Advanced Composites Division (ACD) of CSIR-National Aerospace Laboratories (NAL) is regarded as a Centre of Excellence in Composite Structures by Aeronautics Research and Development Board (ARDB). ACD has significantly contributed to the design and development of composite structures for both military and civil aircrafts. The division with a judicious mix of basic research and applied R&D has strived hard to identify future trends and stayed at the forefront of technology. It has a high level of expertise in the areas of design, fabrication, non-destructive evaluation, repair and structural testing capable of delivering “Concept to Certification” solution. The division is rigorously pursuing R&D activities in the forward looking areas of Structural Health Monitoring, Damage Tolerant Structures, Processing of Thermoplastics, 3D Composites and Nano Composites.

SARAS (14 Seater aircraft)

ACD has contributed to nearly 1/3rd of airframe with its composites technologies. Primary structures like Wing, Horizontal Tail, Fin, Rear Pressure Bulkhead, Control Surfaces, Floor Boards, Wall Assemblies, Fuselage Top Skin and Nacelle have been developed. Innovative design and manufacturing approaches have resulted in substantial reduction in part count, weight and cost. The division has developed and patented a cost effective manufacturing process, namely VERITY (Vacuum Enhanced Resin Infusion Technology) for the fabrication of carbon fibre composite wing.
LCA Program

ACD has played a pivotal role in the development of advanced composite structures for the Indian Light Combat Aircraft (TEJAS) programme. The division has developed the co-curing technology for complex parts like Fin, Rudder, Centre Fuselage and Main Landing Gear Doors. The division has not only contributed to the technology demonstrators and prototypes, but has also taken up the challenge to productionise these through public-private partnership (PPP) with an industry.

The division has capabilities in classical stress analysis methods and finite element analysis using tools like MSC-NASTRAN®, ABAQUUS® & RADIOSS®. A state-of-the-art CAD facility equipped with geometrical modelling software like CATIA®, AUTOCAD® and the like are available for carrying out the detail design and digital mock up (DMU).

Repair technology is a crucial area helping to maintain the structures during their service life. The division is actively involved in the development of repair technologies for damaged aircraft structures for both in-situ and depot level repairs for IAF.

- Established composite repair facility at 11 BRD, Air Force station Nasik
- Repaired many primary aircraft parts like fin, rudder, wing of MiG 21, MiG 29 etc,
- Repair of Radomes for AN 32 & IL 76.

The division has expertise in the area of non-destructive evaluation encompassing ultrasonics, real time X-ray imaging, infrared thermography and acoustic emission techniques. A state-of-the-art NDE facility has been established having computer controlled water coupled ultrasonic C-scan systems, air coupled ultrasonic systems. Innovative NDE methodologies have been developed for the inspection of co-cured constructions for national programmes. ACD also offers NDE services to the industry.
Structural Health Monitoring (SHM)

The division along with Israeli Ministry of Defence and ADE developed and successfully demonstrated a load monitoring system in flight on Nishant UAV. The collaborative work involved design of sensor networks, sensor integration with host composite structure, development of rugged & airworthy instrumentation, on-board data management and algorithm development. The technology development showcased the capability of estimating the flight loads based on the in-flight sensor data. Similar exercise was carried out on HANSA aircraft by ACD. The final objective would be to establish a fully on-line SHM system.

Damage tolerance studies towards airworthiness certification and structural substantiation is an important thrust area of the division. Numerical simulations supported by extensive tests are conducted as part of the industry standard ‘Building Block Approach’ towards certification of full-scale composite primary aircraft structures.

The division is actively involved in the development of Fibre Metal Laminate (FML) technology for energy absorbing applications. The main focus is to identify a FML leading-edge configuration for wing & empennage of a civil aircraft. The division has conducted extensive characterization studies on various FML configurations, as well as bird-strike tests and simulations towards certification along with Structural Technologies Division (STTD).

The Division has excellent infrastructure and trained manpower towards destructive testing of composite parts – coupons to full-scale test articles. ACD also has supported DRDO labs and private industries in mechanical characterization of advanced composite materials. Facilities include UTM, Hydraulic and Servo-hydraulic actuators, Digital Image Correlation (DIC) system, Draw-wire sensors and multi-channel multi-purpose Data acquisition (DAQ) systems.
Thrust Areas

- Improvement of surface electrical conductivity of carbon fibre composites using carbon nano tubes
- Processing of thermoplastics like PPS and PEEK
- Design & development of 3D composites to replace fatigue critical metallic fittings

Facilities

- State-of-the-art Design centre
- Cold chest
- Prepreg cutting machine
- Water jet cutter
- Clean rooms equipped with laser projection system for accurate layup
- Ovens
- Autoclaves for thermosets and thermoplastics
- Infusion/RTM equipment
- Stitching machine
- Tooling & Assembly Bay
- Air and Water coupled Ultrasonic systems
- Thermography
- Acoustic Emission
- X-Ray facility
- Machine Shop

Valued Clients, Sponsors and Collaborators

**Government Agencies:** ADA, HAL, ADE, ASL, DRDL, IAF, NSTL

**Industries:** TAML, GM, GE, Mercedes Benz, Enercon

**Academia:** IISc, IITs, VNIT, Manipal Institute of Technology

**Foreign Collaborators:** Israel Aircraft Industries, Tel Aviv University and Manchester University.

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