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A General Method for Fatigue Analysis of Vertical Axis Wind Turbine Blades*

Paul S. Veers
Applied Mechanics Division IV 1524
Sandia National Laboratories
Albuquerque, NM 87185

Abstract

The fatigue life of wind turbine blades that are exposed to the random loading environment of atmospheric winds is described with random data analysis procedures. The incident wind speed and the stresses caused by these winds are expressed in terms of probability density functions, while the fatigue life vs stress level relationship is treated deterministically. This approach uses a "damage density function" to express fatigue damage as a function of wind speed. By examining the constraints on the variables in the damage density expression, some generalizations of the wind turbine fatigue problem are obtained. The area under the damage density function is inversely related to total fatigue life. Therefore, an increase in fatigue life caused by restricted operation in certain wind regimes is readily visualized. An "on parameter", which is the percentage of total time at each wind speed that the turbine actually operates, is introduced for this purpose. An example calculation is presented using data acquired from the DOE 100-kW turbine program.

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