Advanced Materials Research Program

The application of polymeric composite materials to aerospace structures over the past 30 years is well documented.

The higher specific strength and stiffness of reinforced composites versus metals as well as other attributes such as tailorability to load directionality, acoustic damping, and high fatigue endurance are attractive to manufacturers. The weight savings combined with improved structural efficiency are directly translated into increased payload, reduced acquisition and operating costs, and increased performance. A pound of weight saved on a commercial aircraft is estimated to be worth $100 to $300 over the service life of the aircraft. This has led to large sections of transport airframes, entire empennages, and major portions of wing structure (see figure on back page) being made from composites. The advantages of composites have been especially important to the helicopter and small aircraft; small aircraft have been built with all composite airframes, and helicopter rotor blades are fabricated entirely of composites or hybrid composite-metal combinations.

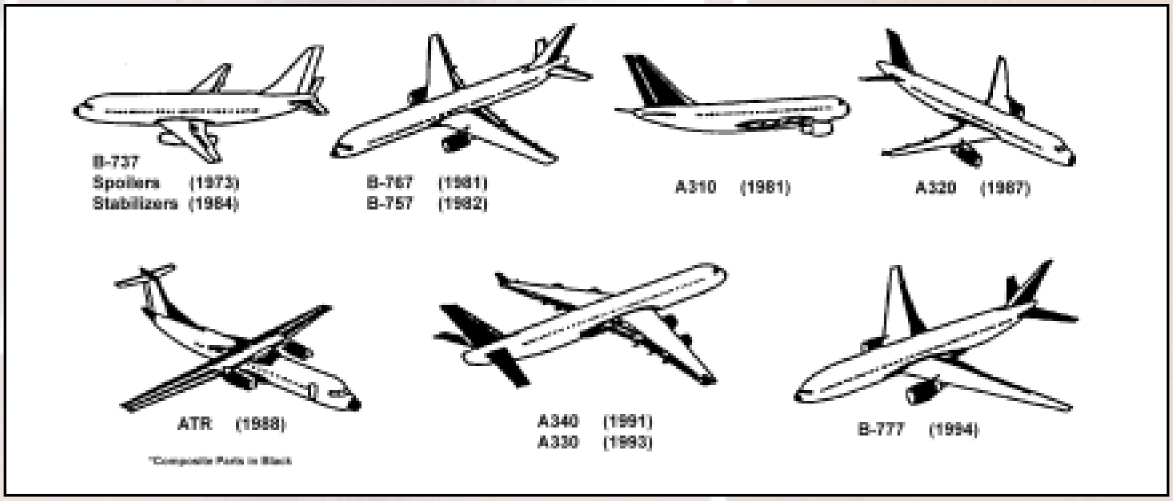
Recently, in part due to NASA's Advanced General Aviation Technology Experiment (AGATE) initiative, the use of composites in these small aircraft has increased at a great rate. Two small aircraft, the Cirrus SR20 and the Pacific Aviation Lancair Columbia 30D, have obtained type certificates. Several other new aircraft with significant amounts of composite structure are anticipated in future years. Very large transport aircraft anticipate use of composites in keel beams, outer wing, and pressure bulkheads. In the upcoming years, higher temperature capable

polymeric composites, metal matrix, and ceramic matrix composite materials will find extensive use in engine parts.

The goals of the research conducted at the FAA William J. Hughes Technical Center are to ensure the safety of U.S. civil aircraft constructed of advanced materials, to provide consistent guidance for compliance in certification of aircraft structures made from advanced materials that will lead to shorter, less costly certification process, and to foster standardized engineering approaches. This will lead to a secondary economic benefit of improving the balance of trade, which is of national interest.

The Advanced Materials Research Program has been developed to meet the needs identified by the FAA, aircraft manufacturers, and airlines. It closely follows the current and forecasted advanced materials applications to airframes and engines. The future of general aviation aircraft is dependent on fabricating airframes out of composites that are affordable. Hence, materials research must also explore new methods of manufacture that are cost-effective. Although the use of composite materials has increased, there are still technical areas where lack of knowledge has

Safety



resulted in composite structure that may be too conservatively designed and have poor supportability features. Filling the knowledge gaps will spur greater use of composites for applications such as transport aircraft wings and fuselages.

With each new technology innovation or evolution, the design variables (materials, concepts, and processes) to be assessed during the certification process will expand. The increased use by industry of verified structural optimization methodologies and analysis techniques to reduce the cost of innovations will create pressure to streamline the qualification and certification time by reducing testing, but safety cannot be compromised. This is only possible with the full understanding of material behavior and analytical modeling.

The advanced material research effort conducted at the William J. Hughes Technical Center is being coordinated with other government agencies. The FAA coordinates with NASA to leverage research expenditures. The FAA concentrates on safety and certification issues, including testing, while NASA has the lead in analysis and design issues. Currently, the FAA supports NASA efforts to develop a database for the safe use of composites in the wing and fuselage structure of general aviation (GA) aircraft under the NASA Advanced GA Transport Experiment (AGATE)/Integrated Design and Manufacturing (IDM) Program. The FAA Advanced Materials Program has initiated a partnership with NASA and the Rotorcraft Industry Technology Association (RITA) consortium to exchange technical program activities on composite structural applications.

The FAA co-sponsors MIL-HDBK-17 with the U.S. Army, which is a primary and authoritative source for statistically based characterization data of current and emerging composite materials. This international reference reflects the best available data and technology for testing and analysis, and includes data development and usage guidelines. The handbook is used by FAA officials as a primary supporting document in structural substantiation in the certification process.

To find out more about the Advanced Materials Research Program, contact:

Airport and Aircraft Safety Research
and Development Division
Airworthiness Assurance Research
and Development Branch
Airframe Structures Section, AAR-431

Federal Aviation Administration
William J. Hughes Technical Center
Atlantic City International Airport, NJ 08405
Phone: (609) 485-4967
Fax: (609) 485-4569
www.tc.faa.gov