The life duration for disc under torsional vibrations of the compressor blades

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The life duration estimates are calculated for compressor discs under torsional vibrations of blades (VHCF – Very High Cycle Fatigue).

The new numerical-analytical method is proposed for calculation of 3D stress-strain state (SSS) of elastic discs of variable thickness under action of cyclic loads from torsional vibrations of blades.

The approximate representation is assumed for dependence of solution on coordinates along thickness and in the circumferential direction. Special system of differential equations is derived to determine the coefficients of the formulas of this representation, depending on the radial coordinate. Boundary value problems for the system are solved using the method of orthogonal shooting.

The calculated SSS from vibrations was imposed on SSS from flight cycles (cyclic centrifugal loading) and was used for life duration estimations and for damage zone detection using the generalized criterion of VHCF failure. There was found a significant drop of life duration (up to $10^{9.5} - 10^{10}$ cycles) on the outer rim in the area of contact disc and blades. It indicated the need to consider such mechanism of fatigue-breaking predicting the durability of the safe operation of aircraft structures.

The study is supported by the Russian Foundation for Basic Research project № 15-08-02392-a.