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## A NOVEL VENTILATION AND HEATING SYSTEM FOR RESIDENTIAL BUILDINGS

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## Indoor climate in residential buildings and importance of ventilation

- Indoor air pollutants in residential buildings can lead to discomfort or may cause health implications
- Pollutants are produced externally or within the building
- Ventilation is a key factor in maintaining a satisfactory indoor climate for the occupants



Common sources of indoor air pollution

#### **Residential ventilation**

- Transition from traditional ventilation concepts towards mechanical ventilation with heat recovery
- Due to strict energy regulations mechanical ventilation is common a requirement in residential buildings



Ref. Technical Note AIVC 57: Residential ventilation, 2002 Ref. Danish Building Regulations, 2018

- Incorporation of heating into ventilation system
- Simplified space-heating distribution system, reduction of HVAC system installation and maintenance costs
- Suitable for passive houses, where thermal comfort can be achieved solely by postheating of the supply air
- Possibility to supply heat via supply air at ventilation rates based on IAQ requirements with a maximum supply air temperature of about 50°C

Ref. Passive House Institute. 2014. The Passivhaus Standard. Ref. Feist et al. 2005. Energy and Buildings, 37, 1186-1203.

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- > The same supply air temperature  $t_{air}$  in all rooms
- Regulation in individual room is not possible
- According to Danish regulations it should be possible adjusted the air temperature on room level

#### Ph.D. project

Title:

#### A new ventilation system for sustainable residential buildings

# Supervisor:Alireza Afshari, professor with specific responsibilities, SBi, AAUCo-supervisors:Niels Christian Bergsøe, senior researcher, SBi, AAUGöran Hultmark, development manager, R&D, Lindab A/S; adjunct professor, SBi, AAU

Objectives: The goal of the project is to design, develop and evaluate the performance of a novel, temperature-based demand controlled ventilation system. The novelty of the system is its capability to adjust the supply air flow rate and air temperature on a room level.

Methodology: Calculations/ Simulations Experiment in a laboratory Full-scale test in a real building

#### Regulation on room level



#### Regulation on room level



Ref. Polak et al., Development of a novel temperature-based demand controlled ventilation system for residential buildings, accepted for Indoor Air Conference, 2018

## Supply ductwork



Ref. www.lindab.com

#### Laboratory experiment

#### Full-scale prototype of the system



Experimental setup, Lindab A/S, Farum

#### Control of the air temperature

The temperature of the supply air can be controlled individually in each of the supply ducts in a range of 25 °C and 52 °C, for the input parameters used in the experiment



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#### Effectiveness of heat exchange

The effectiveness of heat exchange was defined as a ratio of the actual heat transfer rate to the maximum possible heat transfer rate and calculated as:



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#### Thermal comfort in a room



#### Further steps

Energy performance



Installation in a building



Simulations: Modelica model of the system

Residental climate control



#### Thank you

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