INTERNATIONAL ENERGY AGENCY
Energy conservation in buildings and
community systems programme

27th AIVC Conference

Technologies & Sustainable Policies for a Radical Decrease of the Energy Consumption in Buildings

Conference Report

Air Infiltration and Ventilation Centre
Operating Agent and Management
INIVE EEIG
Boulevard Poincaré 79
B-1060 Brussels
Belgium

Written by Martin Liddament
November 2006

0 Introduction

Ventilation is essential for meeting the health and air quality needs of occupants. However there is a significant energy and environmental penalty related to both the venting of thermally conditioned air and to the electrical load needed to drive mechanical systems. In practice, ventilation related energy can typically account for 50% of building energy use while buildings themselves can account for approximately 40% of total greenhouse gas emissions. There is hence much interest in improving the performance of ventilation systems. Sometimes there is also pressure to reduce ventilation rates but this could be in conflict with health and productivity needs.

The 27th AIVC conference, held in conjunction with the EPIC conference in Lyon, France between 20th and 22nd November 2006 provided an opportunity to address these issues and provide substantive evidence on the vital need for ventilation. Papers were presented in 7 sessions in which all authors and presenters made key contributions. The following covers a brief synopsis of each paper.

1 Session 1 - Indoor Air Quality and Efficient Ventilation

1.1 Outdoor Gaseous Pollutants

Ventilation requires unpolluted outdoor air and this can be difficult to achieve in urban environments. While particle filtration systems are common, the removal of gaseous pollutants is not usually considered. This was addressed by the first paper of the conference entitled "The real life efficiency of gas-phase filters used in general ventilation and their influence on the indoor air quality of an office building" presented by Alain Ginestet of CETIAT, France. Measurements were made in an existing, air conditioned nine storey building located in Lyon, France. The system was fitted with an F6 particle filter combined with a gas phase filter containing 12.5 kg of activated carbon. Performance was analysed in relation to the influence on indoor air quality and the impact of such parameters as filter loading and the temperature and humidity of the incoming air. The study showed that gas filtration was effective at reducing ozone and nitrogen dioxide concentration but was less effective for nitrous oxide. Efficiency reduced over time by as much as 20%. Overall gas phase filter was shown to have a positive benefit on IAQ.

1.2 Fungal Spores

The development of fungal spores and mould growth in buildings can occur through indoor climate conditions. The second paper, presented by Hans Peter Leimer BBS Institute in Germany entitled "Indoor air pollution with fungus inside well insulated houses - biological aspects" looked at the impact of ventilation strategy on fungal concentrations by using two identical test chambers. The first was ventilated by means of window ventilation, combined with a mechanical extractor, while the second was ventilated using a balanced ventilation system with heat recovery. In each case the ventilation rate was maintained at 0.5 ach. Results indicated that there were lower concentrations of spores in the balanced ventilation cell. This was attributed to a lower humidity conditions.

1.3 System Maintenance

Ventilation performance and energy efficiency suffer when systems are not maintained. In the next presentation Masaki Tajima, of the National Institute for Land and Infrastructure Management, Japan presented a paper entitled "The effect of cleaning of residential ventilation systems on fan energy use and ventilation performance". This presented results on airflow rates and energy performance before and after cleaning. Analysis showed that occupants were largely not interested in cleaning these systems and, as a result, flow performance falls dramatically while fan energy increased. Results showed that fan power increased by a factor of up to 2.7 times while flow rates reduced by up to 66% over a period of 6 months (Figure 1).

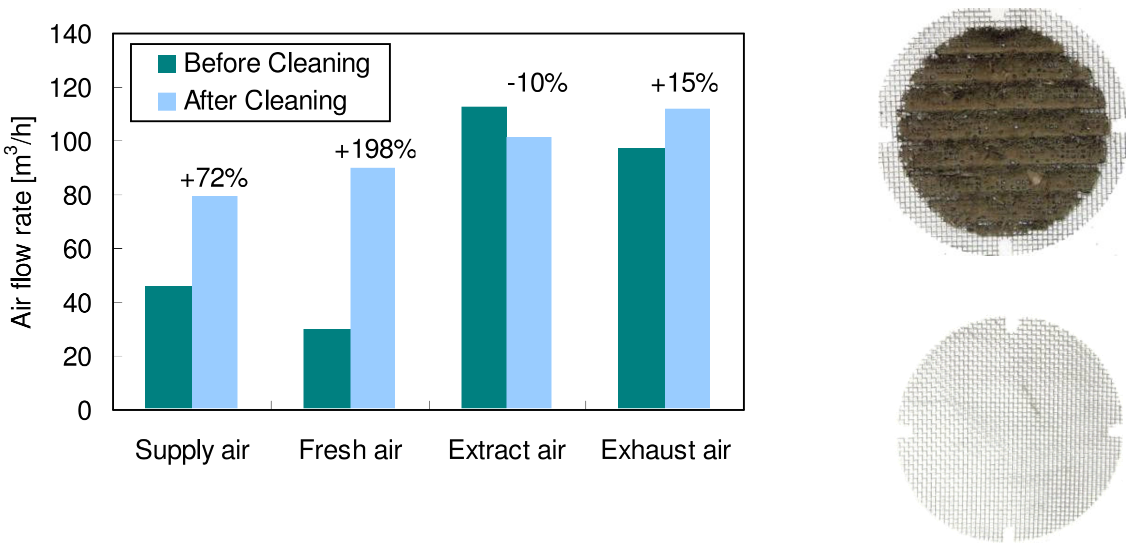

Figure 1: Cleaning has a vital impact on mechanical ventilation performance as illustrated by before and after cleaning performance.

1.4 Workplace productivity

There is growing evidence that productivity is influenced by ventilation rate and that this has been demonstrated by various studies. In the next paper of this session Professor Olli Seppänen of Helsinki University, Finland presented a paper entitled "Ventilation and work performance in offices". This summarized the results of current research.

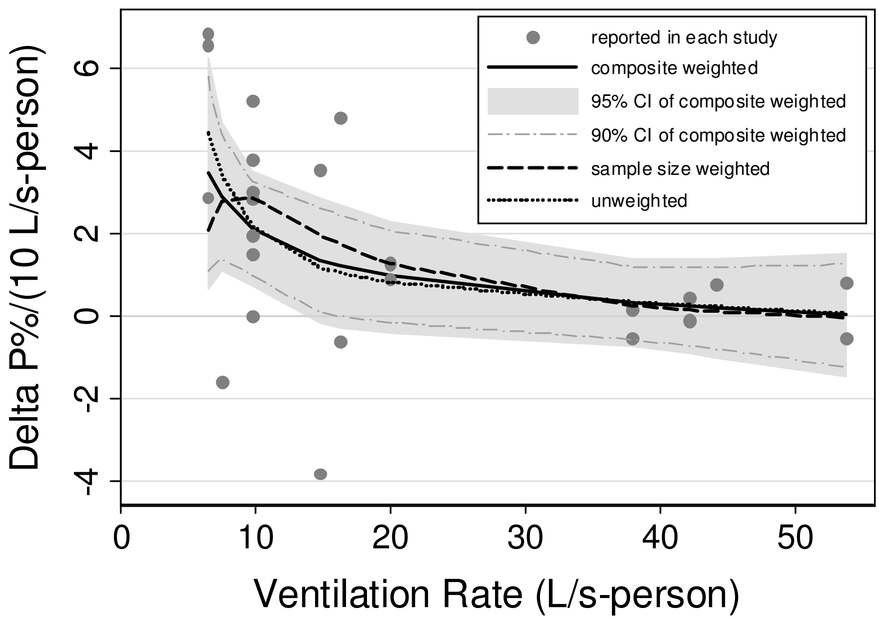

Figure 2: Increase of performance (%) vs. increase in ventilation rate of 10 L/s-person.

Almost all studies found that performance increased with increasing ventilation rate. For example an increase in ventilation rate from 6.5 L/s to 10 L/s per person increases performance by 2 -3.5%. This is increased by a further 1-2 % for a ventilation rate increase from 10 L/s to 20 L/s. It was concluded that improved productivity should be included in life cycle calculations and that good energy efficiency can be achieved in buildings with good indoor air quality.

1.5 Environmental Tobacco Smoke

Environmental tobacco smoke is of considerable concern and individual countries are taking various actions to minimize the risk to health. In some cases smoking is banned in public places whereas, in others, various ventilation solutions are being considered. The role of ventilation was considered in a paper presented by Willem de Gids of TNO in the Netherlands. This presentation entitled "The reduction tobacco smoke exposure in the hospitability industry" identified ways of minimising risk to bar staff and customers. The analysis included a literature review and modelling studies as well as test cell and field measurements. Results showed that air cleaning is effective at reducing the concentration in smoking rooms. For smokers and non smokers in the same room, mixing ventilation gave a 50 – 90% reduction in ETS concentration while displacement ventilation gave up to a 98% reduction. Where smokers and non smokers were in different rooms an effective ventilation strategy could provide a 99.98 - 99.999 % reduction in concentration.

1.6 Duct Leakage

Mechanical systems become inefficient when duct leakage is high. Leakage outside the conditioned space results in energy loss while leakage within the conditioned space can result in air quality problems. Pierre-Jean Vialle of CETIAT France presented a paper entitled "Air tightness of ventilation ductwork equipped with joints". The real onsite performance of ducts was compared with relevant Standards. Duct leakage was described as poor especially in relation to duct joints. This was attributed to lack of space, access problems and insufficient installation time. In comparison measurements under laboratory conditions showed that achieving good airtightness was possible. It was concluded that the use of ducts with purpose provided joint firings could overcome many of the leakage problems identified.

2 Session 2 - Ventilation and Energy

The second session was devoted to some of the energy issues related to ventilation. This covered a range of aspects from compliance to the pre- conditioning of supply air.

2.1 Certification

In the first presentation John Hamilton of the Testing Adjusting and Balancing Bureau in the United States presented a paper entitled "Why HVAC Certification for balancing and commissioning contractors is necessary for ventilation measurement, verification, validation and decreased energy consumption". This presentation stressed the need to adopt the ISO 17024 certification program for commissioning and maintenance. Evidence showed that failure to undertake these tasks results in substantial energy waste and unreliable ventilation performance.

2.2 Energy labelling

Continuing with performance testing, Pierre-Jean Vialle of CETIAT, France presented a paper entitled 'The development of energy labelling for ventilation units. He proposed an energy labelling criteria for fans incorporated in ventilation systems that followed the A to F energy labelling scheme of Europe. His proposed energy ratings in terms of specific fan power are summarised in the Table 1 below. Measurements were made for several office and domestic buildings. These showed current results in the E to G range.

Table 1. Proposed Fan SFP Energy Labelling Scheme.

Electrical energy classification	A	B	C	D	E	F	G
Specific Fan Power limits (W/(m^3/h))	0.05 - 0.10	0.10 - 0.15	0.15 - 0.20	0.20 - 0.25	0.25 - 0.30	0.30 - 0.40	0.40 - 0.50*

2.3 Earth heat exchange systems

Fadi Chlela of CSTB France presented a paper entitled the "Numerical evaluation of earth to air heat exchangers and heat recovery ventilation systems" The aim of this work was to evaluate the energy consumption reduction and the improvements in summer thermal comfort obtained by the integration of a heat recovery balanced ventilation system and an earth to air heat exchanger to a small family house. His analysis showed that the overall contribution of an earth to air heat exchanger to winter heat gain and CO_2 emissions was relatively small in comparison to that offered by air to air heat recovery. However a buried pipe of 40m length could make a significant improvement on summer cooling needs.

The theme of earth heat exchangers was continued in a presentation by Jérôme Conraud-Bianchi of Concordia University, Canada entitled "CFD modeling of heat convection in a large cross-section earth-to-air heat exchanger". In this paper the theoretical analysis of ground heat pipes were evaluated against experimental data. The results showed that large variation of convective heat flux exists at different locations of the duct surface. Verification against experiment has enabled this approach to assist in optimising earth heat exchanger design.

2.4 Sunspaces

Sunspaces are an attractive technique for providing pre heating to ventilation air in winter. This reduces the risk of cold draughts and reduces the amount of space heating energy required to meet thermal comfort conditions. This topic was covered by John Currie of Napier University in the UK entitled "Sunspace augmented positive input ventilation of buildings"

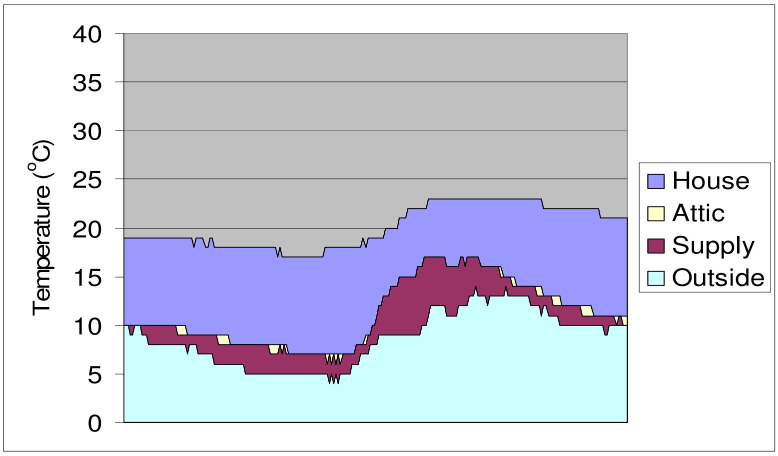

Figure 3: Supply temperature (from sunspace) pre – heats the outside air thus reducing space heating need.

Monitored data (Figure 3) showed that using a sunspace can save up to 15 % of the domestic heating requirements when compared with traditional infiltration ventilation, and more than doubled the energy benefit of that obtained by positive input only ventilation. Occupant feedback suggested that the sunspace overheated in summertime. However, the inclusion of an openable window at a high level within the sunspace would provide the occupant with some control over such conditions. A thorough understanding by occupants of the system was essential for correct operation but, unfortunately, many of the occupants indicated a lack of understanding of how this approach operated.

2.5 Energy performance monitoring case studies

Detailed monitoring performance provides valuable information about how systems actually function in practice. Andreas Wagner of the University of Karlsruhe, Germany presented a paper entitled "Ventilation systems and their energy consumption in energy efficient commercial buildings - experiences and results of the German Funding Programme ENOB" This study focused on the energy and environmental monitoring of a range of office buildings including naturally ventilated, mechanical exhaust only systems and balanced systems with heat recovery. Cooling systems included night cooling, thermal mass and ground to air heat exchangers. All the buildings were aimed at consuming far less energy than standard offices while still providing summer and winter comfort. Results showed that natural ventilation can meet air quality and thermal comfort needs in winter and summer in small office rooms but performance strongly depends on the occupants' behaviour. Exhaust air systems improve the air quality by guaranteeing good control. Heat recovery systems strongly depend on quality control during design and construction as well as on proper operation. Mixed mode systems were also shown to provide energy efficient ventilation.

3 Session 3 - Modelling Airflow

Developments in numerical simulation tools continue to play an important role in understanding flow patterns and assisting in ventilation design. Flow modelling can now consider both indoor and outdoor conditions.

3.1 Outdoor Airflow

The 'ventilation' of outdoor spaces has considerable impact on the removal of pollutants in urban areas and the provision of comfort to pedestrians. In the first presentation of this session Mojtaba Navvab of the University of Michigan presented a paper entitled "Pedestrians' Comfort Index in urban settlements using CFD analysis" This described a CFD modelling approach that included the effects of wind speed, temperature, relative humidity, clothing, activity, solar radiation as an index for pedestrians' comfort. The study shows the CFD presents a design tool that can accelerate the planning of layout of urban locations.

3.2 Indoor Air Quality

Eduardo Breviglieri P. de Castro of Universidade Federal de Juiz de For a, Brazil or J. Virgone of INSA de Lyon, France presented a paper entitled A TRNSYS Component to Calculate Natural Ventilation and Indoor Air Quality in Multizone Buildings. This described a standalone application used to generate the input files for running the thermal model TRNSYS. This module calculates air infiltration and air quality for every time step of the simulation and thus enables the coupling between ventilation and other building thermal losses to be determined. The standalone version, AEOLUS-MZ, enables a great number of simulations to be carried out at the design stage to optimise ventilation strategy.

3.3 Coupled heat and mass transfer

Continuing with the thermal coupling of air flow with building heatloss Leila Gharbi of Ecole Nationale d'Ingénieurs de Tunis, Tunisia presented a paper entitled "The Modelling of coupled heat transfer and mass transfer in unconditioned buildings: application to winter thermal comfort. This expressed the need for accurate knowledge of the air temperature and velocities fields inside the considered spaces. This has been achieved by the development of a three-dimensional dynamic modular model, ZAER, of coupled heat transfer and airflow. This was used to study the influence of glazing upon the air temperature distribution and the thermal comfort quality in an unconditioned room. The results showed that a passive solar component can be an efficient heating measure to improve thermal winter comfort in the Mediterranean region. This approach was also shown to overcome the limitations of isotherm models to describe thermal comfort within a building.

3.4 Heat loss due to air leakage in wall structures

The behaviour of airflow within wall cavities can affect heat loss. However this is often ignored in heatloss calculations. H. Barhoun and G. Guarracino of ENTPE presented a paper on this topic entitled "The influence of air leakage in building's walls on heat transmission loss through its envelope". This study presented the results of a parametric study conducted on a single family dwelling and a school building (Figure 4). Calculations showed that a significant part of energy load could be attributed to the impact of air leakage through the wall modifying the thermal transmission characteristics. This corresponded to 8% for the single family dwelling and 12% for the school building. Thus without incorporating this component the heat loss can be miscalculated.

Figure 4: Dwelling and school building used in the study.

3.5 Industrial Buildings

Industrial buildings are often characterised by high heat loads, thermal discomfort, dust and poor air quality. In a presentation by J.-H. Moon *of Hanyang University, Korea*, entitled "Improvement of indoor air environment in a large welding factory by displacement ventilation" a new development of displacement ventilation was proposed Based on experimental results, the concentration of dust was decreased by between 42-60% compared to that of the existing system and visibility was increased by about 11-18%. Numerical analysis was conducted to solve the existing and alternative ventilation system performances for various wind velocities and the wind directions.

3.6 Mixing Jet Systems

In many conditioned spaces, mixing jet ventilation systems are commonly installed. More recently, displacement ventilation approaches have been introduced but dehumidification and reheat energy can become obstacles. In a paper by Jatuwat Varodompun of the University of Michigan, USA, entitled "Ventilation Performances of Mixing, Displacement, and Impinging Jet System under Different HVAC Scenarios" impinging jet ventilation is introduced and its performance was compared with conventional systems. This approach involves facing the supply terminal toward the floor within the impinging range. The aim is to utilize the advantages of mixing and displacement systems while minimising the disadvantages. This presentation described the use of CFD to analyse a total of 96 scenarios. Under appropriate supply velocity and temperature conditions results indicated that energy consumption and IAQ could be improved.

4 Session 4 - REHVA

REHVA – The Federation of European Heating and Air-conditioning Association plays an important role in the development of practical ventilation guidelines for industry. Session 4 consisted of a small workshop devoted to their activities introduced by Olli Seppänen. Presentations included:

Introduction to REHVA activities	Olli Seppänen, Helsinki University of Technology, Finland
Low temperature heating	Bjarne Olesen, Technical University of Denmark, Denmark
Chilled beam cooling	Risto Kosonen, Halton Oy, Finland
CFD in ventilation design	Francis Allard, University de la Rochelle
IAQ and productivity	Olli Seppänen, Helsinki University of Technology, Finland
New task force on air distribution	Risto Kosonen, Halton Oy, Finland

Figure 5: Current REHVA Guidebooks.

REHVA is aimed at providing practical guidance to industry and much of their output is used to produce Guidebooks. The present series was introduced (titles are summarised in Figure 5). This workshop was also devoted to new work including developments in CFD for ventilation design and developments in air distribution.

5 Session 5 - Ventilation Control

Energy efficient ventilation systems are dependent on precision control. This is an area where considerable development is taking place.

5.1 Large building control strategies

In the first presentation of the session Nicolas Cordier of the Ecole Nationale des Travaux Publics de l'Etat, France presented a paper entitled "Assessment of Ventilation's Control Strategies adapted to Large Buildings". Measurement methods and CFD analysis were used to evaluate fuzzy control systems based on the occupation levels within a large building over time. Analysis was based on CO_2 concentrations. Results showed that occupant control provided an opportunity for combining energy savings with good thermal comfort and indoor air quality.

5.2 DCV Field Studies

The theme of demand control continued with a presentation by Anne Tissot of CETIAT, France entitled "Demand controlled ventilation as efficient means to achieve energy savings in tertiary sector buildings". This outlined the still rather limited use of DCV throughout Europe and presented an assessment of the real operational reliability that can be expected. The analysis was based on field studies carried out on six buildings in which each was analysed over a period of 15 days. This looked at comfort, indoor air quality and energy benefit as well as installation and maintenance issues. Results showed that CO_2 concentrations could be maintained at below 1000 ppm. In addition, significant energy savings in excess of 50% were achieved at all sites when compared to the pre – installation condition. The importance of building management staff to understand the operation and maintenance needs of DCV systems was stressed.

5.3 DCV Energy Analysis

Bjorb. Sørensen of Narvik University College, Norway presented a paper entitled a "A detailed study of DCV energy usage by simulation. This concluded that energy use is strongly coupled to occupancy and that savings of 30 – 45% should be possible. This could further be improved by refinements to the control algorithms.

5.4 A simple design tool

Simple design tools are vital in bringing research concepts into practice. Pierre Michel of ENTPE, France introduced such a design tool in his paper entitled "PHACES: Natural ventilation control strategies design tool". This tool is based on an analysis of shading and natural ventilation to achieve cooling in summer. The tool was developed using MATLAB/SIMULINK (Figure 6) and is based on measurements made in an experimental test cell. A key conclusion was the need to fine tune systems in order to optimise control set-points. This simple design tool combines a thermal model with ventilation and takes into account climate and design features such as shading and thermal mass. It may be used for building design and the optimisation of controls. PHACES can also be used in the design process to improve IAQ, reduce noise and prevent local discomfort while reducing instabilities and costs.

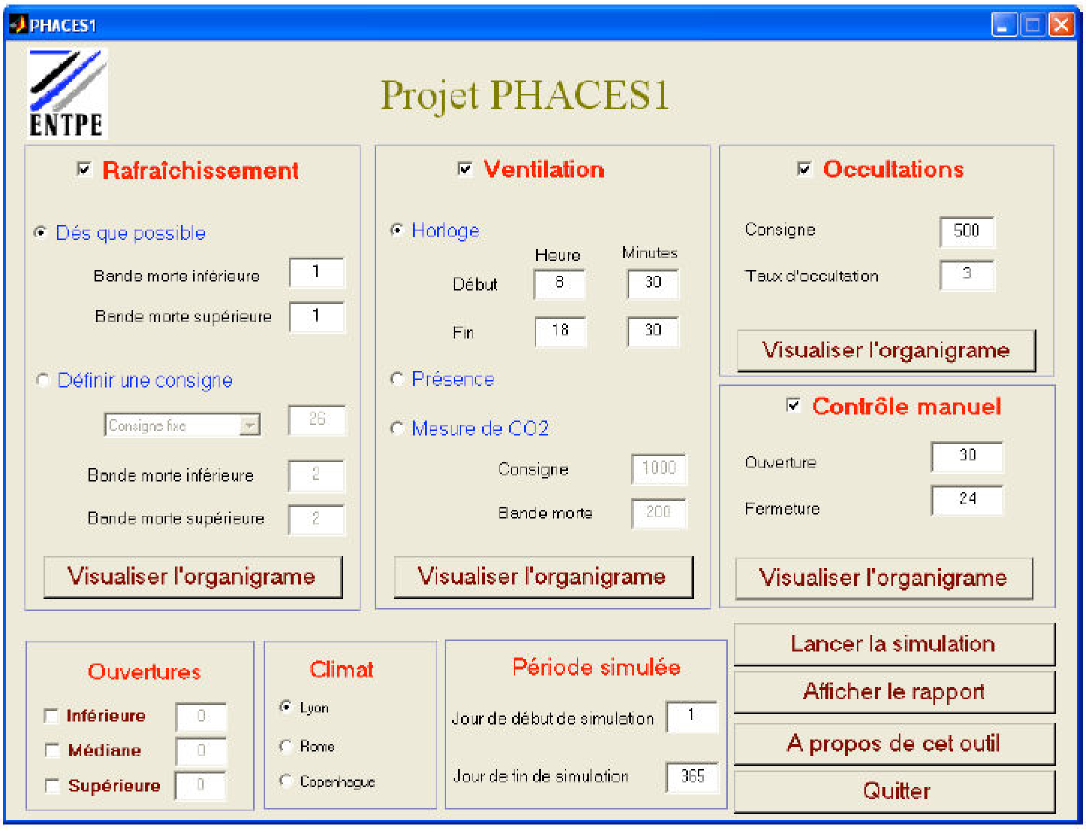

Figure 6: PHACES control panel

5.5 Humidity Sensitive Control

Humidity controls have important applications in wet zones, especially when dealing with moisture problems in bathrooms and kitchens. Jean-Luc Savin of Aeroco, France introduced a paper entitled "Management of the time-distribution of the needs for indoor air renewal in humidity sensitive ventilation" which was based on case study analysis of 'global' and individual behaviour'. While global observations assist in design and sizing, individual needs are shown to vary considerably. In dwellings, humidity sensitive control systems enable these varying needs to be satisfied.

6 Session 6 - Natural Ventilation

Natural ventilation continues to dominate interest in milder climates where the cost and energy performance of mechanical systems, especially for smaller buildings, are often difficult to demonstrate and where occupants often express a preference for natural systems. This session, therefore, provided an opportunity to provide an update to theory and methods.

6.1 Airflow structure

In the first paper Shigeki Nishizawa of the National Institute for Land and Infrastructure Management, Japan presented a paper entitled "A study on the airflow structure in cross-ventilated rooms with the full-scale model experiment" This outlined a detailed measurement analysis of room airflow patterns induced by cross flow ventilation for various wind directions (Figure 7). Various characteristics are presented and it is concluded that the property of the actual cross-ventilated space is complicated by the changing of wind direction and velocity in the actual environment. Thus it is important to examine the properties of cross ventilated space by means of wind tunnel analysis and measurements in actual buildings.

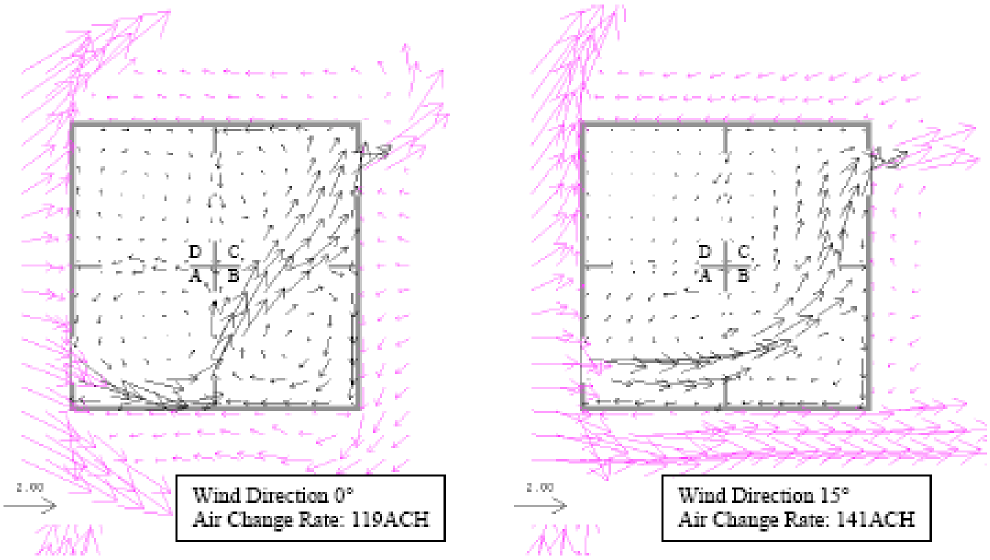

Figure 7: Examples of wind induced cross flow.

6.2 Urban Canyons

Urban areas are characterised by 'canyons' consisting of streets lined by tall buildings. The canyons influence flow patterns as well as the climate within the canyon. Constantine Syrios of Imperial College, London, UK introduced a paper entitled "Urban canyon influence on building natural ventilation". This analysis was based on laboratory flume models for three cases in which various wind and temperature stratification conditions were investigated. The implications of results on thermal comfort conditions were also considered. Results showed that canyons reversed the effect of the wind on thermally-driven ventilation of an otherwise isolated building. Winds that, in general, enhance/oppose the thermally-driven passive ventilation flow through a fully-exposed building were found to oppose/enhance the thermally-driven flow through a canyon building. This reversal was evident for canyons as wide as five times the building height. A design implication is that ventilation openings may have to be positioned counter intuitively, namely, with high-level vents on the windward façade and low-level vents on the leeward façade. The reversal of the wind's impact when canyons are present may be explained in terms of the surface pressure on the leeward façade exceeding the surface pressure on the windward façade of the ventilated building. This pressure imbalance arises from the different flow patterns in the upstream and downstream canyon. It is therefore important for architects to understand canyon flow.

6.3 Night cooling

Using ventilation for night cooling has long been incorporated into passive cooling designs and is now of interest in modern design as a means to eliminate or minimise the need for mechanical cooling. In the presentation of Servando Alvarez of the Universidad de Sevilla entitled "Flow patterns effects on night cooling ventilation" theoretical consideration is given to various simple natural ventilation configurations applied to a similar sized enclosure. This shows that the capacity of thermal mass to absorb heat is dependent on ventilation configuration according to the amount of thermal contact that the air has with the mass. Over an eight hour charging cycle the best configuration had an efficiency of 18% and the least effective had an efficiency of only 3% (as a consequence of minimal contact). It is important, therefore, to consider the flow pattern and contact regime in order to maximise night cooling performance. The use of correct heat transfer coefficient was also discussed since designs often assume only a purely convective heat transfer coefficient which can underestimate the true value.

6.4 Natural ventilation for cooling in the tropics

Natural ventilation is still widely used, even in hot and humid climates. Development in this area is important because economics and location may often prevent mechanical solutions. Leopoldo. Bastos of the Beck Universidade Federal do Rio de Janeiro, Brazil covered this topic in a paper entitled "Potential of natural ventilation in a tropical climate". In Brazil a new Standard ABNT NBR 15220-3 has established bioclimatic zones and guidelines for low-income houses. To assist accurate development of natural ventilation solutions this paper describes a method used to provide average wind data at heights of 1.5 m and 6 m above the ground. The average wind velocities were calculated using a logarithm profile with available average velocities from data charts.

6.5 Industrial natural ventilation case study in a hot climate

Large industrial buildings can be especially difficult to cool by mechanical means and often rely on natural systems even in hot climates. In addition to maintaining an acceptable environment for occupants, the industrial process itself could slow down if temperatures become extremely hot. Barry Harmsworth of Al Mutaiwie General Trading LLC, Dubai, United Arab Emirates gave a presentation entitled "Natural ventilation -a strategy for increased productivity" in which these issues were covered. This example used driven turbine ventilators that could take advantage of the availability of wind in the Arabian Gulf. Reference was also made to a hybrid wind driven turbine ventilator assisted with an electronic low power motor. This is currently being tested in Australia with good results.

7 Session 7 - Ventilation Measurements

The measurement of ventilation performance is an important part of design, commissioning and maintenance. The final session of the conference was devoted to performance measurements.

7.1 Monitoring of a passively cooled office building

This session began with a paper by Michael Kleber of the University of Karlsruhe, entitled "The results of monitoring a naturally ventilated and passively cooled office building in Frankfurt Germany. This covered the monitoring over 3 years of an office building that was mostly naturally ventilated and passively cooled. Monitoring results showed that the integrated design resulted in very low energy consumption for heating, ventilation, cooling and lighting. Monitoring also helped to reveal operating problems and thus, by rectification, further reduced energy consumption. Results showed that good thermal conditions could be achieved in summer by utilising night cooling and thermal mass. In winter, air change rates were sufficient to minimise the number of hours in which CO_2 exceeded 1500 ppm.

7.2 Ventilation in primary schools

Adequate ventilation rates in schools are often difficult to achieve, especially in winter. This is because occupant density is high and therefore a high rate of airflow is needed. This can result in cold draughts and high energy consumption. Go Iwashita of the Department of Architecture, Musashi Institute of Technology, Japan introduced the results of a monitoring program in Japan in a paper entitled "Air exchange rates in the elementary schools in southern Japan". Measurements covered the concentrations of volatile organic compounds (VOCs) and the air exchange rates in four classrooms in Kagoshima City. The measurements also included CO_2 in a selected classroom with occupancy of the pupils. The average summer air exchange rate of the classrooms was high at 18 ach, where windows and doors were all open. In winter, the air change rates were relatively low at 1 ach since windows were closed.

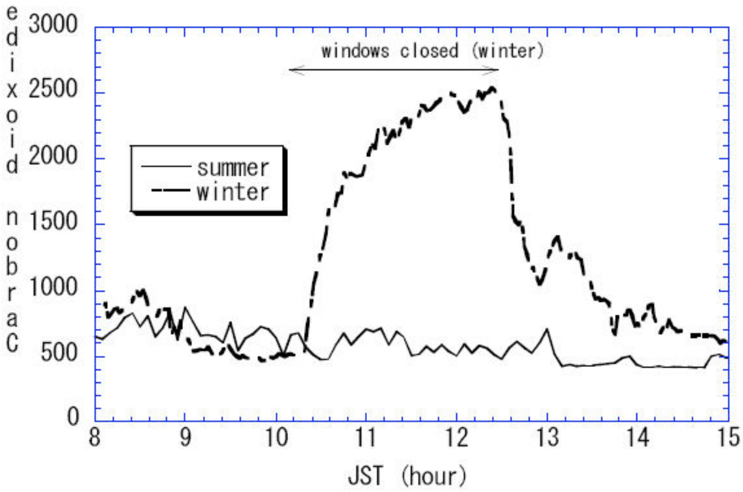

Figure 8: Example summer and winter carbon dioxide concentrations.

Measurements showed that:

- Classroom temperature and humidity was high in summer;
- VOC's in recently painted classrooms were above guideline values;
- High concentrations of 1,4-dichlorobenzene was found in the toilet and in the adjoining classroom;
- More ventilation is needed in winter since indoor CO_2 concentration exceeded the guideline value (Figure 8).

7.3 Winter mechanical ventilation in primary schools

Further information on the climate in primary schools in Japan was presented by Hiroshi Yoshino of *Tohoku University*, Japan in his presentation entitled "Indoor air quality and thermal environment of elementary schools in winter". Modern schools must incorporate 0.3 ach of forced (mechanical) ventilation which is topped up to 2.2 ach by window and door opening. An occupant CO2 concentration approximately correlates with the 2.2 ach overall requirement and can therefore be tested by CO2 monitoring. This study focused on an analysis of the classroom climate including temperature, humidity, CO2, ventilation airflow rates, concentrations of chemical substances, and the opening condition of the windows and doors in two schools. Results showed that CO_2 concentration tended to be higher than 1500 ppm and that the mechanical exhaust ventilation rates averaged 10% lower than the design rate. Poor flow rates were directly attributable to inadequate maintenance of the ventilation system including the failure to clean filters.

7.4 Airtightness measurements in dwellings

Sigrid Dorschky of BlowerDoor GmbH, Germany presented a paper entitled "Blower Door Measurement – Air-Tightness Testing in Passive Houses". This stressed the need for airtightness to achieve ventilation efficiency and proposed a standard of 0.6 ach at an induced pressure of 50 Pa. The procedure for testing was discussed as well as procedures for achieving airtightness in design. It was concluded that potential leakages can be designed out thus ensuring airtightness after construction.

7.5 Performance of mechanical ventilation in dwellings

Rie Takaki of Tohoku University, Japan presented a paper entitled "A study on the performance evaluation of mechanical ventilation systems for occupied houses".

Based on extensive measurements in 12 mechanically ventilated houses made between 2001 – 2005 low ventilation rates were found in many houses. These were attributable the lack of cleaning of grilles, filters and insect protection meshes. This study found that some of the ventilation systems were not properly operated and airflow rates were insufficient in almost all houses because of accumulated dust on the filters as airflow rate at inlet/outlet increased after the filter was cleaned. Only very few occupants reported that they regularly cleaned filters. The investigation confirmed that an airflow meter (Figure 9) is a convenient and efficient method to measure airflow rate, particularly for the occupied house.

Figure 9: Use of an airflow meter to monitor flow rates.

7.6 PFT tracer techniques

The final paper was by Manuel Pinto of the Viseu Polytechnic Institute Portugal entitled "Measuring air change rates using the PFT technique in residential buildings in northern Portugal". This described measurements in 94 apartments in the Porto area using the passive tracer gas method, more precisely the PFT technique. These apartments contained a mixed ventilation system consisting of an air inlet through self-adjustable inlets in bedrooms and living rooms, natural exhaust in bathrooms and fan exhaust systems in kitchens. Measurements showed that ventilation rates on average were reasonable at 0.65 ach in summer and 0.81 ach in winter.

The Air Infiltration and Ventilation Centre was inaugurated through the International Energy Agency and is funded by the following eight countries:

Belgium, Czech Republic, France, Greece, Japan, The Netherlands, Norway and United States of America.

The Centre provides technical support in air infiltration and ventilation research and application. The aim is to provide an understanding of the complex behaviour of the air flow in buildings and to advance the effective application of associated energy saving measures in both the design of new buildings and the improvement of the existing building stock.

Air Infiltration and Ventilation Centre
Operating Agent and Management
INIVE EEIG
Boulevard Poincaré 79
B -1060 Brussels - Belgium

www.aivc.org

Tel: +32 2 655 77 11
Fax: +32 2 653 07 29
inive@bbri.be
www.inive.org