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INTERLAMINAR SHEAR FATIGUE IN COMPOSITES MATERIALS USED IN WIND TURBINE AND AIRCRAFT INDUSTRIES

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Abstract: The interlaminar shear fatigue is a case where the shear stresses act between laminas. This type of fatigue may be present in several situations in laminate composites and be the cause of serious failures. Two particular cases are described: wind turbine and aircraft skin fuselage. In the first case, the blades of the wind turbines are sometimes modeled as cantilever beam with static and cyclical loads. Commonly, blades of wind turbine units of 1MW or more have lengths greater than 25m. As a consequence of these lengths, the laminate skin thickness can achieve values of 20mm or more, especially near the blade's root and interlaminar shear fatigue becomes of special interest as a possible failure mechanism. In the second case interlaminar fatigue in Fiber Metal Laminates (FMLs) is presented. FMLs were created and developed mainly for aeronautical applications. Interlaminar shear stresses have an important role in the fatigue behavior of FML. E.g., the high resistance to fatigue crack growth in FMLs is largely due to the crack bridging mechanism where a part of the fatigue loads acting in the aluminum layers near the crack is transferred by the unbroken fiber layers. Cyclic shear stresses in the interface metal-fiber/matrix transfer these loads and they cause delamination at the interface that reduces the fiber bridging stress and prevents fiber failure. However, when delamination is too large, the bridging stress in the fibers decreases and the bridging mechanism is less efficient. From the point of view of the crack nucleation stage, this delamination delays the crack initiation in the interior metal layers. In this keynote lecture several items related to the interlaminar shear fatigue of glass fiber reinforced polyester laminates (GFRP) and Glare® (a commercial FML) are presented:

• The advantages and limitations of the short-beam shear (SBS) fatigue test to evaluate interlaminar shear fatigue in specimens of GFRP and Glare.

• The effect of load frequency in SBS fatigue of GFRP.

• The use of constant life-time diagrams in SBS fatigue to compare two GFRP materials.

• The SBS fatigue life in two principal orientations of samples of Glare and various failure modes observed in this material.