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Non-Destructive Evaluation of Wind Turbine Blades Using an Infrared Camera*

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Abstract

The use of a digital infrared thermography camera as a non-destructive evaluation (NDE) tool was explored in two separate wind turbine blade fatigue tests. The first test was a fatigue test of part of a 13.1 meter wood-epoxy-composite blade. The second test was on a 4.25 meter pultruded fiber glass blade section driven at several mechanical resonant frequencies. The digital infrared camera can produce images of either the static temperature distribution on the surface of the specimen, or the dynamic temperature distribution that is in phase with a specific frequency on a vibrating specimen. The dynamic temperature distribution (due to thermoelastic effects) gives a measure of the sum of the principal stresses at each point on the surface. In the wood-epoxy-composite blade fatigue test, the point of ultimate failure was detected long before failure occurred. The mode shapes obtained with the digital infrared camera, from the resonant blade tests, were in very good agreement with the finite-element calculations. In addition, the static temperature images of the resonating blade showed two areas that contained cracks. Close-up dynamic infrared images of these areas showed the crack structure that agreed with subsequent dye-penetrant analysis.

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