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POSSIBLE APPLICATION OF THE OPERATING PRINCIPLE OF AN ADAPTIVE COMPLIANT WING IN CERTAIN UNITS WITH VARIABLE GEOMETRIC CHARACTERISTICS

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At the moment, one of the least well-known but theoretically effective design solutions in aviation is the adaptive compliant wing. In this paper, the principle of its application in a number of aerodynamic surfaces is investigated.

An adaptive compliant wing (ACW) is a wing that has sufficient flexibility to change the shape of its aerodynamic profile (airfoil) in flight [1]. This is done by deflecting the front and rear edges of the wing using hydraulic units located inside the structure, parallel to the longitudinal power set of the wing. This solution eliminates the need for most of the high-lift units: flaps, slats, interceptors.

This system is also subdivided according to the principle of operation of the deflected surfaces: in addition to the flexible edges of the wing, solutions with variable curvature (camber), chord length, sweep, and fully variable geometry are known, the practical implementation of which is still considered too expensive and complicated.

As a theoretical comparison of this solution with the currently used aerodynamic layout, data obtained from wind tunnel tests during the NASA-MACW (Mission Adaptive Compliant Wing) research program were used [2]. Here are graphs of the dependencies of lift-to-drag (L/D) ratio on the angle of attack (Fig. 1) and on the coefficient of lifting force (Fig. 2)

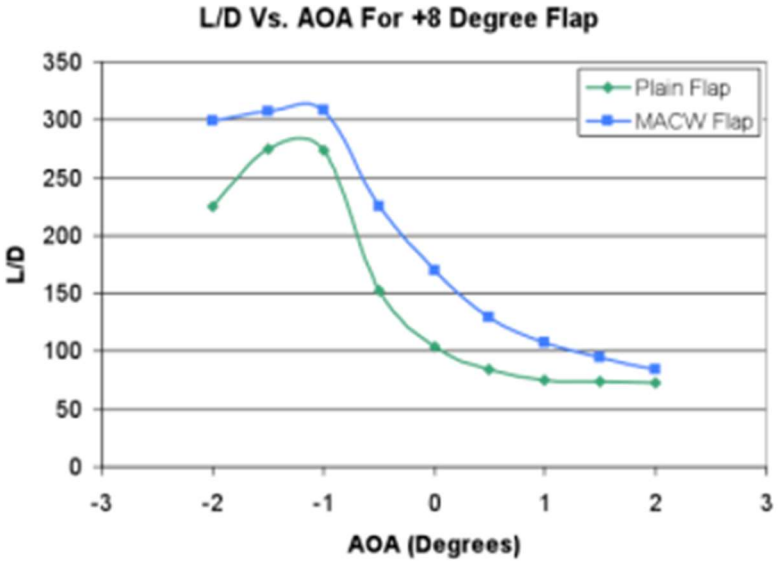

Figure 1 – Graph of the dependence of L/D ratio on the angle of attack

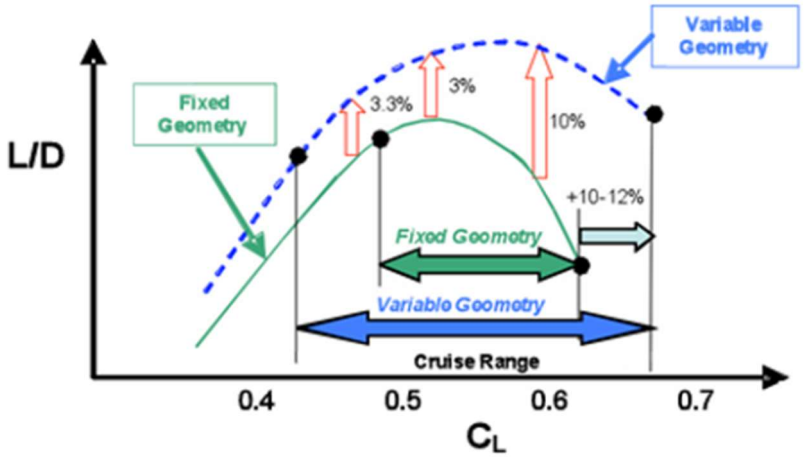

Figure 2 – Graph of the dependence of L/D ratio on the lift coefficient

We successfully calculated the inner theoretical shell of the wing, under the influence of a downward load of 6 kPa (Fig. 3).

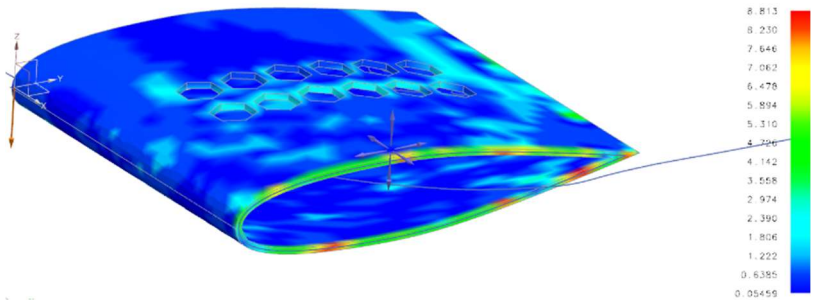

Figure 3 – Theoretical calculation of a section of a wing with a constant cross-section

In the process of the study, a variant of using a monolithic structure limited by two spars and two flexible edges with deflectable external surfaces was proposed [3]. Thus, it becomes possible to maintain the strength of the structure and ensure the necessary mobility.

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