are typically presented both in their "raw" form and curve fit to define their average properties. For design, confidence limits must be placed on these descriptions. In particular, most designs call for the "95/95" design values; namely, with a 95 percent level of confidence, the designer is assured that 95 percent of the material will meet or exceed the design value. For such material properties as the ultimate strength, the procedures for estimating its value at a particular confidence level is well defined if the measured values follow a normal or a log-normal distribution. Namely, based upon the number of sample points and their standard deviation, a commonly-found table may be used to determine the survival percentage at a particular confidence level with respect to its mean value. The same is true for fatigue data at a constant stress level (the number of cycles to failure N at stress level S_1). However, when the stress level is allowed to vary, as with a typical S-N fatigue curve, the procedures for determining confidence limits are not as well defined. This paper outlines techniques for determining confidence limits of fatigue data. Different approaches to estimating the 95/95 level are compared. Data from the MSU/DOE and the FACT fatigue databases are used to illustrate typical results.

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[*]Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin company, for the U.S. Department of Energy under contract DE-AC04-94AL85000.