

NALFOQA and smart fatigue meter

Towards safer and more comfortable flying

NAL has developed a software solution to monitor the flying performance of aircraft and alert airlines about the quality of their flight operations. The smart fatigue meter records 'g' levels that aircraft cross during flying manoeuvres.



A modern aircraft can fly safely and economically for a very long time if airlines set up efficient mechanisms to continually monitor the aircraft's flying performance.

Typical printouts from NAL's FOQA software for flight operations quality assurance

NALFOQA offers attractive animation and visualization capability. This software tool can be used for investigating flying incidents and for flight crew training.



The micro-controller based smart fatigue meter is for use in military aircraft. It is powered by the aircraft power unit and has a built-in accelerometer to sense the change in 'g' levels.

Smart fatigue meter



Products and solutions for the civil aviation industry

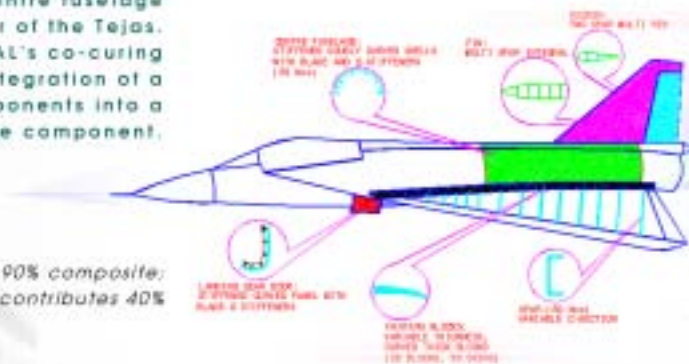
Contributions to Tejas aircraft

Critical support in the design and development of the fighter

NAL has pioneered the development and fabrication of composite structures for the Tejas (LCA) aircraft using very innovative, and cost-effective, fabrication technologies and developed the unstable aircraft's control law software.

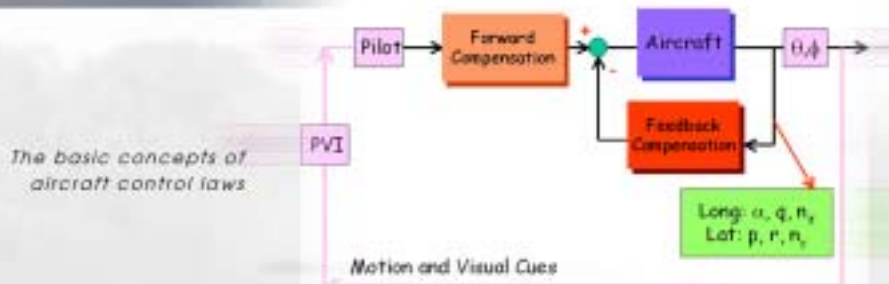
NAL fabricates wing spars, fairings and fairing blocks, fin, rudder, centre fuselage and the landing gear door of the Tejas. The principal advantage of NAL's co-curing technology is the integration of a number of subcomponents into a single component.

The Tejas airframe is 90% composite; NAL contributes 40%



The Tejas control laws have so far performed extremely well.

Control Law Schematic



Notable Inputs in helping the Tejas fly

Repairing aircraft structures

The technology of curing

NAL uses innovative bonding techniques to repair metallic and composite aircraft structures. A portable adaptive cure controller has been developed to repair aircraft structures on the airfield itself.



A damaged part is examined visually and by NDT techniques to determine if repair is feasible. If yes, a repair scheme -- involving the design of a patch and joint -- is finalized and repair implementation, by adhesive bonding or mechanical fastening, is completed. The repair is then validated by NDT before final acceptance and certification.

Damaged radome and fin repaired



The portable PC based system for in situ bonded repair of aircraft structures is rugged, has MIMO adaptive PID control to maintain job temperature uniformity and appropriate accompanying software. The entire system, except the heaters, works on a single PC adapter.

Cure controller for bonded repair



Wide experience in repairing aircraft structures

The NAL mission

Technology is our core vehicle

NAL's mandate is to develop aerospace technologies with a strong science content, design and build small and medium - sized civil aircraft, and support all national aerospace programmes.



SARAS flying at the Bangalore air show in 2005;
HANSA VT-XBL flying at Jakkur airport.

*SARAS is a multi role transport aircraft;
HANSA is an all-composite trainer*

Relaminarization
on swept wings under
high-lift conditions.

*NAL successfully
addressed this complex
flow phenomena
with carefully planned
experiments at low
speeds together with
data analysis*



NAL was a very active partner in the Tejas (LCA)
design and development programme.

CFD analysis for Tejas



*Quality solutions
to problems of flight*

SARAS is airborne

A milestone in Indian civil aviation

NAL's multirole light transport aircraft, SARAS, had its maiden flight on 29 May 2004. The aircraft took off at 8:15 am, and flew for over about 25 minutes. SARAS is the first civilian aircraft designed and developed in India.

The first flight was smooth and uneventful in moderately cloudy and windy conditions.

The test pilots, Sqn Ldr Venugopal and Wg Cdr Makker, after the first flight



SARAS has a Pratt & Whitney power plant.

P&WC PT6A-66 engine



SARAS has been designed for many roles: executive transport, light package carrier, remote sensing, air ambulance etc.

The many possible roles of SARAS



Luxurious executive aircraft



14 seater commuter aircraft



Ambulance version



Combi version with 7 seats and place for light packages



Creating a vibrant and profitable Indian civil aviation industry

The HANSA success

The all-composite aircraft is flying at many Indian flying clubs

HANSA is India's first all-composite aircraft ideally suited for ab initio training. The aircraft was type certified in February 2000. Seven aircraft are currently flying in Indian skies.



HANSA has a neat cockpit with good visibility, dual controls with excellent control harmony and is rugged, operationally cost effective and easy to maintain.

HANSA flying near Jakkur airport

The HANSA aircraft have together flown over 2500 h.

Details of HANSA's flying record

Serial no.	Flying club/institution	Flying hours so far
VT-HSL	Indian Aerospace Laboratories, Bangalore	298.45 h
VT-HSO	Indian Institute of Technology, Kanpur	144.40 h
VT-HSP	Andhra Pradesh Aviation Academy, Hyderabad	782.25 h
VT-HSQ	Swaha Aviation Training Centre, Srirangapatna	484.20 h
VT-HSR	Madhya Pradesh Flying Club, Indore	122.10 h
VT-HSV	Swaha Aviation Training Centre, Srirangapatna	328.22 h
VT-HST	Raytheon Institute of Civil Aviation, Karamal, 28.23 h	



HANSA is lightning protected and certified for day/night flying by DGCA under FAR-23.

The HANSA aircraft built by NAL over the years

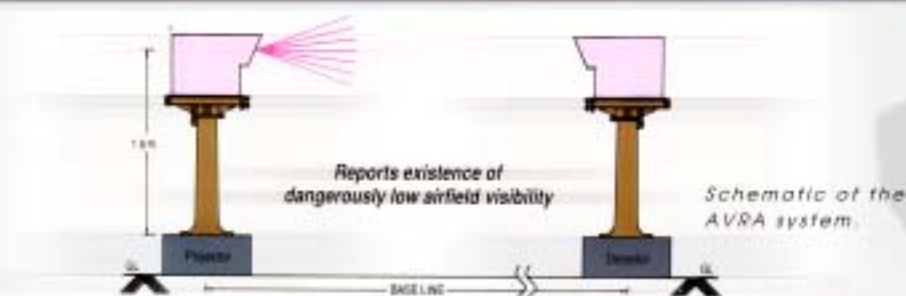


HANSA: an Indian aircraft in Indian skies

Innovative aircraft instrumentation

Ensuring a safe touchdown

AVRA is a fast-acting accurate instrument that automatically measures and reports the runway visual range and the meteorological optical range.



NAL's Automatic Visual Range Assessor (AVRA) forewarns incoming pilots about the runway visibility and helps them decide if they should land or divert the aircraft. More sophisticated AVRA systems are being developed for the Indian Navy.

AVRA's have been installed at Bangalore, Chennai, Kochi airports, and at the Indian Navy base in Goa.



Attractive products for the civil aviation industry

Smart structures

Improving aircraft landing characteristics

Smart technologies can be used to develop adaptive structures that continually change their shape to suit the varying flight conditions. Such solutions save power, enhance redundancy and optimize the performance.



The mousche is an additional aerodynamic control surface attached to the forebody of a naval military aircraft to improve its landing characteristics. It is deployed only during the landing phase.

Three gear relay arrangement to transfer force from the SMA to the mousche.

A shape memory alloy (SMA) based mechanism was developed to deploy the mousche.

Different positions of mousche deployment



Additional lifting surface

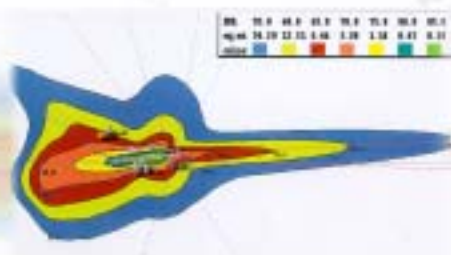


Towards adaptive aircraft structures

Air traffic management

Simulation studies to optimize airport performance

NAL can undertake R&D simulation studies to conceptualize new airports, evaluate controller workloads, study flight delay scenarios and analyse vicinity noise levels using both fast-time and realtime simulations.

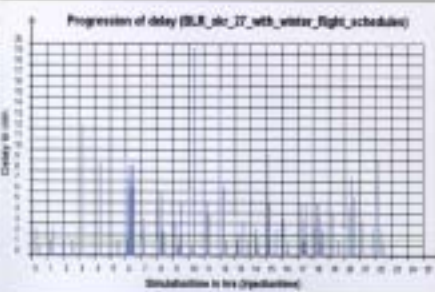
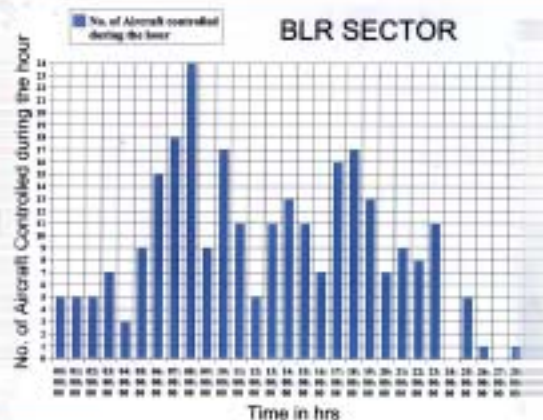


NAL uses integrated noise models to evaluate aircraft noise and its likely impact in the vicinity of the airport.

Noise contour on a busy day at Bangalore's NAL airport. Computing potential noise levels before constructing a new airport would greatly benefit the neighbouring community.

Controller workload studies, based on air traffic patterns and ATC equipment, can lead to better air traffic management strategies and reduce human stress.

The number of aircraft controlled by Bangalore's air traffic control (ATC) every hour.



By modelling the airfields, airspace, airspace routes and flight schedules, delay studies can be undertaken using fast-time simulation models.

Progression of delays (in minutes) in the airspace over Bangalore aircraft during a typical winter schedule. There can be delays because of high traffic, inclement weather or VIP and fighter aircraft movement.



Making airports safe and comfortable