venticool
the international platform for ventilative cooling

IEA EBC
Annex 62
The IEA project
on ventilative cooling
EBC

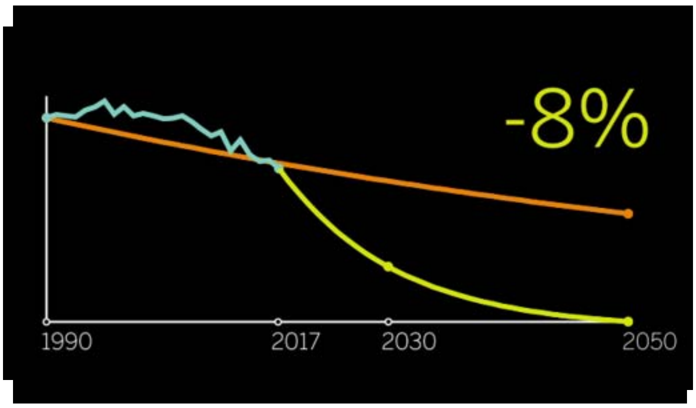
Ventilative cooling in buildings: now & in the future

Hilde Breesch (KU Leuven Technology Campus Ghent)

INIVE EBC bbri.be KU LEUVEN

context

- Evolution of CO_2 emission in Belgium



 De Standaard 13/10/2017 Source: http://www.standaard.be/cnt/dmf20171013_03129318

Workshop

- Objective
  - Discuss implementation of ventilative cooling & its role to ensure good thermal summer comfort in buildings
- Topics
  - Design guidelines
  - Solutions & technologies
  - EPBD calculations & recommendations for standards
  - Future challenges & opportunies
- 2 parts
  - Outcomes of IEA EBC Annex 62 Ventilative cooling
  - Broader Scene and Future International Collaboration

3

Programme
Outcomes of IEA EBC Annex 62

	Title	Speaker
9:45	Introduction to Annex 62 – Interactive voting	Per Heiselberg
10:05	Design Guidelines	Annamaria Belleri
10:25	National energy performance calculation methods	Michal Pomianowski
10:45	Solutions and technologies	Theofanis Psomas, Hans Martin Mathisen
11:05	break	
11:30	Implementing technologies in a kindergarten and a lecture room	Guilherme Carrilho da Graça, Maria Kolokotroni
11:50	Lessons learned from actual buildings	Paul O'Sullivan
12:10	Interactive voting	Rémi Carrié
12:25	Panel discussion: ventilative cooling in practice	Peter Holzer, Ivan Pollet, Bruno Deraedt, Wout Parys, Erik Smeets Hilde Breesch
13:05	Lunch	

Programme
Broader Scene & Future collaboration

	Title	Speaker
14:05	Future challenges and opportunities	Peter Wouters
14:25	Recommendations and challenges for CEN and ISO standards	Christoffer Plesner
14:45	Interactive voting	Rémi Carrié
14:55	Panel discussion: the role of ventilative cooling to guarantee good thermal summer comfort	Flourentzos Flourentzou, Karsten Duer, Hendrik-Jan Steeman, Ann Van Eycken Per Heiselberg
15:30	break	
16:00	Future international research: Resilient cooling	Peter Holzer
16:15	Group discussion	Peter Holzer
16:50	Closing remarks	Per Heiselberg
17:00	reception	

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IEA EBC Annex 62
The IEA project on ventilative cooling

Brussels, Belgium
23 October 2017

Ventilative cooling in buildings: now & in the future

International Workshop

Peter Wouters and François Rémi Carrié
INIVE EEIG

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the international platform for ventilative cooling

venticool is the international ventilative cooling platform launched in October 2012 to accelerate the uptake of ventilative cooling by raising awareness, sharing experience and steering research and development efforts in the field of ventilative cooling.

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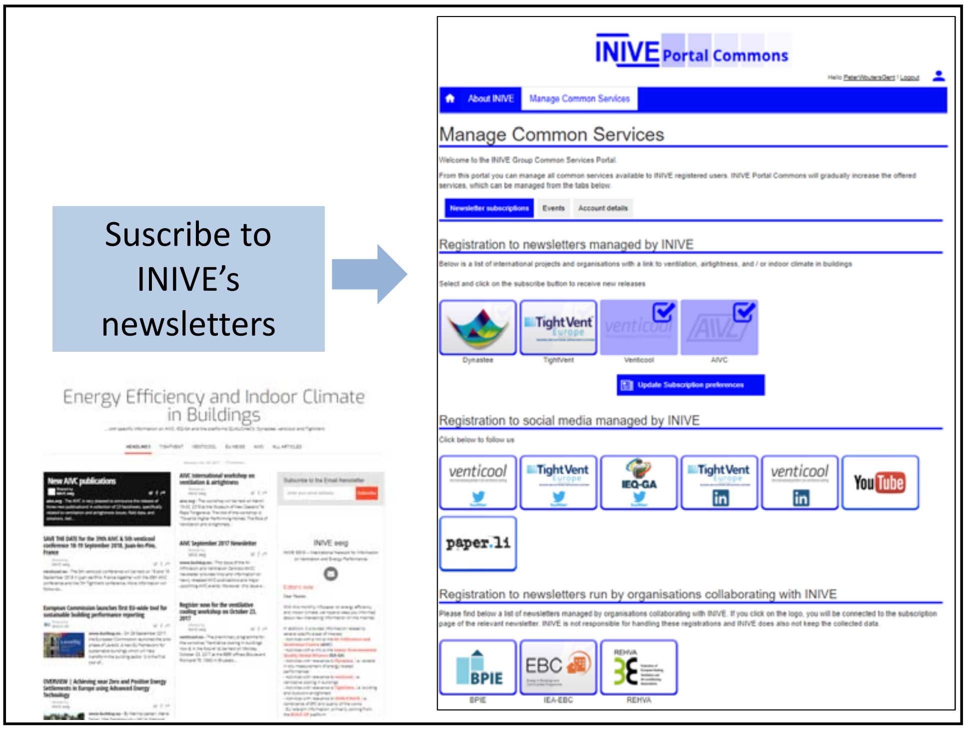
INFORMATION ON VENTICOOL
INFORMATION ON EBC ANNEX 62
Dear visitor,
Welcome to this combined website of the venticool platform and of IEA EBC Annex 62 –
Ventilative Cooling
SAVE THE DATE for the 39th AIVC – 7th TightVent – 5th venticool conference 18-19
September 2018, Juan-les-Pins, France
The 5th venticool conference will be held on 18 and 19 September 2018 in Juan-les-Pins, France
together with the 39th AIVC conference and the 7th TightVent conference. More information will
follow soon so stay tuned. ...
Continue reading →
Recent updates
SAVE THE DATE for the 39th AIVC & 5th venticool conference 18-19 September 2018, Juan-les-Pins, France
38th AIVC – 6th TightVent – 4th venticool joint conference – Final programme released
Register now for the ventilative cooling workshop on October 23, 2017
Keynote speakers/topical sessions/list of accepted papers at the 38th AIVC – 6th TightVent – 4th venticool joint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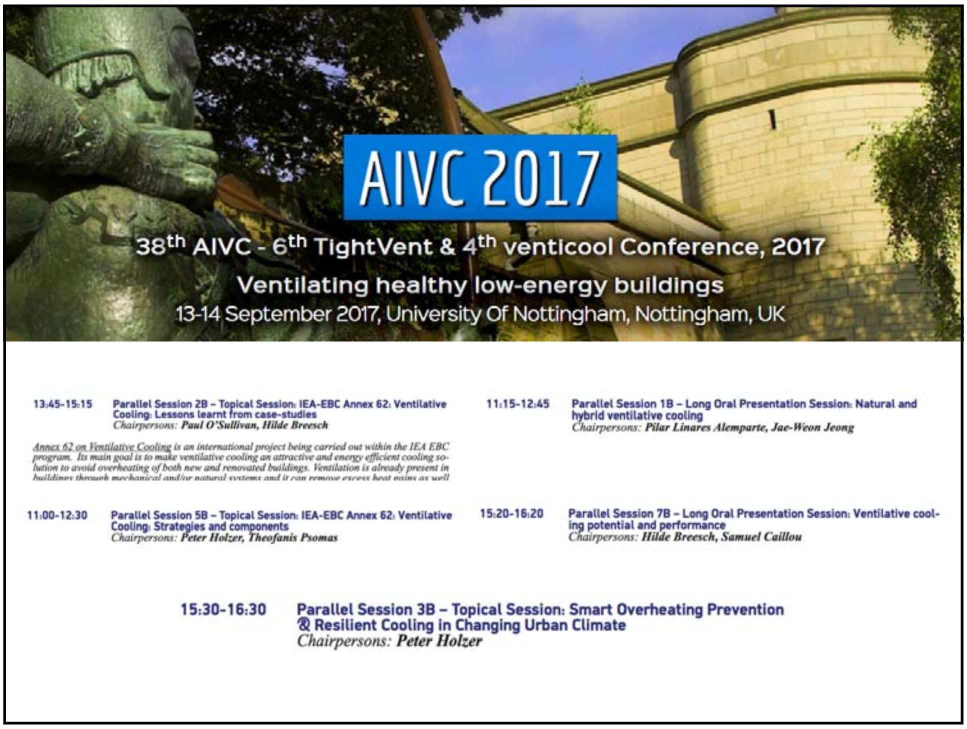
AIVC 2017
38th AIVC - 6th TightVent & 4th venticool Conference, 2017
Ventilating healthy low-energy buildings
13-14 September 2017, University Of Nottingham, Nottingham, UK
13:45-15:15 Parallel Session 2B – Topical Session: IEA-EBC Annex 62: Ventilative Cooling: Lessons learnt from case-studies
Chairpersons: Paul O'Sullivan, Hilde Breesch
Annex 62 on Ventilative Cooling is an international project being carried out within the IEA EBC program. Its main goal is to make ventilative cooling an attractive and energy efficient cooling solution to avoid overheating of both new and renovated buildings. Ventilation is already present in buildings through mechanical and/or natural systems and it can remove excess heat gains as well
11:15-12:45 Parallel Session 1B – Long Oral Presentation Session: Natural and hybrid ventilative cooling
Chairpersons: Pilar Linares Alemparte, Jae-Weon Jeong
11:00-12:30 Parallel Session 5B – Topical Session: IEA-EBC Annex 62: Ventilative Cooling: Strategies and components
Chairpersons: Peter Holzer, Theofanis Psomas
15:20-16:20 Parallel Session 7B – Long Oral Presentation Session: Ventilative cooling potential and performance
Chairpersons: Hilde Breesch, Samuel Caillou
15:30-16:30 Parallel Session 3B – Topical Session: Smart Overheating Prevention & Resilient Cooling in Changing Urban Climate
Chairpersons: Peter Holzer


AIVC 2018
5th venticool conference
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Specific sessions foreseen on ventilative cooling, summer comfort, overheating prevention, etc.
Call for papers to come
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PRESENTATION OF IEA EBC ANNEX 62 VENTILATIVE COOLING

International Energy Agency

EBC Energy in Buildings and Communities Programme

PER HEISELBERG
DEPARTMENT OF CIVIL ENGINEERING

OPERATING AGENT
IEA EBC ANNEX 62

AALBORG UNIVERSITY
DENMARK

BACKGROUND

EBC Energy in Buildings and Communities Programme

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 ONE OF 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

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WHY DO WE EXPERIENCE AN OVERHEATING PROBLEM?

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OVERHEATING IS A "NEW AND INCREASING PROBLEM" FOR LOW ENERGY BUILDINGS

- More focus on energy than indoor environment (less requirements for documentation)
- Is underestimated and is not given enough focus in the design process
- Old rules of thumb still used

TOO SIMPLIFIED DESIGN METHODS USED

- Averaging heat loads in time and space
- Uncertain correlation between cooling need and overheating risk

NO (VERY FEW) STANDARD TECHNICAL SOLUTIONS AVAILABLE, ESPECIALLY FOR DWELLINGS

NO (VERY LIMITED) USER EXPERIENCE ON HANDLING OF OVERHEATING PROBLEMS - "ONE-OF-A-KIND" SOLUTIONS ARE OFTEN NOT WELL-ADAPTED TO "PRACTICAL USE"

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WHY DO WE EXPERIENCE AN OVERHEATING PROBLEM?

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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

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VENTILATIVE COOLING IS A SOLUTION

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VENTILATIVE COOLING IS AN ATTRACTIVE AND ENERGY EFFICIENT PASSIVE SOLUTION TO COOL BUILDINGS AND AVOID OVERHEATING.

- Ventilation is already present in most buildings through mechanical and/or natural systems
- 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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DEFINITION OF VENTILATIVE COOLING

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VENTILATIVE COOLING IS APPLICATION OF VENTILATION FLOW RATES TO REDUCE THE COOLING LOADS IN BUILDINGS.

*VENTILATIVE COOLING UTILIZES THE **COOLING POTENTIAL** AND **THERMAL PERCEPTION POTENTIAL** OF OUTDOOR AIR.*

THE AIR DRIVING FORCE CAN BE NATURAL, MECHANICAL OR A COMBINATION

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POTENTIAL AND LIMITATIONS

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OUTDOOR CLIMATE POTENTIAL

- Outdoor temperature lower than the thermal comfort limit in most part of the year in many locations
- Especially night temperatures are below comfort limits
- Natural systems can provide “zero” energy cooling in many buildings

LIMITATIONS

- Temperature increase due to climate change might reduce potential
- Peak summer conditions and periods with high humidity reduce the applicability
- An urban location might reduce the cooling potential (heat island) as well as natural driving forces (higher temperature and lower wind speed). Elevated noise and pollutions levels are also present in urban environments
- High energy use for air transport limit the potential for use of mechanical systems
- Building design, fire regulations, security are issues that might decrease the potential use of natural systems

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IEA EBC Annex 62 Overview

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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 LEADERSHIP

PARTICIPATING COUNTRIES

Australia, Austria, Belgium, China, Denmark, Finland, Ireland, Italy, Japan, Netherlands, Norway, Portugal, 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: Denmark, represented by Theofanis Psomas, AAU

SUBTASK C:

Leader: China, represented by Guoqiang Zhang, Hunan University
Co-leader: Ireland, represented by Paul O’Sullivan, CIT

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ANNEX ORGANIZATION

EBC Energy in Buildings and Communities Programme

SUBTASK A: METHODS AND TOOLS

- Analyse, develop and evaluate methods and tools for prediction of cooling need, ventilative cooling performance and risk of overheating in buildings that is suitable for design purposes

SUBTASK B: SOLUTIONS

- Investigate the cooling performance of existing mechanical, natural and hybrid ventilation systems and technologies and typical comfort control solutions Develop flexible and reliable ventilative cooling solutions that can create comfort under a wide range of climatic conditions.

SUBTASK C: CASE STUDIES

- Demonstrate the performance of ventilative cooling through analysis and evaluation of well-documented case studies

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ANNEX DELIVERABLES

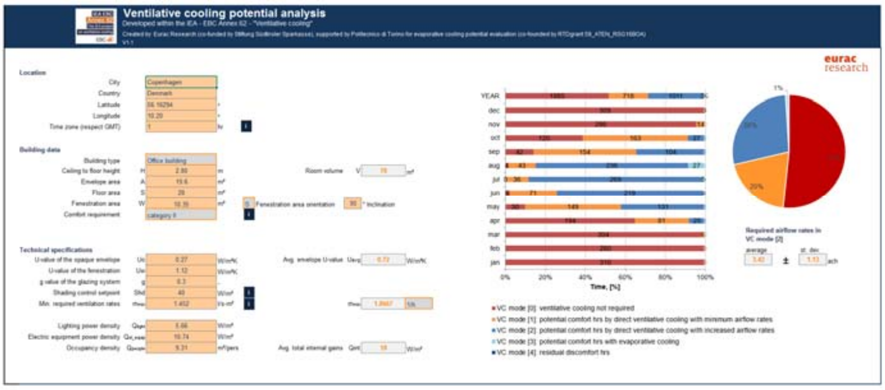
EBC Energy in Buildings and Communities Programme

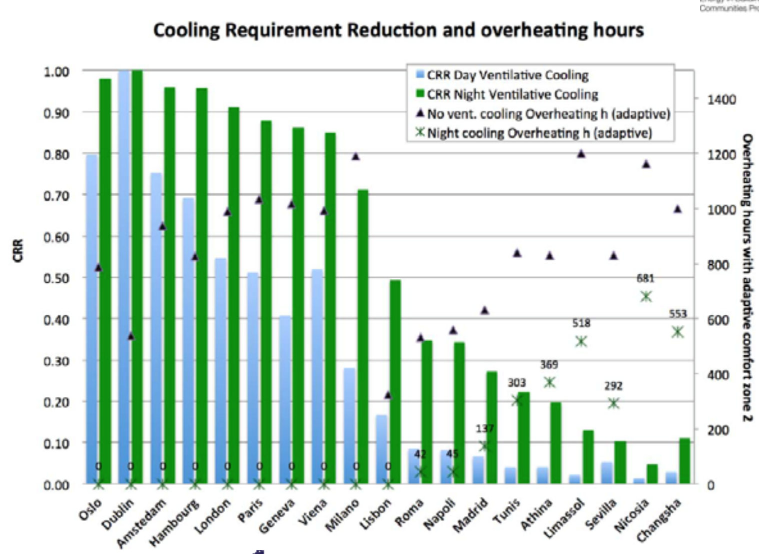
ID	Official Deliverable	Target Group
D1	Overview and state-of-the art of Ventilative Cooling	Research community and associates. Policy makers
D2	Ventilative Cooling Source Book	Building component and ventilation system developers and manufacturers. Architects, and design companies, engineering offices and consultants
D3	Ventilative Cooling case studies	Architects, consulting engineers
D4	Guidelines for Ventilative Cooling Design and Operation	Architects and design companies, engineering offices and consultants
D5	Recommendations for legislation and standards	Policy makers and experts involved in building energy performance standards and regulation
D6	Project Summary Report	Research community and associates + ECBCS Programme

VC TOOL

CHARACTERISTICS

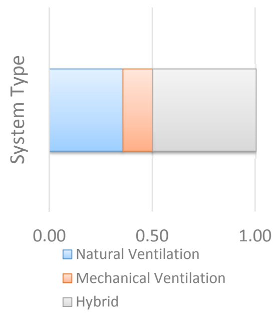
- Can estimate climate potential
- Suggest potential relevant strategies
- Estimate necessary air flow rates





LESSONS LEARNED

Ventilative cooling Concepts	Natural driven	Mech. Supply Driven	Mech. exhaust driven	Natural night ventilation	Mech. night ventilation	Air conditioning	Indirect Evap. Cooling	Earth to Air Heat Exch.	Phase Chang eMaterials
zero2020 (IE)	X			X					
Brunla Primary school (NO)	X			X					
Solstad barnehage (NO)	X		X	X	X				
Wanguo MOMA (CN)		X	X		X	X			
UNI Innsbruck (AT)	X		X	X					
wk Simonsfeld (AT)	X		X						
Renson (BE)	X			X					
KU Leuven Ghent (BE)	X		X				X		
Maison Air et Lumiere (FR)	X								
Mascalucia ZEB (IT)	X			X				X	
Nexus Hayama (JP)	X					X			
CML Kindergarden (PT)	X			X					
Bristol University (UK)					X	X			X
Living Lab (NO)	X								



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CASE EXAMPLES

Kindergarten, Portugal

University, United Kingdom

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BUILDING COMPONENTS

AIRFLOW GUIDING VENTILATION COMPONENTS
- WINDOWS, ROOFLIGHTS, DOORS, DAMPERS, FLAPS, LOUVRES, GRILLES, VENTS

AIRFLOW ENHANCING VENTILATION COMPONENTS
- CHIMNEYS, ATRIA, VENTURI AND ROTATING EXHAUST VENTILATORS,
- WIND TOWERS, -CATCHERS, -SCOOPS, DOUBLE FACADES

PASSIVE COOLING VENTILATION COMPONENTS
- CONVECTIVE, EVAPORATIVE, PHASE CHANGE MATERIAL

ACTUATORS
- CHAIN, SPINDLE, ROTARY

SENSORS
- TEMPERATURE, HUMIDITY, CO2, OCCUPANCY, ...

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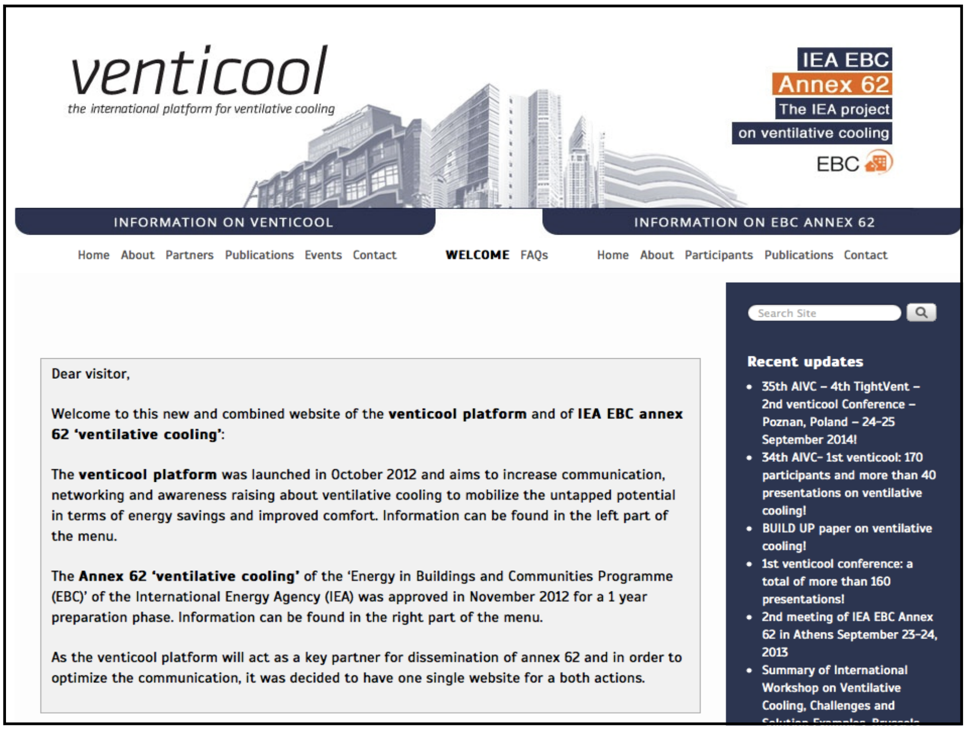


Thanks for your attention
More information on IEA EBC Annex 62 on www.venticool.eu

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Fondazione Cassa di Risparmio sostenuto da

IEA Annex 62
Ventilative Cooling

Design guidelines

Annamaria Belleri
Eurac Research

Ventilative cooling in buildings: now & in the future
October 23rd , Bruxelles

EBC

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Contents

- Introduction
- Ventilative cooling principles
- Design Process
- Ventilative cooling potential
- Key performance indicators
- Design evaluation

EBC

Introduction

- Ventilative cooling can be an attractive and energy efficient natural cooling solution **to reduce cooling loads and to avoid overheating** in buildings.
- Ventilation is already present in most buildings through mechanical and/or natural systems and by adapting them for cooling purposes, cooling **can be provided in a cost-effective way** (the prospect of lower investment and operation costs).
- Ventilative cooling can both remove excess heat gains as well as increase air velocities and thereby **widen the thermal comfort range**.

Ventilative Cooling Principles

		Ventilative Cooling	Supplementary Solutions
Daytime mean outdoor temperature	Cold (> 10°C from comfort zone)[1]	Minimize air flow rate - draught free air supply	-
	Temperate (2-10°C)	Increasing air flow rate from minimum to maximum	Strategies for enhancement of natural driving forces to increase flow rates Natural cooling strategies like evaporative cooling, earth to air heat exchange to reduce air intake temperature during daytime
	Hot and dry (-2°C …. +2°C)	Minimum air flow rate during daytime Maximum air flow rate during night time	Natural cooling strategies like evaporative cooling, earth to air heat exchange, thermal mass and PCM storage to reduce air intake temperature during daytime. Mechanical cooling strategies like ground source heat pump, mech. cooling
	Hot and humid	Natural ventilation should provide minimum outdoor air supply	Mechanical cooling/ dehumidification

[1] *Temperature difference between indoor and outdoor air temperature.*

Design process

Conceptual design phase
- Targets
- Ventilative cooling potential
- Ventilative cooling principle
- Supplementary passive or natural cooling

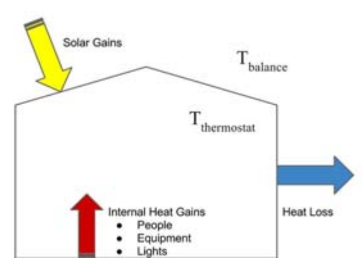
Basic design phase
- Integration of building and ventilative cooling system
- Load calculation

Detailed design phase
- Type and location of ventilative cooling components
- Control strategy
- Design validation

How to evaluate the ventilative cooling potential at early design stages?

How to assess ventilative cooling performance?

Ventilative cooling potential

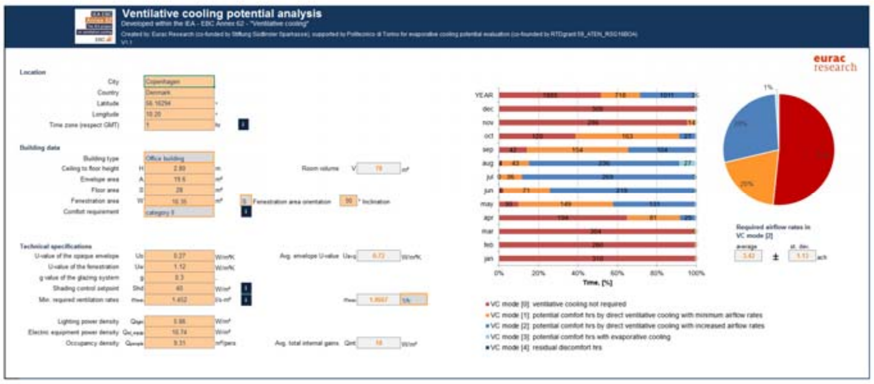


To assess the potential of ventilative cooling by taking into account also:

- building envelope thermal properties
- internal gains
- ventilation needs

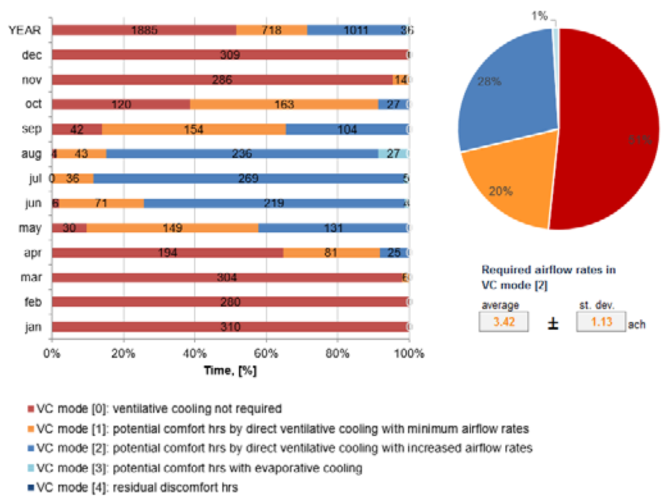
Ventilative Cooling mode [0]: no ventilative cooling required;
Ventilative Cooling mode [1]: potential comfort hours by direct ventilative cooling with minimum airflow rates;
Ventilative Cooling mode [2]: potential comfort hours by direct ventilative cooling with increased airflow rates;
Ventilative Cooling mode [3]: potential comfort hours with evaporative cooling;
Ventilative Cooling mode [4]: residual discomfort hours.

Ventilative cooling potential



http://venticool.eu/wp-content/uploads/2017/05/V1.0_Ventilative-cooling-potential-analysis-tool.xlsm

Ventilative cooling potential



Key performance evaluation

- to evaluate and compare in a fairly way both new and old, innovative and standard, passive and active technologies;
- to value the performance of ventilative cooling both in energy and thermal comfort terms;
- to include KPIs for ventilative cooling and push towards their application in standards, design protocols and guidelines, monitoring protocols, dynamic simulation tools, energy labels;
- to assess designs in a standardized way.

Design for thermal comfort

Thermal comfort indicators should take into account the following aspects:

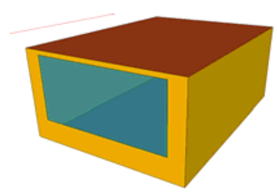
- represent discomfort situation due to both overheating and overcooling;
- different thermal comfort models (Fanger, adaptive);
- overheating severity

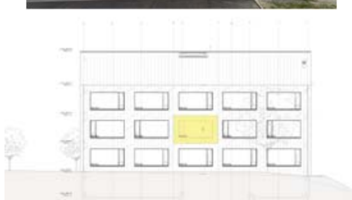
Design for energy saving

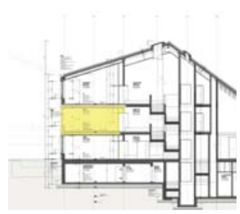
Energy indicators should be able to take into account the following aspects:

- cooling need and/or energy savings related to ventilative cooling;
- ventilation need and/or savings related to ventilative cooling only;
- possible drawbacks on energy behavior during heating season, i.e. increase of heating need due to cold draughts or higher infiltrations etc..;
- ventilative cooling effectiveness: match of cooling need and ventilative cooling “generation”

Reference office

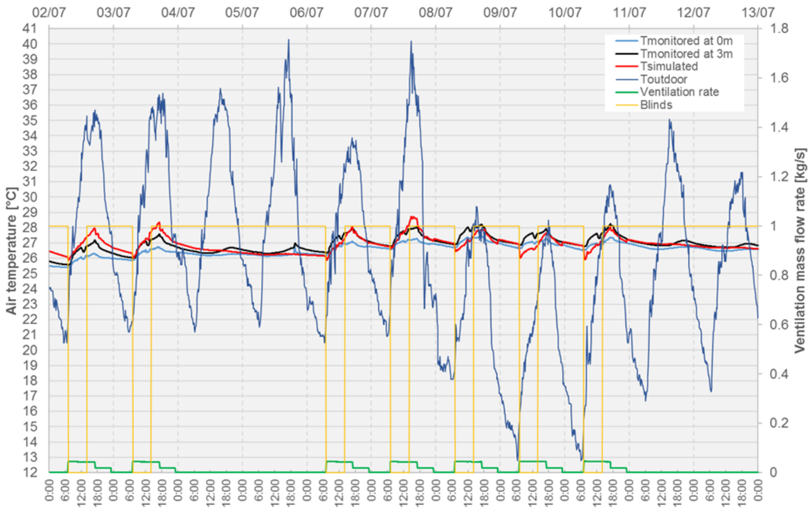




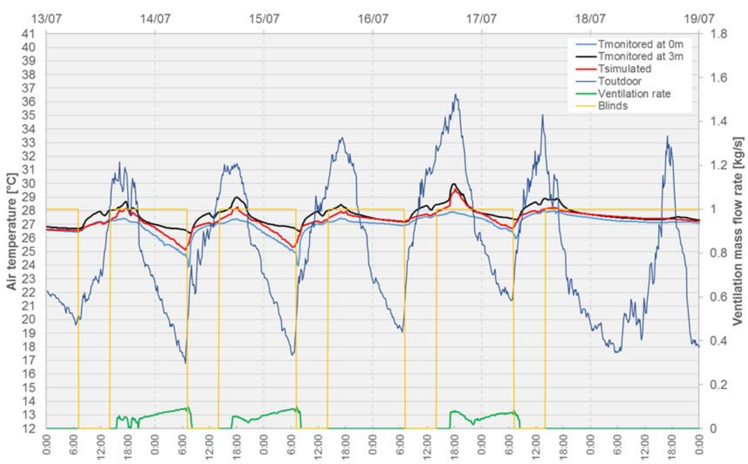


Location: Sion (CH)

Model validation: mechanical ventilation



Model validation: natural ventilation

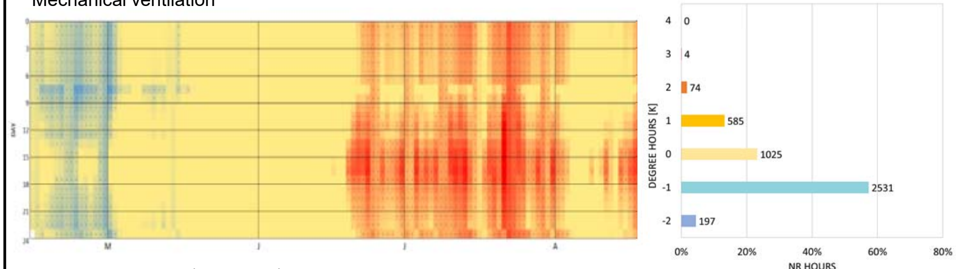


Ventilation strategy

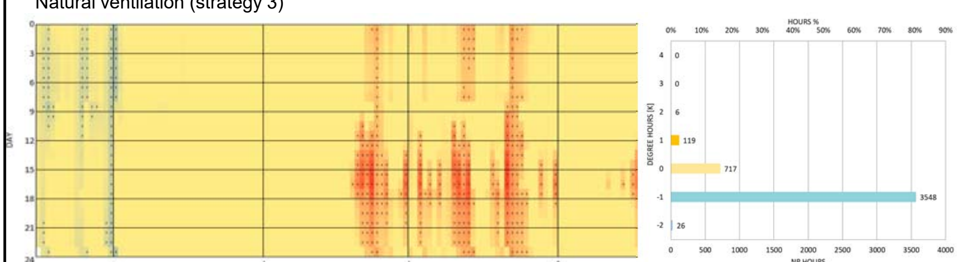
1. Balanced mechanical ventilation
2. Direct natural ventilation with window control based on indoor-outdoor temperatures: Tzone > Tout AND Tzone > 23°C
3. Direct natural ventilation with window control based on thermal adaptive comfort: Tzone > Tcomfort
4. Passive night ventilation: Tzone > Tout AND Tzone > 23°C

Degree hours criteria

Mechanical ventilation



Natural ventilation (strategy 3)

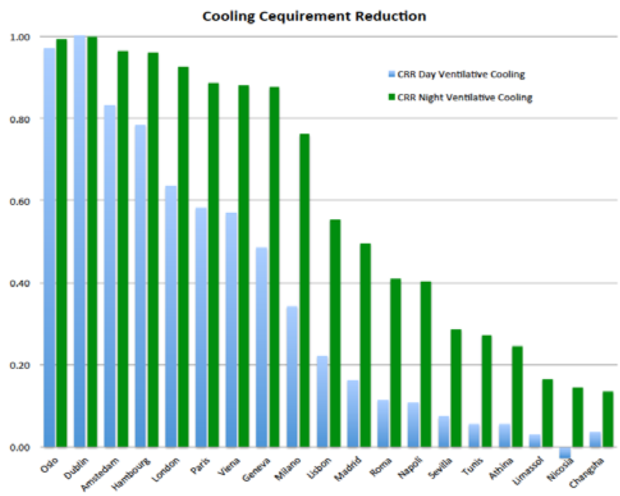


Thermal comfort

Index	Description	Mechanical ventilation	Daytime natural ventilation	Adaptive daytime natural ventilation	Daytime and night-time natural ventilation
POR	Percentage outside the range	48%	17%	20%	2%
DhC (warm)	Degree hours Criterion (warm period)	478	176	148	5
DhC (cold)	Degree hours Criterion (cold period)	66	0	16	0

Index	Description	Metric	Mechanical ventilation	Daytime natural ventilation	Adaptive daytime natural ventilation	Daytime and night-time natural ventilation
Q_t	Annual heating and cooling energy demand	[kWh]	54	44	44	16
$Q_{H/C,sys}$	Total system energy use for space heating and cooling and for ventilation systems	[MJ]	48	6	6	1
$Q_{el, vent}$	Electricity consumption for ventilation	[kWh]	103	0	0	0
$Q_{pe, HVAC}$	Primary energy for heating, cooling and ventilation	[kWh_pe]	346	45	40	10
CRR	Cooling Reduction Requirement	%	-	0.4	0.5	0.9

Cooling Requirement Reduction (CRR)



Source: Flourentzou et al., 2017

Conclusion

- In general, ventilative cooling is particularly suitable to temperate and hot and dry climates
- Ventilative cooling potential depend not only on outdoor temperature, but more on solar radiation and internal heat gains
- The Percentage Outside the Range (POR) and the Degree Hours Criteria (DhC) enable to identify overheating time and severity as well as overcooling situations
- The Cooling Requirement Reduction (CRR) expresses the reduction of the energy need for cooling due to ventilative cooling

Thank you for your attention

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Annex

Thermal comfort indicators:
- Percentage Outside the Range (POR)
- Degree hours Criteria (DhC)

Energy indicators:
- Primary energy consumption
- Cooling Requirement Reduction (CRR)
- Seasonal Energy Efficiency Ratio (SEERvc)
- Ventilative Cooling Advantage (ADVvc)

Thermal comfort indicators

The **Percentage Outside the Range** index calculates the percentage of occupied hours when the PMV or the operative temperature is outside a specified range.

$$POR = \frac{\sum_{i=1}^{Oh}(wf_i \cdot h_i)}{\sum_{i=1}^{Oh} h_i}$$

Degree hours criterion: the time during which the actual operative temperature exceeds the specified range during the occupied hours weighted by a factor which is a function depending on how many degrees the range has been exceeded.

$$DhC = \sum_{i=1}^{Oh}(wf_i \cdot h_i)$$

Energy indicators

annual primary energy consumption for ventilative cooling

$$Q_{pe,vc} = Q_{pe,v} + Q_{pe,h} + Q_{pe,c} - Q_{pe,v\_hyg}$$

where

$Q_{pe,v}$ = annual primary energy consumption of the fan,

$Q_{pe,h}$ = annual primary energy consumption for space heating

$Q_{pe,c}$ = annual primary energy consumption for space cooling

Q_{pe,v_hyg} = annual primary energy consumption of the fan when operating for hygienic ventilation.

Energy indicators

Cooling Requirements Reduction (CRR), is meant to express the percentage of cooling requirements saved of a scenario with respect to the ones of the reference scenario. where $Qt{,}cref$ is the cooling need of the reference scenario and $Qt{,}cscen$ is the cooling requirement of the ventilative cooling scenario.

$$CRR = \frac{Q_{t,c}^{ref} - Q_{t,c}^{scen}}{Q_{t,c}^{ref}}$$

where

$Qt{,}cref$ = cooling need of the reference scenario
$Qt{,}cscen$ = cooling requirement of the ventilative cooling scenario.

Energy indicators

The Seasonal Energy Efficiency Ratio of the ventilative cooling system, which expresses the energy efficiency of the whole system.

$$SEER_{VC} = \frac{Q_{t,c}^{ref} - Q_{t,c}^{scen}}{Q_{el,v}}$$

where

$Qt{,}cref$ = cooling need of the reference scenario
$Qt{,}cscen$ = cooling requirement of the ventilative cooling scenario
$Q_{el,v}$ = electrical consumption of the ventilation system

Energy indicators

The ventilative cooling advantage (ADV_{VC}) indicator defines the benefit of the ventilative cooling in case ventilation rates are provided mechanically, i.e. the cooling energy difference divided by the energy for ventilation.

$$ADV_{VC} = \frac{Q_{el,c}^{ref} - Q_{el,c}^{scen}}{Q_{el,v}}$$

where

$Q_{el,c}^{ref}$ = electrical consumption of the cooling system in the reference case
$Q_{el,c}^{scen}$ = electrical consumption of the cooling system in the ventilative cooling scenario
$Q_{el,v}$ = electrical consumption of the ventilation system

VENTILATIVE COOLING IN NATIONAL COMPLIANCE TOOLS

MICHAL POMIANOWSKI
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Flourentzos Flourentzou/Jerome Bonvin, Annamaria Belleri, Hilde Breesch, Peter Holzer/Philipp Stern

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Disposition

- Contributing countries
- Objective of this activity
- Case building
- Method
- Results
- Conclusions
- Recommendations

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Contributors

Country	Tool
Denmark	Be15 / BSim
Switzerland	Dial +
Belgium	EPB
Italy (South Tirol)	ProCasaClima
Austria	ArchiPHYSIK

* All contributing countries are also participants of Annex 62 on Ventilative Cooling

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Objectives

- To investigate how ventilative cooling (VC) is considered in national compliance tools (tool features and barriers)
  - To indicate differences and similarities through tool review and results comparison
- To draw conclusions if VC is sufficiently addressed and influences energy and comfort in national compliance calculations.

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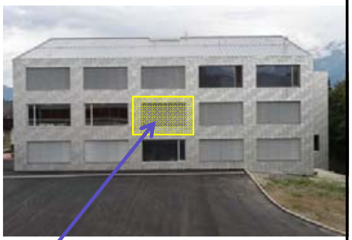
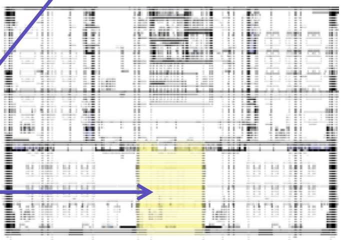
Case building

- The same building (office / school) to be calculated by all contributors.
- Building is located in Switzerland
  (but compliance calculations are done with local national weather data)
- Construction details are provided
  (but each country was permitted to do changes to envelope U values to fulfill national building code)
- **Energy compliance calc. at building level**
- **Comfort compliance calc. at room level**





Room selected for comfort calculation

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Method - first attempt

- All contributors were given large freedom and flexibility to perform calculations – It was specified they should follow national building codes.
- They received building and were simply asked to perform compliance calculations and report on energy performance and comfort (if required by national legislation). Heating and cooling demand, over temperature.
- They were asked to answer several open questions about compliance calculations and compliance tool.

Outcome:
- Large variety in the approach to the calculation case.
- It was not possible to compare results.
- It was hardly possible to draw any coherent conclusions.

But, not obtaining expected outcome is also an outcome!

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Method - second attempt

- More controlled comparing to the first attempt.
- Contributors were still allowed to modify envelope to fulfill local legislations (none did)
- Though several major criteria with respect to ventilative cooling were predefined:
  - Ventilation strategies: mechanical and /or natural ventilation
  - Ventilation strategies: day and/or night operation
  - Air flows
  - Activation time

- Moreover predefined were:
  - People load
  - Appliance load
  - Heating recovery
  - Infiltration
  - Heating source and set point

Approach this time was closer to sensitivity analysis and variable parameter was ventilation strategy (predefined)

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Method - predefined ventilation strategies

Strategy 1: **Mechanical ventilation (all year), only occupied hours**. Air flow at 0.3 l/sm²

Strategy 2: Strategy 1+ **Natural ventilation, only occupied hours (summer)**. Air flow at 0.3 l/sm²

Strategy 3: Strategy 2 + Mechanical night ventilation. Air flow at 0.3 l/sm²

Strategy 4: Strategy 2 + Natural night ventilation. Air flow at 0.3 l/sm²

Natural ventilation promotion (Strategy 3 → Strategy 4)

Strategy 5: Strategy 2 + Natural and mechanical night ventilation. Air flow at 0.3 l/sm²

Strategy 6: Strategy 5 + Air flow increased to 0.4 l/sm²

Strategy 7: Strategy 5 + Air flow increased to 0.6 l/sm²

Strategy 8: Strategy 7 + Only natural night ventilation at 1.2 l/sm²

Natural ventilation promotion (Strategy 7 → Strategy 8)

Strategy 9: Strategy 5 + Air flow increased to 0.8 l/sm²

Strategy 10: Actual air flow as designed in case building (300 m³/h in class rooms and 150 m³/h in offices) + mechanical night ventilation and natural ventilation possibility.

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Method – outcome parameters

- **Energy related**:

  - Primary total energy to operate building
  - Primary energy for cooling
  - Primary energy for heating
  - Primary energy for fan

- **Comfort**:

  - Hours with temperature above 26 °C
  - Hours with temperature above 27 °C

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Results – summary of compliance tools features

National compliance tools

Compliance tool	Denmark	Italy-SouthTirol	Austria	Switzerland	Belgium
Tool 1	Be15	ProCasaClima 3.0	ArchiPhysic	DIAL +	EPB
Tool 2	*Bsim (comfort)	TTERMOLOG Epix 7	Excel based tool	LESOSAI	
Tool 3		**DOCET	Other tools...	SIA-TEC	
Tool 4		Other tools ...		Other tools...	

- Denmark and Belgium have each one obligatory compliance tool (energy compliance calculation)
- Italy, Austria, Switzerland have many compliance tools.

* Documents thermal comfort but other dynamic tools can be also used
** Only for residential buildings
Obligatory tool
Not obligatory tool (other can be used)
Software used in this invetigation

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Results – summary of compliance tools features

Compliance calculation: building, room , zone , not calculated

Compliance calculation	Denmark	Italy-SouthTirol	Austria	Switzerland	Belgium - office/educational use	Belgium - residential
Comfort	Room level	Not calculated	Room level (design day)	Room level	Not calculated	Building level
Energy	Building level	Building level	Building level	Heating : Building level Cooling : Room level	Zone level (with same functions)	Building level

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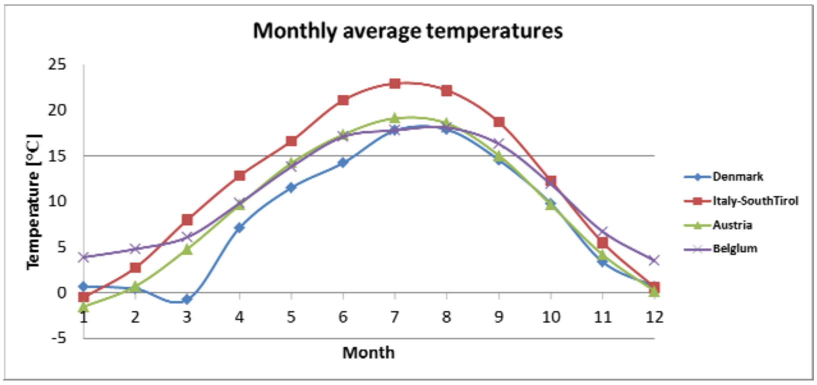
Results – summary of compliance tools features

Calculation time step (energy compliance)



- Switzerland performs hourly calculations

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Results – summary of compliance tools features

Set points (energy compliance)

Country	Heating set point	Mechanical cooling set point	Set point for increased ventilation	Night cooling activation	Comment
Denmark	20 °C	25 °C	23 °C	24 °C	Set points apply for standard energy performance calculation and in that respect they are considered as requirement.
Italy-SouthTirol	20 °C	26 °C	-	-	
Austria	20°C	27°C	-	25°C	
Switzerland	20 °C	26 °C	-	-	Heating set point applies for heating energy calculation and is therfore considered as requirement Cooling set point applies at the room level and is not mandatory -> recommended
Belgium - non residential	depends on function and inertia	depends on function and inertia	-	-	
Belgium - residential	18 °C	23 °C	-	-	

Results – summary of compliance tools features

Proof recognition (energy compliance)

Proof type	Denmark	Italy-SouthTirol	Austria	Switzerland	Belgium - office/educational use	Belgium residential
Burgalry proof	should be regarded	not regarded	not regarded	not regarded	not regarded	regarded
Acoustic proof	should be regarded	not regarded	not regarded	not regarded	not regarded	not regarded
Air quality proof	should be regarded	not regarded	not regarded	should be regarded	not regarded	not regarded
Rain proof	should be regarded	not regarded	not regarded	not regarded	not regarded	not regarded
Insect proof	not regarded	not regarded	not regarded	not regarded	not regarded	not regarded

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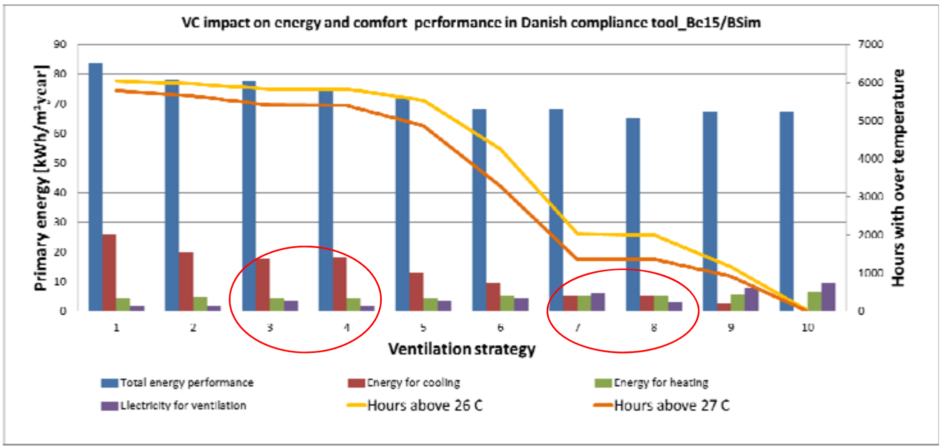
Results – case building **Denmark**

Energy and comfort compliance results



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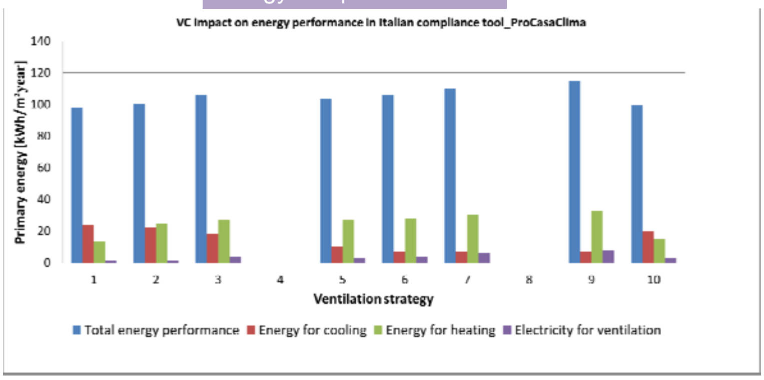
Results – case building **Italy**

Energy compliance results



- Mechanical ventilation rates are set for summer and winter together
- Monthly calculations do not allow user to schedule higher ventilation rates over night time and by that take the account for thermal mass.
- Natural day ventilation is considered together with infiltration

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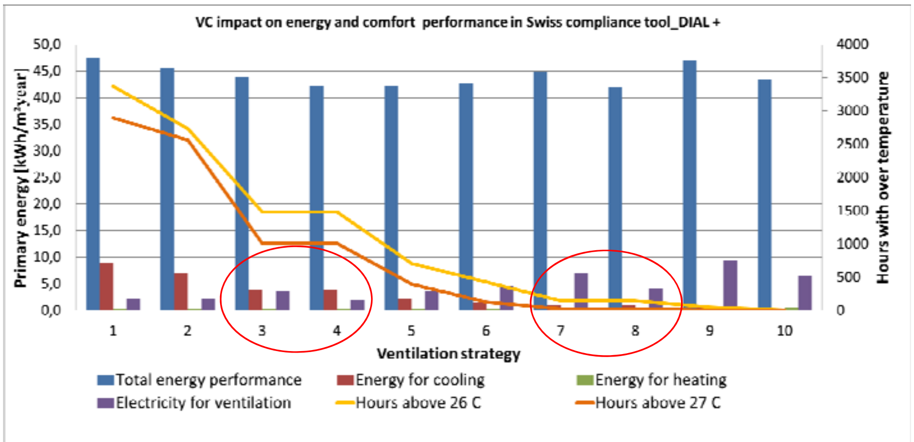
* Comfort is not required in Italy

Results – case building **Switzerland**

Energy and comfort compliance results



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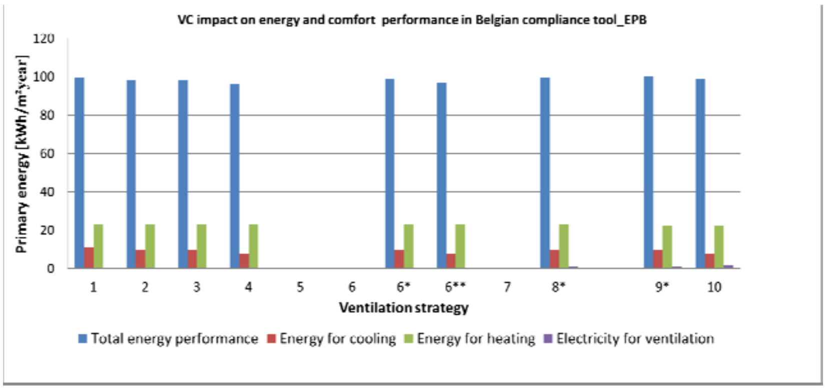
Results – case building **Belgium**

Energy compliance results



- **It is not possible to combine natural and mechanical ventilation at night.**
- **Software seems to be insensitive to ventilation strategy.**

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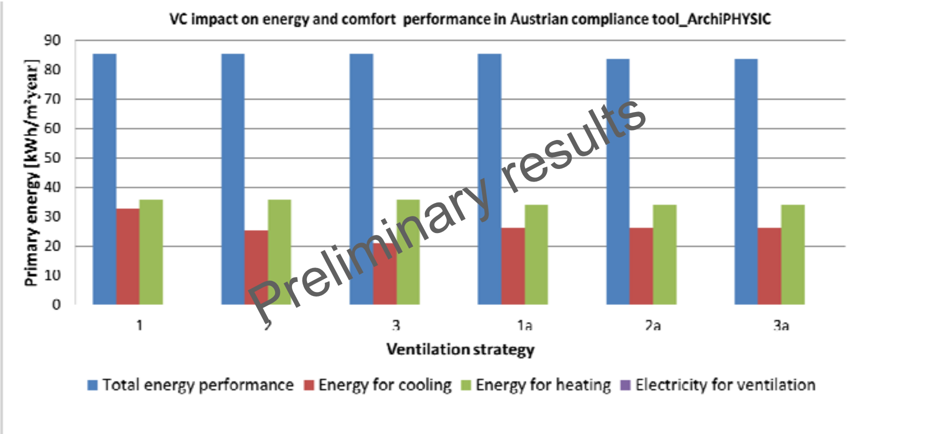
* Comfort is not required in Belgium

Results – case building **Austria**



- **Software seems to be insensitive to ventilation strategy.**

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THANK YOU

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SOLUTIONS AND TECHNOLOGIES

DR. THEOFANIS PSOMAS
VENTILATIVE COOLING IN BUILDINGS: NOW & IN THE FUTURE
INTERNATIONAL WORKSHOP
23RD OCTOBER 2017

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Ventilative Cooling Sourcebook: Annex 62

The sourcebook is oriented to architects, engineers and building service designers, aiming to support them in selecting the right component, in appropriate quality, for implementation in their specific ventilative cooling projects.

- Supplementary material of the Ventilative Cooling State-Of-The-Art-Review
- ✓ Airflow guiding ventilation components
- ✓ Airflow enhancing ventilation components
- ✓ Passive cooling ventilation components
- ✓ Automation components
- Performance indicators of components
- New developed components (13 national projects) and product examples
- Glossary (AIVC, Standards and other sources)

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Ventilative Cooling Sourcebook: Annex 62

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Overheating risk

- Even during transition months
- Central and northern Europe
- Simplified monthly methods of calculation (average in time and space)
- New challenge for designers and occupants (unknown problem)

Degrade the indoor environmental quality, affect productivity, satisfaction, well-being, morale, increase morbidity and mortality-vulnerability of the occupants

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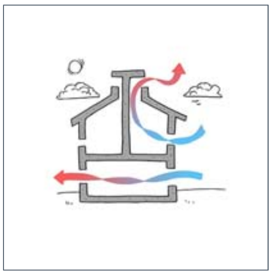
Ventilative cooling

Cooling from the outdoor air

- Energy-efficient, attractive, sustainable, simple and cost-effective solution
- High potential in central and northern Europe
- High efficient at night
- Present in every buildings through natural and/or mechanical systems
- Remove excess heat gains as well as increase air velocities and thereby widen the thermal comfort acceptability



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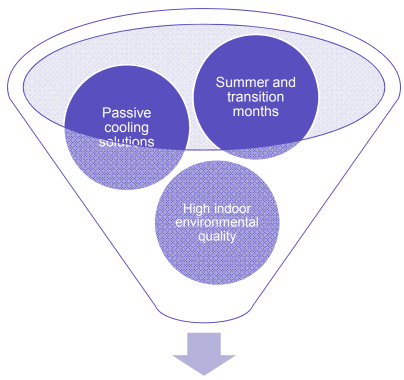
VELUX DOVISTA visility

Goals of the system



VDV Automated window opening control system

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VDV Automated window opening control system

- 3 Functions (cooling, shading and indoor air quality)
  - ✓ Indoor natural ventilation cooling temperature, set point range: 18-30°C
  - ✓ Indoor temperature for shading, set point range: ±3°C relative to indoor natural ventilation cooling temperature
  - ✓ Carbon dioxide, set point range: 400-2000ppm
  - ✓ Relative humidity, set point range: 50-90%
  - ✓ Time interval for control action, range: never, 10 minutes, 30 minutes, 1 hour, 4 hours

- 3 Occupancy states (non-occupied, occupied, night (zone level), also based on time)
- Possibility to set parameters, override or deactivate the system
- Environmental parameters of current day
- Special signals show up for critical values
- Rain sensors pre-fitted

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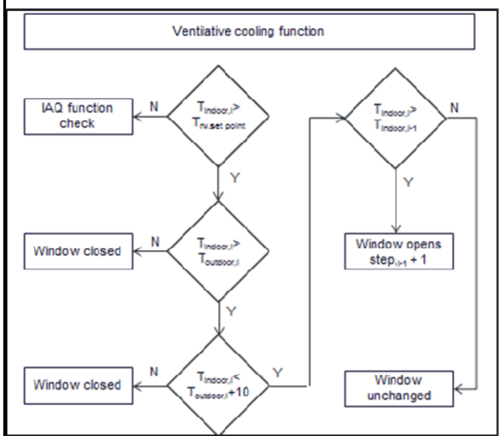
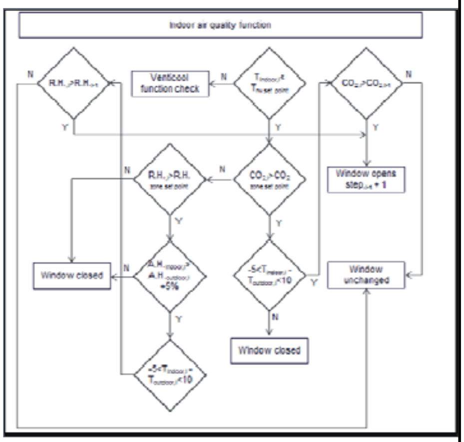
Heuristic algorithms of the system





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Case study

- Built in 1937 in Birkerød, Denmark
- Area: 172.4 m^2 (363.3 m^3)
- East-West orientation
- 2-storey detached with inclined roof and basement (4 members family)
- Renovation in steps 2006-2014
- Façade side-hung wooden windows from 90s (internal shading systems)
- Pivot roof windows (9 with motors and actuators); all internal blackout shading and southern with external shading systems (awnings)
- Mechanical ventilation with heat recovery (both floors)

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Case study

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Monitoring campaign

- May 2015: Silver-box encapsulated accurate commercial sensors (ISO 7726:1998) of upper floor and outdoors
- ✓ Temperature (indoor, outdoor; ±0.3 ^oC)
- ✓ Carbon dioxide concentration (±50 ppm or 5%)
- ✓ Relative humidity (indoor, outdoor; ± 3 %)

- May 2016: additional 2 sensors, at the living room and kitchen, ground floor

- Time step: 5 mins

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Ventilation and cooling of the space

- 2015 summer (June, July, August)
- ✓ Manual use of façade-shading systems
- ✓ Balanced mechanical ventilation system constantly (based on temperature setpoints)
- ✓ Semi-automated system (4 times per day 15', 50% for 15' (manual), leaving home and holiday system, sun screening hotter hours, goodnight/morning function etc.) at the roof windows

- 2016 summer (June, July, August)
- ✓ VDV system at the roof windows
- ✓ No use of façade windows and shading systems (also 2 roof windows without actuators)

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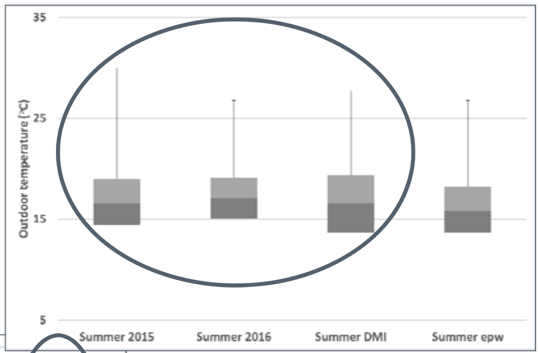
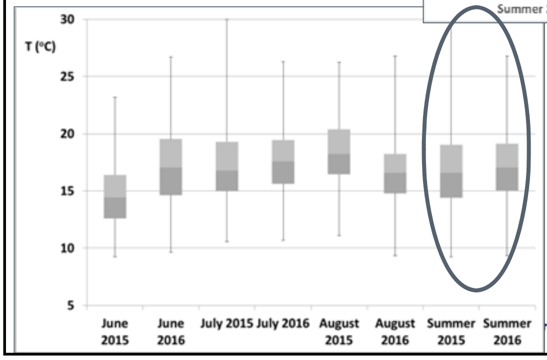
Weather conditions

(outdoor temperature)





Weather conditions

- 2015 and 2016 are "typical" Danish summers
- Peak temperature in July for 2015 and in August for 2016
- Similar wind intensity, temperature and global solar radiation
- 181 hours of rain (2015) and 185 (2016)

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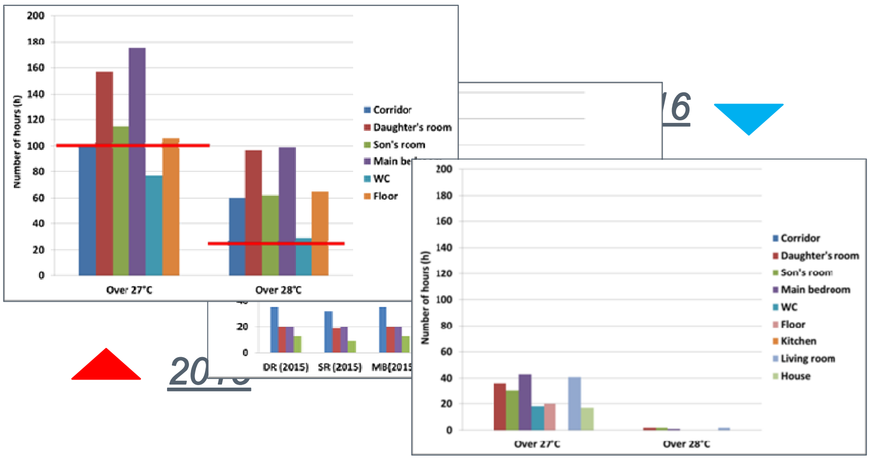
Thermal comfort assessment

(Static index)



Energy use

- Mechanical ventilation system: ***Summer 2015***

220.8 kWh

- VDV system (opening, shading and both gateways): ***Summer 2016***

10.1 kWh

95.4% savings!

Conclusion

The developed window system (95% energy savings) may significantly diminish the indoor discomfort without any compromise of the air quality.

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Automated Windows Market is Predicted to Grow Approximately At 5.12% CAGR By 2023

Press release from: **Market Research Future**

Global Automated Windows Market By Product (Electric, Mechanical, Hybrid), By Component (Sensors & Detectors, Control Panels, Motors & Actuators, Switches and Others), By Application (Residential, Commercial, Industrial) & by Region - Global Forecast to 2023

Factors such as rising population and favorable conditions for international trade & tourism have impelled various governments across the globe to invest heavily in the construction of urban infrastructure and public infrastructure projects, which is anticipated to drive the automated windows market during the forecast period. The automated windows market is expected to reach USD 7.1 Billion by 2023.
Get a sample report at www.marketresearchfuture.com/sample_request/4023 .
Market Research Analysis
The global automated windows market has been analyzed based on the three segments, namely product, component, application and regions. On the basis of product, the global automated windows market is segmented as electric, mechanical and hybrid. Electric segment accounted for largest market share in 2016. The integration of high reliable actuators and sensors for automated control and the ability to maintain the ambient temperature will augment the growth of the segment.
Based on component, the global automated windows market is bifurcated as sensors & detectors, control panels, motors & actuators, switches and others. Through the installation of these components, noise reduction and automated control can be achieved. Based on application, the global automated windows market is bifurcated as residential, commercial, and industrial. Among these, the residential segment accounted for the largest share in 2016.
Scope of the Report
This study provides an overview of the global automated windows market, tracking two market segments across four geographic regions. The report studies key players, providing a five-year annual trend analysis that highlights market size, volume and share for Asia-Pacific, North America, Europe and Rest of the World (ROW). The report also provides a forecast, focusing on the market opportunities for the next five years for each region. The scope of the study segments the global automated windows market by its product, by component, by application and regions.

DENMARK

Ventilative cooling in buildings: now & in the future
International Workshop
23 October 2017

Solstad Kindergarden

Solutions and technologies

Professor Hans Martin Mathisen

Department of Energy and Process Engineering

Faculty of Engineering

Norwegian University of Science and Technology

Norwegian University of Science and Technology

NTNU

Solstad Kindergarten
in Larvik

- Floor area 788 m^2
- Completed in 2011
- South of Norway, close to the coast
- Heating Degree Days, 3870
- Annual average temperature, 7 ^oC
- Design temperature heating, -18 ^oC
- Well insulated building:
  - Window U-value 0,92 W/m^2K
  - Wall U-value 0,18 W/m^2K

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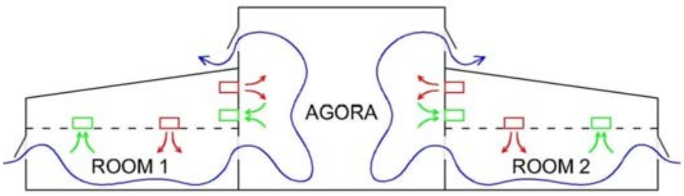
Ventilation principle



- Balanced mechanical ventilation
- Natural ventilation through motor operated windows and hatches
- Mixed mode type of hybrid ventilation
- Advanced control system for mechanical and natural ventilation
  - Demand controlled ventilation (DCV) due to CO_2 and temperature
- The janitor stops the mechanical ventilation during the warmer time of the year

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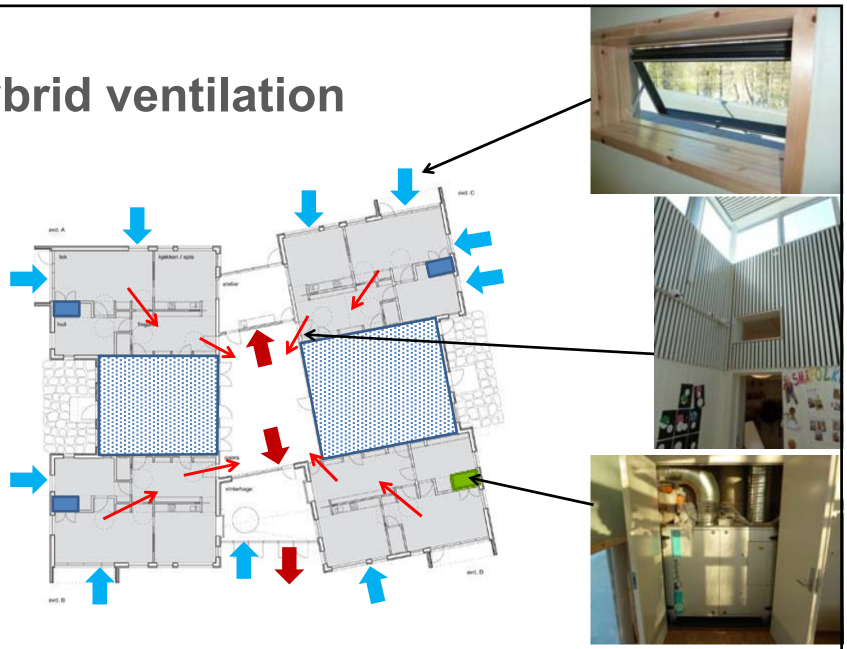
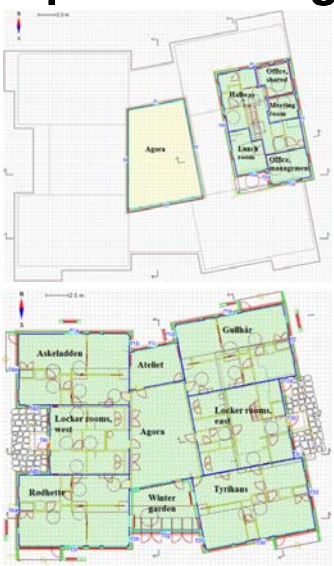
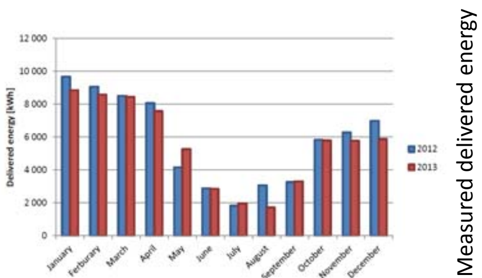
Hybrid ventilation



Space heating



- Heating system with a ground source heat pump
- Hydronic system 45/35 °C
- Floor heating
- Calculated annual energy use is 46,4 kWh/m² for heating
- Plus 10 kWh/m² for DHW



Control system

- Winter:
  - DCV for mechanical: Set point 900 – 1200 ppm CO_2
  - DCV for window: Set point 950 – 1500 ppm CO_2
  - Window operation limited by indoor temperature, 19 °C
  - Windows will only operate if mechanical system can not handle air quality (as measured by CO_2)
- Summer
  - DCV for mechanical: Set point 900 – 1300 ppm CO_2
  - Zone set point for window operation is indoor temperature exceeding 21 °C
  - Night time ventilation allowed (If t_i > 23 °C after 17:00, open until t_i< 18 °C)
- Limitations related to wind an rain

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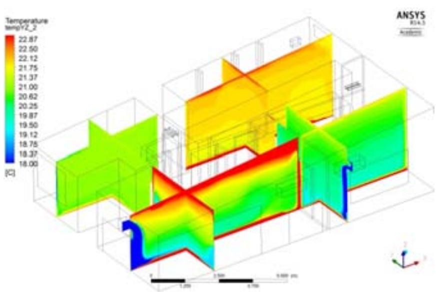
Simulations, window ventilation



- Outdoor temperature 9 °C
- Simulated indoor temperatures 1,5 K lower than measured
- However, indicates a risk of overcooling

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Other findings and comments

- Users an building owner are very satisfied with the solutions for ventilation, cooling and heating
- The indoor temperature is very well controlled with very few to warm hours. 2 % of working hours > 25 ^oC, less than 1 % above 28 ^oC
- The system requires qualified personnel for operation
- The janitor overrules the control system i.e. he stops the mechanical ventilation during summer
- There is a risk of overcooling

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IEA EBC Annex 62
The IEA project on ventilative cooling

Implementing technologies in a kindergarten

Guilherme Carrilho da Graça
Eng. Physics (IST), MSc (MIT), PhD (UCSD)

Assistant Professor in Building Energy Systems
University of Lisbon

Kindergarten design developed by Natural Works

Location	Lisbon, Portugal
Building Type	Kindergarten
Retrofit (Y/N)	N
Surroundings (Urban / Rural)	Urban
Ventilative Cooling Strategy	SS and DV
Year of Completion	2013
Floor Area (m^2)	680
Shape Coefficient (%)	32
Openable Area to Floor Area Ratio (%)	8
Window to Wall Ratio (%)	18
Sensible Internal Load (W/m^2)	53
STA KPI	-
Climate Zone (KG)	Csa
No. of Days with T_e max > 25	120
Cooling Season Humidity	Low
Heating Degree days (Kd)	215

IEA EBC Annex 62
The IEA project on ventilative cooling

2 Building Information

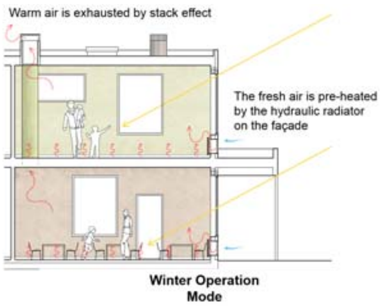
Parameter	Level of Influence
Initial Costs	●
Maintenance Costs	•
Energy costs	•
Solar Loads	●
Internal Loads	●
External Noise	•
Internal Noise Propagation	•
Air Pollution	•
Rain Ingress	●
Insect prevention	●
Burglary prevention	●
Privacy	●

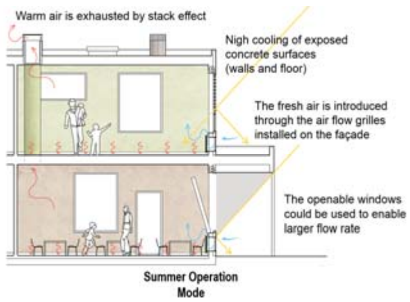
4 Ventilative Cooling

IEA EBC Annex 62
The IEA project on ventilative cooling

5 Control Strategies

IEA EBC Annex 62
The IEA project on ventilative cooling

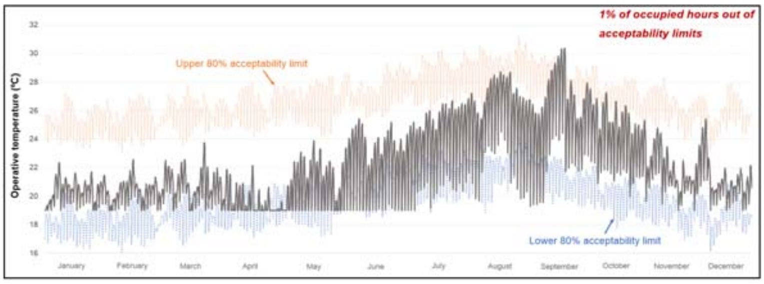


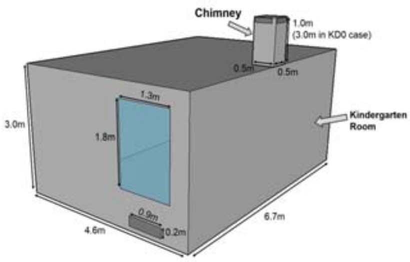


Season		Grille 0%= closed, 100% = open	Chimney 0º= closed, 90º = open	Window 0%= closed, 100% = open
Winter/Autumn	Day Night	30% 0%	30º 0º	30% 0%
Spring	Day Night	50% 50%	45º 45º	50% 0%
Summer	Day Night	100% 100%	90º 90º	100% 100%

6 Design Simulation

IEA EBC
Annex 62
The IEA project
on ventilative cooling

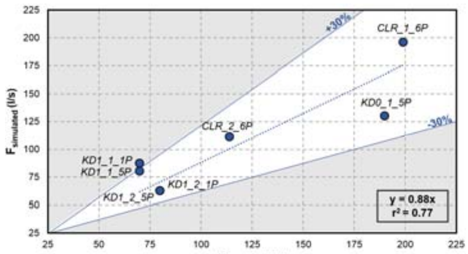




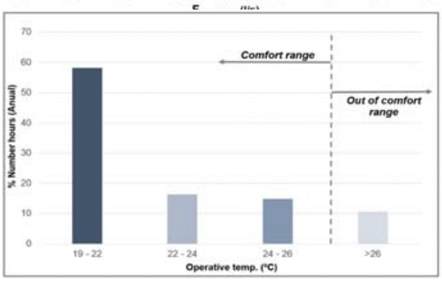
Parameter	Value
T_e , Summer External Temp	30
T_z , Summer Operative Temp	26ºC
Overheating criteria	Adaptive comfort model (80% acceptability limit) for 99% hr_{occ}
Min IAQ air supply rate	7l/s/occupant
Cooling air supply rate	-
Noise Level Rating	-

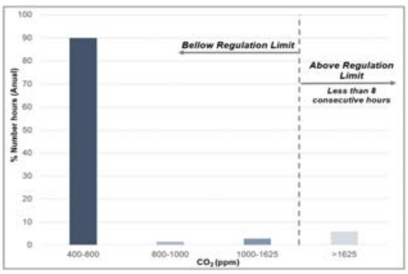
7 Performance Evaluation

IEA EBC
Annex 62
The IEA project
on ventilative cooling



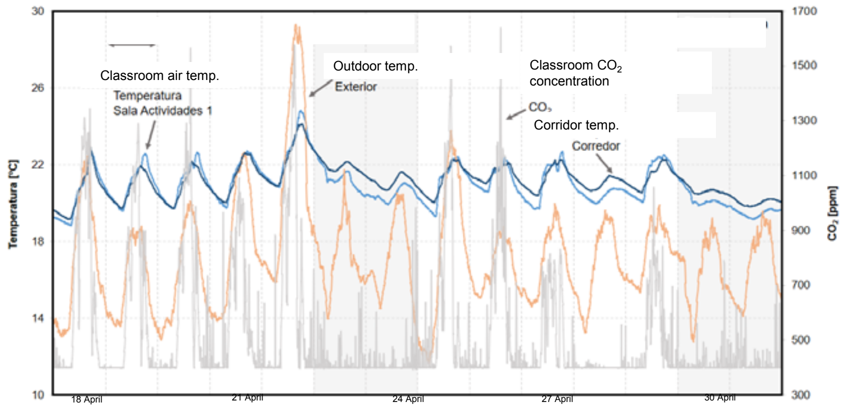
Parameter	Typical year (TMY)
Total Hours > 25°C	12%
Occ Hours > 25°C	16%
Total Hours > 26°C	7%
Occ Hours > 26°C	10%





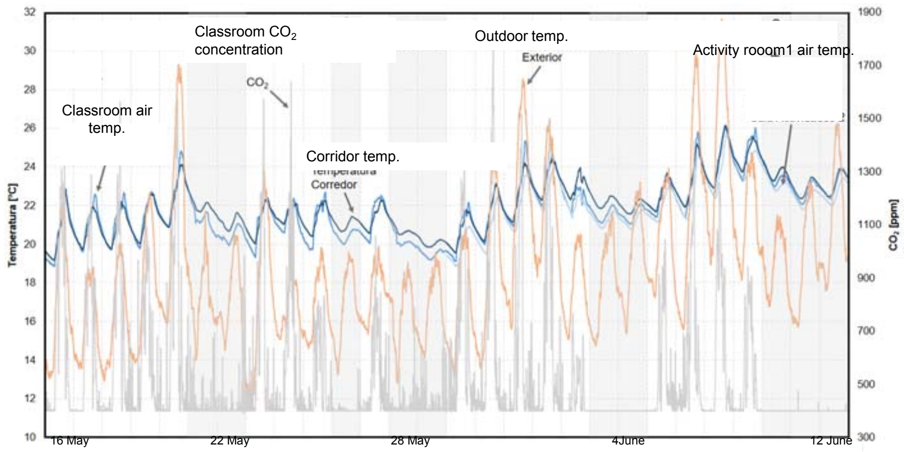
8 Performance Evaluation

IEA EBC Annex 62
The IEA project on ventilative cooling



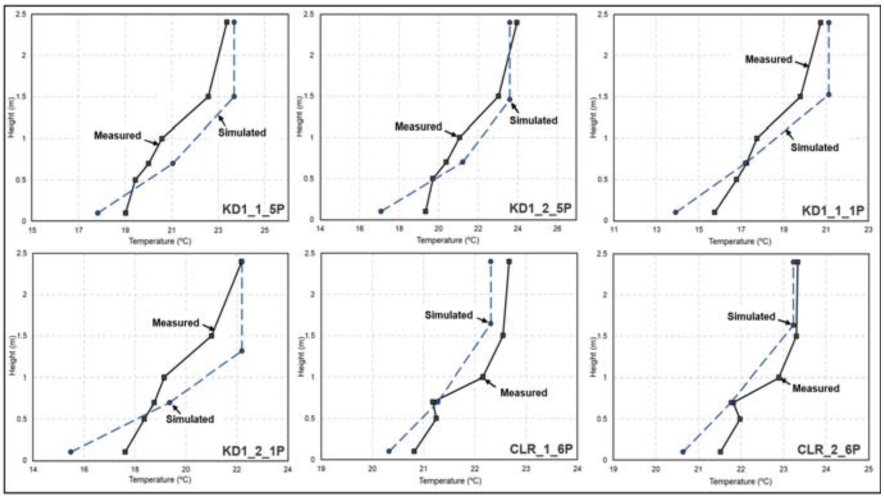
8 Performance Evaluation

IEA EBC Annex 62
The IEA project on ventilative cooling



9 Performance Evaluation

IEA EBC
Annex 62
The IEA project
on ventilative cooling



10 References

IEA EBC
Annex 62
The IEA project
on ventilative cooling

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Nuno M. Mateus, Gonçalo Nunes Simões, Cristiano Lúcio, Guilherme Carrilho da Graça, Comparison of measured and simulated performance of natural displacement ventilation systems for classrooms, Energy and Buildings, Volume 133, 1 December 2016, Pages 185-196, ISSN 0378-7788, http://dx.doi.org/10.1016/j.enbuild.2016.09.057.

Thank you for your time!

International Workshop
Ventilative cooling in buildings: now & in the future

Implementing technologies in a lecture room

Maria Kolokotroni, Thiago Santos

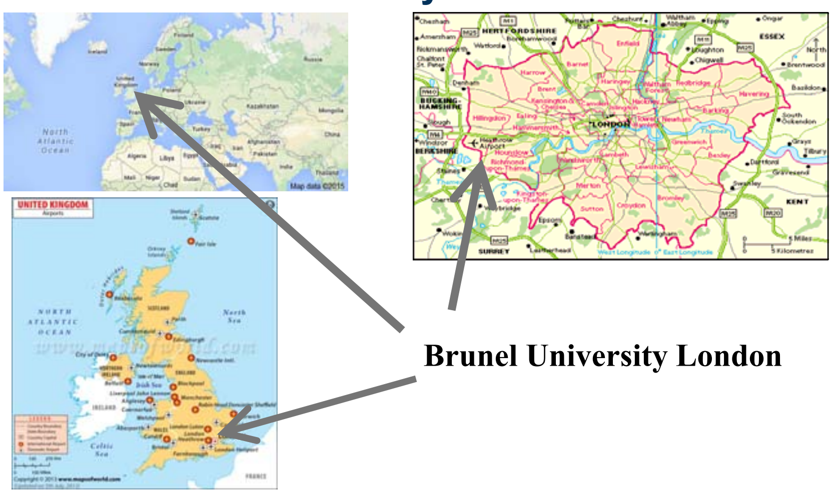
Institute of Energy Futures

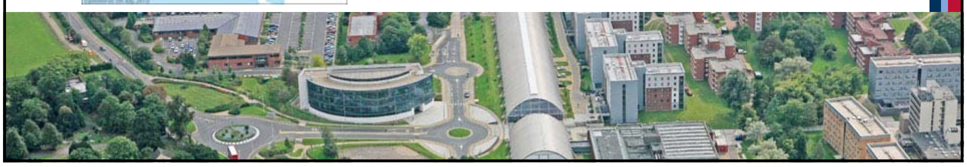
Department of Mechanical, Aerospace and Civil Engineering

Brunel University London

Where is Brunel University?

30 October 2017





Some background facts

A University since 1966

15,000 students

2,000 international students from over 100 countries

Strong research activities in engineering

Brunel University London

Who was Brunel ?

Isambard Kingdom Brunel

Famous Engineer

Born 1806, died 1859

EBC Annex 62 Expert meeting – Sep 2014
In front of Brunel's statue at Brunel University

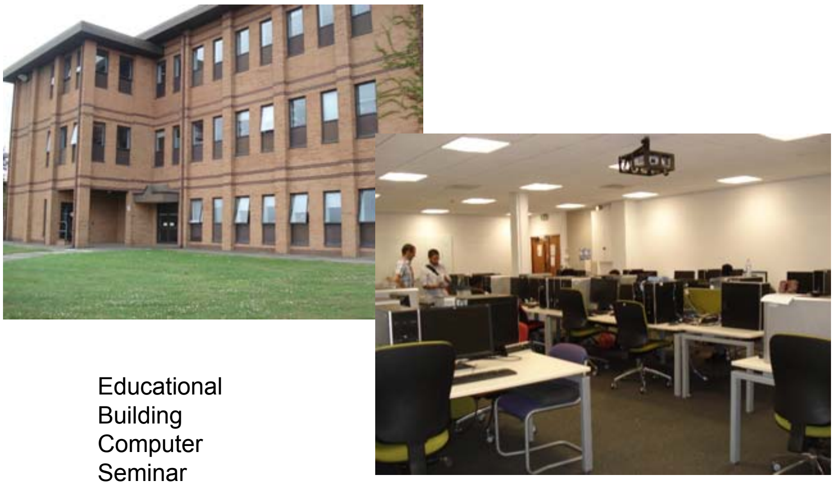
Clifton Suspension Bridge, spanning the River Avon at Bristol

930 ft bridge for
Great Western Railway

Brunel University London

Annex 62 – Subtask C – Case-study

30 October 2017

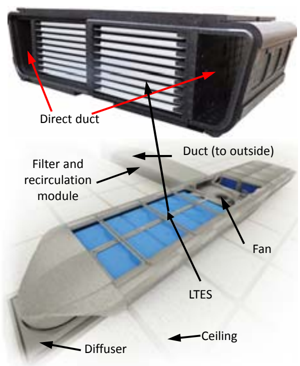


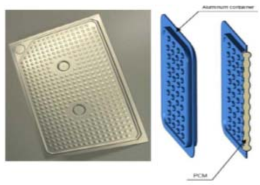
Educational Building Computer Seminar Room

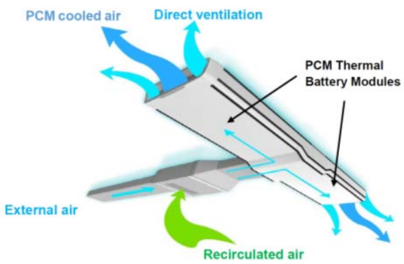
Ventilation system: CoolPhase by Monodraught

30 October 2017

The Cool-Phase® system uses the concept of **Latent Thermal Energy Storage** consisting of Phase Change Material (PCM) plates within the ventilation path to capture and store heat

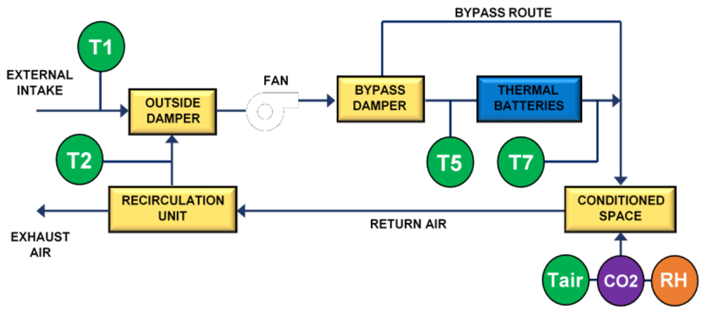






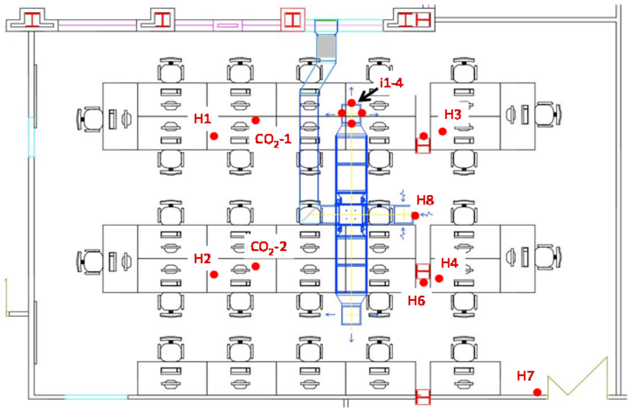
Ventilation system

30 October 2017



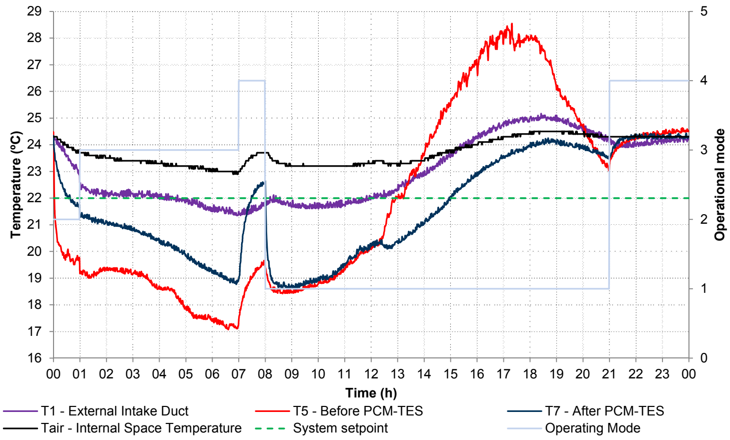
Case-study: University Seminar Room

30 October 2017



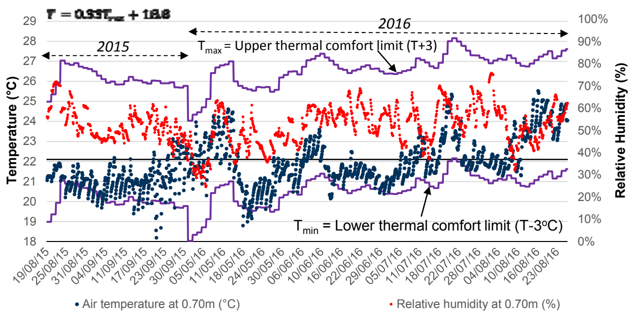
Operation during a summer day

30 October 2017



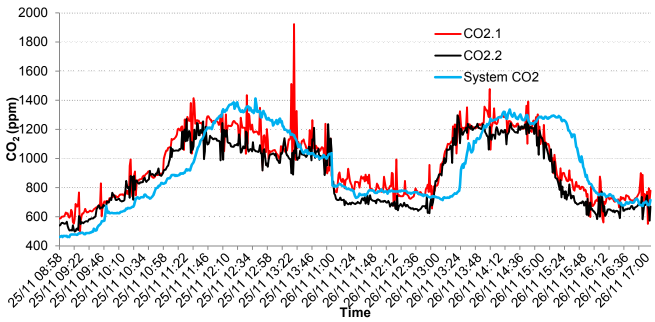
Monitoring inside the room

30 October 2017



IAQ using metabolic CO_2 indicator

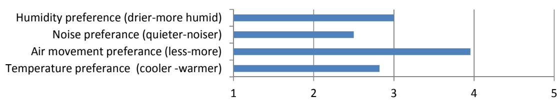
30 October 2017

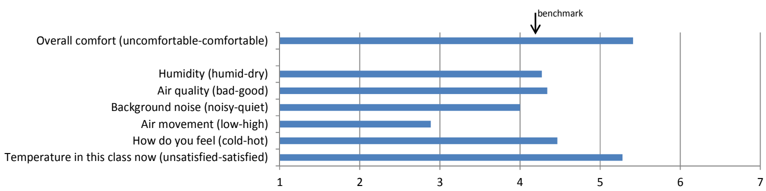


Brunel University London Annex 62 International Workshop, Brussels 11

Occupants' questionnaire

30 October 2017

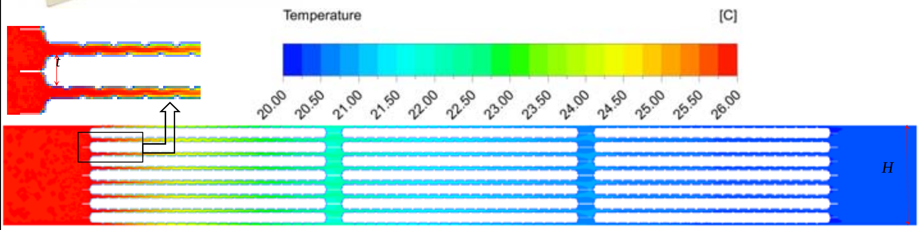




Brunel University London Annex 62 International Workshop, Brussels 12

Improving heat transfer through the encapsulation

3D Design → Validation → 2D Design → Refinement → Final Design



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30 October 2017

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Kolokotroni M, Santos T and Hopper N (2016), Ventilative cooling of a seminar room using active PCM thermal storage, REHVA Journal, January 2016, pp36-40

Forthcoming: Annex 62 case-study brochures

Thank you!

Ventilative Cooling in Buildings: Now & In The Future
BBRI Institute 23rd October 2017

Design and Performance of Ventilative Cooling: A Review of Principals, Strategies and Components from International Case Studies

Paul D O'Sullivan
Cork Institute of Technology

agenda

- Annex 62 & Subtask C
- Climate
- Overview of Contributions
- Design Influences
- Building Characteristics
- VC Strategies
- Control Strategies
- Design Criteria, Simulation and Overheating risk
- Lessons Learned
- Brochure & Dissemination

Well Documented Case Studies of VC Annex 62 – Sub Task C

Objectives of Annex 62 - STC

To fulfil the scope of the Annex and to make energy-efficient use of ventilative cooling (air-based systems) the preferred solution the Annex focuses on the following specific 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 (Subtask A).
- To give guidelines for integration of ventilative cooling in energy performance calculation methods and regulations including specification and verification of key performance indicators (Subtask A).
- 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 (Subtask B).
- **To demonstrate the performance of ventilative cooling solutions through analysis and evaluation of well-documented case studies. (Subtask C).**

Objectives of Annex 62 - STC

- Activity C.1.

Analysis and evaluation of performance of ventilative cooling solutions and of used design methods and tools using similar criteria and methods

- Activity C.2.

Lessons learned and development of recommendations for design and operation of ventilative cooling as well as identification of barriers for application and functioning.

What Climates Are Covered In The Case Studies?

Climate of Case Studies

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Variation in climate regions for all case study buildings.

(Please refer to the Koppen-Geiger climate classification system for details on KG abbreviations in column 1)

K-G	General Description	Qty	Locations
Cfb	Temperate with warm summers and no dry season	5	Cork, IE; Ernstbrunn, AT; Waregemand Ghent, BE; Verrieres-le-Buisson, FR; Bristol, UK
Cfa	Temperate, hot summers and no dry season	3	Changsha, CN; Hayama, JP
Dfb	Cold with warm summers and no dry season	3	Stavern, NO; Trondheim, NO; Innsbruck, AT
Dfc	Cold with no dry season and cold summer	1	Larvik, NO
Csa	Temperate with dry, hot summers	2	Sicily, IT; Lisbon PT

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Who, Where, What, When?

Contributions

Country	Building Name	Building Type	Year	Floor Area m²	Strategy
IE	zero2020	Office	2012(R)	223	Natural
NO	Brunla Primary school	Education	2011(R)	2500	Hybrid
NO	Solstad barnehage	Kindergarten	2011(N)	788	Hybrid
AT	UNI Innsbruck	Education	2014(R)	12,530	Hybrid
AT	wk Simonsfeld	Office	2014(N)	967	Hybrid
BE	Renson	Office	2003(N)	2107	Natural
BE	KU Leuven Ghent	Education	2012(N)	278	Hybrid
JP	Nexus Hayama	Mixed Use	2011(N)	12,836	Natural
JP	GFO Building Osaka	Office	2013(N)	394,000	Hybrid
PT	CML Kindergarden	Education	2013(N)	680	Natural
UK	Bristol University	Education	2013(R)	117	Mechanical

Country	Building Name	Building Type	Year	Floor Area m²	Strategy
CN	Wanguo MOMA	Residential	2007(N)	1109	Mechanical
FR	Maison Air et Lumiere	House	2011(N)	173	Natural
IT	Mascalucia ZEB	House	2013(N)	144	Hybrid
NO	Living Lab	Residential	2014(N)	100	Hybrid

What were the design influences for Ventilative Cooling ?

Design Influences

Country		Building	Lower Initial costs	Lower Maintenance Costs	Lower Energy Costs	Reducing Solar Loads	Reducing Internal Loads	Reducing External Noise	High Internal noise propagation	Elevated Air Pollution	Avoiding Rain Ingress	Insect Prevention	Burglary Prevention	Reduced Privacy	Air Leakage
IE	**R**	zero2020	H	M	H	H	L	L	L	L	M	L	H	M	M
NO	**R**	Brunla Primary school	H	H	H	L	M	L	L	H	M	L	L	L	H
NO	**R**	Solstad barnehage	L	L	H	L	L	L	M	H	L	L	L	L	H
AT	**U**	UNI Innsbruck	H	H	H	M	L	M	L	L	M	L	L	L	H
AT	**R**	wk Simonsfeld	H	H	H	M	L	L	L	L	L	L	L	L	M
BE	**R**	Renson	L	M	L	H	H	H	L	L	L	L	L	L	L
BE	**U**	KU Leuven Ghent	H	L	H	H	H	L	L	L	M	L	L	L	H
JP	**R**	Nexus Hayama	M	M	H	H	L	L	L	L	M	H	H	M	M
JP	**U**	GFO Building	H	M	L	L	L	L	L	L	L	L	L	L	L
PT	**U**	CML Kindergarden	H	L	L	M	M	L	L	L	M	M	M	M	L
UK	**R**	Bristol University	H	H	H	L	H	L	M	L	M	M	H	L	L
CN	**U**	Wanguo MOMA	H	M	H	H	L	L	L	L	M	L	M	L	H
FR	**U**	Maison Air et Lumiere	M	M	L	H	M	L	L	H	L	L	M	L	M
IT	**R**	Mascalucia ZEB	H	M	H	H	L	L	L	L	L	L	M	L	M
NO	**U**	Living Lab	L	L	H	H	M	L	M	L	H	L	L	L	H

How did We Do VC?

Ventilative Cooling Strategies

EBC

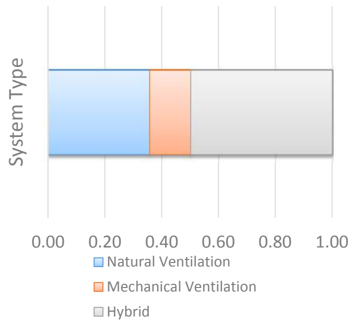
Ventilative cooling Concepts	Natural driven	Mech. Supply Driven	Mech. exhaust driven	Natural night ventilation	Mech. night ventilation	Air conditioning	Indirect Evap. Cooling	Earth to Air Heat Exch.	Phase Chang eMaterials
zero2020 (IE)	X			X					
Brunla Primary school (NO)	X			X					
Solstad barnehage (NO)	X		X	X	X				
UNI Innsbruck (AT)	X		X	X					
wk Simonsfeld (AT)	X		X						
Renson (BE)	X			X					
KU Leuven Ghent (BE)	X		X				X		
Nexus Hayama (JP)	X					X			
GFO Building (JP)	X	X	X			X			
CML Kindergarden (PT)	X			X					
Bristol University (UK)					X	X			X
Wanguo MOMA (CN)		X	X		X	X			
Maison Air et Lumiere (FR)	X								
Mascalucia ZEB (IT)	X			X				X	
Living Lab (NO)	X								

Ventilative Cooling Strategies

EBC

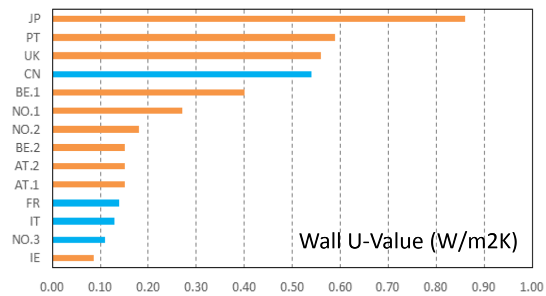
Summary points

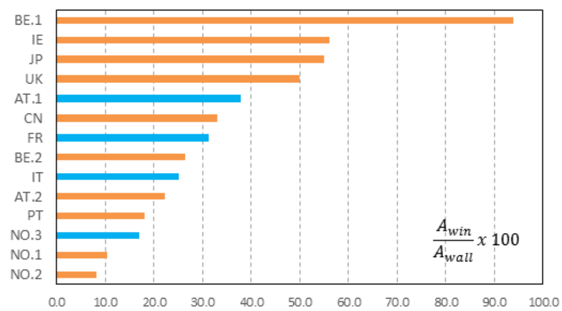
- 86%, of the case studies use natural ventilation in their VC strategy
- Generally, sensible internal loads for NV ≤ 30 Wm^{-2}. (Average is 25 Wm^{-2}.)
- No. of Days with a maximum daily external temperature ≥ 25°C was ≤ 30 in all cases except Portugal
- Hybrid VC most prevalent strategy with 50% of buildings using this approach
- The internal loads in Hybrid spaces were ≥ 40 Wm^{-2} in Norway and Belgium, in Austria & Italy they were ≤ 10 Wm^{-2}



What Were the Building Characteristics?

Building Characteristics

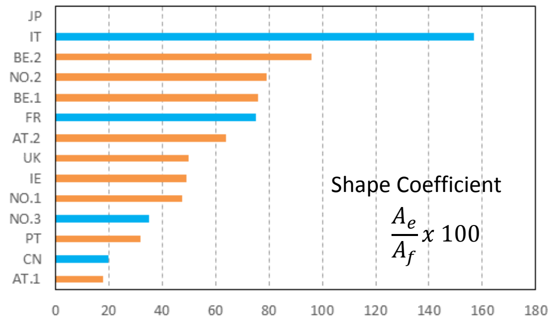




- Mean elemental U-value is 0.41 W/m^2K
- standard deviation is 0.34 W/m^2K
- Six case studies heavy /very heavy thermal mass (ISO13790)
- Average infiltration at 1.13 h^{-1}, (0.51 to 1.85 h^{-1})
- Average window/wall area ratio is 34%.
- Four case studies area ratios greater than 50%

- Some very good and very poor thermal performance
- Large variation in building shapes
- Norwegian case studies lowest window/wall ratios
- Belgium Offices from 2003 almost exclusively glass

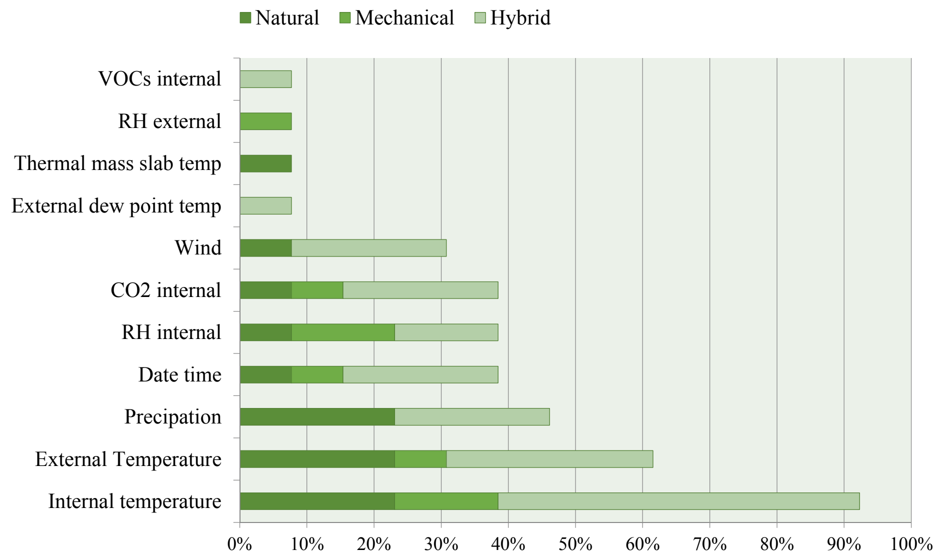
Building Characteristics



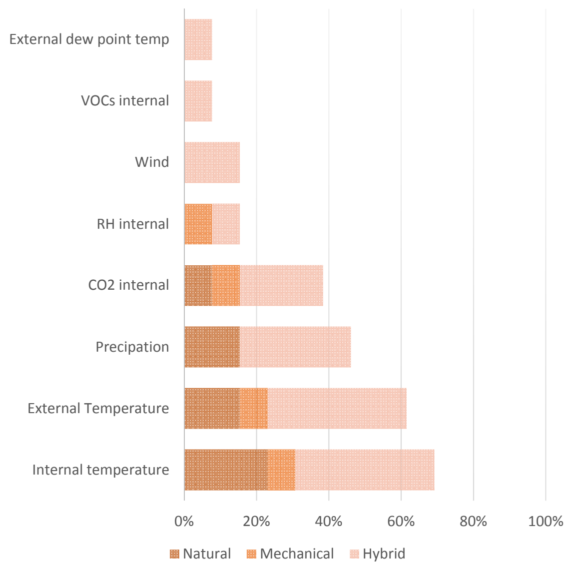
- Minimum shape coefficient of 0.18
- Maximum shape coefficient of 0.96
- Italian home has very high shape coefficient

How Do We Control VC?

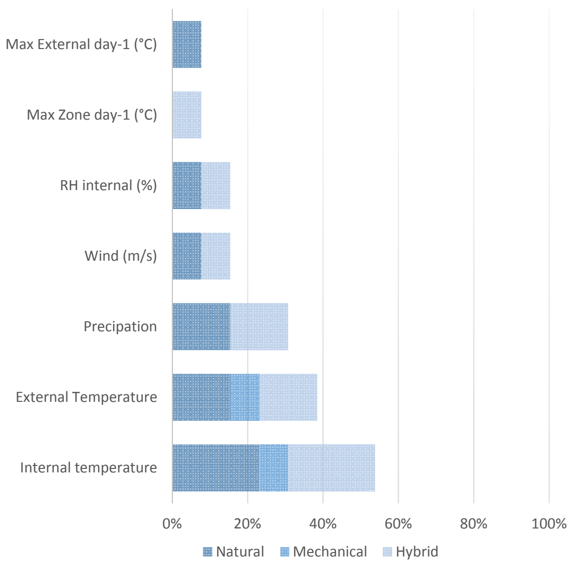
Control Strategies - Overall



Control Strategies – Occupied & Night Vent



Occupied Hours



Night time ventilation

Control Strategies - Summary

Summary points

- **Temperature** and **RH** were the **main parameters** used (CO_2 for IAQ).
- Internal temperature used by all cases studies with set-point control
- Mean internal air temperature set-point was around 22°C. (20-24°C)
- Over 60% of case studies use **external temp** as a **low temp limit**
- Mean external low temperature limit set-point 14°C. (10-18°C)

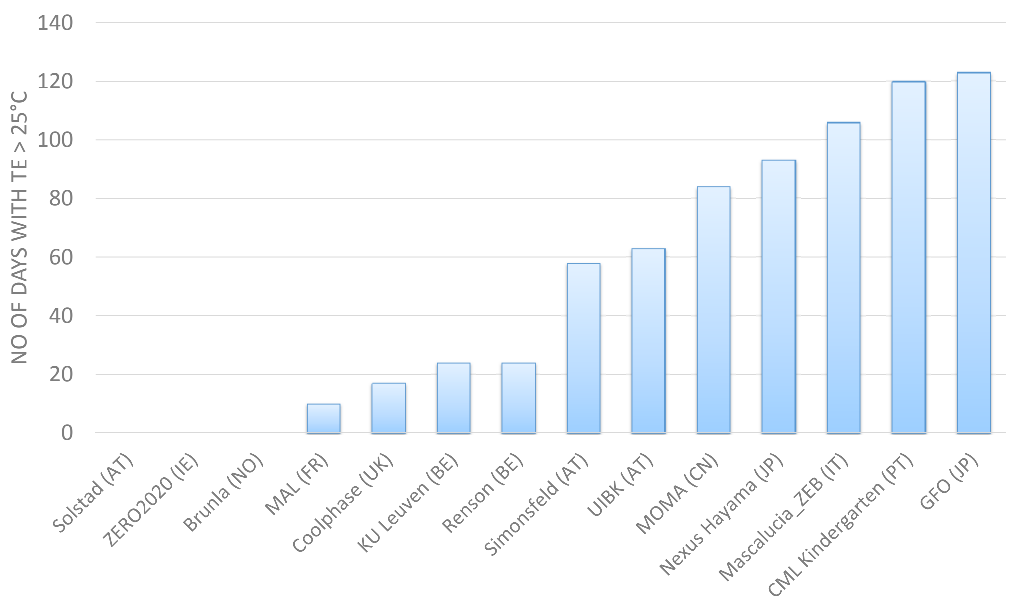
Control Strategies - Summary

Summary points

- All NV case studies had occupant interaction with the VC system
- Only 60% of hybrid systems had this interaction.
- 69% of the case studies had a night ventilation strategy
- Wind speed had to be ≤ 10m/s with no rain for night ventilation systems

How Have these Buildings Performed?

Climate Indicator



Design Criteria & Overheating

Preliminary results of VC performance evaluation

Country	Building	Summer Design Values		overheating criteria	% Occ hrs above threshold		Occ hrs
		T_e	$T_{i,o}$		28°C	25°C	
IE	zero2020	26.0	25.0	T_i < 28°Cfor 99% occ hrs	0.7	5.5	2600
NO.1	BrunlaSchool	25.0	26.0	T_i > 26°C	0.0	0.0	2600
NO.2	Solstad	25.0	24.0	T_i > 26°C	0.0	0.0	2860
AT.1	UNI Innsbruck	34.0	27.0	T_i < 26°C for 95% occ hrs	1.1	16.2	2600
AT.2	wkSimonsfeld	34.5	24.0	T_i > 26°C zone / T > 29°C gallery	0.0	5.0	3250
JP	Nexus Hayama	26.0	26.0	T_i < 28°C for 99% occ hrs (check)	1.0	40.0	8736
PT	Kindergarden	30.0	26.0	80% acceptability for 99% hr occ	2.6	16.0	3640

How are We Simulating VC?

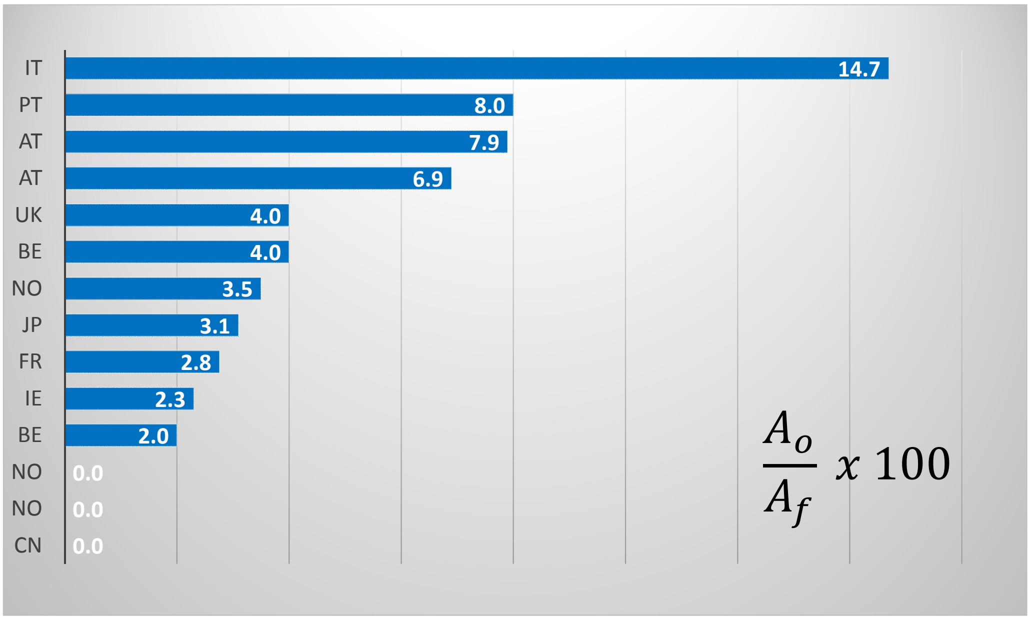
Design Simulation

Scope Development	Concept Design	Detailed Design	Performance Analysis
IE CIBSE Guide A	CIBSE Admittance	IES Apache /Macro	TRNSYS / PHPP / R
NO NS 3700	SIMIEN	Windmaster/SIMIEN	IDA Ice
NO NS 3700	SIMIEN	Windmaster / SIMIEN	IDA Ice
PHPP	Dynbil	TRNSYS	TRNSYS
TAS 9.2	TAS 9.2	TAS 9.2	PHPP
-	CAPSOL	-	-
RT2005 F	VELUX Daylight Vis.	Bsim (DK)	RT2012
PHPP	PHPP	EnergyPlus + GenOpt	PHPP
CASBEE	BEST/CFD/STREAM	CFD / STREAM	-
EnergyPlus	EnergyPlus	EnergyPlus	EnergyPlus
CIBSE Guide A	EFA / CIBSE TM 52	IES Apache	IES Apache
-	SIMIEN	-	IDA Ice

UK & IE – IES and CIBSE
NO – IDA ICE
IT, AT & IE – PHPP
PT - EnergyPlus

What about the Percentage Opening Area to Floor Area Ratio? A Key VC Metric?

Key Design Metrics – POF Ratio



$$\frac{A_o}{A_f}\ x\ 100$$

What Lessons did We Learn?

Lessons Learned

Design and Construction

- **Detailed building simulation is important when simulating ventilative cooling strategies.** Most case studies analysed highlighted the need for reliable building simulations in the design phase of a ventilative cooling system. This was considered most important when designing for hybrid ventilation strategies where multiple mechanical systems need harmonization.
- Some studies also said that **simulating the window opening in detail was important**.
- **Customisation may be an important factor in when designing a ventilative cooling system**. In order to ventilate certain buildings it may be necessary to design custom components. Some case studies highlighted the need to have custom design systems that were specific to country regulations and the use of a building or space.

Lessons Learned

Design and Construction

- Some consideration should also be given to the **clients expectations** around specific issues like **rain ingress and insect prevention**.
- **Ventilative cooling systems were considered cost-effective and energy efficient in design** by most case studies, but **particularly with naturally ventilated systems.** It was indicated that designing with the integration of manual operation and control was important, particularly in a domestic setting.

Operation

- **Engaging with the building owners or operators as soon as possible is integral to guaranteeing building performance for IAQ, comfort or energy savings**. For some case studies this specifically meant educating or working with the facilities operator or manager for the building, for others it meant educating the building occupiers themselves.
- It was suggested by some that this **engagement should be as early as the design stage**.

Operation

- **VC in operation is generally a good option**. Case studies comment on the reduction of overheating and improvement of comfort conditions in the buildings that used outside air. However **correct maintenance and calibration of the systems is integral to maintaining performance.**
- Some case studies highlighted the need to **exploit the outside air more with lower external air control limits** during typical and night-time operation.
- Others suggested that **exploiting the thermal mass of a building was key.** However it was noted that care must be taken with considering these low temperatures as some case studies, particularly in cold climates observed more incidences of overcooling than overheating.

Case Study Brochure

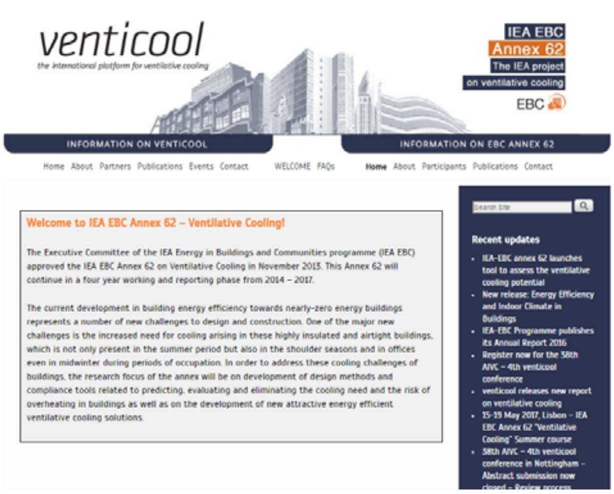
EBC

Pg	Information
1	Introduction, Local Climate & Key Information
2	Building Information & Design Influences
3	Energy Systems
4	Ventilative Cooling Principles and Components
5	Control Strategy overview and description
6	Design stage simulation, design criteria
7-9	Performance Evaluation
10	Lessons Learned
11	References & Project Contacts

Dissemination

EBC

- All brochures will be available at the IEA-EBC Annex 62 website
- Planned for December 2017
- A summary document also available
  - Overview with key data distilled into important findings
  - Key lessons learned
  - Recommendations



http://venticool.eu/annex-62-publications/deliverables/

Dissemination

Stay Tuned for Updates! Thank You

Brussels, Belgium
23 October 2017

Ventilative cooling in buildings: now & in the future
International Workshop

Future challenges and opportunities

Peter Wouters

INIVE - BBRI

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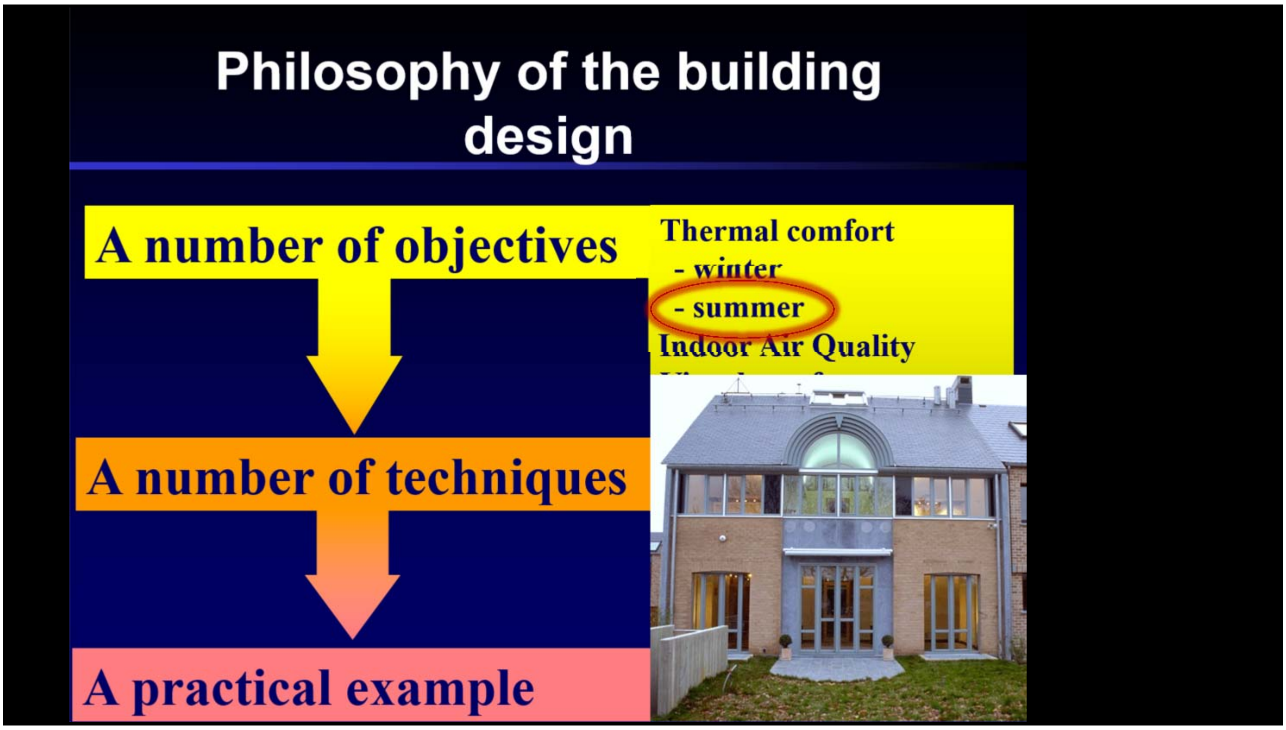
Structure of the presentation

- **Summer comfort and ventilative cooling assessment in the past**
- Present EPBD: Various challenges & Indoor Climate
- EPBD revision - Smartness indicator
- Can BIM be a game changer?
- Conclusions

+32 2 238 22 49

IEA SHC Task 13 (1989-1994): The PLEIADE dwelling

Passive **L**ow
Energy **I**nnovative
Architectural
DEsign



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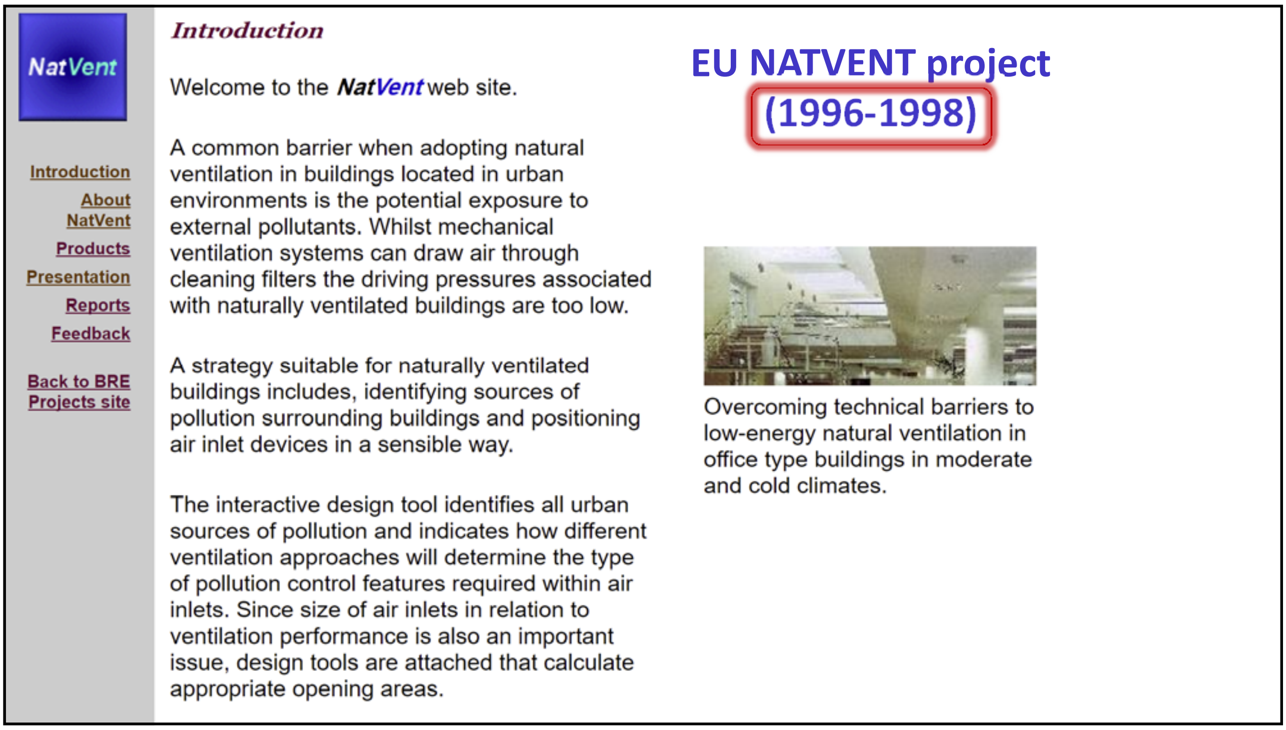
PASCOOL

Project ID: JOU20013

Funded under: FP3-JOULE 2

Passive Cooling for Buildings

From 1992-11-01 **to** 1995-09-30



NatVent

Introduction

About NatVent

Products

Presentation

Reports

Feedback

Back to BRE Projects site

Introduction

Welcome to the ***NatVent*** web site.

A common barrier when adopting natural ventilation in buildings located in urban environments is the potential exposure to external pollutants. Whilst mechanical ventilation systems can draw air through cleaning filters the driving pressures associated with naturally ventilated buildings are too low.

A strategy suitable for naturally ventilated buildings includes, identifying sources of pollution surrounding buildings and positioning air inlet devices in a sensible way.

The interactive design tool identifies all urban sources of pollution and indicates how different ventilation approaches will determine the type of pollution control features required within air inlets. Since size of air inlets in relation to ventilation performance is also an important issue, design tools are attached that calculate appropriate opening areas.

EU NATVENT project (1996-1998)

Overcoming technical barriers to low-energy natural ventilation in office type buildings in moderate and cold climates.

Barrier Reports

Belgium - Barriers to Natural Ventilation Design of Office Buildings	bbar.pdf
Denmark - Barriers to Natural Ventilation Design of Office Buildings	dkbar.pdf
European - Barriers to Natural Ventilation Design of Office Buildings	eubar.pdf
Great Britain - Barriers to Natural Ventilation Design of Office Buildings	ukbar.pdf
Norway - Barriers to Natural Ventilation Design of Office Buildings	nbar.pdf
Netherlands - Barriers to Natural Ventilation Design of Office Buildings	nlbar.pdf
Sweden - Barriers to Natural Ventilation Design of Office Buildings	sbar.pdf
Switzerland - Barriers to Natural Ventilation Design of Office Buildings	chbar.pdf

Technological solutions

Ventilation Technologies in Urban Areas	3.1_air_supply_1.pdf
Air Inlet For Noisy And Polluted Urban Environments	3.1_air_supply_2.pdf
Controlled Air Flow Inlets	3.2_controlled_air_flow.pdf
Heat recovery In Natural Ventilation Design of Office Buildings	3.3_heat_recovery.pdf
Control of Night Cooling with Natural Ventilation	3.4_night_cooling1.pdf
Prototype of Night Ventilator for Cooling	3.4_night_cooling2.pdf
Practical Guidelines for Integrated Natural Ventilation Design	3.5_integration_&_maintenance.pdf

Annex 35

IEA - ECBCS Annex 35 HybVent

Background   Objectives   Products   Research Programme

- Annex 35
- Pilot Study Buildings
- Publications
- Contacts and Participants
- Project area
- Site guide

Annex 35 HybVent - is a taskshared international research project initiated by the IEA Implementing Agreement "Energy Conservation in Buildings and Community Systems (ECBCS)". Annex 35 is a four-year project running from 1998-2002 with about 30 research institutes, universities and private companies from 15 countries world wide participating.

The project has been followed up by an EU project RESHYVENT, which focuses on hybrid ventilation in residential buildings.

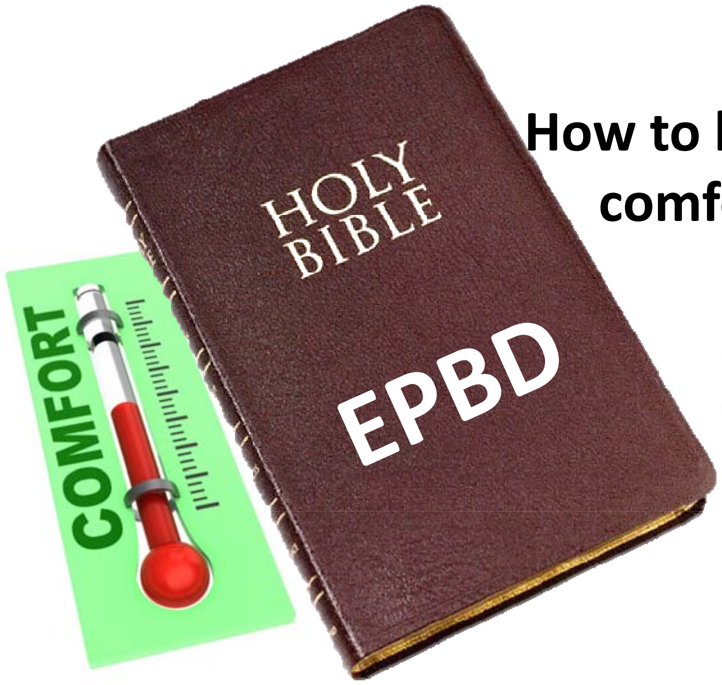
Structure of the presentation

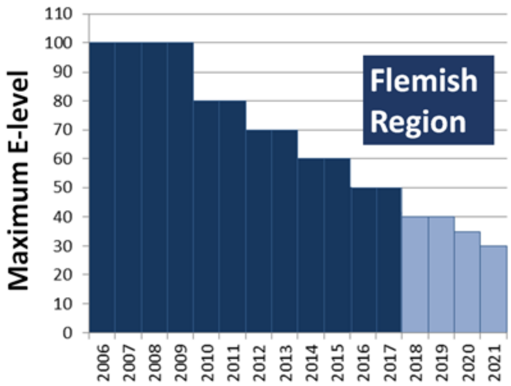
- Summer comfort and ventilative cooling assessment in the past
- **Present EPBD: Various challenges & Indoor Climate**
- EPBD revision - Smartness indicator
- Can BIM be a game changer?
- Conclusions

EPBD List of Available Country Fact Sheets

- Austria
- Belgium Brussels
- Belgium Flanders
- Belgium Walloon
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Slovak Republic
- Slovenia
- Spain
- Sweden
- United Kingdom | England
- United Kingdom | Northern Ireland
- United Kingdom | Scotland
- United Kingdom | Wales

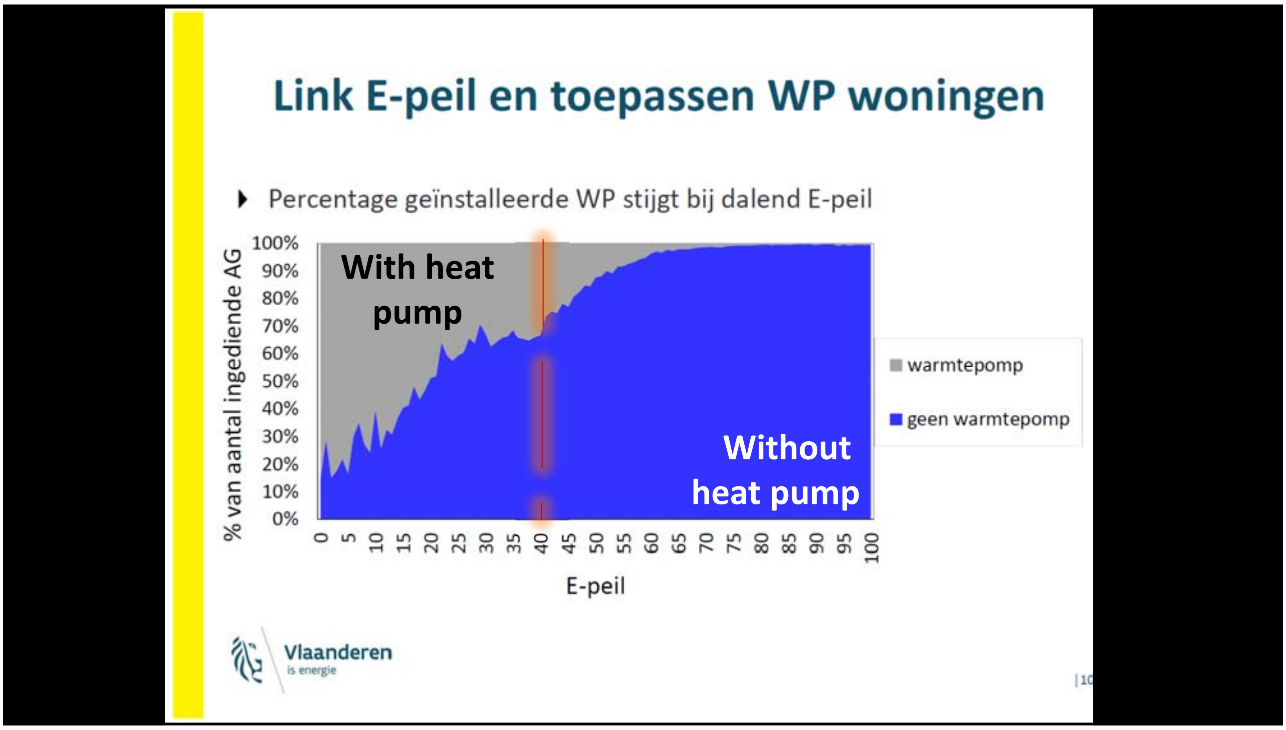
How to build energy efficient comfortable buildings?





Challenges for NZEB buildings

- NZEB =“nearly zero energy buildings”
- **Good indoor climate**
  - Thermal comfort
    - “Warm enough”: nearly no challenge
    - **“Not too warm”: challenging**
      - **Not evident given the very high insulation levels and gains**
      - **In terms of a correct EPBD related assessment**
      - Climate change
  - Indoor air quality
  - Acoustical comfort
  - Visual comfort



Structure of the presentation

- Summer comfort and ventilative cooling assessment in the past
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- **EPBD revision - Smartness indicator**
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- Conclusions

EUROPEAN
COMMISSION

Brussels, 30.11.2016
COM(2016) 765 final

2016/0381 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2010/31/EU on the energy performance of buildings

From Commission proposal to new Directive…

COUNCIL:

- The Council reached a **General Approach** on 26 June 2017.

EUROPEAN PARLIAMENT:

- The **ENVI** (Environment, Public Health and Food Safety) Committee voted its **opinion** on 7 September
- The **ITRE** (Industry, Research and Energy) Committee voted its report on 11/12 October 2017.

European Parliament
2014-2019

Committee on Industry, Research and Energy


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EU Parliament ITRE Committee votes for highly energy-efficient buildings by 2050
12 October 2017
Pan European EU Institutions
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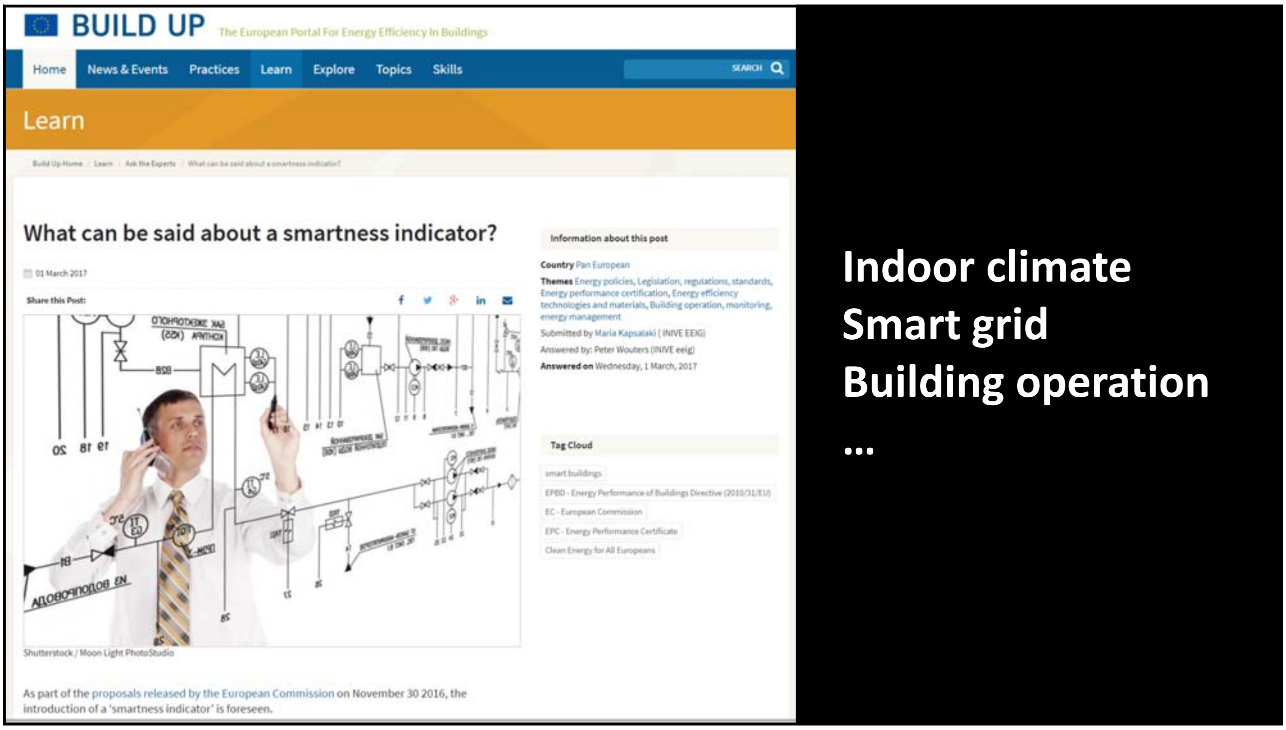
ITRE also voted to enter inter-institutional talks with the Council and Commission, which, if green-lit by the full plenary session on 26 October, means Bendtsen will be able to sit down at the first trialogue meeting, earmarked for 7 November.
Author(s) (organisation) European Parliament
Submitted by: Arla Fytrou-Moschopoulou (SYMPRAXIS TEAM)
Source languages English
Tag Cloud
EPBD - Energy Performance of Buildings Directive (2010/31/EU)
Clean Energy for All Europeans
building energy performance
energy refurbishment / renovation / retrofitting
NZEB - Near Zero-Energy Buildings
Shutterstock / Bjoern Wylezich
New measures to ensure that all new buildings in the EU are as energy-efficient as possible by 2050 were agreed by the Industry, Research and Energy Committee (ITRE) of the European Parliament.


BUILD UP
The European Portal For Energy Efficiency In Buildings
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What can be said about a smartness indicator?
01 March 2017
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Country Pan European
Themes Energy policies, Legislation, regulations, standards, Energy performance certification, Energy efficiency technologies and materials, Building operation, monitoring, energy management
Tag Cloud
smart buildings
EPBD - Energy Performance of Buildings Directive (2010/31/EU)
EC - European Commission
EPC - Energy Performance Certificate
Clean Energy for All Europeans
Shutterstock / Moon Light PhotoStudio
As part of the proposals released by the European Commission on November 30 2016, the introduction of a 'smartness indicator' is foreseen.
Indoor climate
Smart grid
Building operation
…

What to do if no wind?
What to do if no sun?

Storage is (still) very expensive

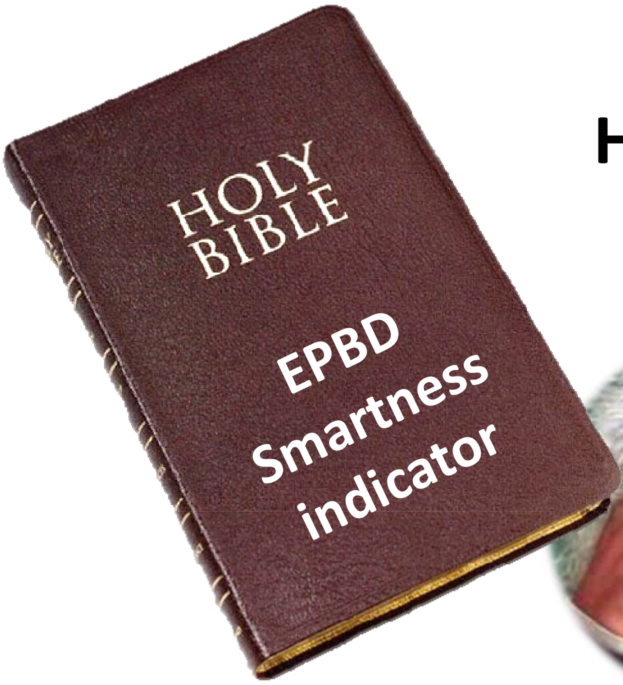
'Flexible/smart' buildings!

Smartness indicator:
At dwelling level…

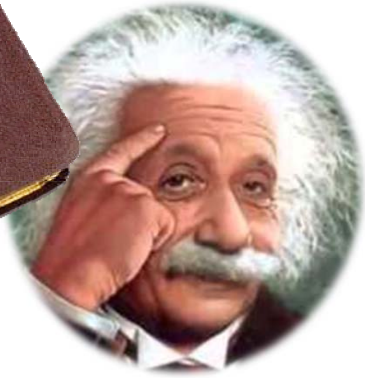
Smartness indicator:
At building level…

Important to stimulate further developments and avoid to become a barrier for innovation

Smart control is very important for robust ventilative cooling strategies



How to make your building SMART?



Structure of the presentation

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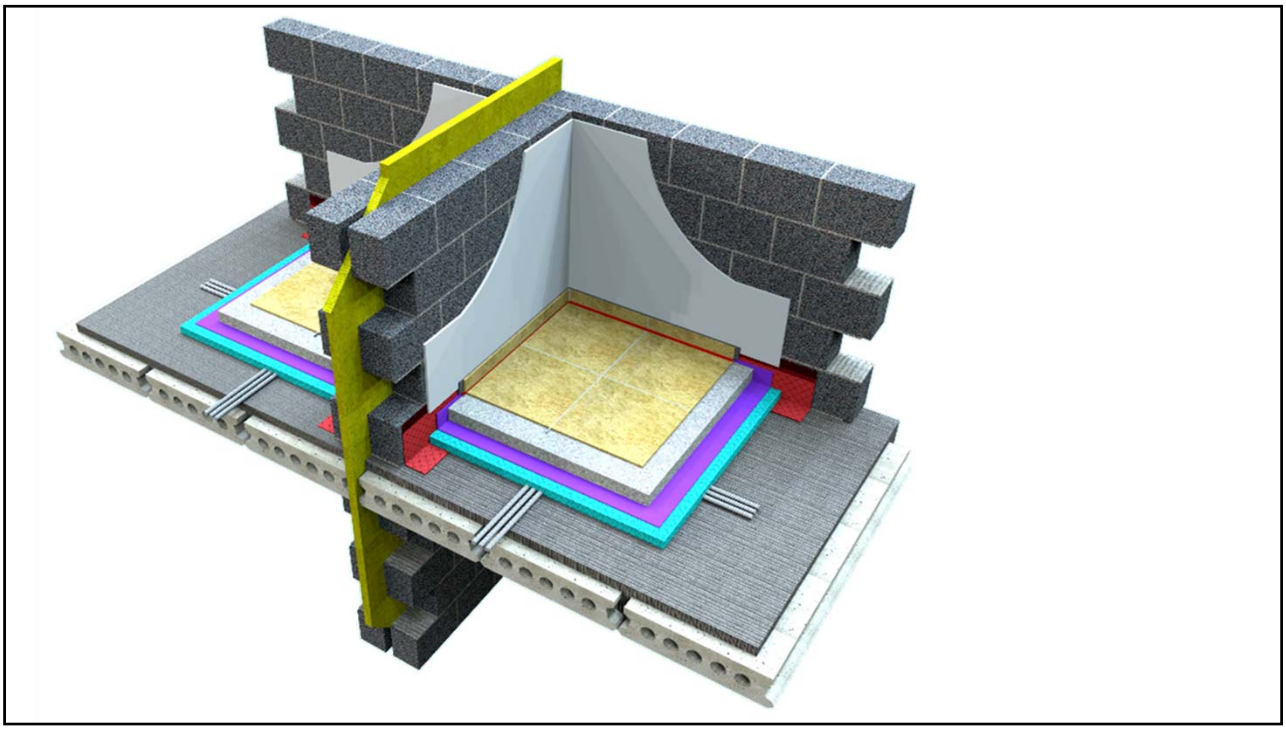
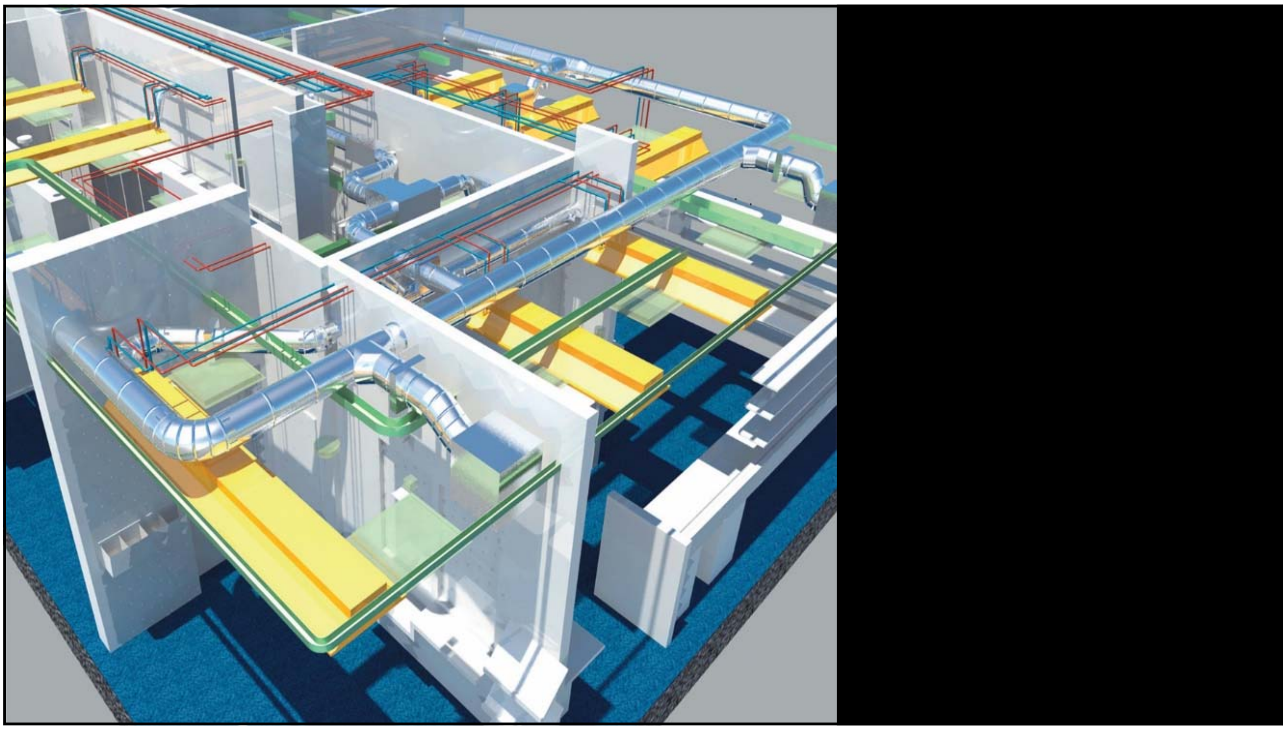
- **Can BIM be a game changer?**
- Conclusions





Articles QUALICHeCK

Can BIM be a disruptive technology for EPC assessment?

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BIM is in may EU countries high on the agenda. This article is focusing on the potential of BIM in relation to the energy performance of building assessment and also in relation to a better quality of the works.

Keywords: EPC, BIM, quality, standardisation, QUALICHeCK

According to Wikipedia*, building information modelling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are files (often but not always in proprietary formats and containing proprietary data) which can be extracted, exchanged or networked to support decision-making regarding a building or other built asset. Current BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse physical infrastructures, such as water, refuse, electricity, gas, communication utilities, roads, bridges, ports, tunnels, etc.

* https://en.wikipedia.org/wiki/Building_information_modeling

BIM developments in Europe

The future market uptake of BIM is difficult to predict with great accuracy, but it clearly is a development with great potential.

In terms of requirements, an increased number of countries impose the use of BIM for certain types of projects, e.g.:

- Since 2007, obligatory in Norway for public buildings, in Finland for any project above 2 M€ and in the USA for any major project
- Since 2012 mandatory in the Netherlands for any major public project
- Since 2014 mandatory in Hong Kong for any public project
- Since 2016 mandatory in South Korea for any project above 50 M$ and in the UK for public projects

QUALICHeCK

QUALICHeCK responds to the challenges related to compliance of Energy Performance Certificate (EPC) declarations and the quality of the building works. Find out more at http://qualicheck-platform.eu

The QUALICHeCK project is co-funded by the Intelligent Energy Europe Programme of the European Union. The sole responsibility for the content of this article lies with the author(s). It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

BIM developments in Europe

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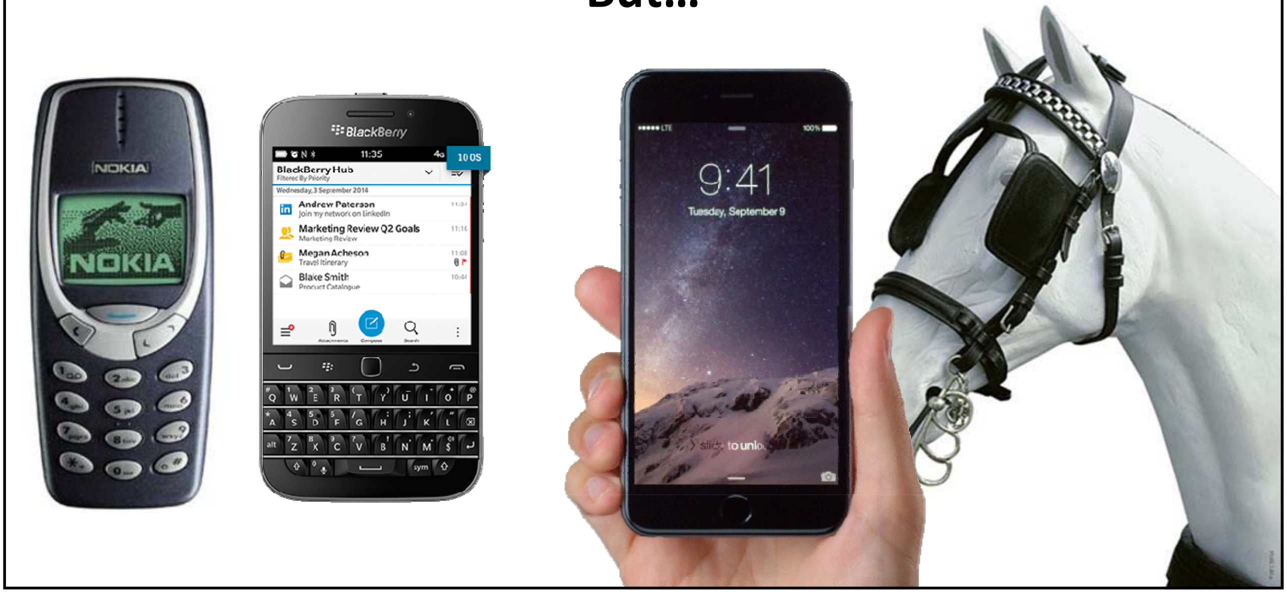
  - Since 2012 mandatory in the **Netherlands** for any major public project
  - Since 2014 mandatory in **Hong Kong** for any public project
  - Since 2016 mandatory in **South Korea** for any project above 50 M$ and in the **UK** for public projects

BIM developments in Europe

- In a 2016 report 'Shaping the Future of Construction – A breakthrough in mindset and technology' by the **World Economic Forum**, prepared in collaboration with the Boston Consulting Group, the market view on a whole range of new technologies has been collected.

- From this survey, **it appears that integrated BIM has the <u>highest likelihood</u> AND the <u>highest expected impact</u> on the construction sector in the future** compared to thirteen other new technologies (such as advanced building materials, augmented reality, 3D printing of components, big data analytics…).

Crucial that we further improve our EPBD approaches… But…



What can BIM mean for EPC calculations?

- At present, the **calculation of the EPC of a building is an activity on its own**.
  - One has to collect all input data (surfaces, volumes, product and system data, …) and enter them into the software tool.
  - This can be very time consuming.
- With BIM, and of course depending on the level of development of the BIM approach, **all the input data for EPC calculations are part of the BIM model**.
- Of course, specific tools have to be developed for the EPC calculations, with the ability to use BIM files for input data, and to generate results that are integrated into the BIM.
- Such **BIM approach can very substantially reduce the required efforts** for producing an EPC.

What can BIM mean for EPC calculations?

- For the **assessment of overheating risks**.
  - At present, most countries use simplified procedures which only give a rough indication of the risk of overheating and/or the related energy consumption for achieving appropriate thermal comfort.
  - With a detailed BIM model, much more refined assessment methods can be used without requiring specific efforts for collecting input data.
- Most countries have at present (very) simplified procedures to assess the energy performance of **HVAC systems**.
  - With BIM, a more refined assessment becomes possible as the actual characteristics of the systems are easily available.

BIM and standardisation

- In order to accelerate the market uptake of BIM, **standardisation of protocols is important**.
  - Within CEN, TC 442 (Building Information Modelling) was created in September 2015.
  - In ISO, TC 59 (Buildings and civil engineering works) is also dealing with BIM.
- With the market uptake of BIM, and assuming that BIM models will be used for EPC calculations, there might be **new tasks for standardisation in relation to EPBD related standards**. BIM offers the possibility to have a better physical modelling of energy processes

BIM and convergence of national EPC calculation procedures

- At present, there are still **major differences in the national EPC calculation methods**. With the new set of CEN standards, one can expect more convergence in the EPC calculation procedures.
  - However, one observes sometimes very big differences in the visions on the need for simplification and this is often a barrier for further convergence.
- With BIM, there is the possibility to come with limited or no efforts for the user to a more accurate physical modelling of the energy performances and therefore the **possibility of nearly no differences in views between member states/countries**.

BIM and EPC compliance

- At present, data collection for calculating the EPC is in most cases an autonomous activity not linked to other design processes. This might fundamentally change if BIM becomes mainstream.
- All relevant product and system data can then be directly integrated into the BIM objects (brick, thermal insulation, fan, heat pump, …)
- Moreover, an integrated BIM model will be updated according to design or execution modifications, making that it will effectively represent what is constructed. Therefore, the energy performance calculation can be made for the **as-built building**.

BIMPLEMENT

Accueil » Projets » BIMplement

RÉSUMÉ

NZEB construction needs an enhanced systematic approach for the quality control of the entire process to reduce the gap between designed and actual performances of buildings. This requires a fully qualified and equipped workforce, capable to implement, execute and perform all the necessary labor actions with understanding of the responsibility of their own profession and actions, as well as the relation with the other involved professions and actions.

BIMplement offers the trainers and the learners a range of tools that fit the objective of developing a fully qualified and equipped workforce, capable to implement, execute and perform all the necessary labour actions. Main aim is to achieve an improved quality for NZEB construction and renovation by setting up a large scale, training, CPD and qualification schemes, addressing the entire process phases in a cross-crafts and cross level multidisciplinary approach, strengthened with hands-on and BIM-enhanced workplace learning tools by following

OBJECTIFS

1. To improve the overall quality of renovations and new constructions, based on a BIM-enabled workplace learning, addressing the entire process phases in a cross-crafts multidisciplinary approach
2. To create a new generation of professionals and craftsmen, equipped and enabled by BIM skills, to enhance the overall quality of construction and renovation across the entire process
3. To foster interactions between different trades and professions enabled by a flexible qualification, certification and accreditation methodology for implementing BIM as a workplace learning environment
4. To sustain the qualification and training schemes a replication and exploitation strategy will be developed and validated

At the end of the 2 years project BIMplement has developed a transferable method based on the experience of previous BUS and H2020 Construction Skills projects and on experimentations in territories with craftsmen and small enterprises.

PARTICIPANTS

Pilote : Alliance Villes Emploi (FR)

Partenaires :

- ASTUS Construction (FR)
- STICHTING INSTITUUT VOOR STUDIE ENSTIMULERING VAN ONDERZOEK OP HETGEBIED VAN GEBOUWINSTALLATIES (NL)
- STICHTING OPLEIDINGS- EN ONTWIKKELINGSFONDS VOOR HET TECHNISCH INSTALLATIEBEDRIJF*ST.POL. EN ONTWIKK.FONDS TECH INSTALL.BEDR OTIB (NL)
- Huygen Installatie Adviseurs (NL)
- REGIONINIS INOVACIJU VADYBOS CENTRAS (LT)
- LIETUVOS STATYBININKU ASOCIACIJA (LT)
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- SERVICIO VALENCIANO DE EMPLEO Y FORMACION (ES)
- MOSTOSTAL WARSZAWA SA (PL)
- CONSEIL DES ARCHITECTES D'EUROPE (BE)

BIMEET

Project: BIM-based EU -wide Standardized Qualification Framework for achieving Energy Efficiency Training

The European Construction sector is facing unprecedented challenges to achieve ambitious energy efficiency objectives (with the aim to generalize Near-Zero Energy Buildings), in an economic crisis context dominated by reduced investments, search for cost effectiveness and high productivity. Moreover the industry is experiencing its digital revolution, with Building Information Modeling (BIM) approach gaining significant interest across Europe. Member states implement very different approaches through regulations and maturity targets, which always face the traditional low-tech and informal practices of construction businesses (a fragmented sector, dominated by SMEs). BIMEET project aims to leverage the take-up of ICT and BIM through a significant upgrade of the skills and capacities of the EU construction workforce. This Coordination and Support Action project is built around a strong consortium relying on educational and research expertise, robust experience of accrediting bodies, training supply chain and a wide engagement of industry led best practice (already committed in an EU-wide expert panel). Through its actions the project will (a) pave the way to a fundamental step change in delivering systematic, measurable and effective energy efficient buildings through BIM training with a view to effectively address European energy and carbon reduction targets; (b) promote a well-trained world leading generation of decision makers, practitioners, and blue collars in BIM for energy efficiency; (c) establish a world-leading platform for BIM for energy efficiency training nurtured by an established community of interest. Its principal outputs are 1) a skills matrix related to BIM and energy efficiency, harmonized thanks to EQF standard, and 2) a training platform contributing to widely disseminate the BIMEET EQF. These results associated with an accreditation scheme will guarantee the sustainability of the project results after its lifetime.

Net-UBIEP

Project: Network for Using BIM to Increase the Energy Performance

The building sector is the largest consumer of energy in Europe, accounting for nearly 40% of the total consumption (EPBD 2010/31/EU). Furthermore the 2030 European Energy [COM(2014)16Final] and Energy Roadmap 2050 [COM(2011) 885 final], strongly requires more focus on the energy efficiency on housing sector. Finally, the Directive 2014/24/EU of the European Parliament and of the Council on public procurement, requires that all member states introduce electronic means to exchange information and communication in procurement procedures. For these reasons we believe that the integrated approach of the Net-UBIEP project, based on Building information Modelling, integrated with energy performance requirements, will be key to solve all the problems in a more effective and efficient manner. The project proposes BIM Qualification Models integrated with energy competences, to widespread a better comprehension of energy issues along all the value chain of building industry so that both existing and new building will have better energy performances. Public Administrations, Professionals (Engineers / Architects), Technicians (Installers / Maintainers) and Tenants will be therefore involved in the Net-UBIEP activities. The definition of the BIM Qualification Models will pass through the identification of specific energy BIM competences for each of the above target needed to implement BIM models during the whole building life cycle. During the project the “integrated” BIM Qualification Models will be validated by stakeholders thanks to the delivering of different training activities (Seminars / Classrooms Courses / E-Learning Courses) addressed to at least six BIM Professional Profiles: BIM Manager, BIM Evaluator, BIM Coordinator, BIM Expert, BIM facility manager, BIM user. Once the schemes will be validated, they will be proposed for standardization to find a broader acceptance at European and international level through regulatory organizations (CEN / ISO).

Structure of the presentation

- Summer comfort and ventilative cooling assessment in the past
- Present EPBD: Various challenges & Indoor Climate
- EPBD revision - Smartness indicator
- Can BIM be a game changer?
- **Conclusions**

Conclusions

- The **very important impact of EPBD related legislation** on the building design process is challenging, also in relation to overheating assessment
- A correct integration of **overheating related aspects in a smartness indicator** is also challenging
- **Smart implementation of BIM based EPBD assessment** can on the longer term be a game changer, with particular relevance for overheating assessment

venticool
the international platform for ventilative cooling

IEA EBC
Annex 62
The IEA project
on ventilative cooling
EBC

Brussels, Belgium
23 October 2017

Ventilative cooling in buildings: now & in the future
International Workshop

Future challenges and opportunities

Peter Wouters

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CHRISTOFFER PLESNER, VELUX A/S
BRUSSELS, OCTOBER 23, 2017

VELUX®

RECOMMENDATIONS AND CHALLENGES FOR CEN AND ISO STANDARDS

Ventilative cooling in buildings: now & in the future

VELUX®

AGENDA

- Background
- New Work Items in CEN & ISO
- Parallel work
- Challenges in CEN & ISO standards
- Recommendations to CEN & ISO standards
- Outlook

VELUX

BACKGROUND

- **Focus and timing of ventilative cooling in standards & regulations**
  - EPBD directive, 2010/31/EU: Passive cooling techniques mentioned (e.g. NV + shading)
  - The revision of many EN standards started from 2012 until 2017 (EPB standards)

- **Natural ventilative cooling (NVC) and natural ventilation (NV) reduce summer indoor temperatures**
  - Open windows to reduce temperature
  - NVC is free and does not consume energy like active cooling

- European Committee for Standardization (CEN) and International Organization for Standardization (ISO)
  - A lot of guidance on "ventilative cooling" is missing in existing CEN & ISO standards on e.g. design of ventilative cooling systems

- Standards, regulations and compliance tools need to support more simple to use evaluation methods, so more specifiers will use natural ventilative cooling and NV in future

3 VELUX COMPANY

VELUX

NEW WORK ITEMS IN CEN/TC 156 (VENTILATION)

- New Work Items in CEN/TC 156 have been proposed and submitted by Danish National Standards body, dealing with ventilative cooling and, natural and hybrid ventilation-systems

- Overall purpose:
  - Make technical documents focusing on the **design aspects (not requirements)** of ventilative cooling and natural and hybrid ventilation-systems in buildings

- Overall scope (e.g. ventilative cooling):
  - "Specify how indoor environmental aspects (prEN 16798-1) have to be used for the building design, system design and dimensioning, energy performance calculations when using ventilative cooling systems to prevent overheating, which serve both residential and non-residential buildings"

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NEW WORK ITEMS IN CEN/TC 156 (VENTILATION)

- Danish National Standards body initially proposed 2 new work items for CEN/TC 156
  - **Ventilative cooling systems (N 1509), now N 1587**
    - All buildings
    - Focus: Thermal comfort (prevent overheating)
    - Type: Technical specification [*]
    - Work proposed to: WG/21
  - **Natural and hybrid ventilation systems (N 1508)**
    - All buildings
    - Focus: Indoor air quality
    - Type: Technical specification [*]
    - Work not proposed yet to any WG

Residential buildings
- Content into Revision of EN 15665 and CEN/TR 14788

Non-residential buildings
- Natural and hybrid ventilation systems in non-residential buildings

5 [*] Technical specifications are right below EN standards in status. Technical Reports are lower status than TS's

NEW WORK ITEMS IN CEN/TC 156 (VENTILATION)

- Natural and Hybrid ventilation systems:
  - **Natural and hybrid ventilation systems in non-residential buildings**
  - Main focus: Indoor air quality
  - Type: Technical specification
  - Work proposed to: WG/20 in CEN/TC 156
  - **Expansion of Natural and Hybrid ventilation in residential buildings in upcoming "Revision of EN 15665:2009 and CEN/TR 14788:2006"**
    - Main focus: Indoor air quality
    - Type: E.g. European standard (Content to be part of revision of EN 15665:2009 + CEN/TR 14788:2006)
    - Work proposed to: WG/2 in CEN/TC 156
- Ventilative cooling systems:
  - **Ventilative cooling systems**
    - Main focus: Thermal comfort (prevent overheating)
    - Type: Technical specification
    - Work proposed to: WG/21 in CEN/TC 156

OVERVIEW OF RELEVANT WORK ITEMS AND REVISIONS

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Main focus	Thermal Comfort for overheating prevention (TC)	Indoor Air Quality (IAQ)	TC & IAQ
Residential (R)		3. **CEN**; NV/Hybrid ventilation to be included in "Revision of 15665 + CEN/TR 14	
Non-residential (NR)	1. **ISO**; Design process of Natural Ventilation (S)	4. **CEN**; Natu ven (TS) 62.1 (S), R	6. **CIBSE**; AM 10 (S), R
R & NR	2. **CEN**; Ventilative co systems (TS)		7. **National**; Natural ventilation standard for design in China (S)

4 technical documents incl. Ventilative cooling initiated!

1. "Design process of Nat reducing cooling demand in energy-efficient non-residential buildings" (ISO standard)
2. "Ventilative coo 7), WG21 in CEN/TC 156 (Technical specification)
3. Expansio brid ventilation in residential buildings in upcoming "Revision of EN 15665:2009 and CEN/TR 14788:2006", WG2 in CEN/ ard)
4. "Natur brid ventilation systems in non-residential buildings" (N 1586), WG20 in CEN/TC 156 (Technical specification)
5. "ASHRA 62.1" – Revision of the natural ventilation procedure (ASHRAE standard, USA)
6. "CIBSE AM10:2005" – Revision of standard (Application manual, UK)
7. "Natural ventilation standard for design" (National standard, China)

EXISTING & NEW WORK ON STANDARDS

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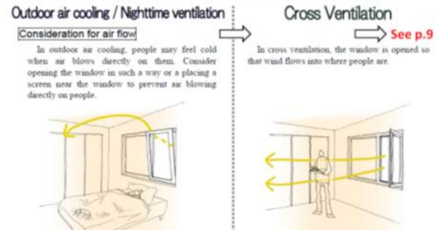
- **European EN standards (finished)**
  - EN 16798-7:2017 on "calculation methods for the determination of air flow rates in buildings" (EPB standard)
    - New (simple) calculation methods for single-sided natural ventilation + cross-ventilation included
    - Increases relevance of ventilative cooling:
      - Cross-ventilation now included in EN standard!
      - Increased stack effect by enhanced height difference (1 window → more windows)
- **International standardisation documents (ongoing)**
  - "Design process of Natural Ventilation for reducing cooling demand in energy-efficient non-residential buildings"
    - CEN/TC 156 to request a liaison with ISO/TC 205, WG2 to coordinate (2 separate documents)
  - "Natural ventilation standard for design from China"
  - Revision of ASHRAE 62.1 and CIBSE AM10 documents on ventilation
- **New Work Items in CEN (Initiated)**
  - Technical documents on **design aspects** of ventilative cooling and natural/hybrid ventilation-systems in buildings
  - 2 New Work Items + 1 revision underway, work to start up Q4:2017

CHALLENGES IN CEN & ISO STANDARDS

- **Ventilative cooling is a new standardisation area**
  - Aim to formalize experience and knowledge on VC → New knowledge in IEA EBC Annex 62
- **Many technical documents ongoing or starting up simultaniously on VC**
  - Big task to sufficiently coordinate among the "VC" documents, to limit overlaps and repetitions
  - May be difficult for some to find out which documents to focus on. Some cover both IAQ + TC
  - Difference in climates, building customs and typology in CEN and between CEN & ISO regions
- **Agreeing on terminology**
  - Definitions not defined in EN 12792, must be discussed and aligned on consensus basis
  - Agreeing on terminology across different CEN national standardisation bodies
- **Agreeing on what topics are most important to cover in the new documents**
  - Many stakeholders interested in influencing the new documents, giving specific interests

INSPIRATION

- **Guidelines:**
  - Japanese design guideline for ventilative cooling:
    - "Design guideline of window for outdoor air cooling, Northern regional building research institute, Japan, 2010"
  - IEA EBC Annex 62 deliverable:
    - "Design Guideline for Ventilative cooling"
- **Standards/norms:**
  - CIBSE AM10:2005
    - First section (design) or in "control of summer overheating"))
  - Danish standard - DS 447:2013:
    - "Requirements for mechanical, natural and hybrid ventilation systems"
    - Includes ventilative cooling expressed as Free cooling, night cooling, passive cooling & cooling by means of natural ventilation)



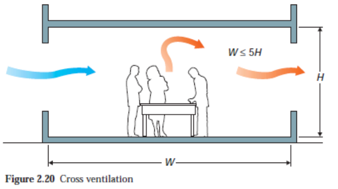
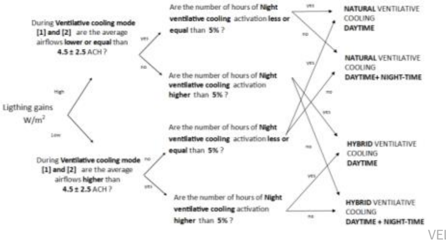


Figure 2.20 Cross ventilation



RECOMMENDATIONS TO CEN & ISO STANDARDS

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- **General alignment among new documents**
  - Try to align methods, to eliminate overlaps or too big variation in results
    - E.g. for calculation of air flow rates through windows for natural ventilative cooling; use EN 16798-7:2017
  - Work together and learn from each other in CEN & ISO; Liasions or workshops

- **Opportunities:**
  - New work give opportunities to increase the knowledge and explain how to utilize the ventilative cooling effects in buildings in upcoming standards
  - Enables e.g. architects & consulting engineers to better design and implement ventilation systems
  - Increased focus on ventilative cooling, will also increase the relevance of hybrid ventilation, encompassing the best of both worlds; NV + MV
  - Content of new documents & guidelines on VC to be "legislation-ready" (open to legislation)

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CONCLUSION

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- **Interest & activities on ventilative cooling in standardisation world!**
  - New work items (all items accepted through voting, work to start up Q4:2017)
  - Alignment and start-up of task groups initiated

- **Evaluation of ventilative cooling in EN 16798-7:2017 standard:**
  - New (simple) calculation methods of air flow rates (EN 16798-7) to hopefully be used in new documents
  - Relevance of ventilative cooling highly increased (e.g. by including cross ventilation)
    - Previously only single-sided ventilation was included

- **Less is more:**
  - Simple to use evaluation methods, to further increase the awareness and knowledge of NVC
  - The more difficult methods to use, the less general exposure of how to use ventilative cooling

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ANNEX 62 - DELIVERABLE

- **Name:** Recommendations for legislations, standards and compliance tools

- **Purpose:** Map detailed differences between national calculation methods for (natural) ventilative cooling on:
  - Legislation level (national, regional or guideline)
  - Compliance tool level (national)
  - Standards level (**ISO, EN** and national)

- **Main focus:** Natural ventilative cooling

- **Countries contributing (9):** Italy, Denmark, UK, Austria, Switzerland, Portugal, Australia, Japan, Ireland

- **Finish:** Q4:2017

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IEA Annex 77 (?)

Smart overheating prevention and

Resilient Cooling

in changing urban climates

Peter Holzer

Institute of Building Research & Innovation
Vienna, Austria

Challenge

- Urbanisation and densification, together with climate change raise issues of overheating prevention & resilient cooling.
- The phenomenon of an increasing need for cooling is relevant for both new and existing, residential and commercial buildings in all densely populated areas all over the world.
- The rapid development towards overheating and cooling need of homes is a global and multi-dimensional issue …

Challenge

- Energy System Issue: Worldwide energy demand and peak-loads for air-conditioning is rising at dramatic speed, rising the danger of blackouts and grid instability and compromising the implementation of green electricity production.
- Public health: Suffering from heatwaves without protection from decently designed homes not only is an issue of comfort but of health.
- Sociocultural issue: Low-income people are most vulnerably exposed to heat stress, e.g. living in dense and polluted urban areas, in poorly designed homes without air-conditioning

Chance

- This global challenge calls for concerted action;
  not at least at technological level.
- Cooperative research towards resilient cooling technologies offers realistic options for both tackling the challenge and furthermore boosting appropriate technological development.
- From today's point of view, promising fields of technical development are expected in the following areas …

Possible Developments

- Passive cooling, prevailingly at low-cost-level, ready for application in refurbishment, increasing the robustness against heatwaves.
  E.g. effective sun protection, reflective coatings, effects from plants
- Natural cooling, not at least for temporary and local cooling.
  E.g. night ventilation together with PCM, comfort ventilation, including adiabatic effects
- Active cooling devices, energy efficient and adaptive, ready for use in renovation, possibly including heat storage effects for increased robustness and for lowering/shifting peak-loads. **E.g. Low exergy cooling emitters. Low ΔT chillers, personal comfort control**
- Combined heating & cooling solutions, making use of low energy cooling and heating and seasonal heat storage, **E.g. borehole heat exchangers together with GSHP and free-cooling**

Annex Scope

- *How can resilient and carbon neutral technologies be developed and implemented to face the challenge of building overheating prevention and cooling in dense urban surroundings?*
- Emphasis shall be put on energy-efficiency as well as resilience: robustness against weather extremes, robustness against blackouts and accessibility for people with low income and applicability to existing, poorly constructed flats.
- The annex will address both residential and non-residential buildings, however, these two sectors will be treated separately. The Annex will address both new constructions and renovation.
- The Annex will welcome contributors from all climate zones, taking advantage of learning from and further developing very specific approaches and solutions.

Annex Subtasks

The Annex will be structured in three Subtasks

A Knowledge Base

B Solutions

C Case Studies

Subtask A: Knowledge base

- Decision making toolkit: Develop a set of criteria for the specific applicability of solutions for overheating prevention and resilient cooling. Driven by parameters such as climate, air-quality, noise level, building construction, building-use.
- Local Climate Effects: Investigate the quantitative effect of the building’s adjacent micro- and meso-climate to building design: urban heat islands, evapotranspiration from green façades, warm upwinds at dark facades and others. Develop amendments to general climate data sets.
- Health impacts: Develop a comprehensive excerpt of up to date knowledge regarding health impacts of heat-stress.

Subtask B: Solutions

- Passive cooling, prevailingly at low-cost-level, ready for application in refurbishment, increasing robustness against heatwaves. **E.g. effective sun protection, reflective coatings, effects from plants**
- Natural cooling, not at least for temporary and local cooling. **E.g. night ventilation together with PCM, comfort ventilation, including adiabatic effects**
- Active cooling devices, energy efficient and adaptive, ready for use in renovation, possibly including heat storage effects for increased robustness and for lowering/shifting peak-loads. **E.g. Low exergy cooling emitters. Low ΔT chillers, personal comfort control**
- Combined heating & cooling solutions, making use of low energy cooling and heating and seasonal heat storage, **E.g. borehole heat exchangers together with GSHP and free-cooling**

Subtask C: Case Studies

- Provide a set of well documented case-studies, including a wide variety of solutions from all possible climate zones. The case studies shall not only illustrate the variety of possible solutions and encourage further application.
- Carry out post occupancy performance evaluations, additional to the case-studies, wherever possible. Explain best practise as well as limitations and learnings.

The Plan

- Write the Annex concept proposal: Done
- Send it to the IEA EBC Program's Executive Committee: Done
- Present it at the ExCo's Ottawa meeting at Nov 8th, 2017 hopefully getting the decision of acceptance. Scheduled

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- 1 year preparation phase until Nov 2018
- 3 year working phase until Nov 2021
- 1 year reporting phase until Nov 2022

Outlook on Preparation Phase

- Formulating national research items
- Formulating overarching research items
- Raising money
- Team building

- Starting in Jan 2017
- Virtual Communication via Mailing List, dropbox, webmeetings
- Real Communication at workshops, adjacent to topical conferences
- Final preparation workshop at AIVC 2018, Antibes Juan-Les-Pins
- Decision upon Annex working phase by ExCo in Nov 2018

The Invitation

- You are very much invited to consider joining the new Annex. If so, please …
  - Let me know: peter.holzer@building-research.at
  - Let your ExCo representative know, before Nov 8th !! http://www.iea-ebc.org/contacts/
- Interest so far from Australia, Austria, Belgium, China, Denmark, France, Italy, Japan, Netherlands, Great Britain

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Thank You !