SIMULATION OF FATIGUE FAILURE IN A V-22 OSPREY HELICOPTER COMPOSITE PROPROTOR YOKE

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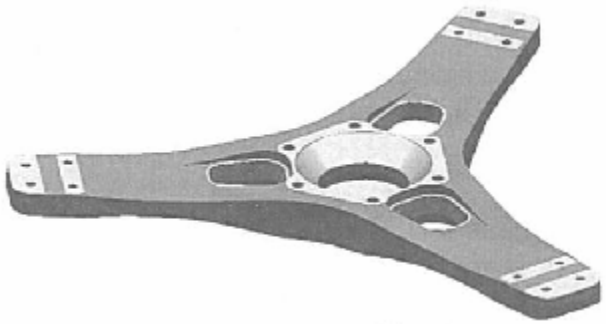
The V-22 composite proprotor yoke is the basic part of the hub assembly, which transmits rotor torque from the drive hub into the grip and reacts to blade loads. It has three equally spaced coning flexure arms that are located 120 degree apart and is made of glass/epoxy composite [1]. The inboard flexure part of each arm contains a hole for the attachment of the inboard pitch change bearing.



Design, finite element modeling and dynamic analysis of the yoke have been carried out using ANSYS software. To estimate the fatigue strength of this element, an energy based model for fatigue life prediction and evaluation of progressive anisotropic damage was used. It is based on the assumption that the rate of anisotropic damage accumulation in composite material of the investigated yoke depends on the value of specific elastic strain energy per cycle W_e, the cycle parameter R, the current level of stress and damage. It was assumed that there exists a power relation between the damage growth rate and elastic strain energy:

$$\frac{dD_{ij}}{dN} = k(R)\cdot(W_e)^n \cdot M_{ijkl}\cdot \tilde{S}_{kl} \ . \qquad (1)$$

The number of cycles to failure was determined at the frequency corresponding to the nominal angular frequency of helicopter rotor blade subjected to cyclic loading. The obtained results showed that the calculated fatigue life of the analyzed yoke could meet the design requirements.

[1] L. K. Altman, D. J. Reddy, H. Moore “Fail-safe approach for the V-22 composite proprotor yoke” *Composite Structures: Theory and Practice, ASTM STP* 1383, P. Grant and C. Q. Rousseau, Eds., American Society for Testing and Materials, West Conshohocken, PA, 2000, pp. 131-139.