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Fatigue life analysis of slewing bearings in wind turbines

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Abstract

Wind energy is a type of green renewable energy that has received increased attention. Wind turbines use wind power to generate electricity. As important components of wind turbines, slewing bearings are large and expensive, and these properties make bearing tests challenging. The theories and methods of slewing bearing design in wind turbines are not perfect, and the field lacks long-term engineering verification. To ensure the service life of slewing bearings, an accurate fatigue life estimation in the design stage is essential. This paper presents a method of testing the fatigue life using a small sample test. Experiments were conducted to determine the actual fatigue life of a small sample, and the changes in local raceway damage, vibration acceleration, and lubrication were monitored. A finite element model of the slewing bearing was established in ABAQUS to obtain the contact stress between the ball and raceway. The calculation results were imported into FE-SAFE to analyse the fatigue life. The Morrow mean stress correction in conjunction with the Brown-Miller strain-life method were used in the analysis. The simulation results were compared with the experimental results to validate the effectiveness of the experiment. Three fatigue life calculation methods have distinct advantages and can be mutually referenced to improve the accuracy of bearing life calculations.

Keywords: slewing bearing; fatigue life; finite element method; rolling contact fatigue

Nomenclature