evektor

SACC

Small Airplane Cockpit Climate

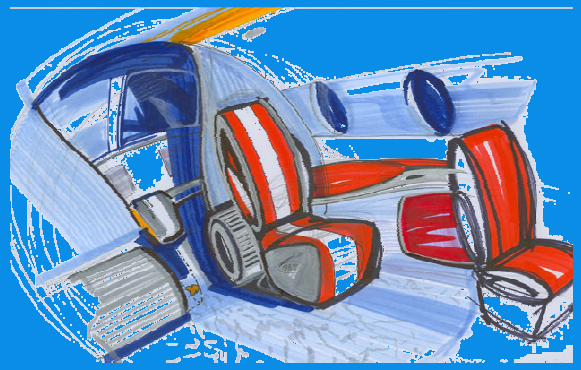
July 2009
Warszawa

Ing. Pavel Růžička, PhD

Cockpit Climate Generaly

Cockpit climate affects:

- Thermal and environmental comfort of passengers
- Thermal comfort and fatigue of crew
- Safety of airplane operation
- Health of passengers and crew



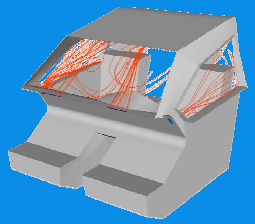
Cockpit climate consists of:

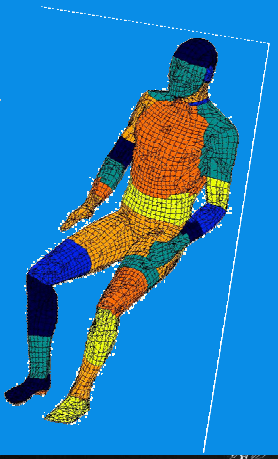
- Thermal comfort: Operation Temperature
  PMV - Predicted Mean Vote,
  PPD - Percentage People Dissatisfied
- Draft rating
- Air pollution

Cockpit Climate Improvement

Computer simulation

- CFD (flow velocity, pressure, ...)
- Thermal calculations (radiation, heating, ...)





Measurements

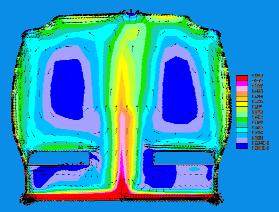
- anemometry (PIV, thermal anemometry, ...)
- flow visualization (smoke, He bubbles, ...)
- thermal field
- thermal dummy

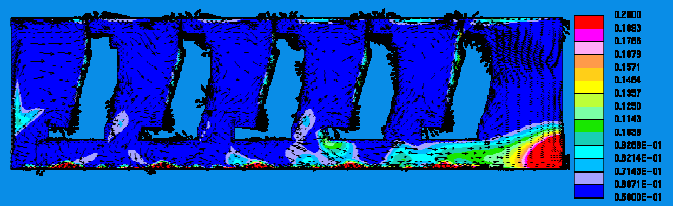
Validation of calculations

Methodology creation

Applicability on small aircrafts

- General aviation and small commuter category airplanes cockpit climate are usually not systematically solved (experience from previous design is used)
- Air condition and ventilation systems are not operating during engine OFF (parking, waiting for take-off) - overheating
- Not pressurized cabin - pollutants (fuel vapours, hydraulic liquid vapours, dust, etc.) can penetrate into cabin
- Lack of methodology to design ventilating and air-condition systems
  - optimizing manifolds and blowers from point of view of pressure drops and direction of flow
  - individual ventilation settings
  - using natural convection for ventilation (system of slots)





Goals of project:

Main objective of the project:

Development of analytic and experimental environment for small commuter and normal class airplane design, regarding satisfaction of thermal comfort of passengers and crew requirements.

Subtasks:

- Reducing thermal inputs inside the cabin (i.e. reduce heat transfer, especially by solar radiation, into cabin)
- Suggesting a solution of standing airplane cooling by means of ventilation slots (natural convection)
- Preventing from lengthwise increasing of concentration of dangerous substances in a cabin (i.e. preventing from lengthwise flow)
- Optimizing manifolds to blowers from point of view of pressure losses and aerodynamic generated noise.
- Suggesting a system of individual ventilation settings

Benefits:

- rationalize airplane structure
- increase the comfort of passengers and crew (and thus operational safety)
- create conditions to increase value of airplane

Ways to achieve the goals

- Numerical simulation – CFD

- Experiment on full-scale model of fuselage, pointing on:

* flow field character (thermal distribution, thermal dummy)
* pressure drops in ventilation system
* thermal field in cabin - passenger comfort
* particle transport from sources placed in several places in cabin (source - receptor relations)
* effect of different materials covering outer surface of fuselage on heat gain

- Validation of CFD models and their checkout

- Computer modelling with proved models - creation of methodology

Extra benefits of the project

- Creation of coupling between basic and applied research.

Transfer of up-to-date piece of knowledge towards design office and on the other hand information about problems solved during airplane design towards basic research.

- Creation of methodology of designing the systems affecting cockpit climate

Increasing the comfort of passengers and crew of small commuter airplanes, allowing achieving the goal with minimum effort and design costs.

Supposed members of consortium

EVEKTOR, Spol.s r.o. - proposal coordinator

TU Brno - Energy Institute - Dept. of Thermodynamics and Environmental Engineering

More partners are welcomed:

Producer of environmental systems

Small airplane producer

Thank you

Ing. Pavel Růžička, PhD
E- mail: pruzicka@evektor.cz
Tel: +420 572 537 841
Fax: +420 572 537 901

EVEKTOR spol. s r.o.
Letecká 1008
686 01 Kunovice
Czech Republic