TOWARDS SMART VENTILATION

AGENTSCHAP INNOVEREN & ONDERNEMEN

flux50

samen voor #sterkgroeien

Towards Smart Ventilation in Mid-sized Buildings

Project presentation flux50 – 05/05/2022

KU LEUVEN

UNIVERSITEIT GENT

Universiteit Antwerpen

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

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Project overview: starting point

- Smart ventilation system (cfr AIVC)
  - Able to adjust itself to provide IAQ while minimizing energy use, discomfort, noise
  - Responsive to e.g. occupancy, outdoor thermal and air quality
  - Can provide info about e.g. IAQ, energy use, need for maintenance

- Current practice in design of ventilation systems
  - Driven by minimum requirements of individual indicators
  - In mid-sized buildings: very conservative and inefficient
  - Existing methods dependent on brainpower of engineer

Research aim and goals

- **Aim** = determine performance based method for smart ventilation design driven by optimisation during whole life-cycle
- **Specific goals**
  - Define performance **sub-indicators** for **indirect metrics**
  - Aggregate all sub-indicators into **1 general economic performance indicator**
  - **Automate and optimise** aerolic **lay-out** ventilation design
  - **improve and optimise positioning of connections** to outdoor and indoor
- **Focus**: new + renovated mid-sized buildings (Q > 1000 m^3/h)
  - multi-family residential
  - schools
  - offices
  - care facilities (elderly homes)

What and how to optimize ?

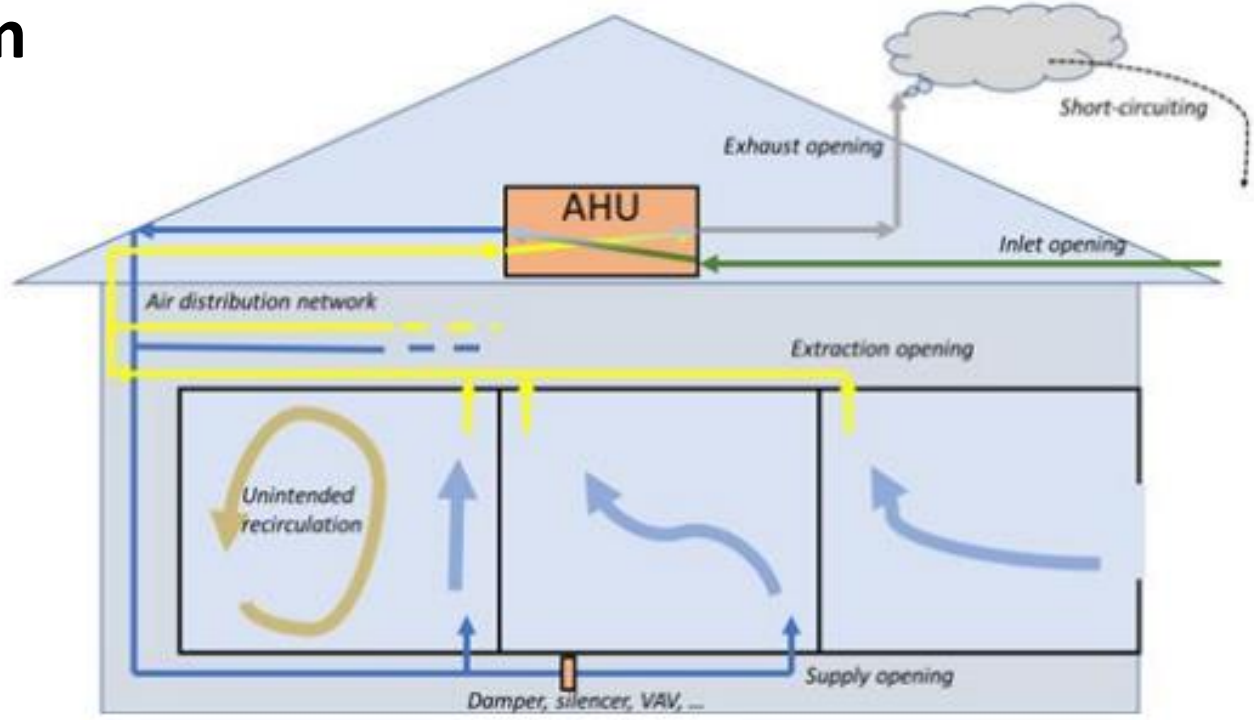
Centralized air distribution system

A variety on design choices

- Air distribution
- Positioning of openings

Methodological challenges

- Accuracy, level of detail
- Feasibility and tool readiness



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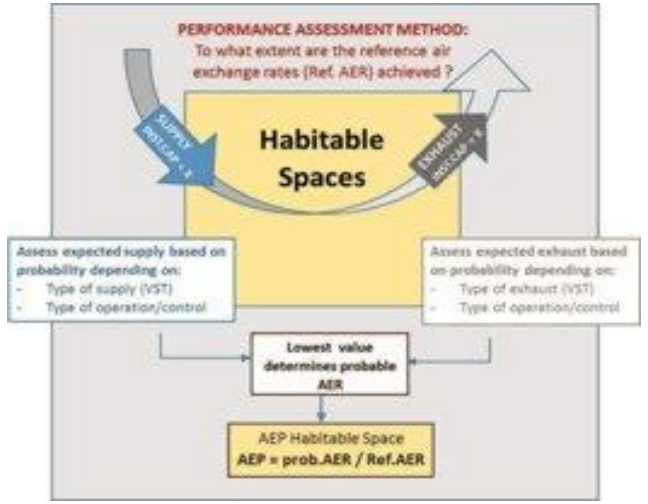
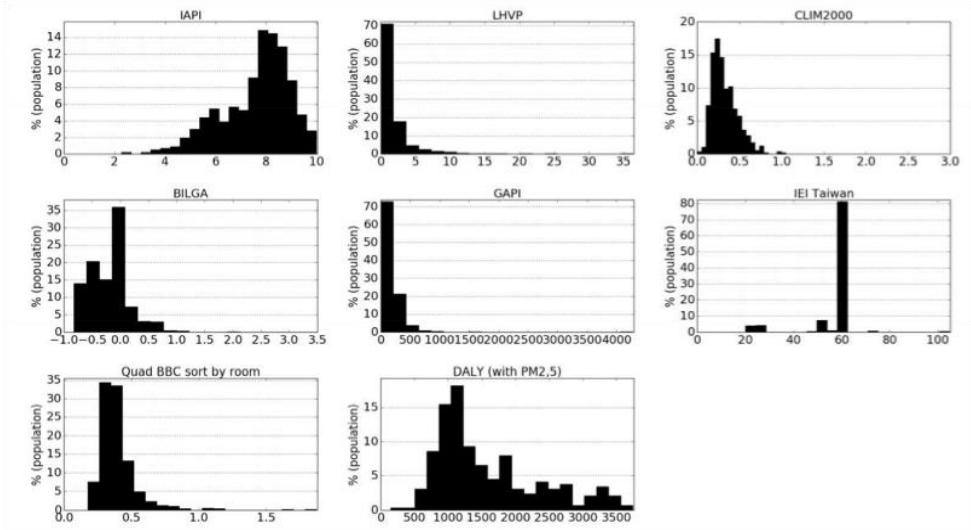
What is optimal ?

- Ventilation performance is a trade-off between IAQ, energy use and comfort, including health, acoustics…
- There is no agreed way to aggregate all these parameters into a general indicator for ventilation performance
- Optimization of ventilation design requires using a general indicator as a cost function
- Inclusion of novel criteria



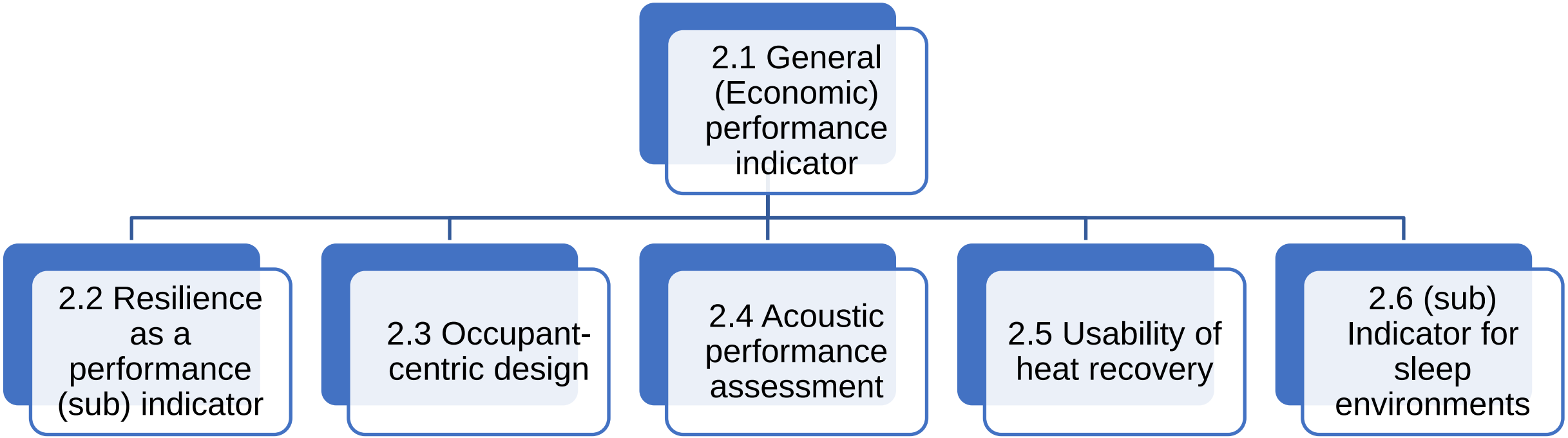


Research method

- WP1: Project management
- WP2: Performance assessment
- WP3: Optimisation of system design
- WP4: Dissemination and valorisation
  - Communication and dissemination
  - Valorisation

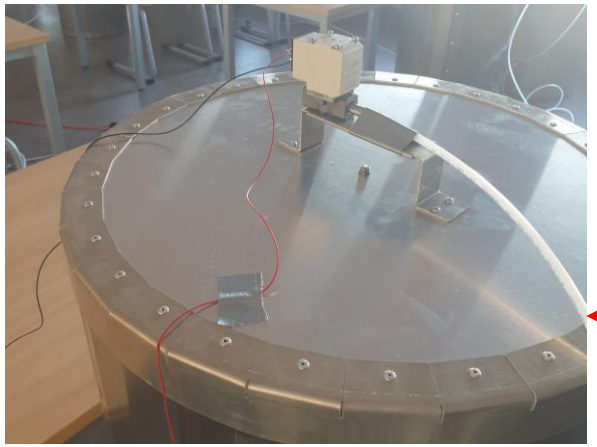
Research method

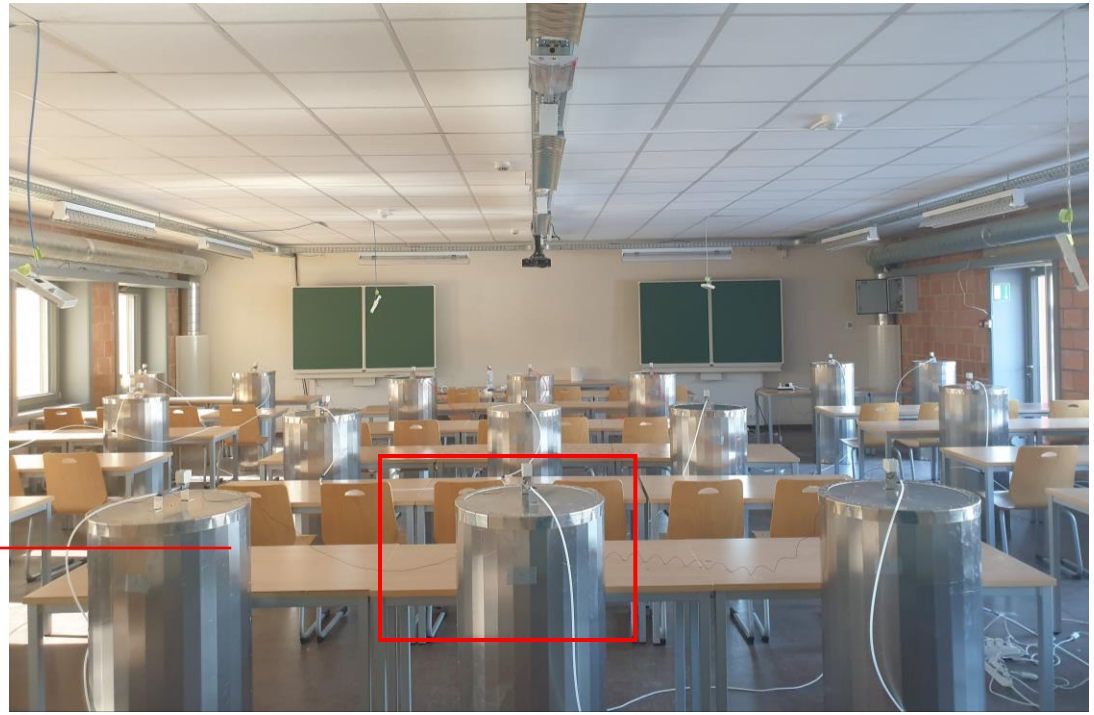
- WP2: Performance assessment



Resilience as a performance sub-indicator for building ventilation strategies

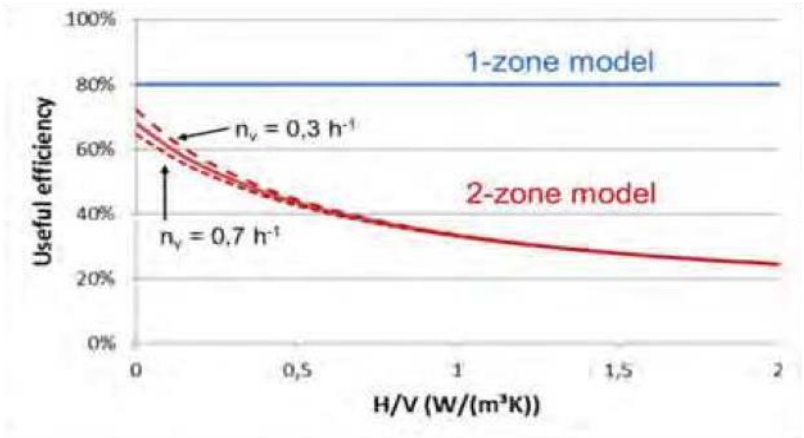
- Case study: KULeuven (school)

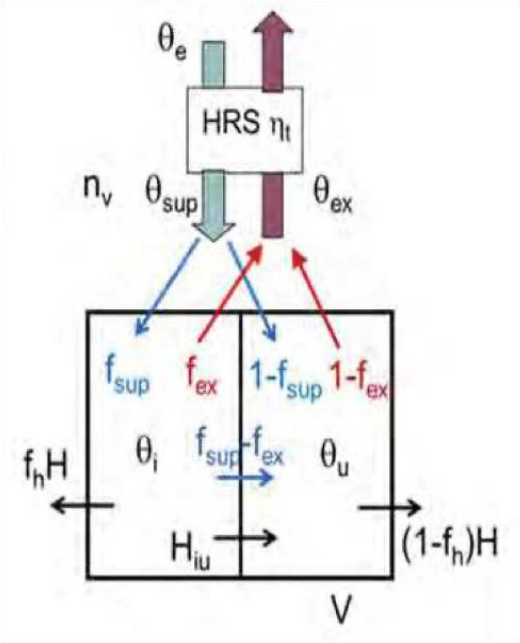




Relation heat recovery potential and ventilation strategy

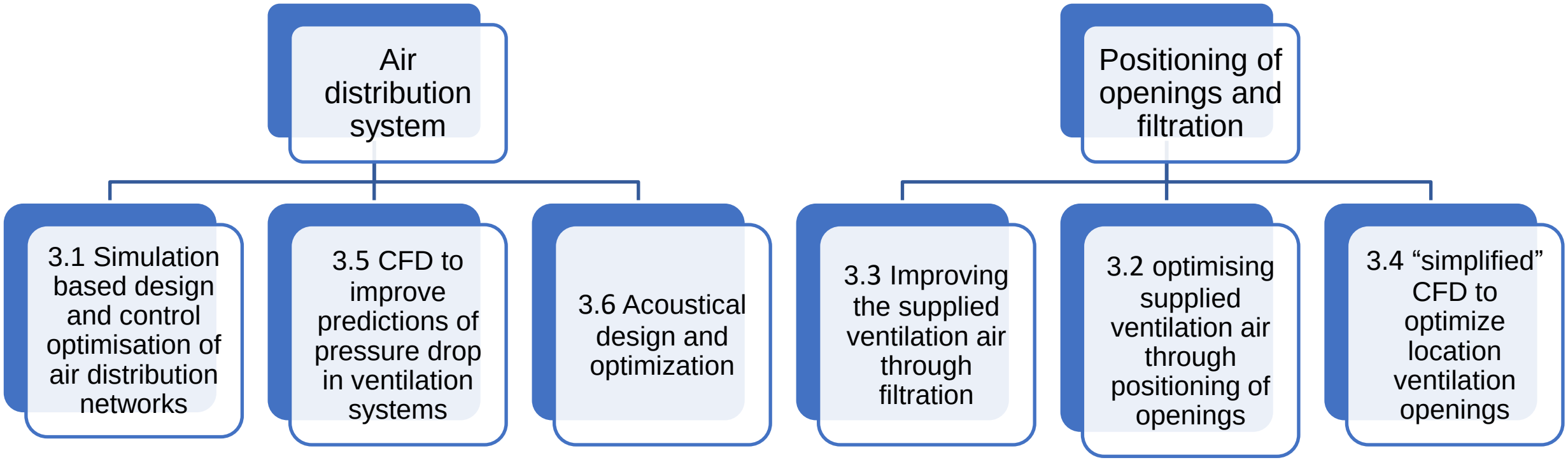
- Simulation test bed





Research method

- WP3: Optimisation of system design

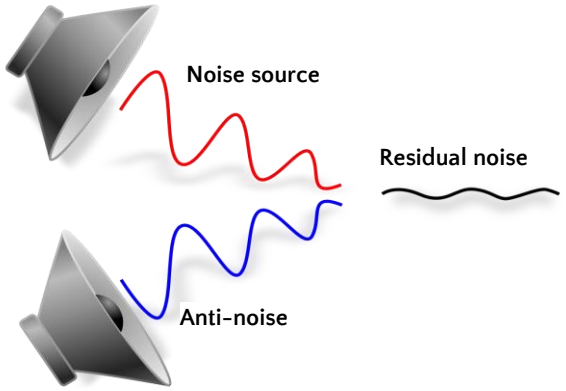


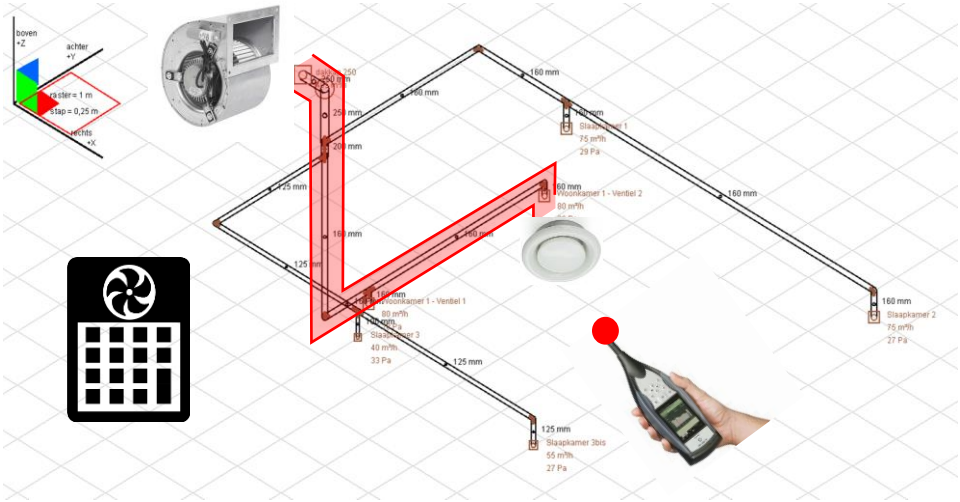
Research: Optimisation of air distribution system

- Optimizing and automating air distribution design and control (routing and design)

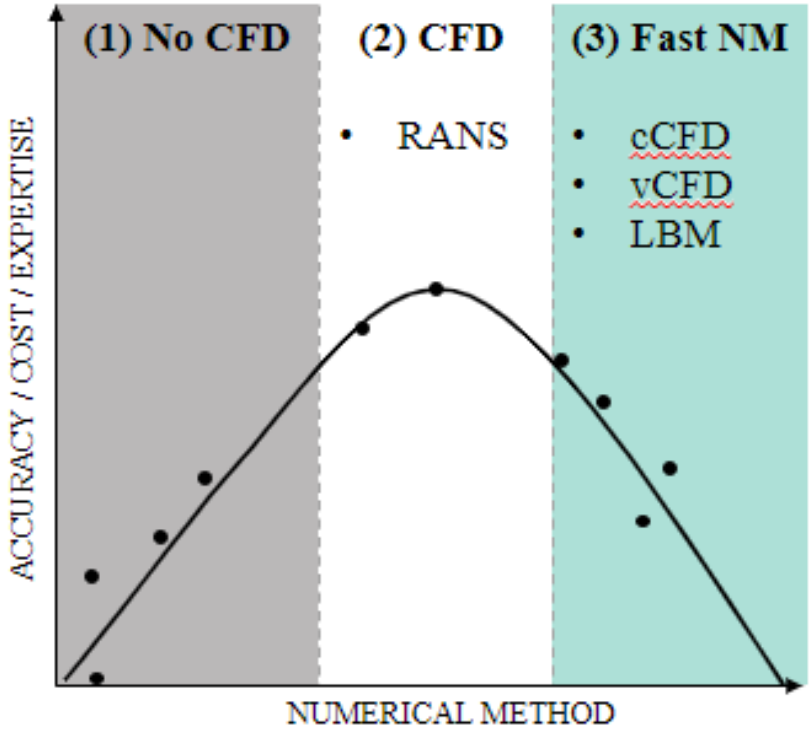
Acoustical design and optimization

- Integrating acoustics in the method
- Researching potential of active noise





Fast numerical methods to optimize placement of ventilation openings



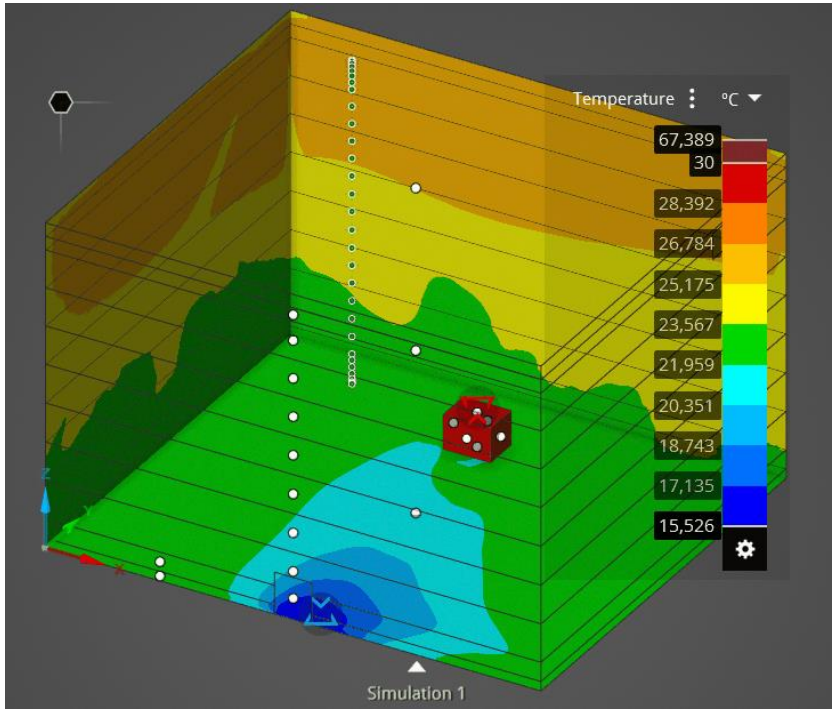


Figure: vCFD using ANSYS Discovery Live 2021 R2

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Valorisation objectives & trajectories

<u>VO1:</u> Conceptual proof, considering practical implementation boundaries of design optimisation

Translation and/or integration of the design approach into design software and/or BIM

<u>VO2:</u> Proof of concept of novel methods for installation, maintenance and control

Development of new control systems to improve performance

Development of commissioning strategies

<u>VO3:</u> The development of new products and initiation of product improvements

Improvement of ventilation systems and components

Development of new or improved services

Partners in the entire value chain

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