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Eurofighter airbrake – a demonstration of advanced composite design

Within the framework of a government-funded guiding concept entitled “FFS – Advanced Aerostructures”, the DLR Institute of Composite Structures and Adaptive Systems, together with partners AIRBUS Defence and Space, Airbus Central R&T and the Bundeswehr Research Institute for Materials, Fuels and Lubricants (WIWeB), has developed an advanced composite and adhesively viable design for aircraft components and demonstrated it in the case of a typical Eurofighter component, the Airbrake B ground demonstrator model.

The primary objective has been to significantly increase the cost efficiency of military aircraft structures, in which respect it has been possible to demonstrate a cost-saving potential of around 40 % through bionically inspired bonded designs as well as suitable materials and manufacturing technologies. While this very forward-looking fibre composite version has not yet attained TRL-6 (Technology Readiness Level 6) maturity, an earlier yet secondary bonded model (A model) of the original airbrake, based on the structural concept of the series-produced airbrake, will this year be undergoing a flight test campaign on Instrumented Production Aircraft # 3 (IPA3) under the supervision of the Bundeswehr Technical Centre for Aircraft and Aeronautical Equipment (WTD 61) after approval by the German Military Aviation Authority (LufABw) in Manching.

Especially the assembly and joining technology plays a crucial role in realising high-performance and, at the same time, cost-efficient lightweight CFRP structures for modern combat aircraft. The development and establishment of a robust secondary bonding technology is, for those reasons, the purpose



Fig. 1: Eurofighter airbrake, a demonstrator structure for “Structural Bonding Technology” (Source: Airbus)

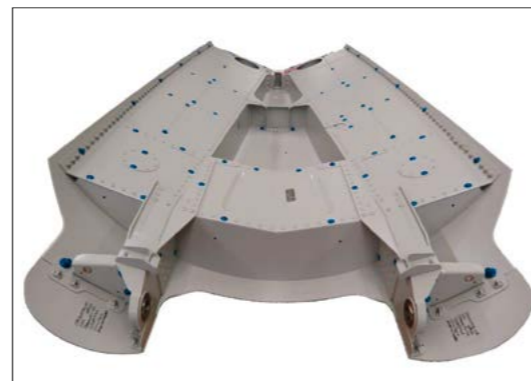


Fig. 2: Final Eurofighter airbrake A-model (Source: Airbus)

of joint activities being undertaken as part of the FFS guiding concept. Bonded structures in differential design are manufactured as smaller, usually less complex components, in contrast to integral structures, and are subsequently joined in a separate bonding process step. This reduces the production costs (lamination costs of complex structures and tooling costs) as well as the risk of expensive integral structures being rejected (in the curing process). A particular challenge where bonding technology is concerned is ensuring a suitable and contamination-free adhesive surface in order to guarantee robust adhesion.

The goal of this collaborative work is to demonstrate the entire process chain for an actual typical secondary bonded component (the A model). The structure selected as an example is the airbrake of the Eurofighter Twin Seater. The A-shaped main stiffening elements in the serial component, the spars, are produced through co-curing technology. While the structural concept of the serial component will be retained and only Eurofighter-specific, fly-ready materials, additives and processes used, the assembly process for the main spar of the A-model will be done by secondary bonding. Complete production and military approval (by the German Military Aviation Authority according to Eurofighter standard) of the flight demonstrator are envisaged including, therefore, demonstration of TRL-6 technology maturity.

Already in parallel with the production of the flight demonstrator, the DLR had designed a variety of new design methods in a consistent, weight-neutral design-to-cost approach. In contrast to the previously presented A-model, the aim of this B-model was to explore new, more cost-efficient design con-

cepts as a means of reducing manufacturing time and costs. At the end of the evaluation and selection process, the decision was made to use a double-shell design in which two flexible shells were pasty-bonded with a continuous adhesive joint, resulting altogether in a stable airbrake component. The two CFRP shells made from cost-efficient, well-drapable dry fibre materials are produced in a liquid resin infusion process and supplemented only with three 3D-printed metal load introduction devices (AddCompS™ – Additive Composite Structures).

Particularly by reducing the number of parts from around 40 to 5 and by dispensing with hundreds of rivets, it has been possible to demonstrate a significant cost-savings potential. In addition, the cost-efficient production technology for the outer and stiffening shell, in combination with the semi-analytical design methodology approach for bonded structures (SAADA Joint – Semi-Analytical Approach for the Design of Adhesive Joints), will have significant cost-reducing implications for future military aircraft structures.

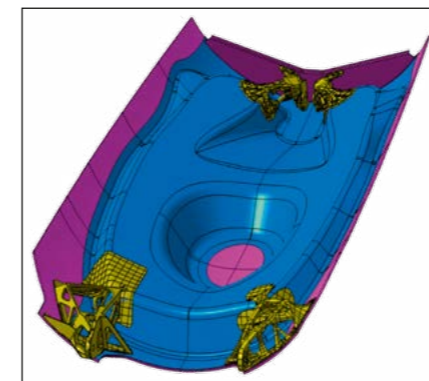


Fig. 3: Engineering design of the airbrake demonstrator B-model



Fig. 4: Eurofighter airbrake demonstrator B-model



Fig. 5: Detailed view of a 3D-printed load application armature for thin-walled CFRP shell structures