Preliminary Design and Concepts of a New Full Composite UAV

A. F. Accardo, P. Basso
University of Naples Federico II, Department of Aeronautical Engineering (DPA)

Abstract

In the paper will be described the preliminary design and concepts of the composite structure of a new Unmanned Aerial Vehicle, seen as an evolutionary update to the DPA's first full composite UAV, "Federica", who started the series on 1999.

Designed by the University of Naples, manufactured by the medium enterprise LMC Spa in the south of Italy, and sponsored by the Italian National Research Council, Federica has been a very useful experience, involving people coming both from university and industry, having the skill improvement in composite airframe design, and the gap filling between manufacturers and technologists, as primary issues [1, 2]. For the Federica's realization by the exclusive use of graphite epoxy autoclave cured laminates, several ground and flight tests were performed during the last four years, when working teams were composed also by students and young researchers, and a first large set of information relative to composites have been catalogued [1 - 5]. The positive scientific and technologic results gained with Federica, and the national curiosities aroused, have so encouraged a new full composite UAV research project whose development will involve also other Italian industries for the next two years.

Main objective of this new project, is the realization of a full composite unmanned vehicles up to 25kg MTOW and a minimum payload of about 8 kg, for close observation missions, able to start a successive finalization for the mass-production.

Composite materials, specifically the carbon epoxy laminates, are intended as a main requirement. As a matter of fact composites have been found as cost and weight effective materials for vehicles of small dimension.

The architecture of the new vehicle is a classical high rectangular wing 3m span, doubled respect to the Federica's wing, with fuselage and all-flying horizontal tail, shown in fig.1. This configuration is very well known at the DPA and has been assessed by several past experiences mainly done for General Aviation aircrafts but also for remote piloted vehicles as the first Meteor models [6]. It assures an easy and a low cost manufacturing, well exploiting the composite advantages for the realization of "one piece" structural parts.

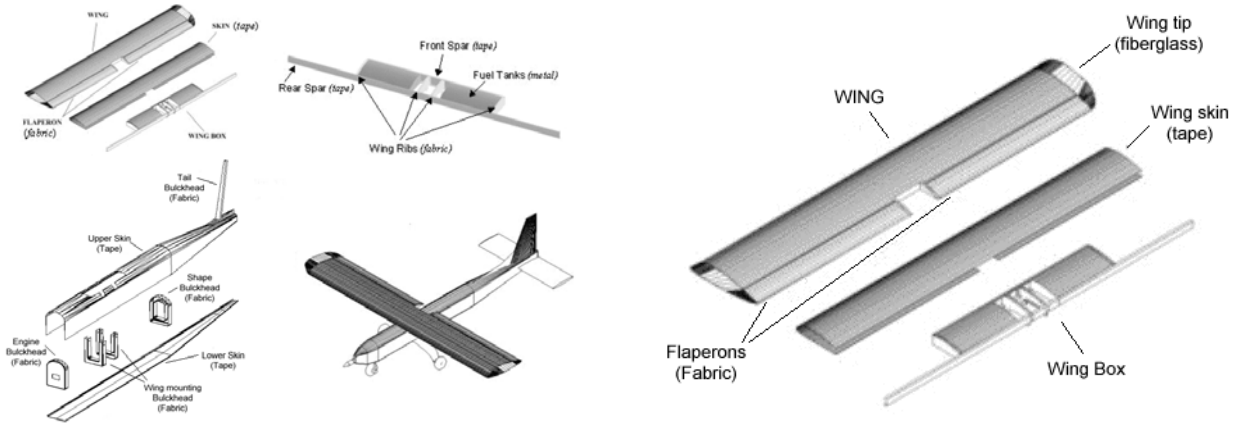

Fig.1 Structural schemes adopted for Federica adopted as a start design point

As for Federica, the main criteria of the design of the carbon epoxy structure, is particularly focused on the reduction of the number of parts and the extensive use of bonded and cocured interfaces to prevent the interlaminar delamination effects, following the structural design algorithm developed for Federica, and shown in fig.2, with small variation.

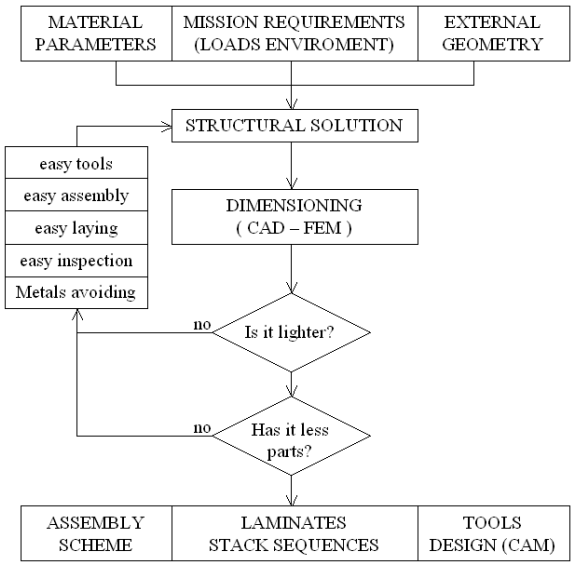

Fig.2 the structural design algorithm adopted

The materials adopted, as previously mentioned, are the carbon epoxy tapes and fabrics for the primary structure, reserving fibreglass only for the fairings such as the wing tips the front nose. The laminates will be hand laid up on metal tools and autoclave cured even if possible future evolution towards oven curing and RTM processes are under evaluation.

As it regards the structural solutions, the wing is a two spars torque box with a one piece skin without any kind of doublers or stringers as for the fuselage, just composed by bulkheads and a two-halves skin. Such solution are obtained by the structural optimisation of those adopted for Federica, with a more specialized design of the fuselage relative to the payload that fixes its main section, as more in detail will be discussed in the rest of the paper.

Reference

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