BUILD UP
energy solutions
for better buildings

Web Seminar

Ventilative cooling

Keep cool and lower peak energy demand

venticool

Ventilative cooling
A hot topic!

Peter Wouters
Manager INIVE EEIG

Content of this presentation

- Ventilative cooling is not a new topic…
- … but new opportunities AND challenges
- The Venticool platform
- Conclusions

Natvent - 1994

A European project aimed to contribute a better understanding of the barriers and possibilities for applying natural ventilation in office buildings.

http://projects.bre.co.uk/natvent

NatVent

IEA EBC Annex 35 HybVent - 1998

An IEA project aimed to:

- develop control strategies for hybrid ventilation systems for office and educational buildings,
- develop methods to predict hybrid ventilation performance in hybrid ventilated buildings,
- promote energy and cost-effective hybrid ventilation systems in office and educational buildings and
- select suitable measurement techniques for diagnostic purposes in buildings with hybrid ventilation systems.

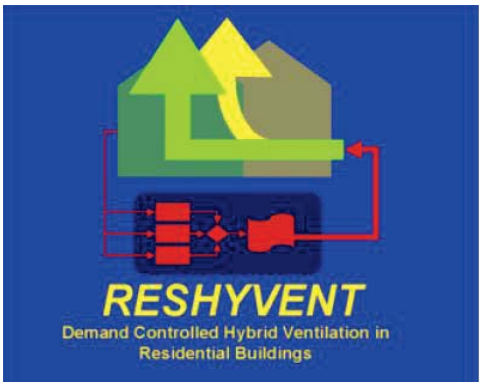
www.hybvent.civil.aau.dk/site_guide/index_site_guide.htm

Annex35 HybVent

Hybrid Ventilation in New and Retrofitted Office Buildings

RESHYVENT - 2002

EU project aimed to develop and to construct totally new advanced ventilation concepts for residential buildings based on demand control, hybrid technologies and integration of renewables



KEEPCOOL - 2005

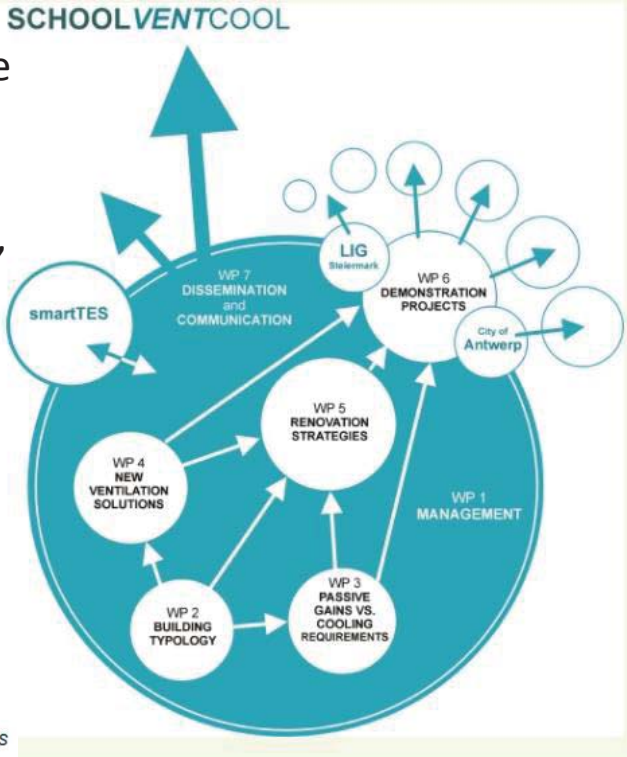
A European project aimed to propose intelligent ways of getting passive cooling to penetrate the market and to establish a new definition of sustainable summer comfort

www.iee-library.eu/images/all_ieelibrary_docs/keepcool_finalreport.pdf

SchoolVentCool - 2012

The EU project “School Vent Cool” developed different high performance renovation strategies for school buildings.

New solutions for ventilation systems, natural cooling and application of prefabricated modules were investigated.



www.schoolventcool.eu

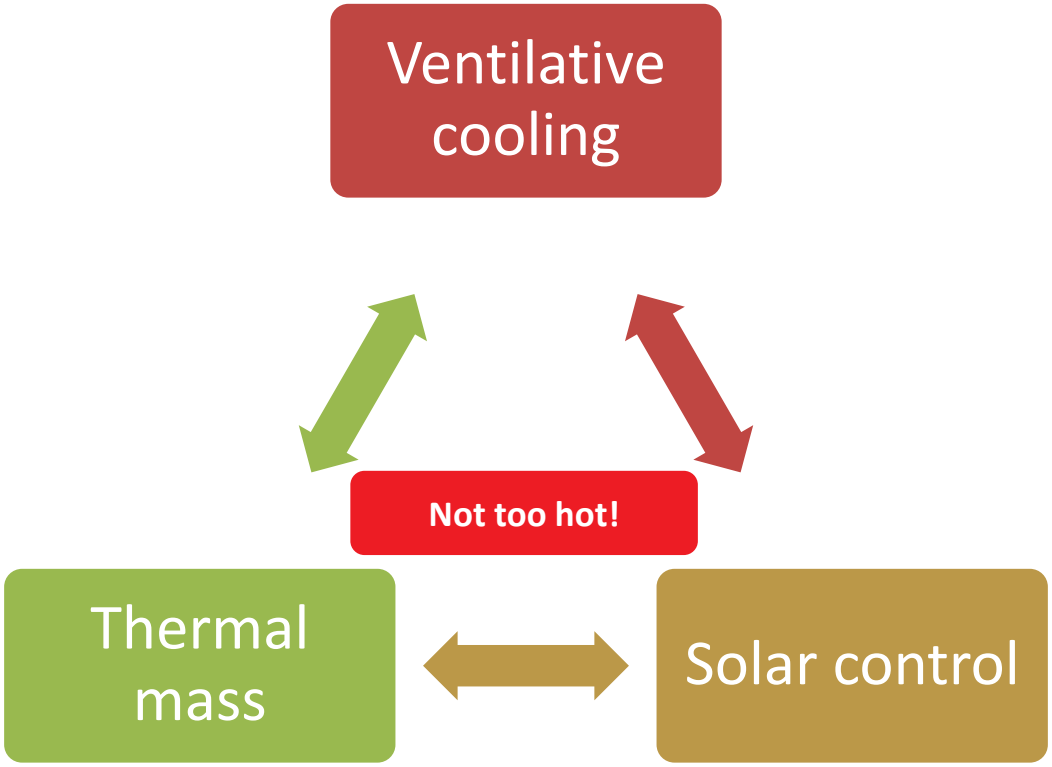
SCHOOLVENTCOOL

Ventilation, cooling and strategies for high performance school renovations

A change in challenges…

ENERGY	**INDOOR CLIMATE**
Heating demand	Warm enough
Energy consumption for heating	Good air quality
Primary energy consumption (including cooling)	Acoustics
	Not too hot!

Important elements in thermal comfort strategy



Content of this presentation

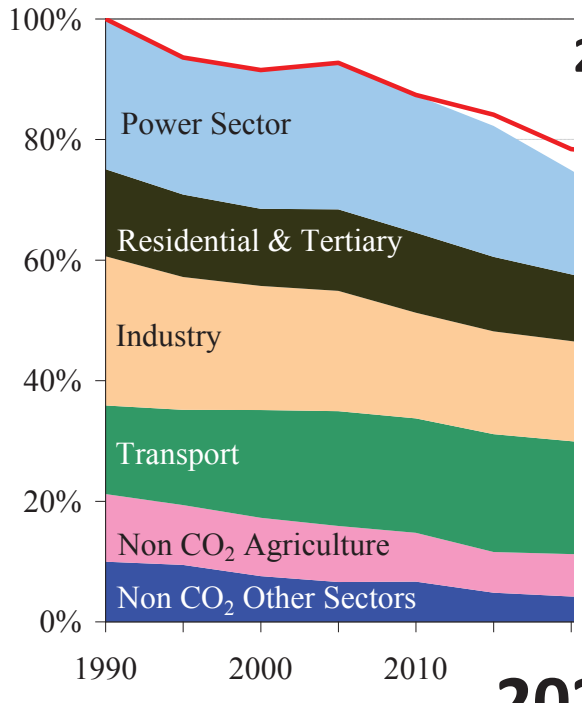
- Ventilative cooling is not a new topic…
- … but new opportunities AND challenges
- The Venticool platform
- Conclusions

More challenges AND opportunities…

ENERGY	INDOOR CLIMATE	OUTDOOR CLIMATE
Heating demand	Warm enough	Ventilative cooling also during less hot periods
Energy consumption for heating	Good air quality	Noise
Extremely low primary energy consumption (including cooling)	Acoustics	Draught
Power management (smart grids)	Not too hot	Rain, … Burglary, …
		Fine dust

European Roadmap 2050

COM(2011)112



2020: Nearly-zero energy buildings

Short term: Cost optimal requirements

2020

Renewables and management of the grid!

EBC

Energy in Buildings and Communities Programme

2014-04-09

IEA EBC Annex on Energy Flexible Buildings

Annex Text

It is foreseen that the Energy Flexibility in buildings will play an important role in facilitating energy systems based entirely on renewable energy sources. Energy Flexibility of buildings will be necessary to control the energy consumption to match the actual energy production from varying energy sources such as solar and wind.

There is, however, at the moment no overview or insight into how much Energy Flexibility different building types and their usage may be able to offer to the future energy systems.

The aim of the Annex is thus to increase knowledge on and demonstrate the Energy Flexibility buildings can provide for the energy grids, and to identify critical aspects and possible solutions to manage this Energy Flexibility.

Contact person: **Søren Østergaard Jensen** - sdj@teknologisk.dk

Opportunities for ventilative cooling

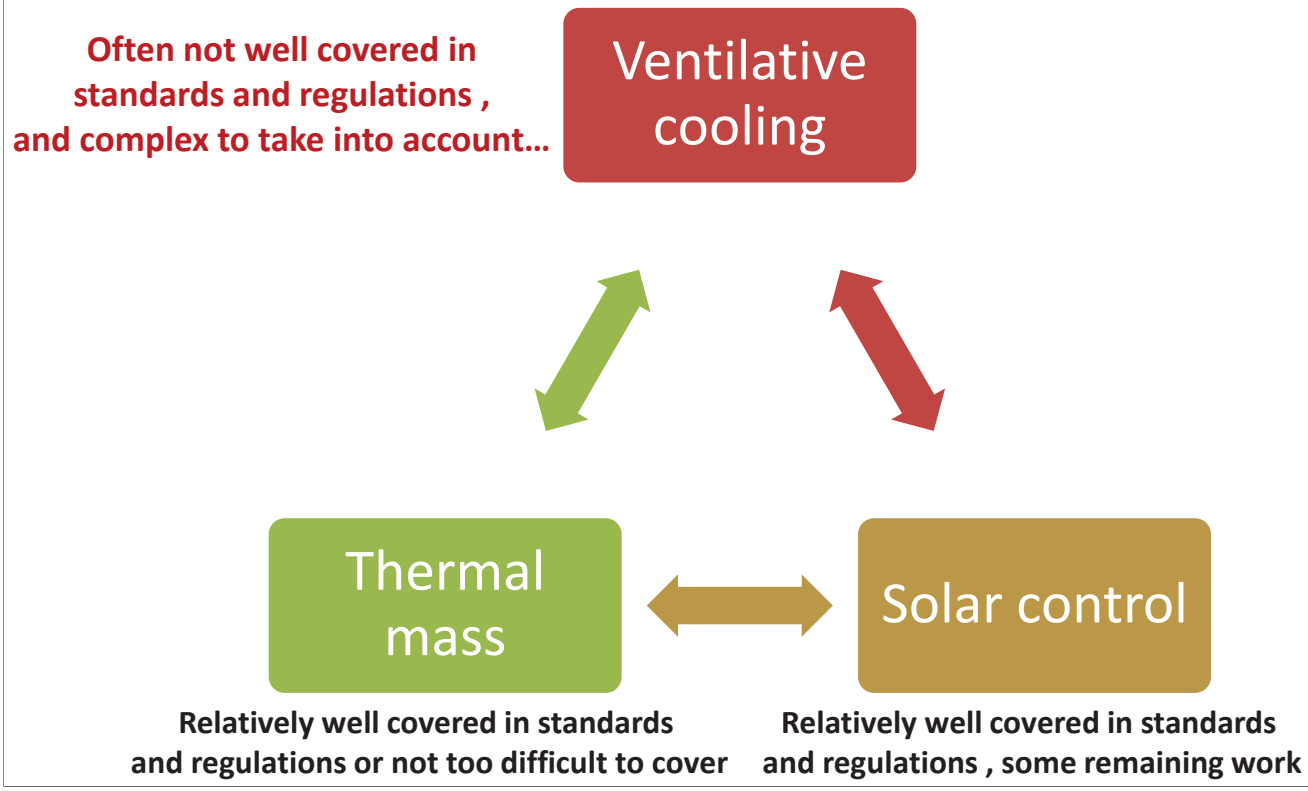
- In NZEB buildings more risks of overheating
- Ventilative cooling also an interesting strategy during less warm periods
- Ventilative cooling can be an efficient strategy for peak power management during warm periods
- Major advances in smart control strategies
- More attention for performance based approach (summer comfort)

Threats for ventilative cooling

- Role of regulations is growing whereby ventilative cooling often not well covered in standards and regulations
- More strict compliance schemes can be a barrier of ventilative cooling, if not well covered in procedures
- Energy requirements become so severe that little room for extra measures outside legal requirements
- More emphasis on indoor climate conditions (acoustics, fine dust,….)

Important elements in thermal comfort strategy

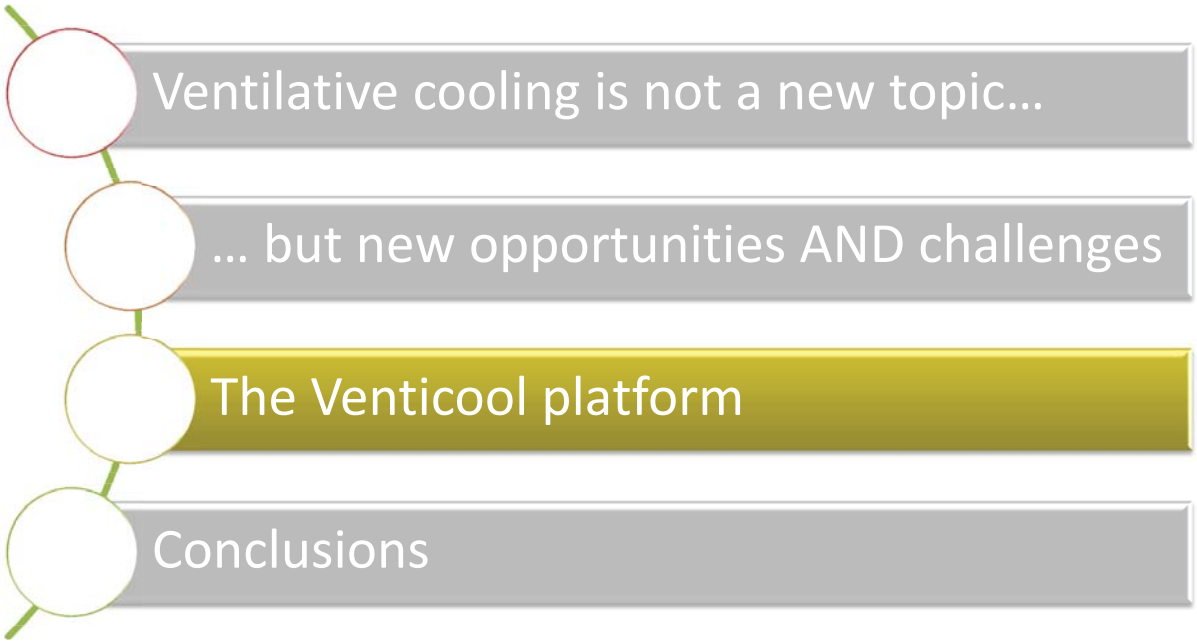
Often not well covered in standards and regulations , and complex to take into account…



Relatively well covered in standards and regulations or not too difficult to cover

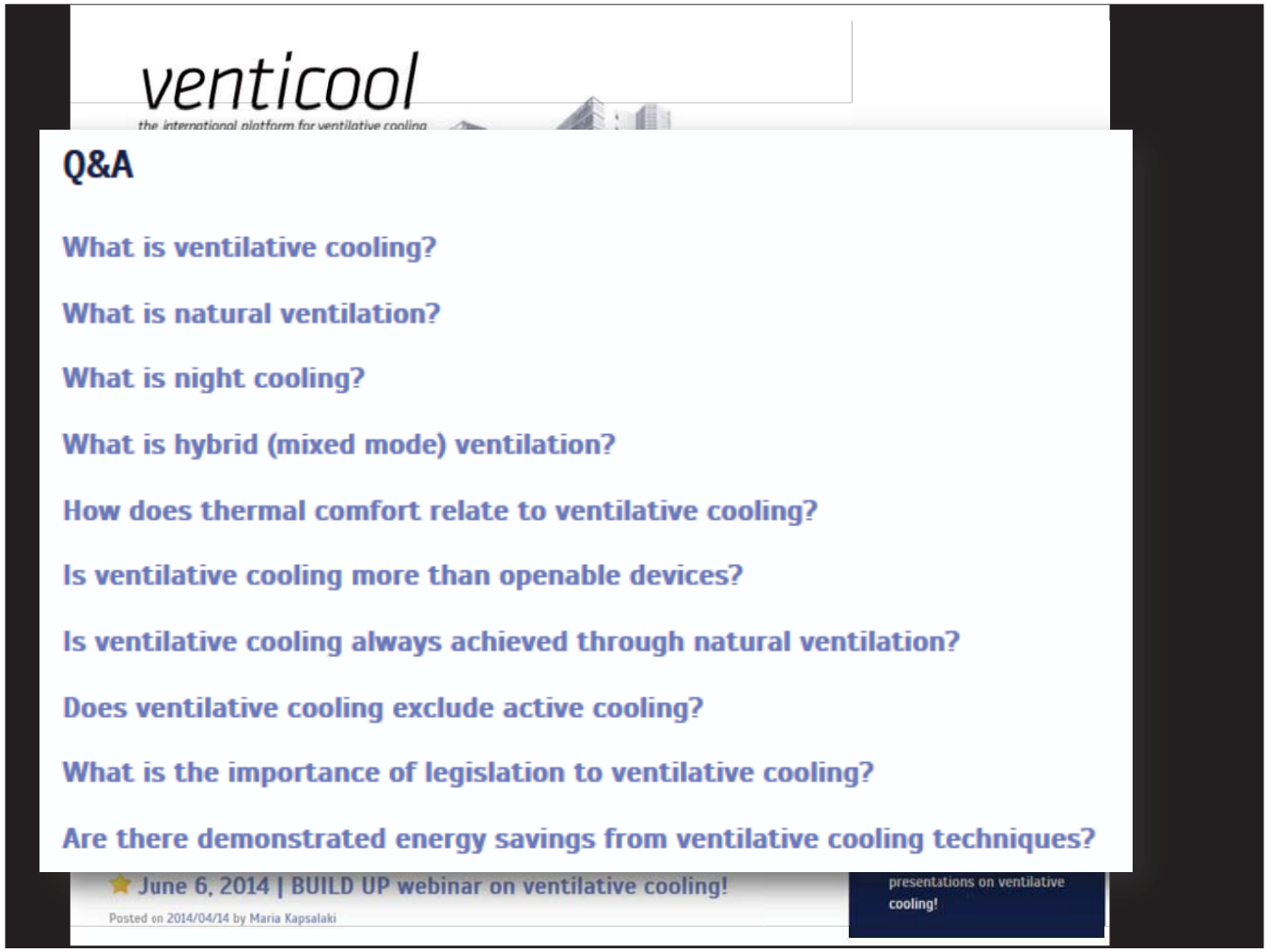
Relatively well covered in standards and regulations , some remaining work

Content of this presentation



Why venticool platform?

1. • Raise awareness about potential and challenges of ventilative cooling
2. • Raise awareness about interesting approaches
3. • Identify relevant activities and initiate actions



venticool
the international platform for ventilative cooling

Newsletter
No 3 • DECEMBER 2013

Foreword

The venticool platform was inaugurated in September 2012 in response to the needs felt to increase awareness regarding ventilative cooling and to foster exchanges on this topic both for practitioners and researchers. 15 months later, its relevance is clearly confirmed:

- The IEA EBC Annex 62 project on "Ventilative cooling" has been approved for a 4-year working phase and will use venticool as key communication partner;
- The 2012 and 2013 AIVC conferences, together with the March 2013 workshop have been major discussion places on this topic and key elements to develop the annex work plan;
- The Intelligent Energy Europe project "QualiCheck" recently approved will address ventilative cooling issues related to compliance and quality of the works in collaboration with venticool.

This opens a period of 4 to 5 years at least with great developments expected on ventilative cooling. We hope you will have a good taste of it with this newsletter.

Peter Wouters, Manager of INIVE EEIG

2013 conference
Summary of the ventilative cooling track

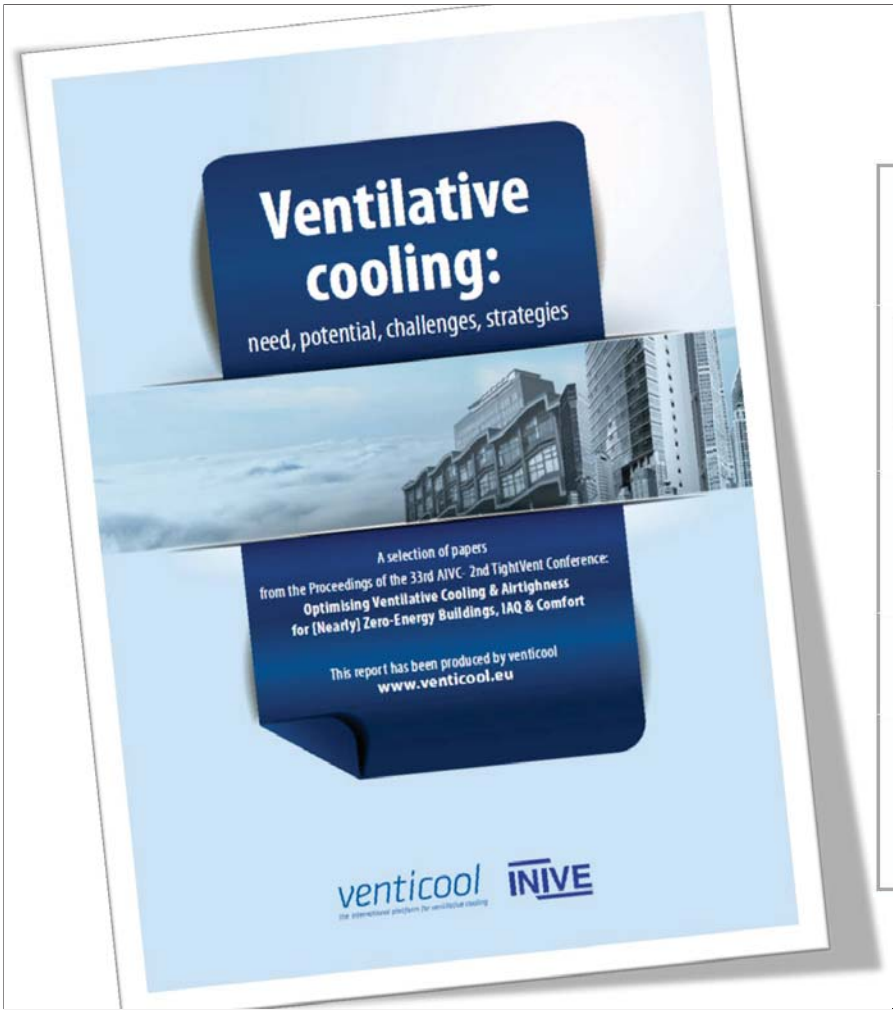
By Maria Kapsalaki, INIVE and Per Heiselberg, University of Aalborg, Denmark.

Over 160 persons attended the joint 34th AIVC, 3rd TightVent, 1st venticool and 2nd Cool Roofs' Conference held in Athens, Greece on 25-26 September, 2013. The conference focused on research, technologies, policies and market transformation to employ in an optimal way proper mitigation and adaptation techniques with the aim to reduce the energy consumption of buildings and improve the urban microclimate. Furthermore, focus was set on the energy impact of ventilation and air infiltration while ensuring good indoor air quality and thermal comfort, as well as converging work on smart materials to reduce the carbon footprint of the building sector.
Ventilative cooling was one of the major themes since the potential of this technique is more and more considered to reduce the cooling energy demand in summer or mid-season conditions, depending on outdoor climate, building design and internal loads. The ventilative cooling track of the conference consisted of 4 sessions with 27 presentations covering the following topics:

- Ventilation for summer comfort – energy impacts
- Experience with ventilative and passive cooling
- Ventilation and cooling strategies
- Ventilative cooling in standards and regulations – Challenges for Annex 62

The paper available at venticool.eu/wp-content/uploads/2013/12/VC-summary_VF-2.pdf gives a bird's eye view of trends and conclusions that appeared in the presentations and discussions in the ventilative cooling track of the conference.

In this issue



AGORIA naventa

ESSO EUROPEAN SOLAR-SHADING ORGANIZATION Energy Savings & Comfort

eurima European Insulation Manufacturers Association

VELUX®

Window Master Natural Ventilation


Energy conservation technologies for mitigation
and adaptation in the built environment:
The role of ventilation strategies and smart materials
34th AIVC Conference
3rd TightVent Conference
2nd Cool Roofs' Conference
1st venticool Conference
25-26
September 2013
Divani Caravel Hotel
Athens, Greece


35th AIVC Conference
24-25 September 2014
Poznań, Poland
Ventilation and airtightness in transforming the building stock to high performance
4th TightVent Conference
2nd venticool Conference


EBC
Energy in Buildings and Communities Programme
AIVC Air Infiltration and Ventilation Centre
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Recent News
AIRBASE Click here for searching in a database of 19.000 publications with more than 7000 pdf documents
d you know?
Highlighted News
35th AIVC conference in Poznań, Poland!
Announcement on the number of selected abstracts-Confirmed plenary session's speakers and...
> 02 June 2014 MORE
June 6, 2014 | BUILD UP webinar on ventilative...
BUILD UP Web Seminar | Ventilative cooling: Keep cool and lower peak energy demand
> 14 April 2014 MORE
Annex 62 "Ventilative cooling" met in Lausanne
IEA EBC Annex 62- Ventilative Cooling- 1st Expert Meeting Updates
> 02 June 2014 MORE
Top events
September 24-25, 2014: 35th AIVC conference in Poznan, Poland
The 35th AIVC conference : 'Ventilation and airtightness in transforming the building stock to high performance' will be held in Poznan, Poland together with the 4th TightVent and the 2nd venticool
MORE
March 18-19, 2014: AIVC workshop on Quality of Methods for Measuring Ventilation and Air Infiltration in...
There is a trend to perform more ventilation and air infiltration measurements in buildings, either to strengthen commissioning procedures or to learn from field data.
MORE
November 14, 2013: Webinar – Airtightness testing part 1: status and trends in competent tester schemes in...
Over the past few years, there has been an increasing number of airtightness tests performed in Europe either for specific high performance buildings programmes or for a wide range of buildings in regulatory
MORE
Energy Impact of Ventilation?
LEARN MORE
Key Publications
Securing the quality of ventilation...
This publication collects papers presented at one of the activities organized...
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AIVC Newsletter, Issue 05, January 2014
The fifth issue of the AIVC newsletter was out in January 2014. Its...
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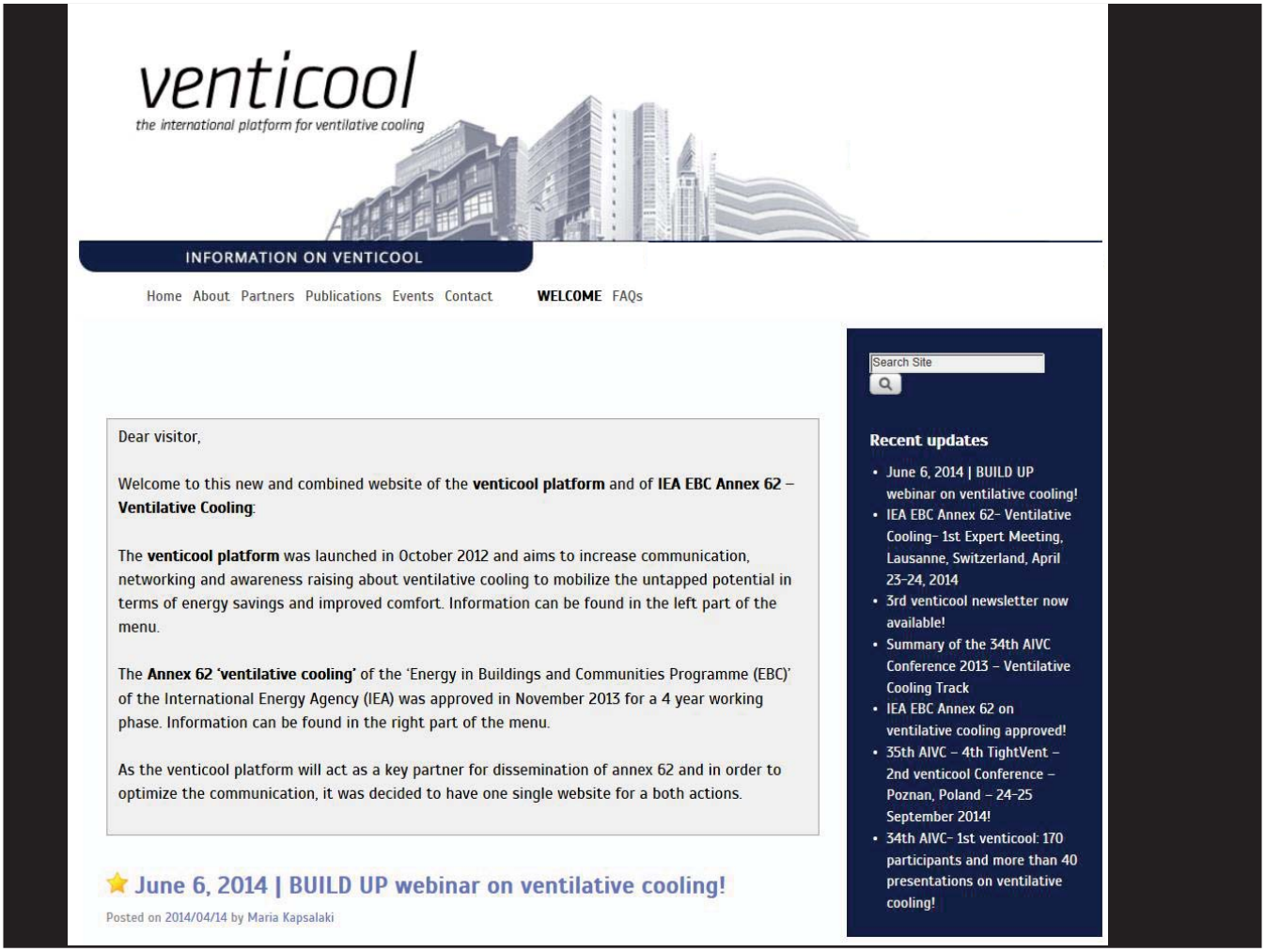

Content of this presentation

- Ventilative cooling is not a new topic…
- … but new opportunities AND challenges
- The Venticool platform
- Conclusions

Conclusions

- There surely is a large potential for ventilative cooling
- Good design and control strategies is crucial
- Role of energy regulations is crucial and should correctly take into account ventilative cooling
- Venticool aims to contribute to progress on qualitative ventilative cooling

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IEA EBC Annex 62
Ventilative Cooling

Ventilative Cooling
06 June 2014

Per HEISELBERG
Aalborg University

Web Seminar
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Background

- The current development towards nearly-zero energy buildings have lead to an increased need for cooling – not only in summer but all year.
- Elevated temperature levels are the most reported problem in post occupancy studies, especially in residences - even 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
- Utilization of the cooling potential of outdoor air can be an attractive and energy efficient solution (cooling is correlated with solar and internal heat load and not outdoor temperature)

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Home for life, Lystrup, Denmark

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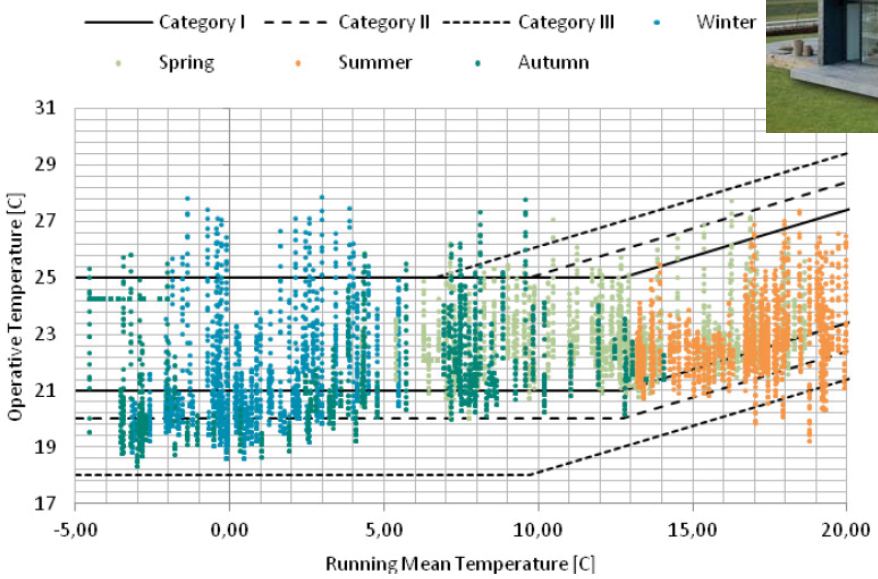
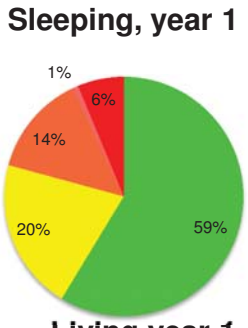
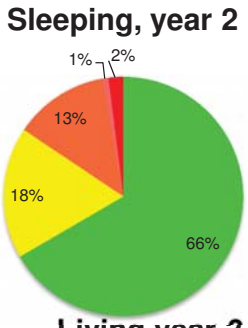
Temperature Levels – Living Room

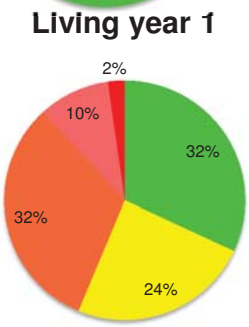


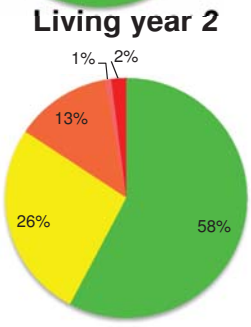
Reference: Esbensen

Improved Control and Operation









Reference: VELUX og Esbensen

Why do we have a overheating problem?

- A “new and increasing problem” for high performance residential buildings in cold and moderate climate
- 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”
- Use of too simplified design methods – no correlation between cooling need and overheating risk

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Ventilative Cooling in Offices

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

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Offices in Cold Climate

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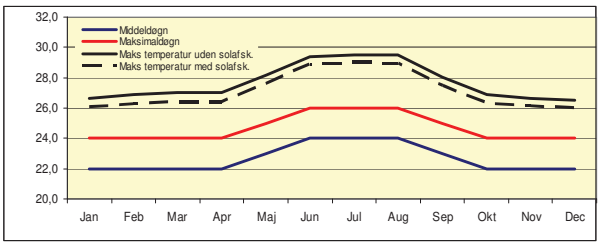
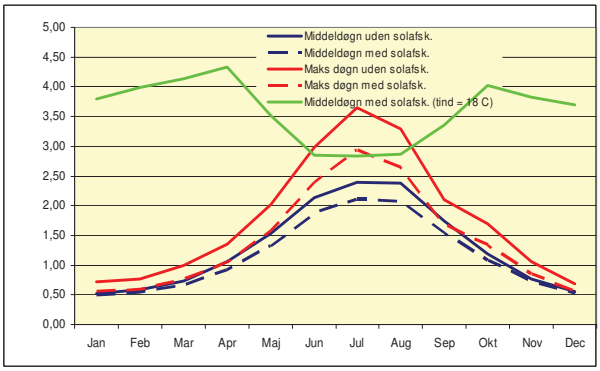
Challenges in a Cold Climate





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Definition of Ventilative Cooling

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

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Ventilative cooling is a solution

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

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IEA EBC Annex 62
Ventilative Cooling

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Annex Objectives

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

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Annex Outcome

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

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Annex Organization

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

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Subtask A: Methods and Tools

- Will 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
- Will give guidelines for integration of ventilative cooling in energy performance calculation methods and regulation including specification and verification of key performance indicators

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Subtask B: Solutions

- Will investigate the cooling performance of existing mechanical, natural and hybrid ventilation systems and technologies and typical comfort control solutions as a starting point for extending the boundaries for their use.
- Will develop recommendations for flexible and reliable ventilative cooling solutions that can create comfort under a wide range of climatic conditions.

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Subtask C: Case Studies

- Will demonstrate the performance of ventilative cooling through analysis and evaluation of well-documented case studies.

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Annex Leadership

- Participating countries
  - Austria, Belgium, China, Denmark, Finland, Greece, Ireland, Italy, Japan, Netherlands, Norway, Switzerland, UK, USA
- Operating Agent:
  - Denmark, represented by Per Heiselberg, Aalborg University
- Subtask A:
  - Leader: Switzerland, represented by Fourentzos Flourentzou, ESTIA
  - Co-leader: Italy, represented by Annamaria Belleri, EURAC
- Subtask B:
  - Leader: Austria, represented by Peter Holzer, IBRI
  - Co-leader: Italy, represented by Lorenzo Pagliano, POLIMI
- Subtask C:
  - Leader: Greece, represented by Mat Samtamouris, NKUA
  - Co-leader: China, represented by Guoqiang Zhang, Hunan University

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Overview and state-of-the art of Ventilative Cooling

- **Ch1- Introduction**
- **Ch2- Potential and limitations to Ventilative Cooling**
- **Ch3- Ventilative cooling in existing Energy Performance Regulations**
- **Ch4- Exemplary existing buildings using Ventilative Cooling**
- **Ch5- Existing components and control strategies for ventilative cooling**
- **Ch6- Existing methods and tools**

To be published at the Annex 62 webite by the end of 2014


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

BUILD UP
energy solutions
for better buildings

venticool
the international platform for ventilative cooling

EXAMPLES OF NATURALLY COOLED BUILDINGS

100% ECONOMY IN CENTRAL EUROPE CLIMATE

50% ECONOMY IN MEDITERRANEAN CLIMATE

Estia

Flourentzos Flourentzou:
Innovation park EPFL
Lausanne, Switzerland

100% glazing in the East en in the South facades , with no visible opening

no visible duct, no visible ventilation grid

pure external vue, without window frames, without accessories

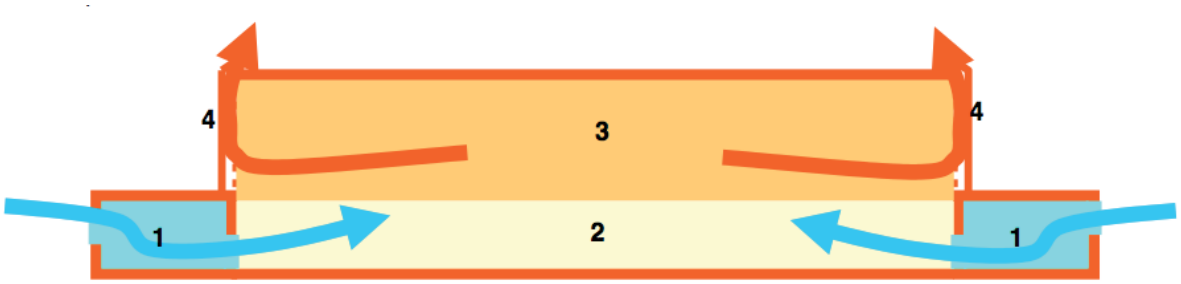
Because

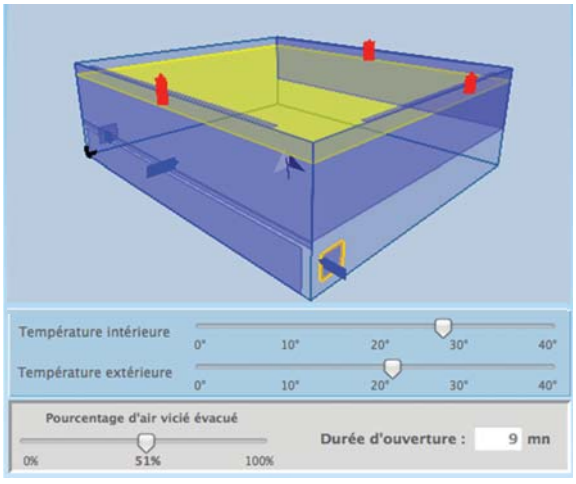
… la vision globale d'un projet est pour nous la plus importante et chaque cas est différent! Ce que les tableaux de calculs ne peuvent transcrire. L'architecture et les qualités des espaces, les atmosphères et les sensations personnelles n'entrent pas compte, car les critères sont subjectifs, ce qui prouve qu'il n'y a pas de recettes miracles et que l'on ne peut pas tout réduire par des calculs et des labels…

… nous essayons toujours de trouver des solutions les moins techniques possibles pour nos bâtiments. Nous trouvons cela beaucoup plus écologique…

patricia capua mann
graeme mann & patricia capua mann
architectes epfl fas sia
ch de monribeau 2
1005 lausanne

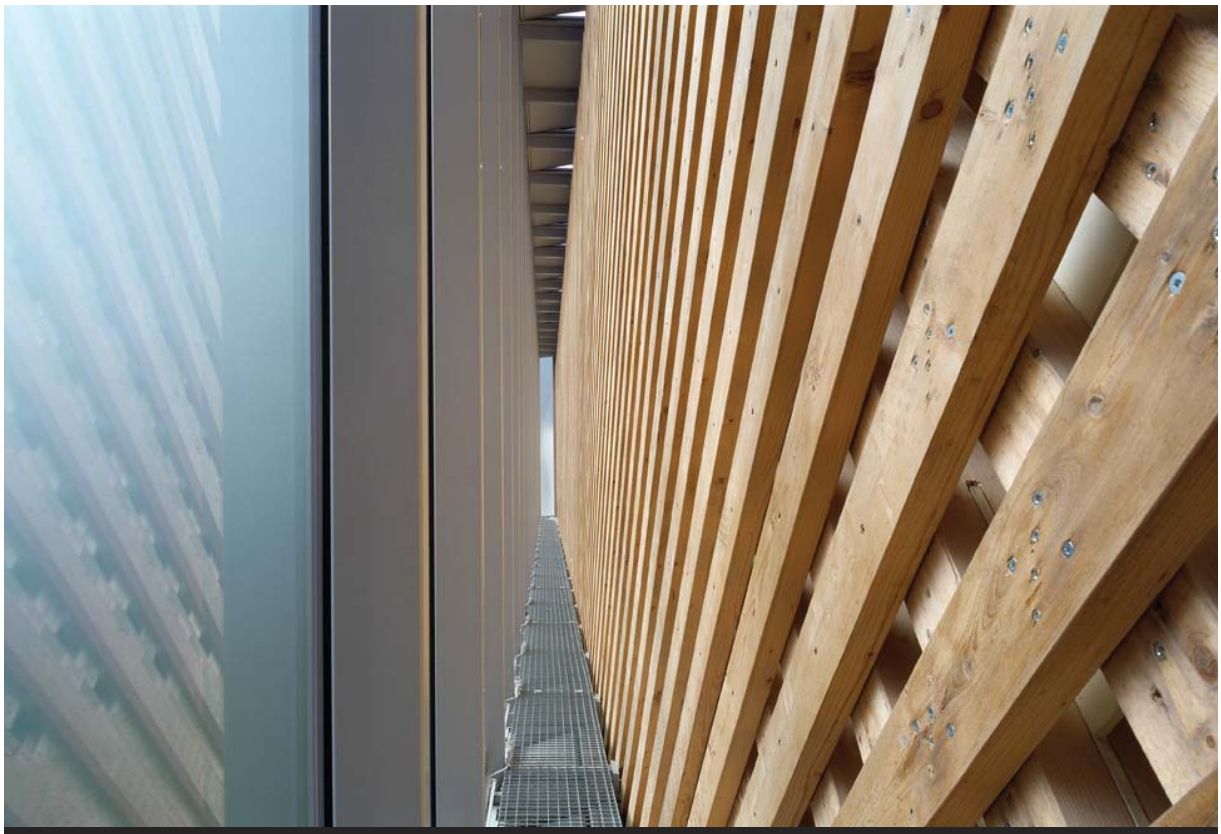
But how ?



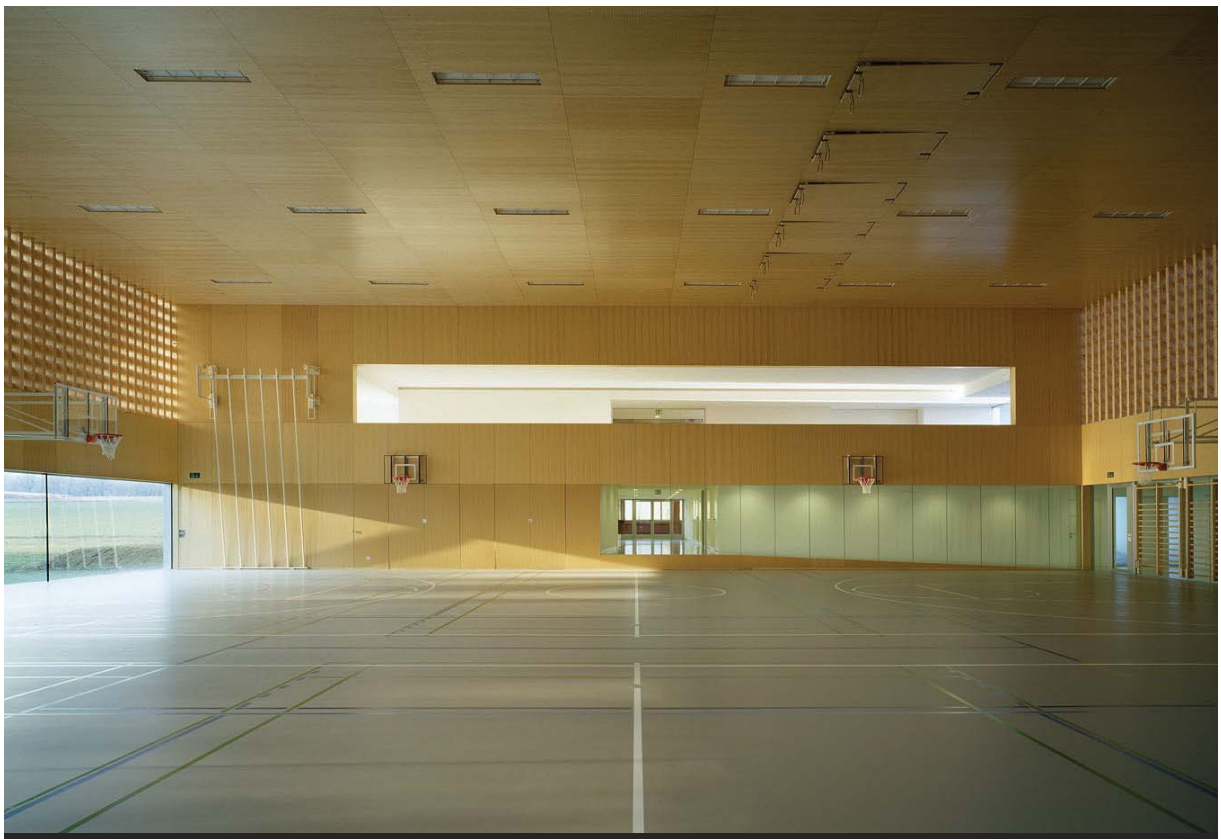


simulation: www.dialplus.ch

Q_1 = 2 X 12'237 m^3/h at ΔT = 6° C, 50% ach in 9 minutes

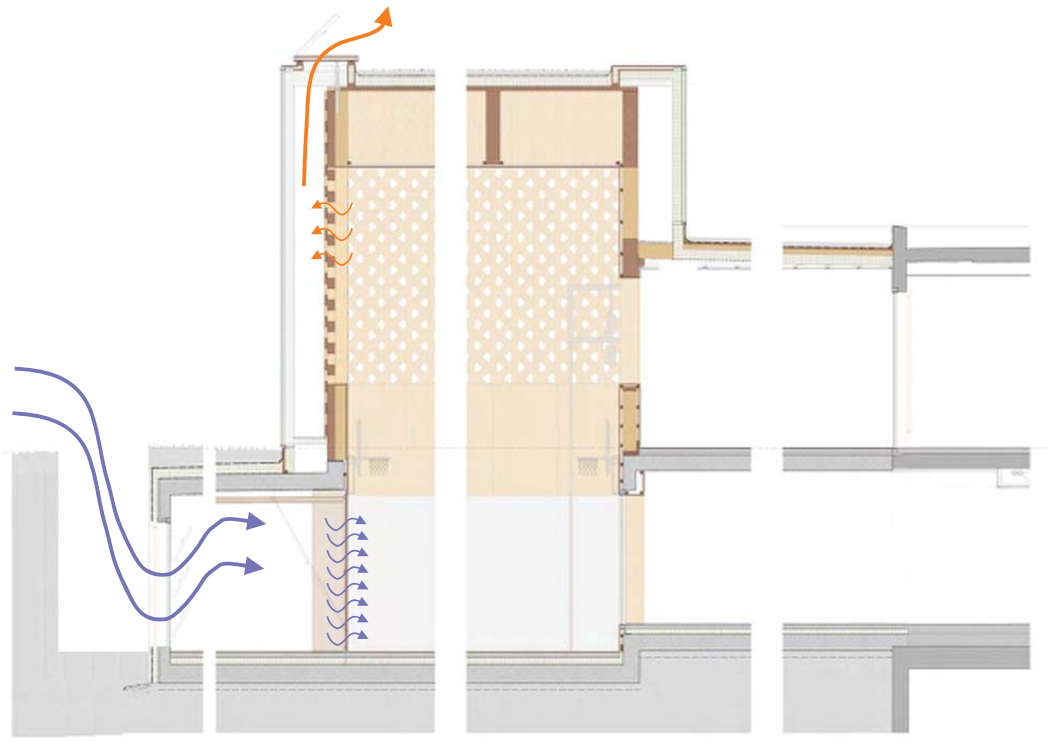


the eco-structure / dynamic solar shading / ventilation duct / acoustic absorber

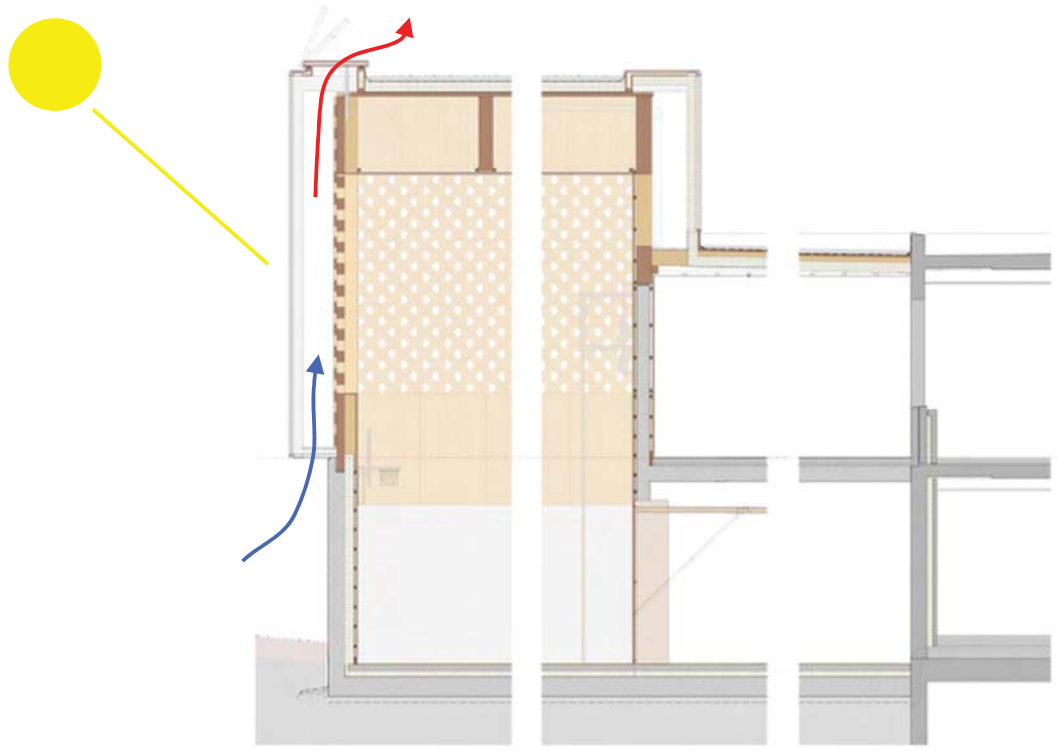


the ventilation inlet grid / storage room door

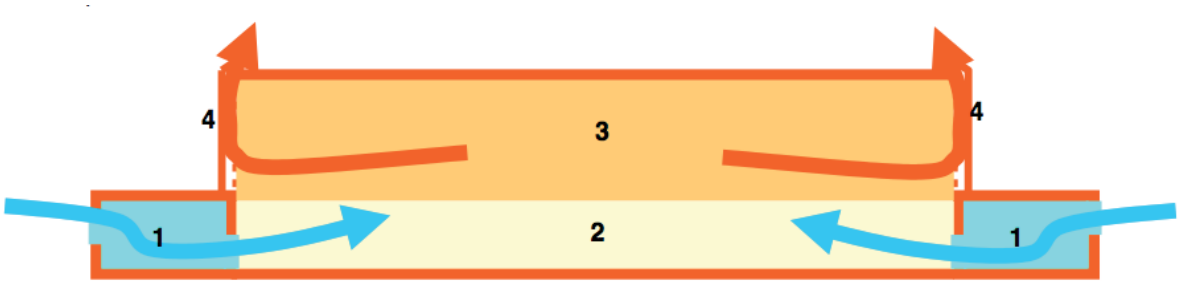
building physics is part of personal sensations, atmospheres and space quality



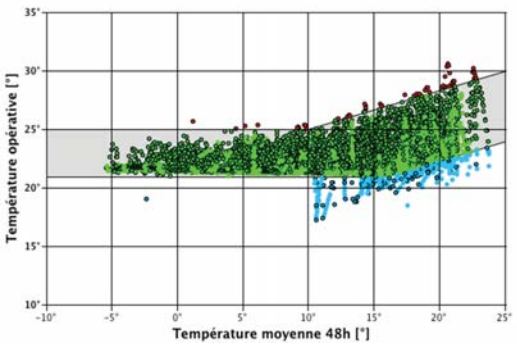
flash ventilation when CO2>800 ppm / night ventilation during summer



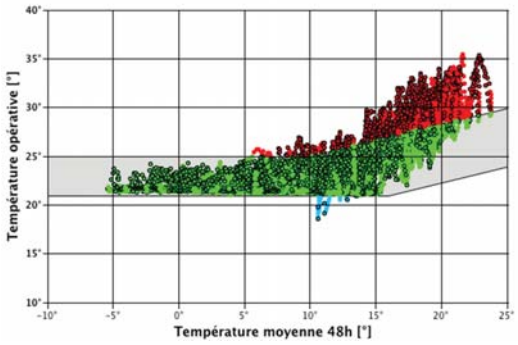
local heat discharge when sun is striking the facade



Nignt ventillation cooling strategy
DIAL+ sumulation: EN 15251 thermal confort

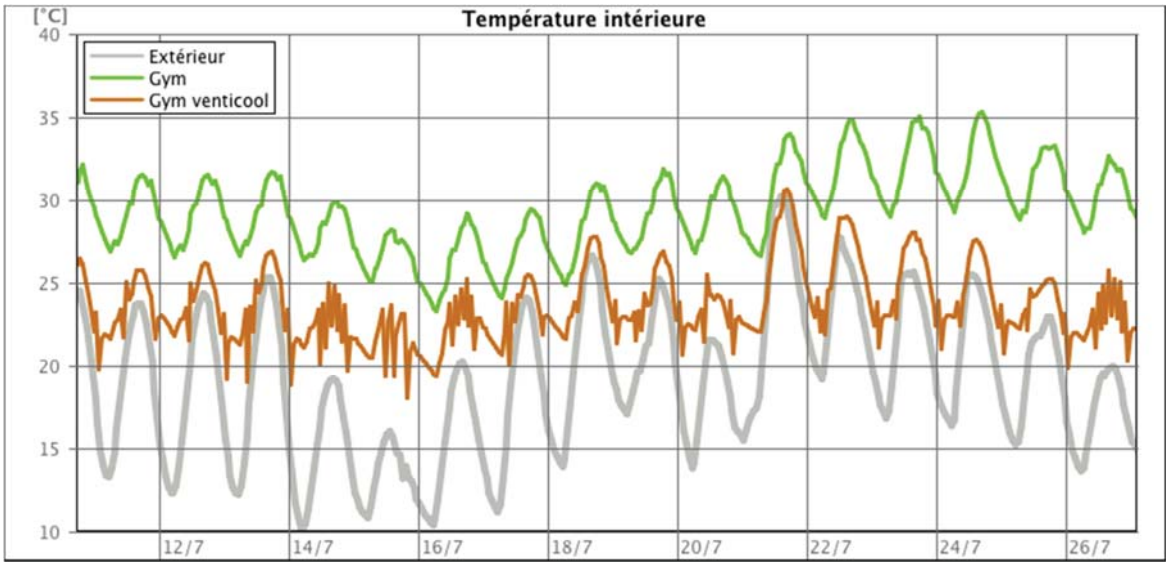


No ventillation cooling strategy
DIAL+ sumulation: EN 15251 thermal confort



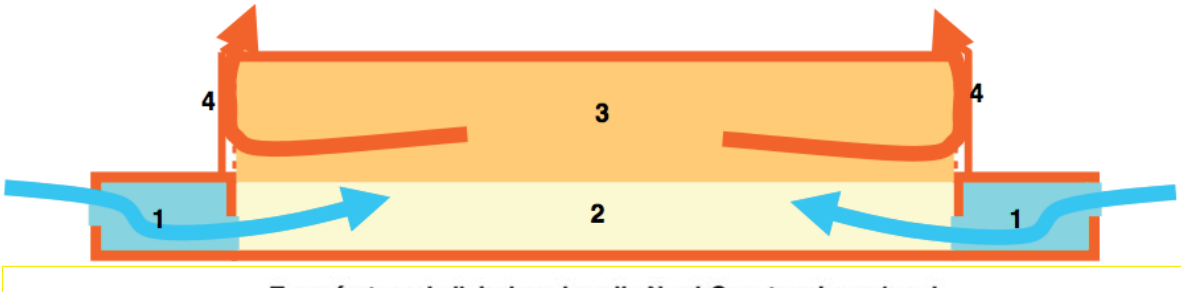
www.dialplus.ch

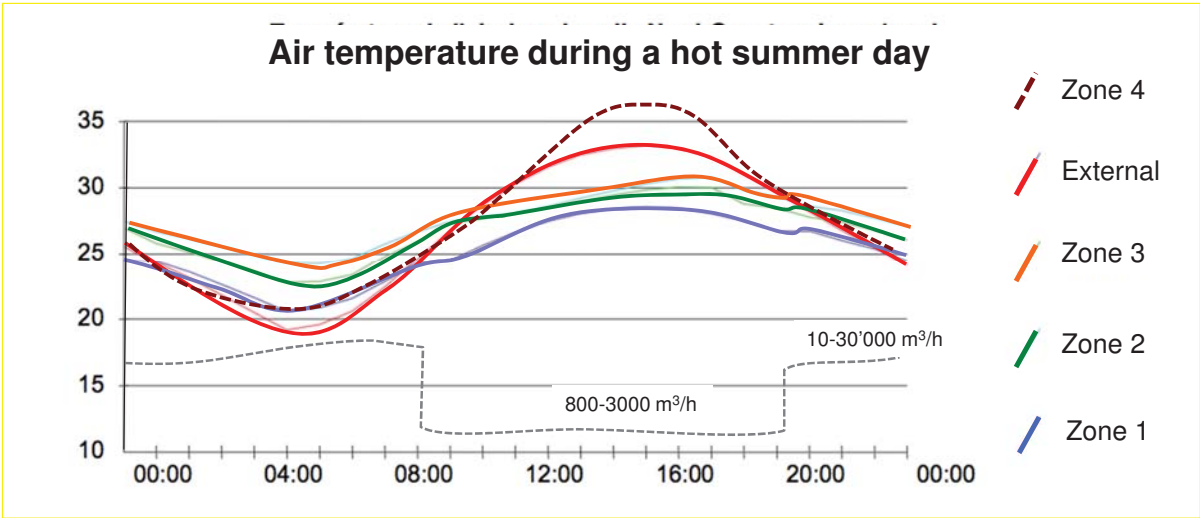
overheating: night ventilation cooling strategy - 55 h / no strategy 1099 h



simulation: www.dialplus.ch

overheating: night ventilation cooling strategy - 55 h / no strategy 1099 h





simulation: lecocool - lesowww.epfl.ch

stratification stragegy: cool the occupied area, avoid ceiling heat trap

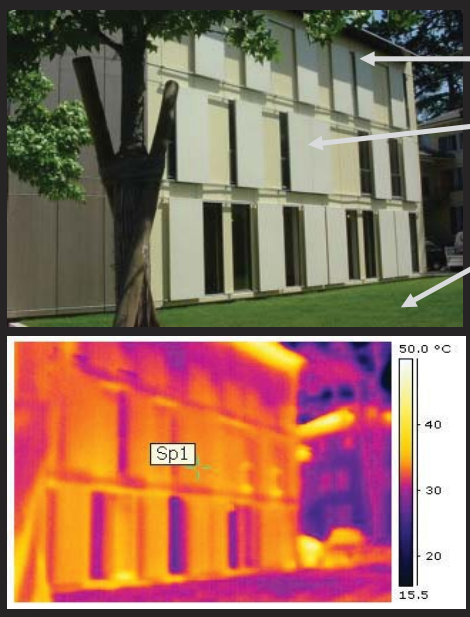
Centre médical des Grangettes

Construction du bâtiment d'accueil

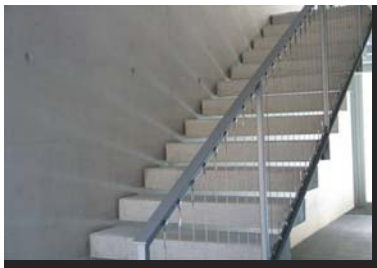
Maître de l'ouvrage	Centre médical des Grangettes SA Chemin des Grangettes 1224 Chêne-Bougeries
Architecte	Eric Dunant Pont-de-Ville 13 1224 Chêne-Bougeries
Physique du bâtiment	Estia SA Parc scientifique EPFL 1015 Lausanne
Projet	2003
Réalisation	2004-2005
Adresse	Route de Chêne 110 1224 Chêne-Bougeries
Coût de construction	Fr. 3'100'000.-

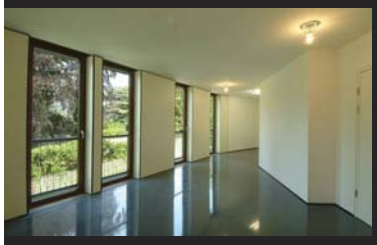
one of the first eco-buildings labeled Minergie in Geneva

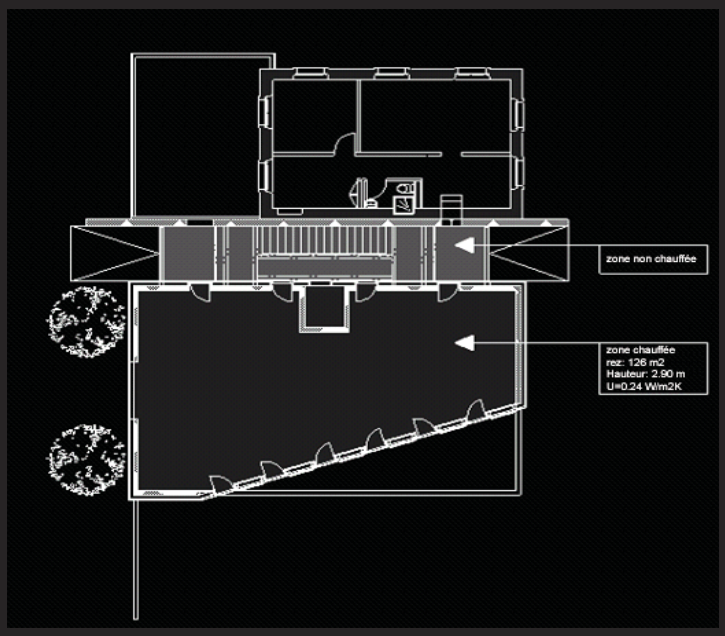
solar shading, color selection, external environment design



solar protection and exterior colors

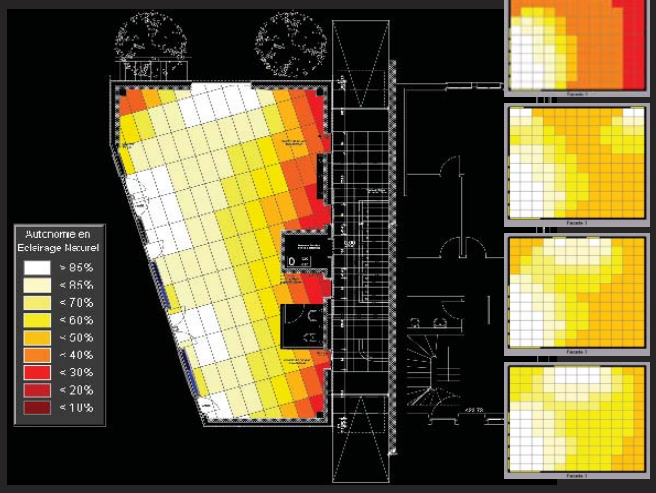






3 storey starecase acting like a chimney

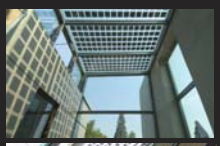
autonomy>65% for300 lux

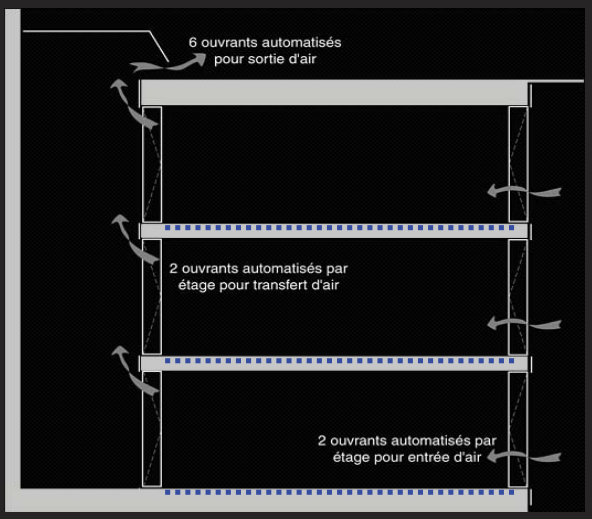


thermal mass for cooling storage and natural light to reduce internal heat gains

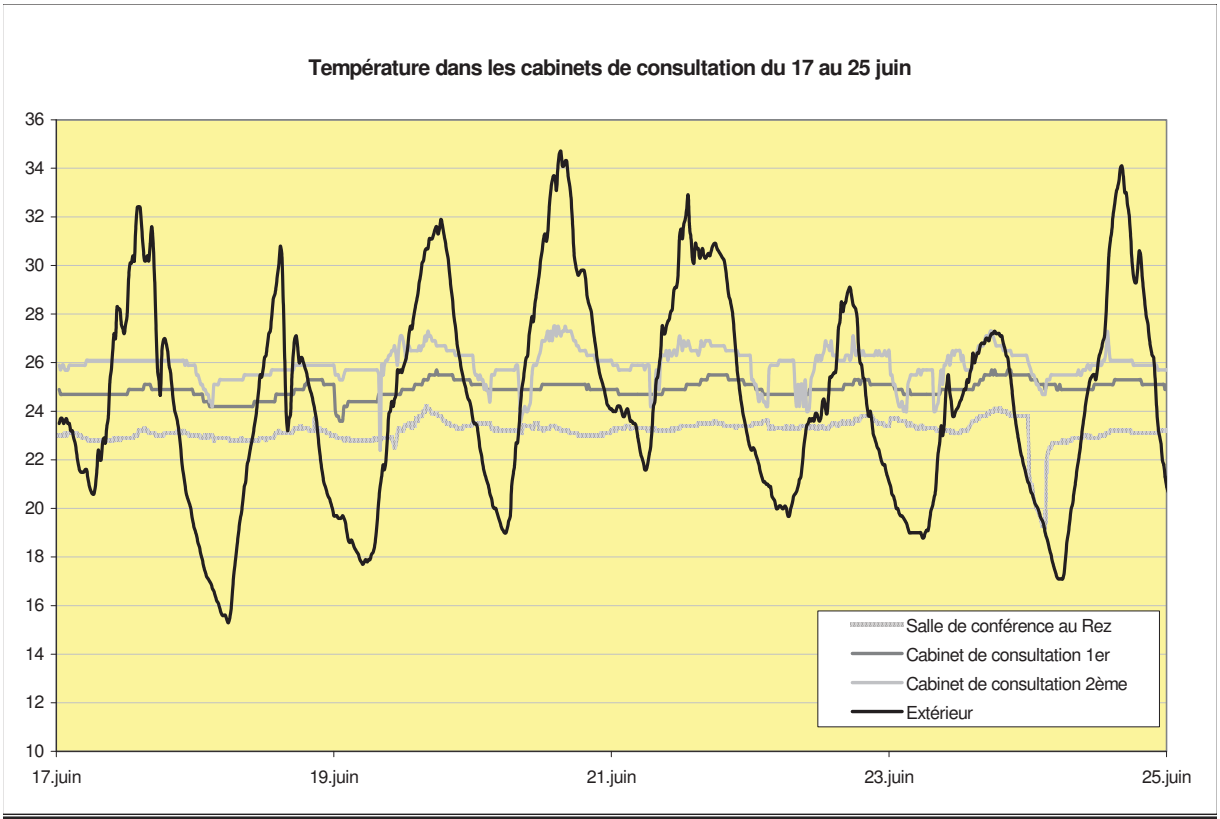
inlet air

exhaust air

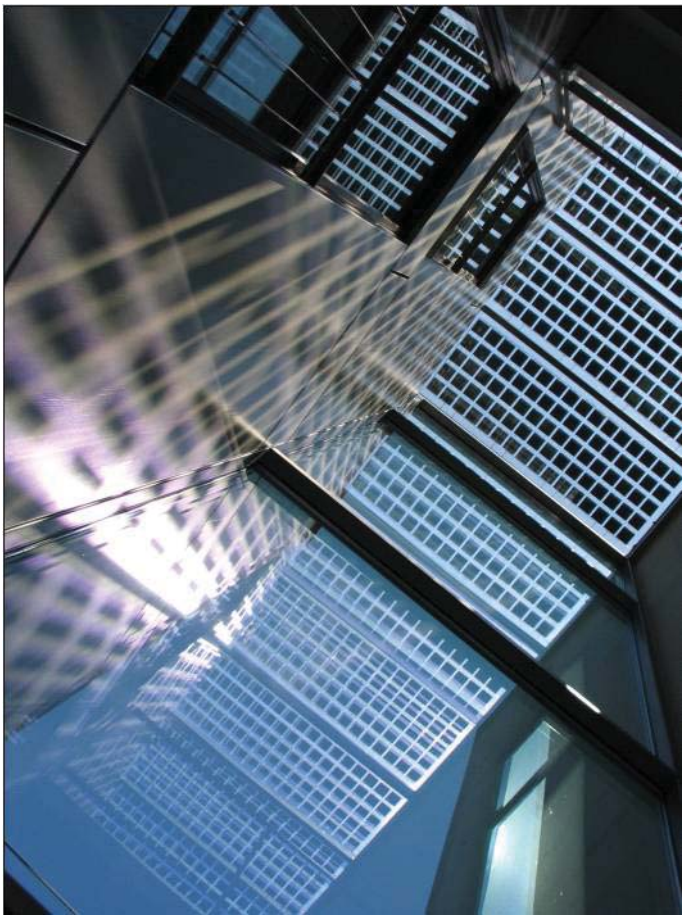




architectural elements act like air ducts, inlet and exhaust devices



during the hotest days of June, internal température < 27/25° C



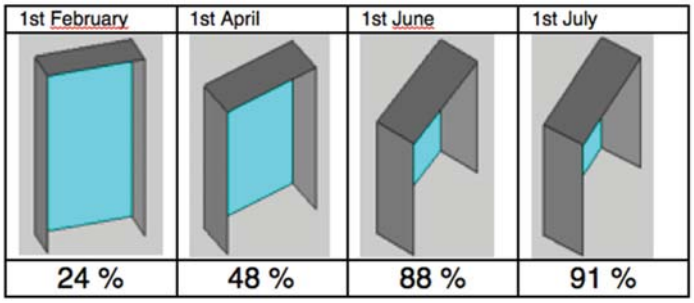
- **Passive techniques**

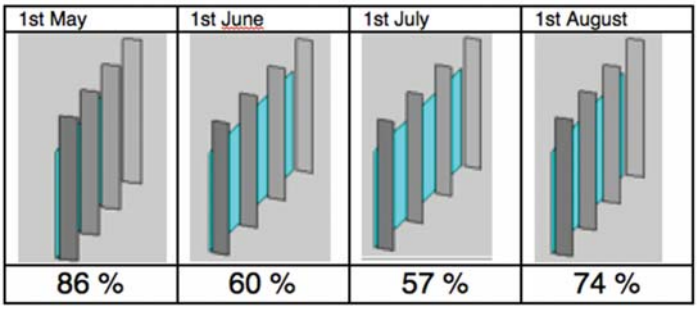
- Thermal insulation
- Solar shading
- Window dimensionning
- Neutral level control
- Thermal mass
- Night cooling ventilation
- Free slab geo-cooling
- Exterior cool landscape

- **10 passive technics**

  - 10 cm thermal insulation, double glazing low e, no thermal bridges
  - Almost perfect solar shading
  - High apparent thermal mass
  - Optimal dimensioning of openings for passive lighting, heating, solar protection
  - 70% of natural light autonomy and high efficiency artificial lighting
  - 30 % of surface area is outside of the thermal envelope (staircases, toilets)
  - Opening design for optimal night ventilation (summer passive cooling)
  - Natural ventilation
  - Use of ceiling funs
  - 100% Solar hot water

- almost perfect solar shading



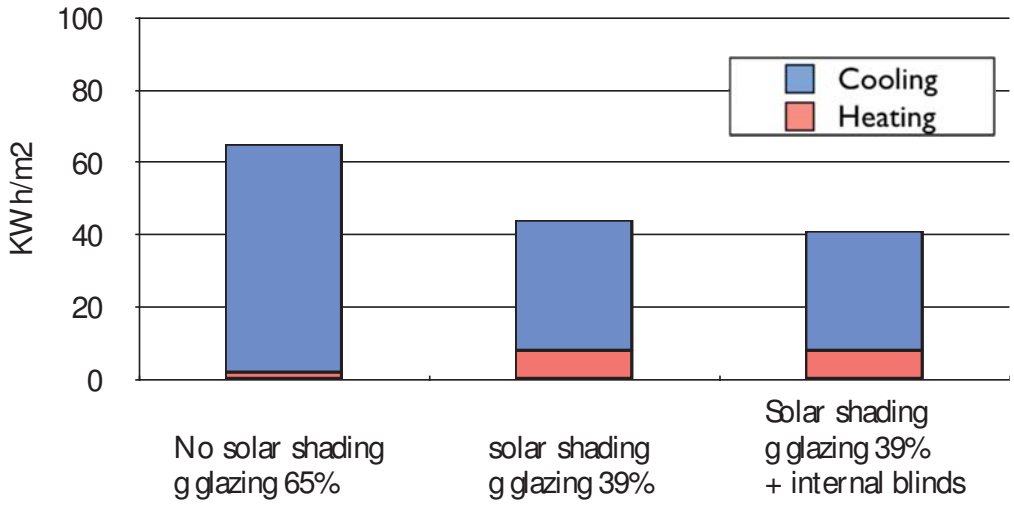


→ Permanent solar protection and glazing g-39%, TL-70%

Nicosia Municipality. Finance Department - South & North Elevation

irwinkritioti.architecture

- **effect of solar protection**

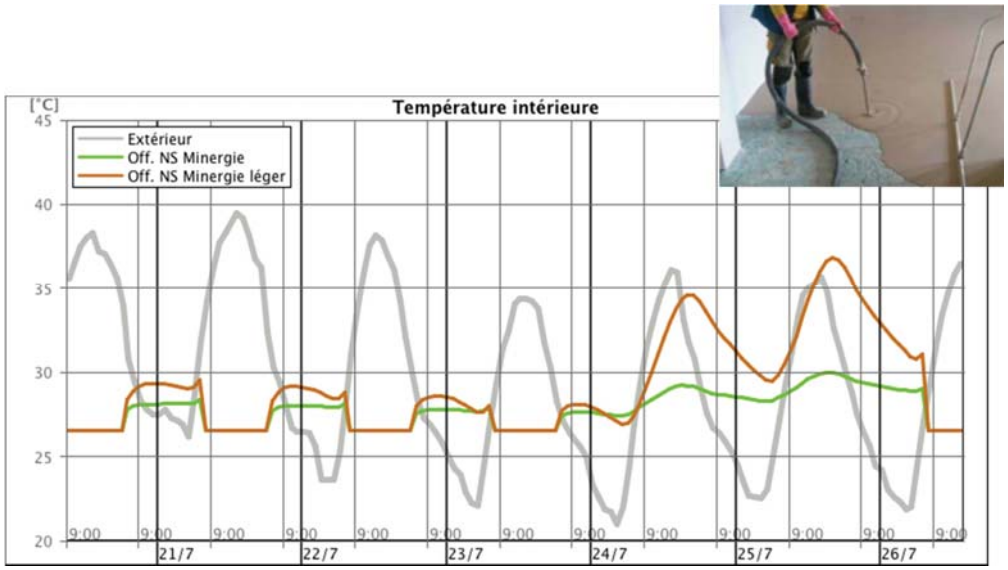


→ **Solar shading and reduced g glazing value saves 37% of energy**

- **apparent thermal mass**

→ **Unhydrid screed for the floor, apparent claded concrete slab.**

- apparent thermal mass



→ Without thermal mass temperature rises to 37° C instead of 30

- Opening dimensioning

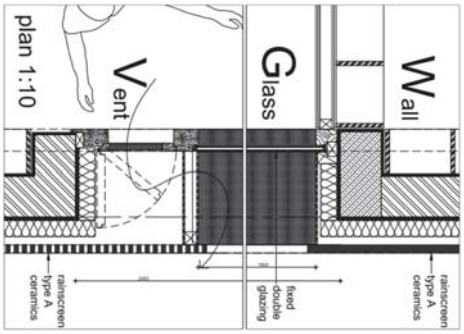
→ 0% east and west, 1X140X300 south, 2X140X300 north.

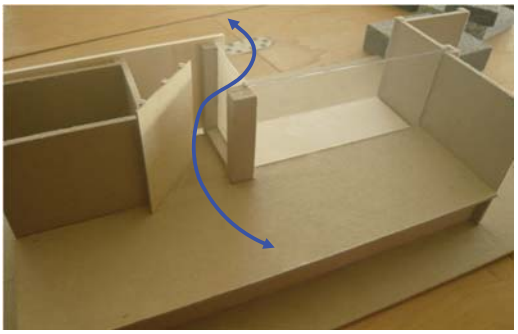
- **Inside – outside in the Mediterranean climate**

→ **682 m² (75%) within the thermal envelope out of a total of 900 m²**

→ **Almost zero energy external / internal staircase.**

- night ventilation design





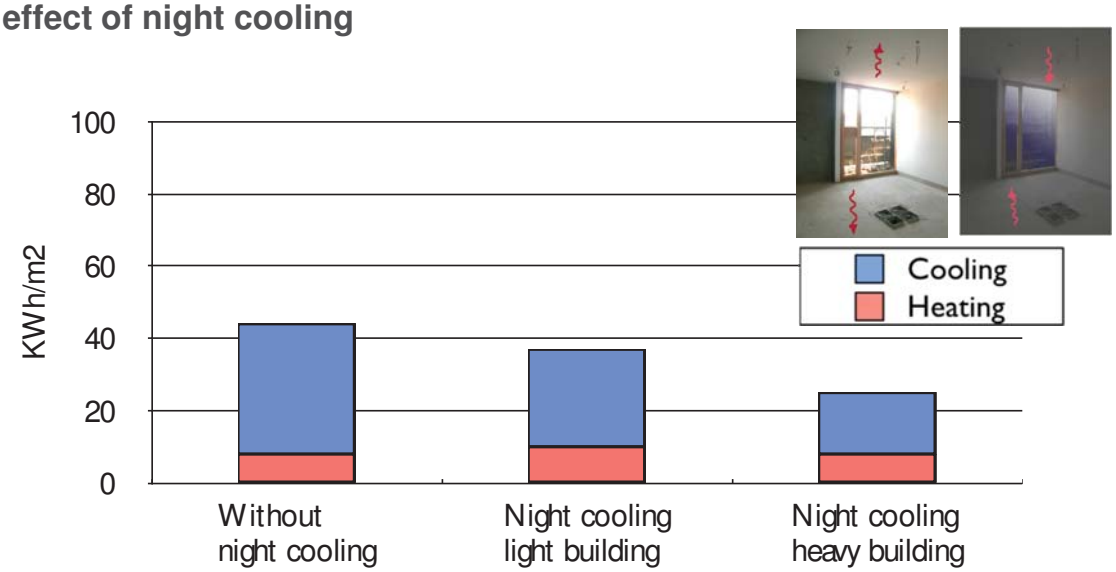
→ safe, protected, flexible openings, dissociation of air from light path

- natural ventilation design

Opening possibilities 40X300	m³/h	
40X300	610	100
40X300 grille	366	60 %
40X122	158	26 %
40X122 + 40X122	499	82 %
15X122 à la française	59	10 %
7X122	28	5 %
15X122+15X122 à la Fr	187	31 %
15 cm à l'italienne (6°)	49	8 %
10 cm à l'italienne (4°)	30	5 %

→ A window offering 30 to 366 m^3/h stack effect single sided airflow at ΔT 5° C

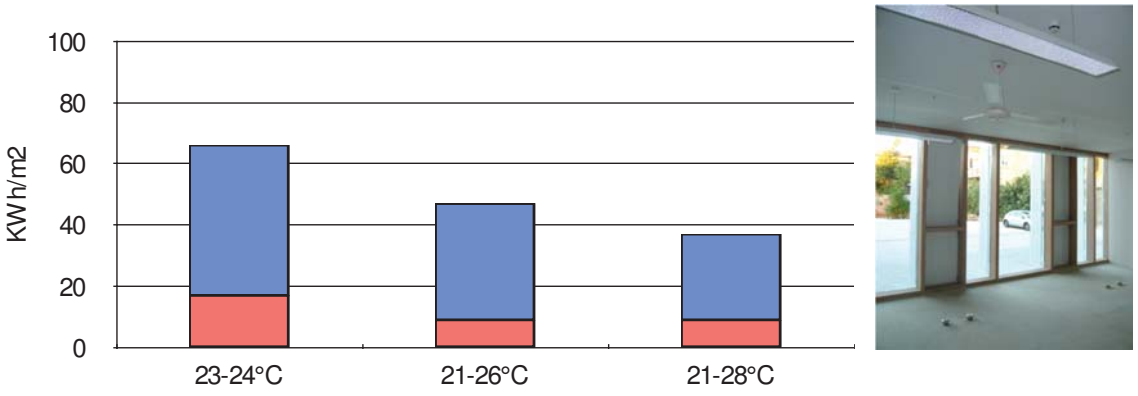
• effect of night cooling



→ Night cooling may reduce cooling need of an aready optimised building by 53%, (17 kWh/m²y instead of 36)

→ A light building has only 25% reduction potential

• Use of ceiling fans to keep windows closed and rise set temperature

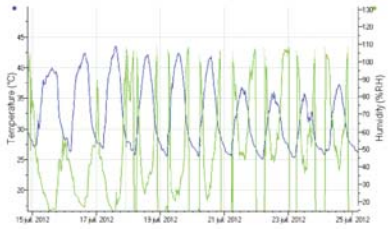


→ 15 % rise of cooling load per ° C of set température decrease

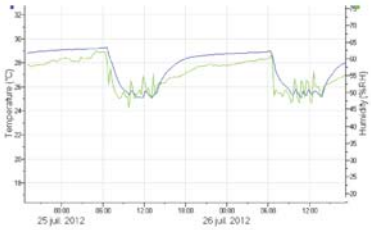
→ Ceiling fans may save 30% of cooling energy consumption

- **Monitoring: outside 45° C – inside 27- 30° C**

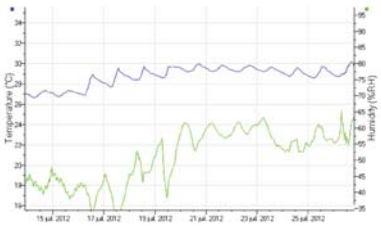
outside



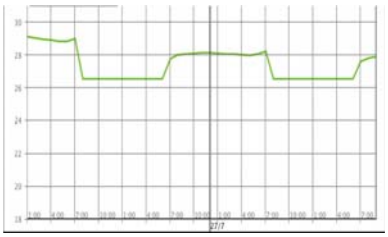
Cooled occupied office



Unoccupied office



simulated occupied office



• Conclusions

- After solar protection and reduction of internal loads, night ventilative cooling is the only passive technique offering significant energy savings for cooling:
  - zero kWh in the central Europe climate
  - 25 - 50% reduction for the hot Mediterranean climates
- Passive cooling is not just opemable windows.
- Passive cooling design needs simple simulation tools (available engineering fees 5 - 10 000 €) – www.dialplus.ch
- There is a need of accounting the energy savings in the national energy regulations. It is the only way to make this technique able to penetrate the market, because there is nothing to sell other than engineering fees.