Impact fatigue damage of coated glass fibre reinforced polymer laminate

Impact fatigue caused by rain droplets, also called rain erosion, is a severe problem for wind turbine blades and aircraft. In this work, an assessment of impact fatigue on a glass fibre reinforced polymer laminate with a gelcoat is presented and the damage mechanisms are investigated. A single point impact fatigue tester is developed to generate impact fatigue damage and SN data. Rubber balls are repeatedly impacted on a single location of the coated laminate. Each impact induces transient stresses in the coated laminate. After repeated impacts, these stresses generate cracks, leading to the removal of the coating and damage to the laminate. High-resolution digital imaging is used to determine the incubation time until the onset of coating damage, and generate an SN curve. An acoustic emission sensor placed at the back of the laminate monitors changes in acoustic response as damage develops in the coated laminate. The subsurface cracks are studied and mapped by 3D X-ray computed tomography. A finite element method model of the impact shows the impact stresses in the coating and the laminate. The stresses seen in the model are compared to cracks found by 3D tomography. The damage is also evaluated by ultrasonic scanning.

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