IEA EBC Annex 62

Ventilative Cooling

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EBC
Energy in Buildings and Communities Programme

Background

- The current development towards nearly-zero energy buildings have lead to an increased need for cooling – not only in summer but all year.
- Elevated temperature levels are the most reported problem in post occupancy studies, even in residences in the "heating season"
- There has been a large focus on reducing the heating need in buildings. There is also a need to address the cooling need and to develop more energy-efficient cooling solutions

Why have we experienced an overheating problem?

- It is not possible to reach goals through more:
  - Envelope insulation, Building airtightness, Ventilation heat recovery,
- Which are robust technologies without user interaction
- New measures needs to be included:
  - Demand controlled ventilation, Shading for solar energy or daylighting control, Lighting control, Window opening
- All technologies:
  - Where performance is very sensitive to **control**
  - Which involve different degree of user interaction
  - Whose function and performance are difficult for users to understand

Ventilative Cooling in Offices

- Always a cooling need during occupied hours
- Cooling is not a new technology, but the need for cooling is increasing and more efficient systems have to be developed to fulfill future energy requirements
- Application of the free cooling potential of outdoor air is widely used in mechanical ventilation systems, while the use in natural and hybrid ventilation system is still limited in many countries

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Offices in Cold Climate

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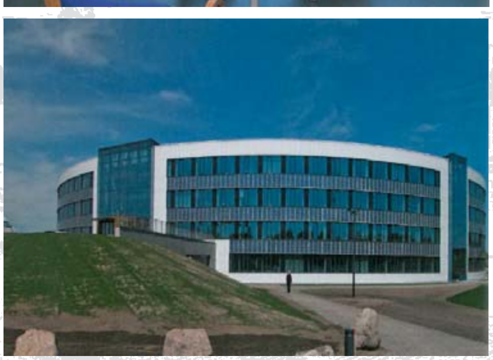
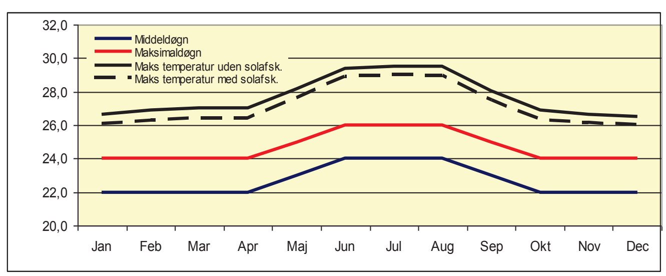
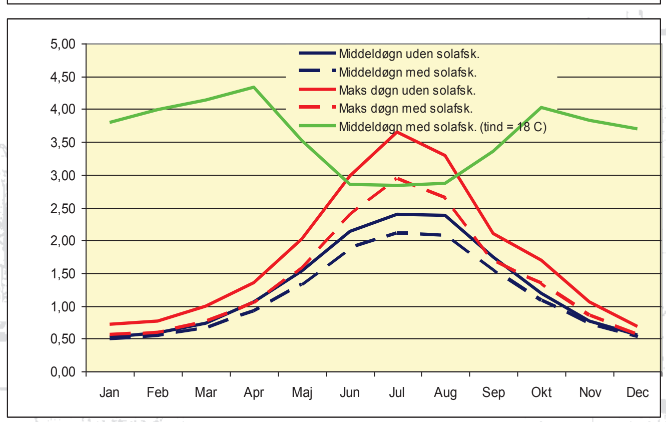
Challenges in a Cold Climate







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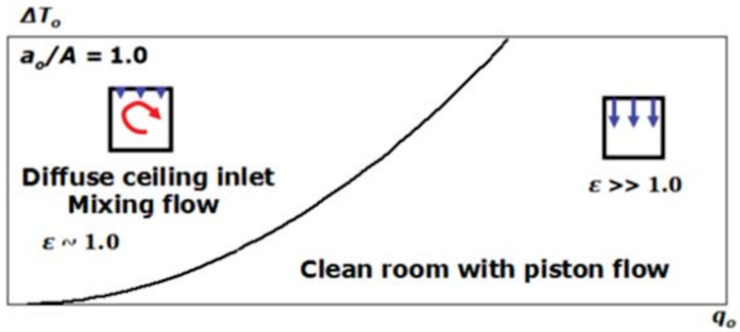
Diffuse ceiling air distribution patterns



Buoyancy control

Momentum control

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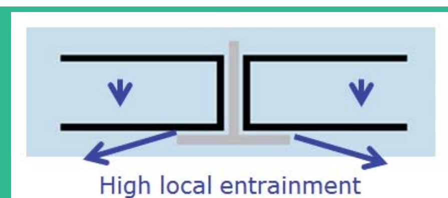
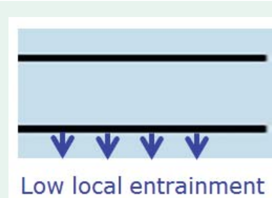
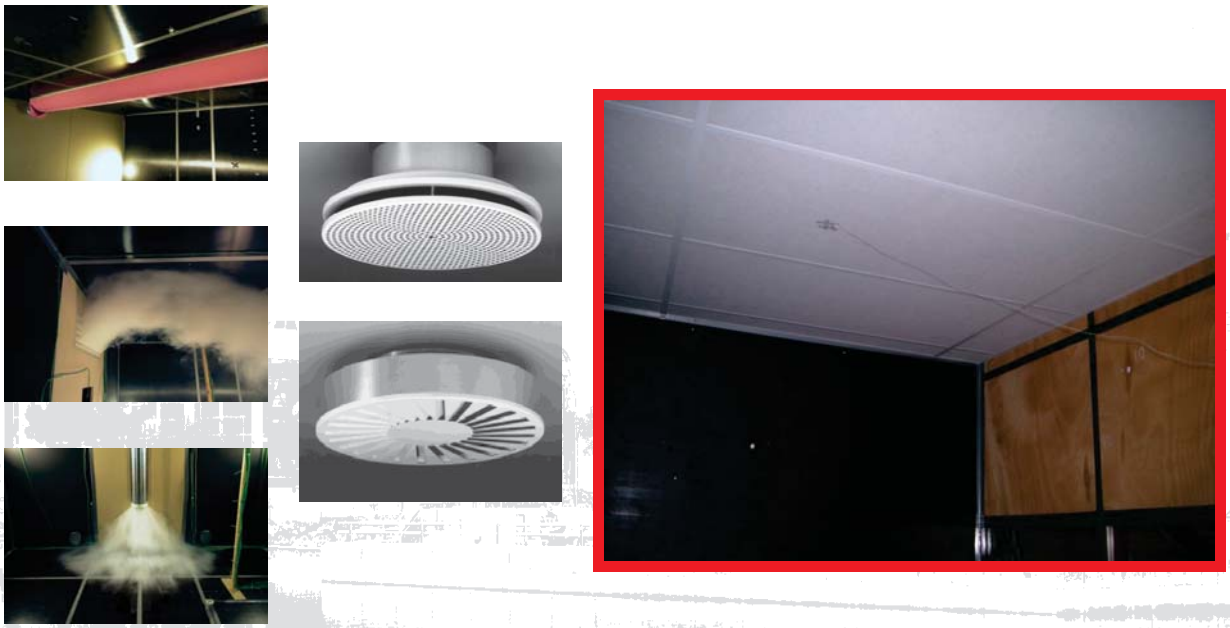
Opening types

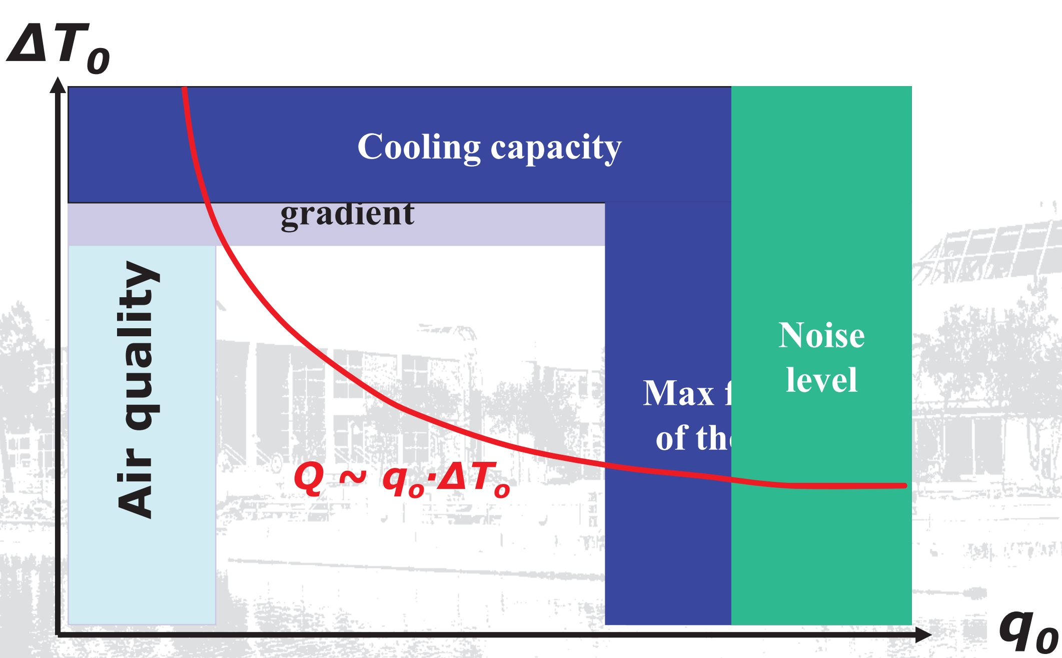
Rockfon ceiling	
Ecophon ceiling	
Fully diffuse ceiling	

Six Different Air Distribution Systems

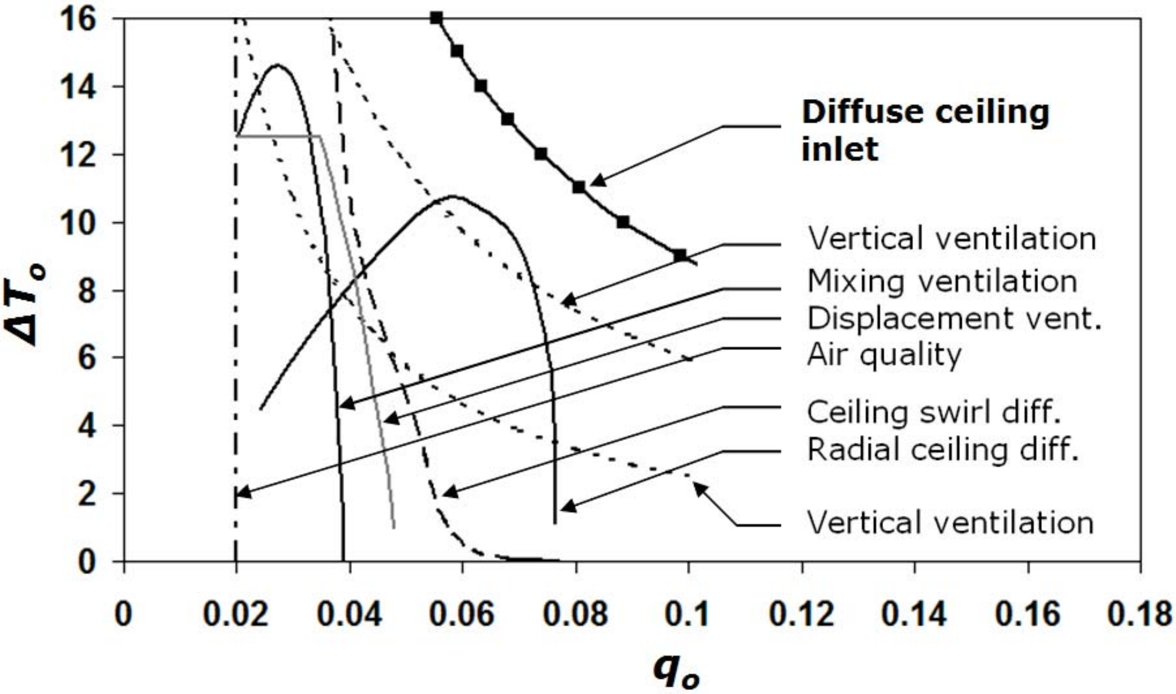
-Tested in the same geometry and with the same load



The q_o-ΔT_o Design Chart



qo - ΔTo Design Chart



Definition of Ventilative Cooling

- Ventilative Cooling is application (distribution in time and space) of ventilation air flow to reduce cooling loads in buildings
- Ventilative Cooling utilizes the cooling and thermal perception potential (higher air velocities) of outdoor air
- In Ventilative Cooling the air driving force can be natural, mechanical or a combination

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Ventilative cooling is a solution

- Ventilative cooling can be an attractive and energy efficient passive solution to avoid overheating.
  - Ventilation is already present in most buildings through mechanical and/or natural systems using opening of windows
  - Ventilative cooling can both remove excess heat gains as well as increase air velocities and thereby widen the thermal comfort range.
  - The possibilities of utilizing the free cooling potential of low temperature outdoor air increases considerably as cooling becomes a need not only in the summer period.

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Status of Application

- Application of Ventilative cooling for residential buildings is at a low level
  - It is considered difficult to evaluate
  - Few technical solutions available – mainly manual window opening only very few automated
- Ventilative cooling is a standard solution in offices with mechanical ventilation
  - Designed for IAQ criteria
  - Limited benefit due to fan energy use
- Ventilative cooling by natural/hybrid ventilation is known
  - But only used in a few cases in offices

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Annex Objectives

- To analyse, develop and evaluate suitable methods and tools for prediction of cooling need, ventilative cooling performance and risk of overheating in buildings that are suitable for design purposes.
- To give guidelines for integration of ventilative cooling in energy performance calculation methods and regulations including specification and verification of key performance indicators.
- To extend the boundaries of existing ventilation solutions and their control strategies and to develop recommendations for flexible and reliable ventilative cooling solutions that can create comfortable conditions under a wide range of climatic conditions.
- To demonstrate the performance of ventilative cooling solutions through analysis and evaluation of well-documented case studies.

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Annex Outcome

- Guidelines for energy-efficient reduction of the risk of overheating by ventilative cooling
- Guidelines for ventilative cooling design and operation in residential and commercial buildings
- Recommendation for integration of ventilative cooling in legislation, standards, design briefs as well as on energy performance calculation and verification methods
- New ventilative cooling solutions including their control strategies as well as improvement of capacity of existing systems
- Documented performance of ventilative cooling systems in case studies

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Annex Organization

- Subtask A: Methods and Tools
- Subtask B: Solutions
- Subtask C: Case Studies

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Annex Leadership

- Participating countries
  - Austria, Belgium, China, Denmark, Finland, Ireland, Italy, Japan, Netherlands, Norway, Switzerland, UK, USA

- Operating Agent:
  - Denmark, represented by Per Heiselberg, Aalborg University
- Subtask A:
  - Leader: Switzerland, represented by Fourentzos Flourentzou, ESTIA
  - Co-leader: Italy, represented by Annamaria Belleri, EURAC
- Subtask B:
  - Leader: Austria, represented by Peter Holzer, IBRI
  - Co-leader: Italy, represented by Lorenzo Pagliano, POLIMI
- Subtask C:
  - Leader: China, represented by Guoqiang Zhang, Hunan University
  - Co-leader: