VENTILATIVE COOLING
EBC ANNEX 62

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DEFINITION OF VENTILATIVE COOLING

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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

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.

POTENTIAL AND LIMITATIONS

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

Climate Potential & Limitations

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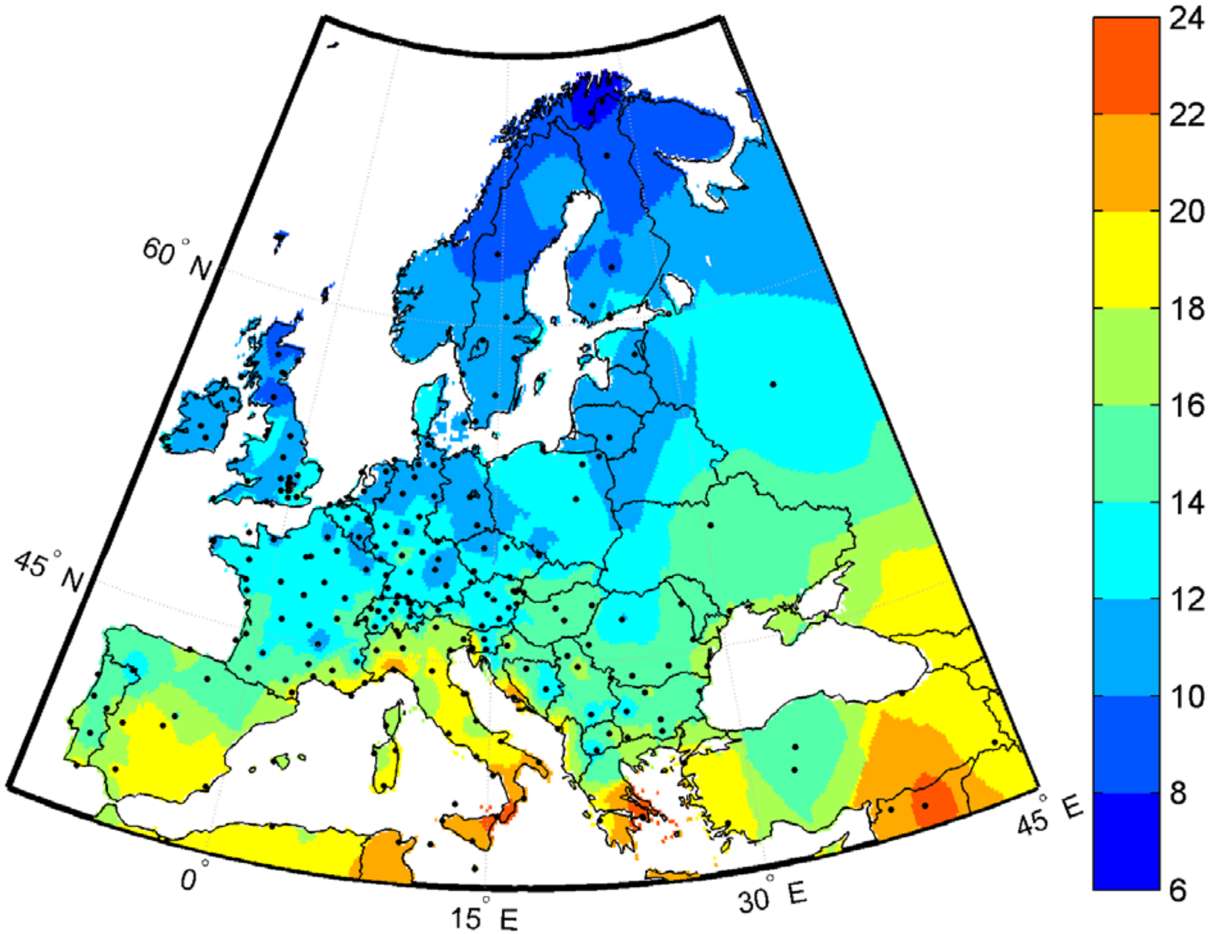
DAILY MINIMUM TEMPERATURE JULY



Meteonorm Data

CLIMATIC POTENTIAL FOR NIGHT-TIME COOLING

DEGREE HOURS METHOD TO QUANTIFY THE CLIMATIC COOLING POTENTIAL (CCP)

HARMONICALLY OSCILLATING BUILDING TEMPERATURE WITHIN A RANGE OF THERMAL COMFORT:

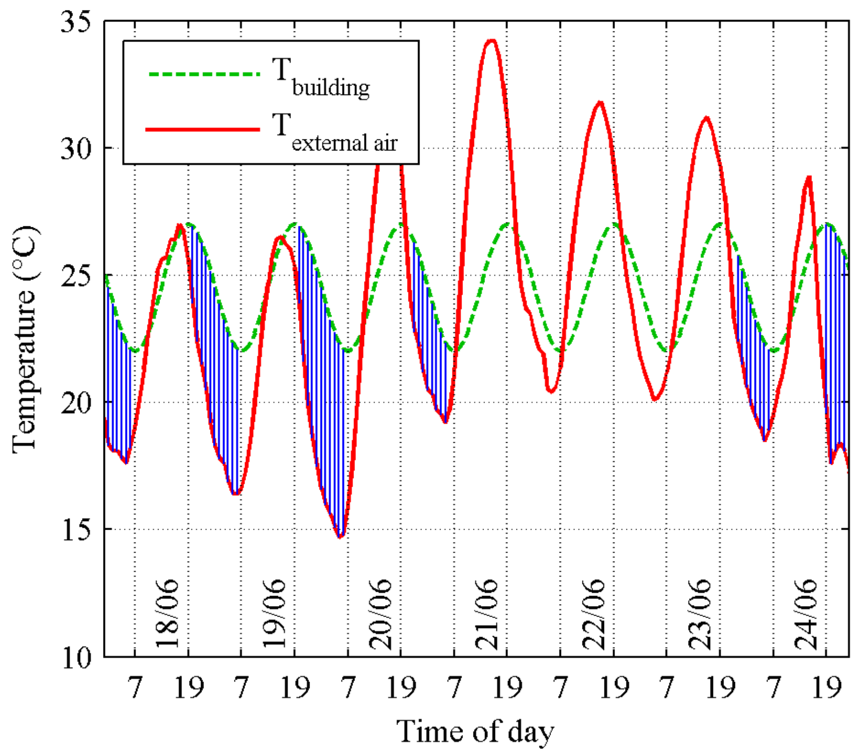
$$T_b = 24.5°C \pm 2.5°C$$

VENTILATION PERIOD: 7PM – 7 AM

MINIMUM TEMPERATURE DIFFERENCE: $\Delta T_{crit} = 3K$

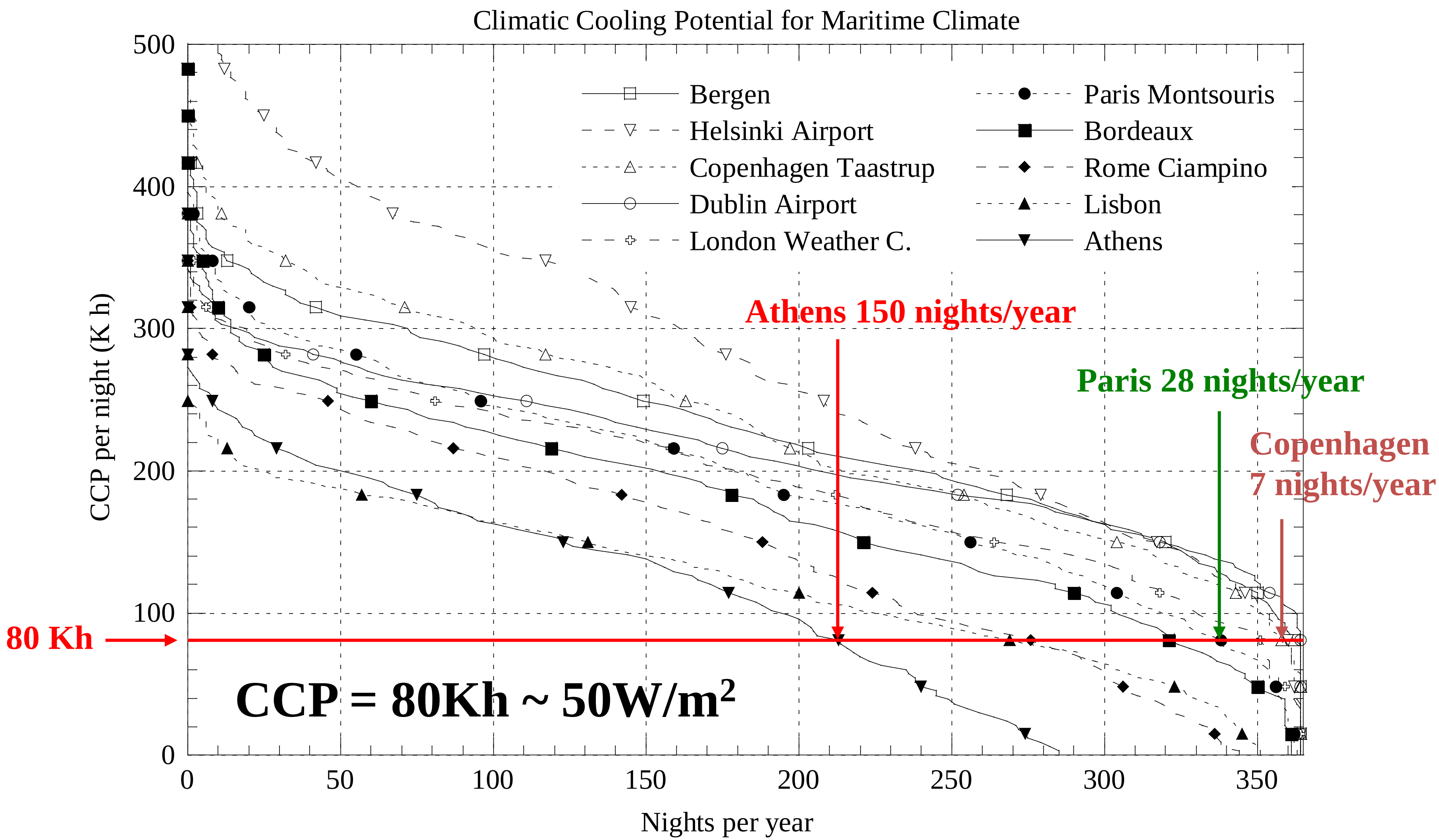
CCP (KH)

$$CCP_d = \sum_{t=t_i}^{t_f} m_{d,t} \left(T_{b(d,t)} - T_{e(d,t)}\right) \qquad \begin{cases} m = 1\,\mathrm{h} & \text{if } T_b - T_e \geq \Delta T_{crit} \\ m = 0 & \text{if } T_b - T_e < \Delta T_{crit} \end{cases}$$



Shaded areas show the climatic cooling potential during one exceptionally hot week in summer 2003 for Zurich SMA (ANETZ data)

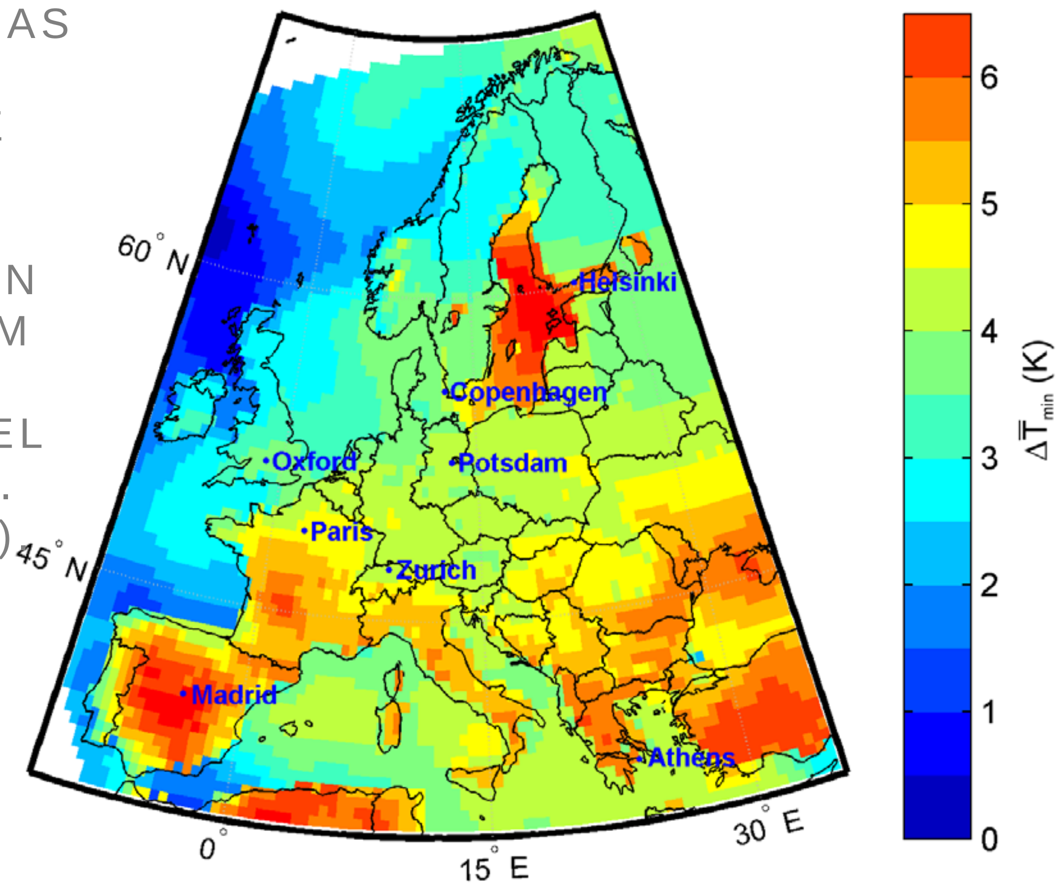
CUMULATIVE FREQUENCY DISTRIBUTION OF CCP



CHANGE IN LONG-TERM MEAN DAILY MINIMUM TEMPERATURE IN SUMMER (JJA)

“A2” EMISSIONS SCENARIO FOR THE YEARS 2071-2100 RELATIVE TO THE BASELINE 1961-1990, AS SIMULATED BY THE DANISH METEOROLOGICAL INSTITUTE

REGIONAL CLIMATE MODEL. SIMULATIONS WERE BASED ON BOUNDARY CONDITIONS FROM THE HADAM3H ATMOSPHERIC GENERAL CIRCULATION MODEL (TABLE A1: SCENARIO NO S1). DATA FROM PRUDENCE (2006).

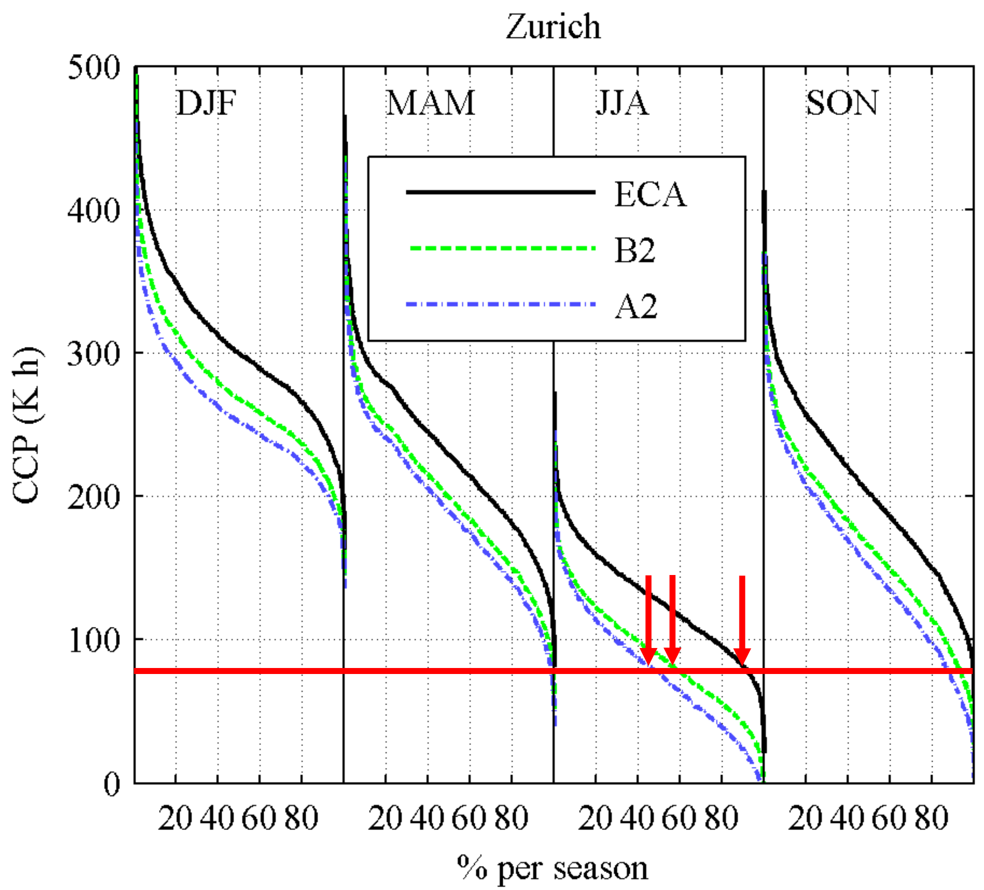


CUMULATIVE DISTRIBUTION OF CCP

Percentage of summer nights when CCP exceeds e.g. 80 Kh

- **Current climate: 90 %**
- **Future climate: 45-55 %**

Significant increase in risk of overheating



Seasonal cumulative distribution functions of CCP in Madrid for current climate (ECA data) and selected simulation runs with mean values for forcing scenarios A2 and B2

CLIMATIC COOLING POTENTIAL, CCP

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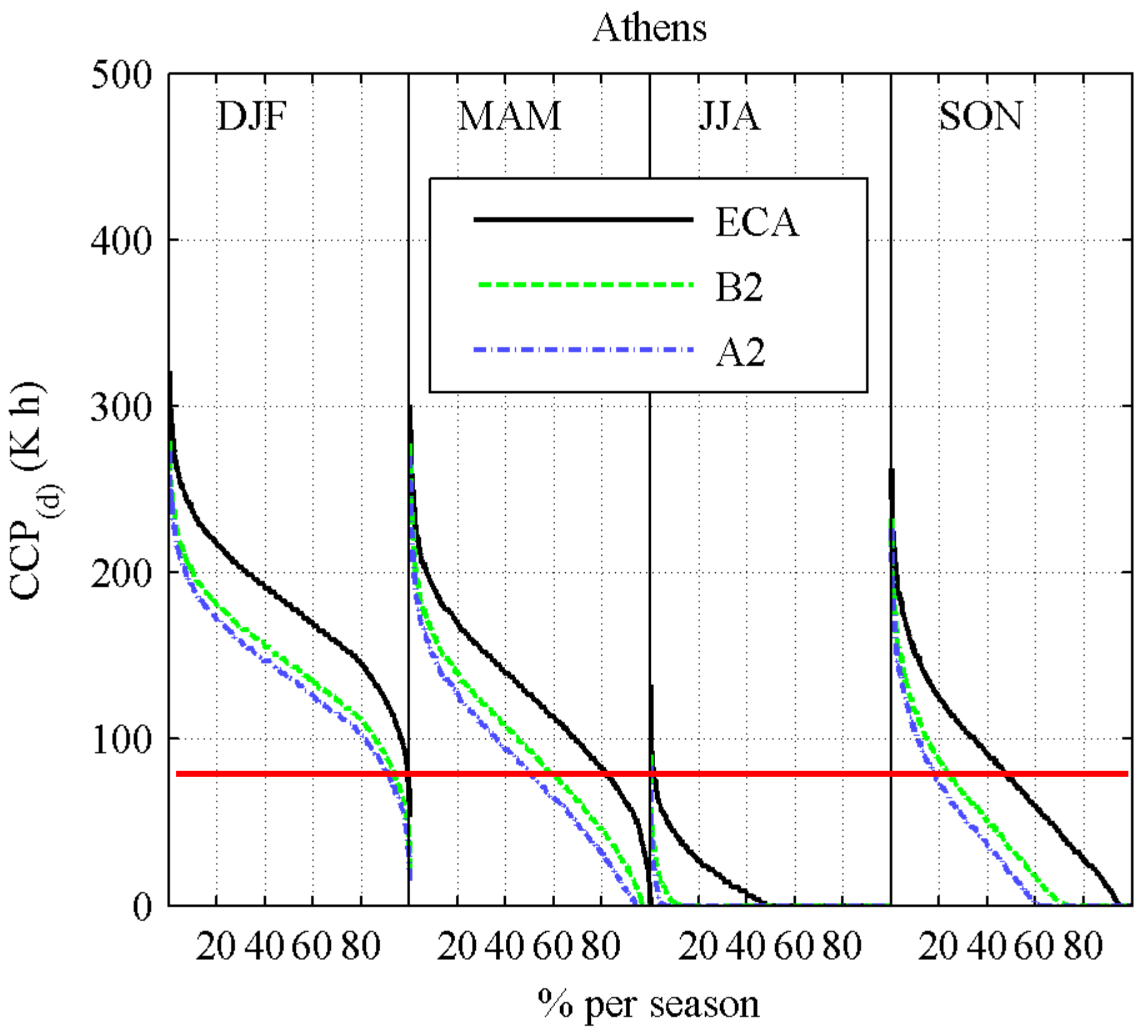

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COOLING IN OFFICES AND EDUCATIONAL BUILDINGS IN COLD CLIMATE

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WITH HIGH INSULATION AND AIR TIGHTNESS LEVELS ALWAYS A COOLING NEED DURING OCCUPIED HOURS EVEN IN THE WINTER SEASON

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, BUT HIGH AIR FLOW RATES ARE NEEDED IN WINTER BECAUSE OF DRAUGHT RISK LEADING TO RELATIVELY HIGH ENERGY USE FOR AIR TRANSPORT

Solution Examples

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VENTILATIVE COOLING IN COLD CLIMATE - DENMARK

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WHAT IS DIFFUSE CEILING VENTILATION

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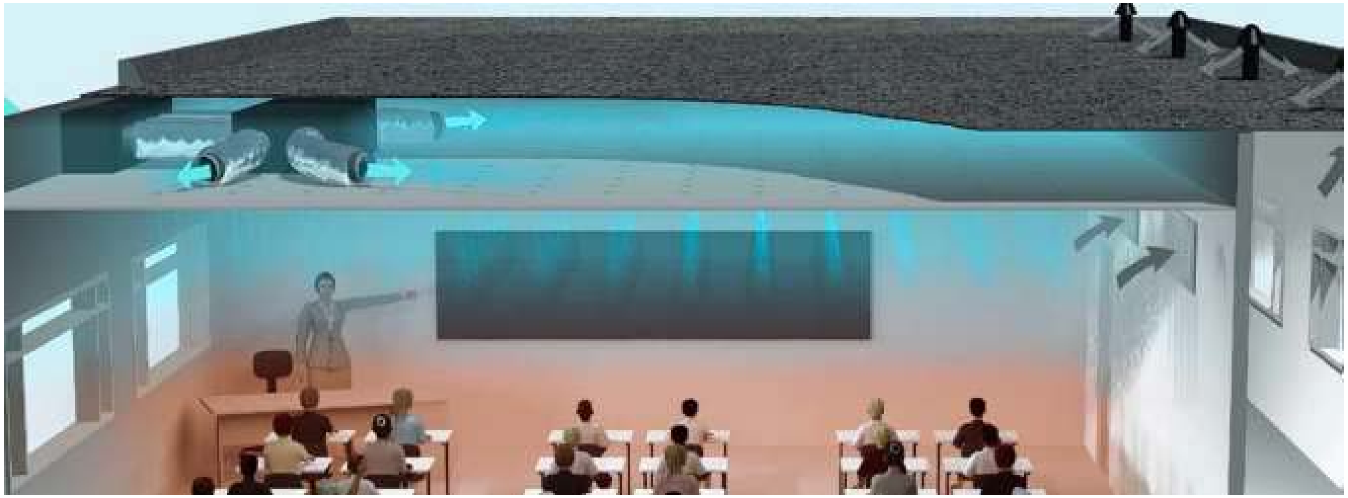
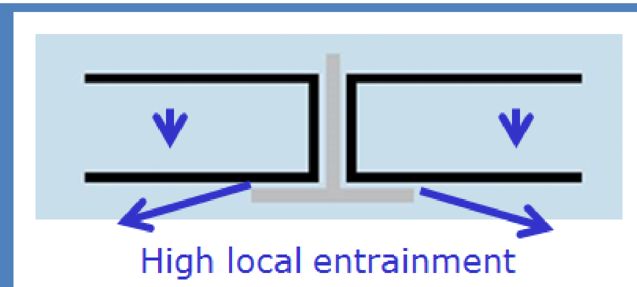
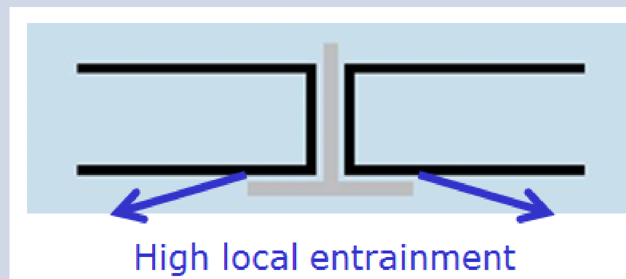
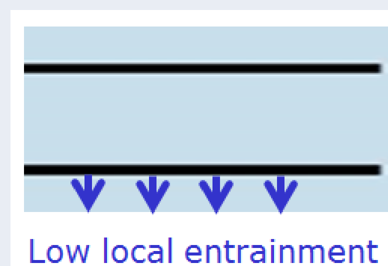
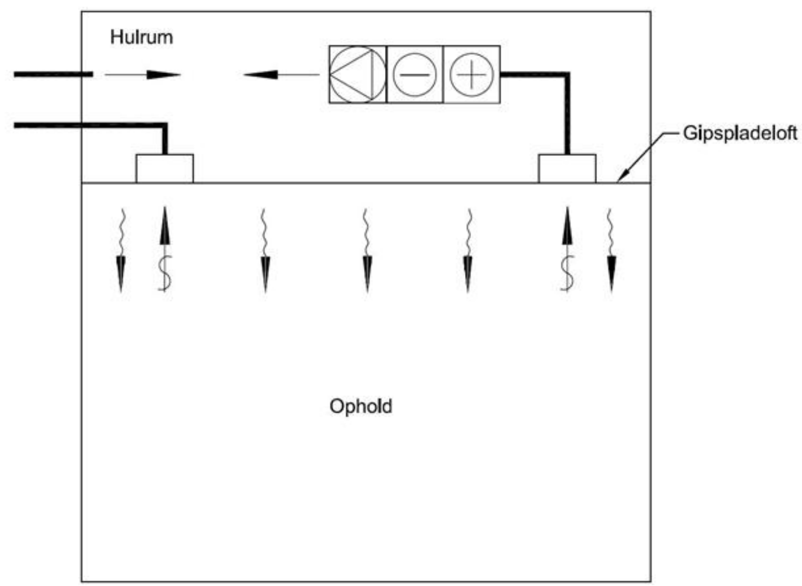
THE SPACE ABOVE A SUSPENDED CEILING IS USED AS A PLENUM AND FRESH AIR IS SUPPLIED TO THE OCCUPIED ZONE THROUGH PERFORATED SUSPENDED CEILING.



THE PRINCIPLE

Rockfon / Troldtekt ceiling	
Ecophon ceiling	
Fully diffuse ceiling	

WIDEX / WESSBERG A/S



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SOLBJERGSKOLEN SOUTHWEST OF ÅRHUS

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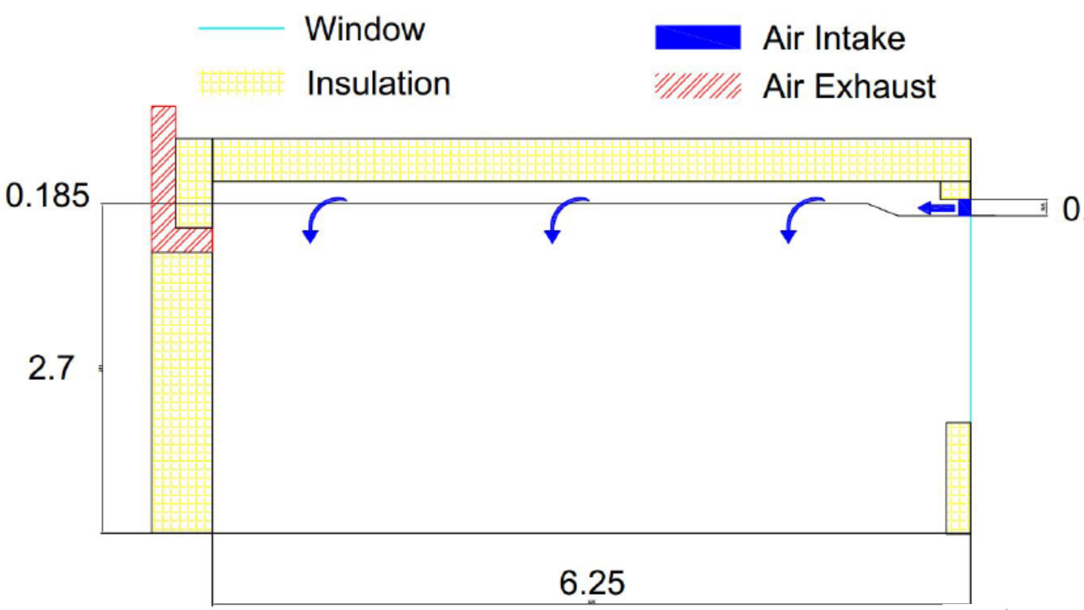
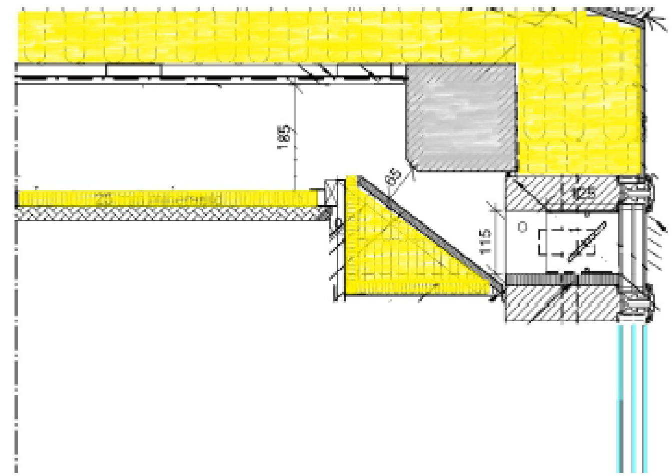
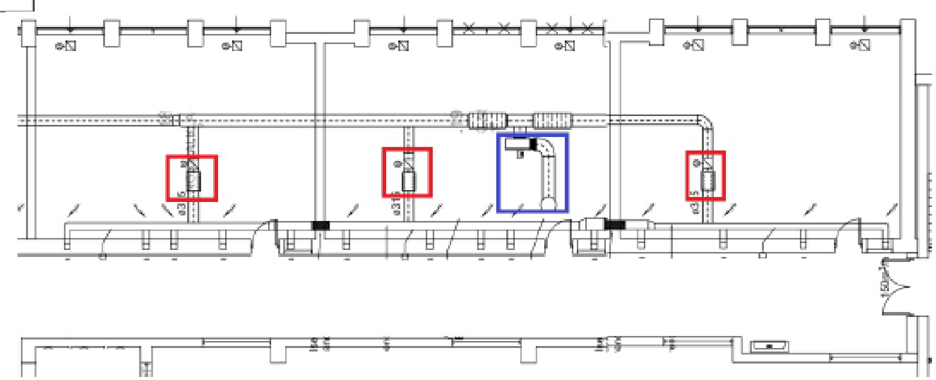
SYSTEM PRINCIPLE

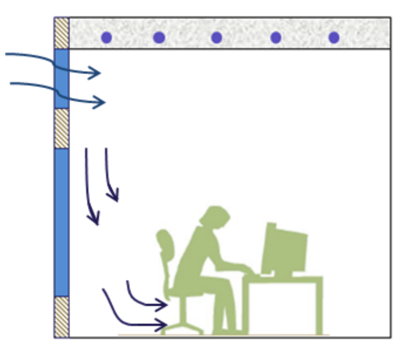


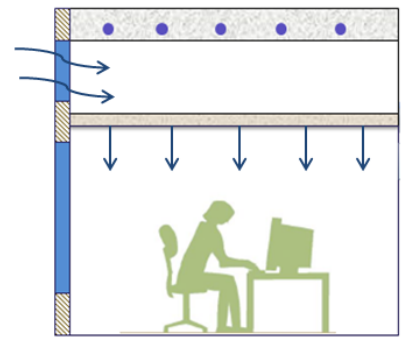


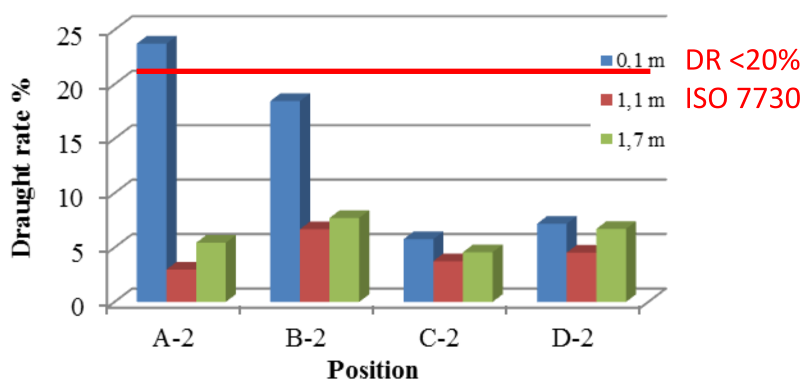


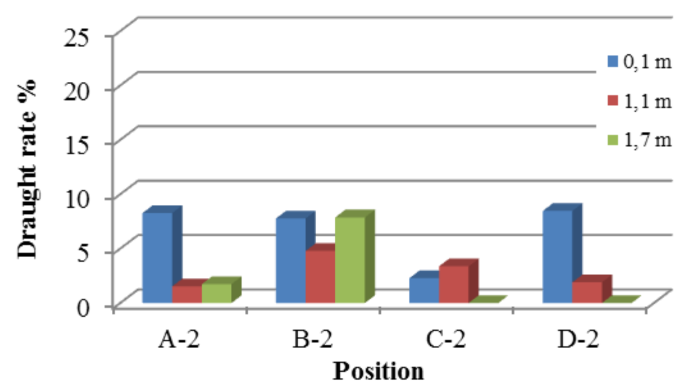
DRAUGHT RISK

Extreme winter condition: supply air temperature -8 ^{o}C, ACH =4









VENTILATIVE COOLING IN WARM CLIMATE - CYPRES

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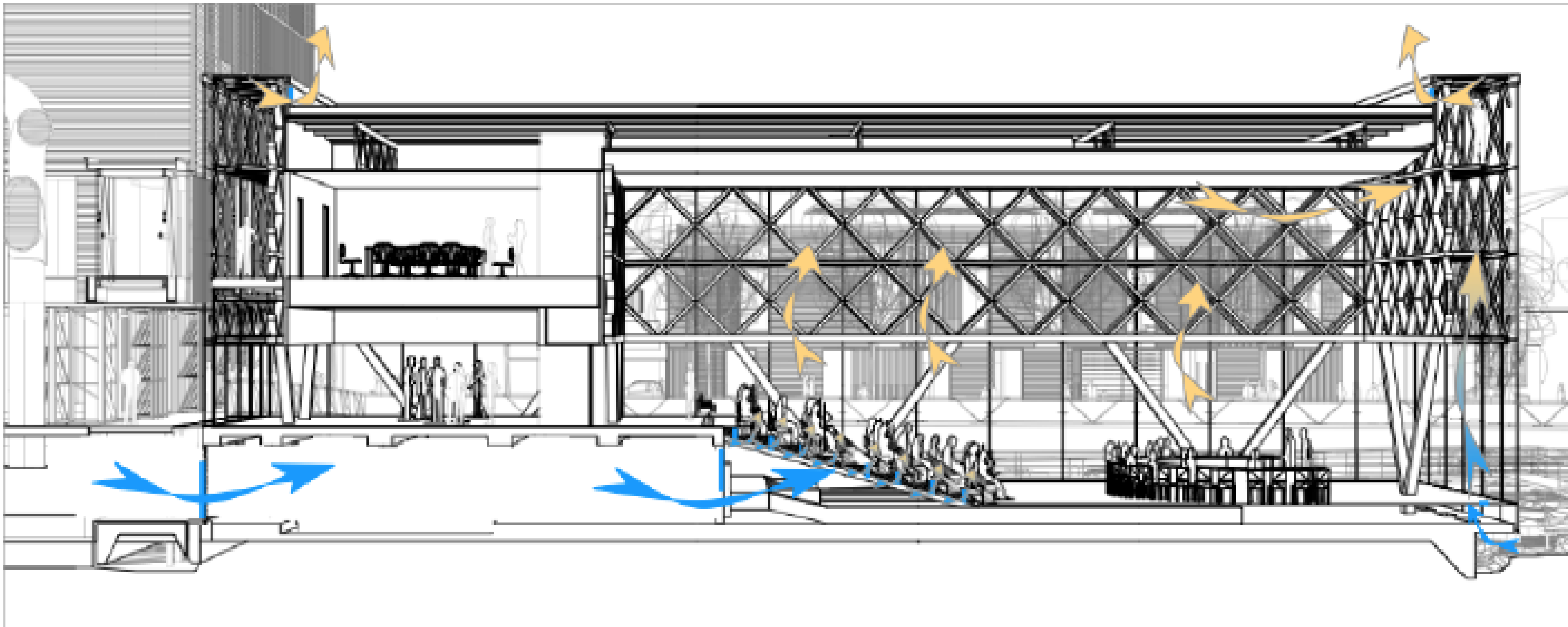
HYBRID VENTILATION OF THE HALL – NATURAL VENTILATION COOLING PATH



COOLING STORING UNDER THE PLENUM, STRATIFICATION, INTELLIGENT STRATEGY

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OFFICE NIGHT VENTILATION DESIGN

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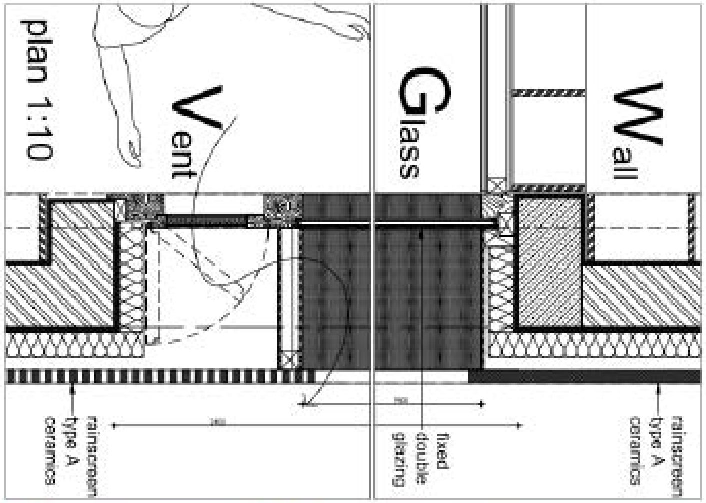

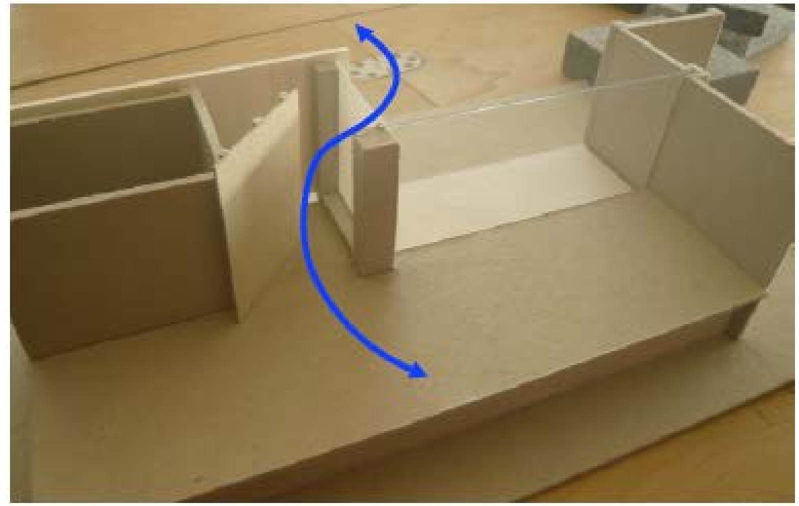

SAFE, PROTECTED, FLEXIBLE OPENINGS, DISSOCIATION OF AIR FROM LIGHT PATH

VENTILATIVE COOLING IN HOT & HUMID CLIMATE – OSAKA, JAPAN

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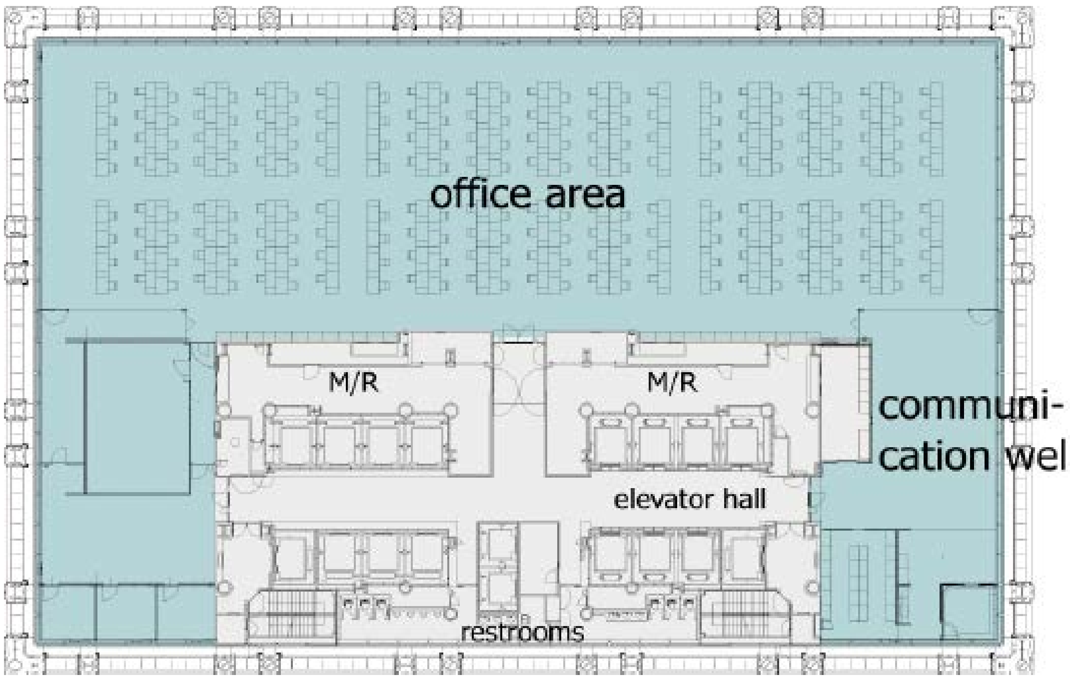
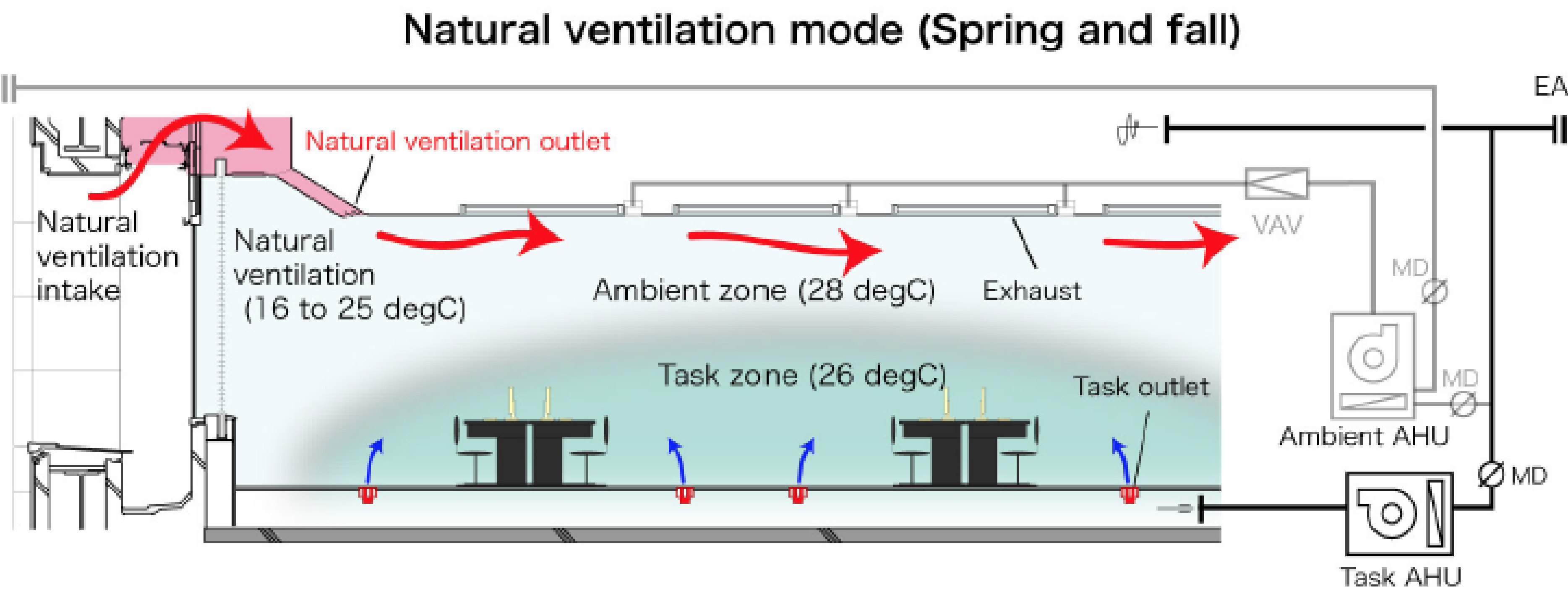


NATURAL VENTILATION COOLING PATH



SPRING AND FALL, AMBIENT ZONE IS NATURALLY VENTILATED IF POSSIBLE (CONDITIONS ARE PRESSURE DIFFERENCE, OUTSIDE AIR TEMPERATURE, HUMIDITY AND ENTHALPY).

TASK / AMBIENT AIR CONDITONING

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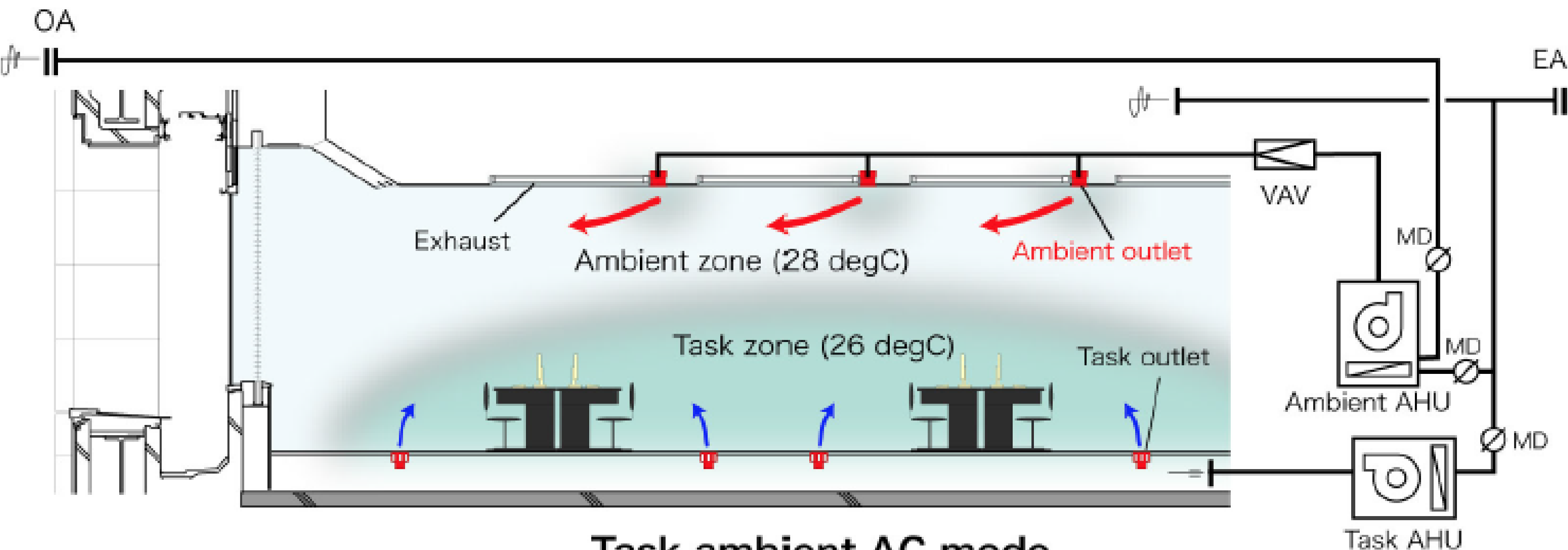

Task ambient AC mode

IN SUMMER TIME, TASK AND AMBIENT ZONE IS ACHIEVED BY UNDER FLOOR AIR SUPPLY (FOR TASK ZONE) AND CEILING OUTLET (FOR AMBIENT ZONE)

VENTILATIVE COOLING IN HOT & HUMID CLIMATE – OSAKA, JAPAN

NATURAL VENTIALTION OUTLET

- AIR OUTLETS SURROUND OFFICE ROOM.
- SHAPE OF AIR OUTLETS ARE WELL-DESIGNED TO GUIDE THE AIR TO INTERIOR BY COANDA EFFECT.

Summary

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SUMMARY

Energy in Buildings and Communities Programme

VENTILATIVE COOLING CAN BE A VERY ENERGY EFFICIENT SOLUTION FOR BOTH MECHANICAL AND NATURAL SYSTEMS

CLIMATE AND BUILDING ADAPTED SOLUTIONS ARE ESSENTIAL FOR OPTIMAL PERFORMANCE

EVEN IF HIGH SUMMER TEMPERATURES MIGHT DECREASE POTENTIAL IN SUMMER, DEVELOPMENT TOWARDS “NEAR” ZERO ENERGY BUILDINGS WITH A COOLING NEED ALL YEAR WILL INCREASE THE POTENTIAL CONSIDERABLY

SOLUTIONS FOR COLD AIR SUPPLY INCREASE POTENTIAL FOR BOTH MECHANICAL AND NATURAL SYSTEMS IN COLD CLIMATES

INTEGRATION AND CONTROL OF VENTILATIVE COOLING IN RELATION TO OTHER PASSIVE COOLING MEASURES, MECHANICAL COOLING SOLUTIONS AND USER PRACTICES ARE ESSENTIAL FOR OPTIMUM PERFORMANCE IN RELATION TO ENERGY USE AND COMFORT


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