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# AIR INFORMATION REVIEW

Vol 24, No. 1, December 2002 A quarterly newsletter from the IEA Air Infiltration and Ventilation Centre

## INSIDE

FEATURES



# Ventilation Modelling Data Guide

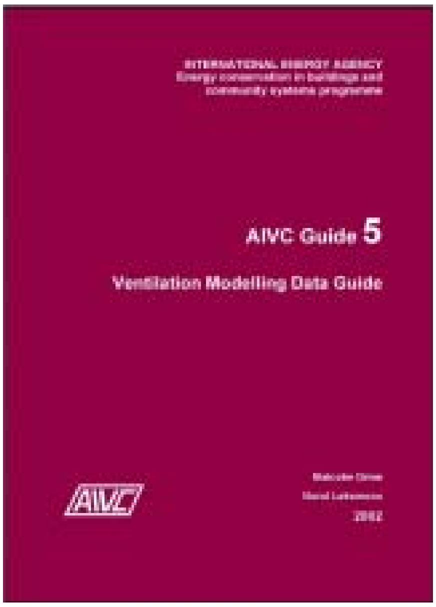
## A new publication of the AIVC

The new Ventilation Modelling Data Guide of the AIVC is now available. The guide replaces the old Technical Note 44 (1994) which was mainly focused on leakage and wind pressure data presented in tables. The new approach is an interactive database available on CD-Rom. The guide itself has the same layout as the other AIVC publications but is provided with hyperlinks to about 300 different documents stored on the CD (245 MB of information).

The items presented in the Ventilation Modelling Data Guide are:

- occupant related information from about 15 countries;
- pollutant data that guides the reader to sources of pollutants for different types of buildings;
- meteorological data from several climates and with different approaches are described;
- modelling information including description and evaluation of 16 models and 10 evaluation datasets;
- building related input data in order to configure ventilation models;
- and ventilation provisions.

Moreover there is information which guides the reader. Parts of the ventilation guide and the modelling technical notes are included for explanation and/or reference. The Ventilation Modelling Data Guide is really the beginning of a new way to find and use data for modelling. A quick search in the content may convince any user to look further and the result will be a lot of useful information made available in a user friendly way.




**THE AIVC CONFERENCE 2003**
**WILL BE HELD IN WASHINGTON DC (USA)**
**12-14 OCTOBER 2003**

**SEE INFO ON PAGE 14**

# AIR INFORMATION REVIEW

The newsletter of the AIVC, the Air Infiltration and Ventilation Centre. This newsletter reports on air infiltration and ventilation related aspects of buildings, paying particular attention to energy issues. An important role of the AIVC and of this newsletter and CD is to encourage and increase information exchange among ventilation researchers and practitioners worldwide.

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**Contributions to AIR:** Suggestions for contributions are welcomed.

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## GUIDE TO THE NEWSLETTER

The Air Information Review is available in electronic format (PDF file) on the AIVC-CD. This electronic version is provided with hyperlinks to other documents located on the CD and to external web sites or e-mail addresses.

In the document, links are represented by small red icons or by red text.
To follow a link: position the pointer over the linked area on the page until the pointer changes to a hand with a pointing finger (the hand has a plus sign in it if the links point to the Web). Then click the link.

**Content of the AIVC-CD**
The AIVC-CD contains various AIVC products, such as the Air Information Review newsletter, Technical Notes, 'Airbase' (the AIVC's bibliographical database) and recent conference proceedings. It also contains a lot of third party publications.

The content of the CD is summarised in a document called "What's on the AIVC-CD?". This document is also available on the CD and is provided with hyperlinks.

In order to have an overview of the content of all the AIVC-CD's, a compilation of their tables of content is now also available on the CD.

**How to find information on the AIVC-CD**
Once you have introduced the AIVC-CD in the CD-Rom driver of your computer, the index.html file should open automatically. (If this is not the case, you can find the file on the main root of the AIVC-CD and open it yourself). This file is provided with hyperlinks to other documents located on the CD.

To find information in a PDF document, you can use the Find command (Edit > Find) to find a complete word or part of a word in the current PDF document.

You can also use the Search command (Edit > Search > Query) to search for a word or combination of words through all the PDF files located on the AIVC-CD.

## WEBSITES

### Action Energy
*link is not available in web edition*

Action Energy helps businesses and public sector organisations save money by improving their energy efficiency. It provides the information, advice, practical help and financial support to start reducing energy costs.

### Energy Technologies and Indoor Air Quality (ETIAQ): results of a project from REHVA
*link is not available in web edition*

REHVA (the Federation of European Heating and Air-Conditioning Associations) presents on its website the results of a completed project about energy technologies and indoor air quality.

Numerous web pages give detailed information and advice:
*link is not available in web edition*

- existing innovative building energy technologies having a positive impact on Indoor Air Quality (IAQ),
- successful building demonstration projects combining low energy consumption and high IAQ,
- trends for future developments in building energy technologies and their influence on IAQ,
- existing norms and trends for future standards related to IAQ and energy consumption,
- strategies for achieving low energy consumption rates and high IAQ standards in buildings.

## INFO FROM PROJECTS

### Two European projects on performance criteria for Healthy Buildings

Website: *link is not available in web edition*

Performance is a very popular topic today. Finance or cost is the most important focus of the parties who make the decisions. This financial performance evaluation is mainly based on the cost aspects of a building: buying land, building, exploitation and maintenance, rarely on the (indirect) turnover, such as productivity gains or potential savings from sickness rate reduction.

Indoor environmental complaints are related to sickness absence rates of office workers. This, together with losses in productivity and in working efficiency, means a large financial loss. In domestic buildings, asthma and allergy related illnesses lead to increased health care costs. Besides that, investigations on costs related to repair and damages show an enormous potential as well. It is therefore important that indoor environmental complaints and illnesses are prevented by creating a healthy and comfortable indoor environment. Performance criteria for healthy and comfortable buildings are required.

At this moment TNO Building and Construction Research is involved in two European projects on performance criteria for healthy buildings (in this context the health of buildings relates to air quality, ventilation, thermal comfort, noise and light):

- HOPE: Health Optimisation Protocol for Energy-efficient Buildings: Pre-normative and socio-economic research to create healthy and energy-efficient buildings. The project HOPE is a European research project under the program ENERGIE with a duration of three years (started January 1st 2002). The outcome will comprise of a methodology for assessing the performance of buildings according to a set of health-energy integrated defined criteria, to improve unhealthy or low energy efficient buildings. (http://hope.epfl.ch)
- PeBBu: Performance Based Building. PeBBu is a Thematic network under the Competitive and Sustainable Growth programme, which started September1st, 2001 and will run for 4 years. TNO is leader of one of the nine domains: the domain 'Indoor Environment'. Special emphasis is put on performance criteria for healthy buildings and on methods, guidelines, protocols and tools to evaluate/measure the health status of buildings or designs for buildings.

### Criteria for Healthy Buildings – Finnish approach

The quality of indoor climate is affected by ventilation, air conditioning, heating, constructions, quality of construction work, building materials as well as the use and maintenance of the building. Because of these multiple origins of the problem, it is important for the building owners and construction industry to specify the performance of the building and the construction process so that the building industry can prove through accepted procedures that the buildings meet the accepted performance criteria for health and comfort. In Finland the first attempt towards such criteria was the Classification of Indoor Climate, Construction, Building Materials and HVAC Components, issued by FISIAQ first in 1995 and revised in 2001. The classification having a status of a voluntary guideline consists of:

1. Target and design values for IAQ
2. Criteria for construction cleanliness and moisture control
3. Criteria for material emissions
4. Criteria for cleaning of HVAC components

The classification defines classes for measurable or approvable quality such as IAQ, thermal comfort, moisture control, cleanliness, etc. Classes are defined for indoor climate (S1, S2, S3), cleanliness of construction and HVAC system (P1, P2) and for material emissions (M1, M2). Such classification of quality makes it flexible to specify relevant quality levels in designs and especially in contractor's agreements. Each class may contain design and target values and instructions for working phases. In practice, an additional effect of the classification has been a tendency to guide towards better quality levels – no S3 and M2 buildings are constructed in practice when the classification has been followed.

The use of the classification has shown that this very promising tool still leaves many questions open, especially in the building site. Within the Finnish Healthy Buildings research programme, a more detailed Criteria for Healthy Buildings has been outlined since 2001. In this work, subject based criteria is integrated into a construction process for being more useful in practice. The criteria is being tested and developed in more detail by four construction companies in four pilot buildings under construction. There the research team has been involved from the conceptual design phase, continuing to the completion of the buildings. These criteria try to specify a construction process for a healthy building. In the design phases, the duties of each stakeholder are specified and guidelines are given in the form of checklists and model specifications and how to include the criteria into agreements and specifications. In construction, phase moisture control and cleanliness of construction work and ventilation system are the main issues. To control these, special moisture and cleanliness control plans are required and numerous instructions and requirements are given for construction timing.

Based on feedback from pilot buildings the research team believes that they are on the right track. It seems that integration of the criteria into a construction process and combining a performance based approach with detailed descriptive measures and procedures of recommended practices enables an improvement in the quality of healthy and comfortable indoor environments. Criteria for office buildings are to be launched at the beginning of 2003.

Project Co-ordinator:
Dr Jarek Kurnitski
*link is not available in web edition*


## Annex 35: Hybrid ventilation in office and educational buildings

Annex 35 "Hybrid Ventilation in New and Retrofitted Office Buildings", an international research project initiated by the IEA Implementing Agreement Energy Conservation in Buildings and Community Systems was finished recently.

The scope of the annex was to obtain better knowledge of the use of hybrid ventilation technologies and to focus on development of control strategies for hybrid ventilation, on development of methods to predict hybrid ventilation performance and on implementation and demonstration of hybrid ventilation in real buildings. To reach the objectives the annex was structured in three subtasks.

*Subtask A*: Development of control strategies for hybrid ventilation, which focused on development of strategies to control hybrid ventilation systems, that at any time and for a certain combination of internal loads, outdoor conditions and comfort requirements can ensure that the immediate demands to the indoor environment are fulfilled in the most energy efficient manner.

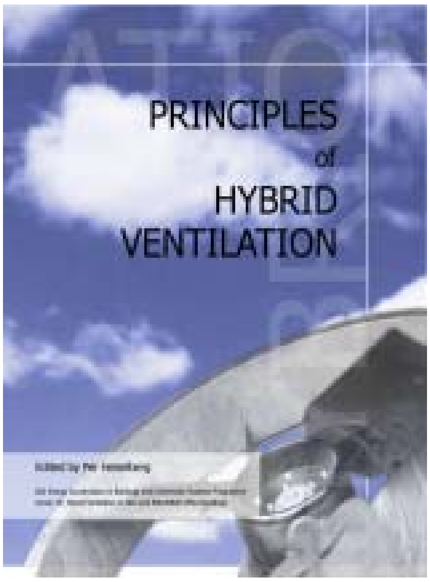
*Subtask B*: Theoretical and experimental studies of performance of hybrid ventilation. Development of analysis methods for hybrid ventilation. This subtask focused on achieving a better understanding and a better control of the hybrid ventilation process, which is a prerequisite for a successful application of hybrid ventilation and, based on this knowledge, to develop methods for hybrid ventilation design and performance prediction.

*Subtask C*: Pilot studies of hybrid ventilation, which focused on implementation of hybrid ventilation systems and demonstration of their performance through case studies covering different climatic conditions as well as building designs and building use.

**Published Research Results**
The research results are summarized in a booklet and a number of technical and case study reports on a CD-ROM. The booklet is aimed at newcomers in the field and gives an introduction to hybrid ventilation. It focuses on office and educational buildings and describes the principles of hybrid ventilation technologies, control strategies and algorithms for hybrid ventilation, as well as integrated ventilation and building design, analysis methods for performance prediction and methods of quality control. The lessons learned from monitoring campaigns in the 13 case studies, including both new build and retrofit designs, are summarized as well as the main ventilation system characteristics.

More detailed information about research results can be found in a number of technical reports, which also includes reports with detailed information, measurement results and conclusions from the investigated case studies, see list below.

It is hoped that the booklet will be helpful for both architects and engineers in their search for innovative and energy-efficient ventilation solutions. The hybrid ventilation concept is quite new, and there are still many problems to be solved, before hybrid ventilation can be considered as a mature and well-established ventilation concept.




**All the reports listed below are available on the AIVC CD**

**List of reports**

***Booklet***
Principles of Hybrid Ventilation
(Editor Per Heiselberg)

***Technical Reports***
Aggerholm, S.
Hybrid Ventilation and Control Strategies in the Annex 35 Case Studies

Heikkinen, J., Heinonen, J.S., Laine, T., Liljeström, K., Vuolle, M.
Performance Simulation of Hybrid Ventilation Concepts

Delsante, A., Aggerholm, S.
The Use of Simulation Tools to Evaluate Hybrid Ventilation Control Strategies

Michel, P., Mankibi, M.El.
Advanced Control Strategy

Willems, E.M.M.,Van der Aa, A.
$CO_2$ Sensors for IAQ:
A High-Tech Instrument is Becoming a Mass Product

Hendriksen, O.J.
A Sensor Survey for Hybrid Ventilation Control in Buildings

Mayer, E.
Individual Thermal Comfort Controlled by an "Artificial Skin" – Sensor

Wouters, P., Heijmans, N., de Gids, W., Van der Aa, A., Guarracino, G., Aggerholm, S.
Performance Assessment of Advanced Ventilation Systems in the Framework of Energy and IAQ Regulations: Critical Issues, Challenges and Recommendations

Van der Aa, A., Op't Veld, P.
Quality Control for Hybrid Ventilation

Van der Aa, A.
Costs of Hybrid Ventilation Systems

Li, Y.—Analysis of Natural Ventilation – A Summary of Existing Analytical Solutions

De Gids, W.—Methods for Vent Sizing in the Pre Design Stage

Li, Y. Integrating Thermal Stratification in Natural and Hybrid Ventilation Analysis

Brohus, H., Frier, C., Heiselberg, P. Stochastic Load Models based on Weather Data

Brohus, H., Frier, C., Heiselberg, P.
Quantification of Uncertainty in Thermal Building Simulation by Means of Stochastic Differential Equations

Brohus, H., Frier, C., Heiselberg, P. Stochastic Single and Multizone Models of a Hybrid Ventilated Building –
A Monte Carlo Simulation Approach

Fracastoro, G.V., Perino, M., Mutani, G.
A Simple Tool to Assess the Feasibility of Hybrid Ventilation Systems

Schild, P.
Probabilistic Calculations by COMIS – Spreadsheet User Interface and General Guide

Heijmans, N., Wouters, P.
Impact of the Uncertainty of Wind Pressures on the Prediction of Thermal Comfort Performances

Sandberg, M.
Wind Induced Airflow through Large Openings: Summary

Seifert, J., Perschk, A., Rösler, M., Richter, W.
Coupled Air Flow and Building Simulation for a Hybrid Ventilated Educational Building

***Case Study Reports***

Rowe, D.
Wilkinson Building, The University of Sydney, Sydney, Australia

Heijmans, N., Wouters, P.
IVEG, Hoboken, Belgium

Heijmans, N., Wouters, P.
PROBE, Limelette, Belgium

Hendriksen, O.J., Brohus, H., Frier, C., Heiselberg, P.
B&O Headquarter, Struer, Denmark

Meinhold, U., Rösler, M.
Bertolt Brecht Gymnasium, Dresden, Germany

Principi, P., Di Perna, C., Ruffini, E., Guzzini
Illuminazione, Recanati (Macerata), Italy

Kato, S., Chikamoto, T.
The Liberty Tower of Meiji University, Tokyo, Japan

Kato, S., Chikamoto, T.
Tokyo Gas Earth Port, Tokyo, Japan

Kato, S., Narita, S.
Fujita Technology Centre, Atsugi, Japan

Tjelflaat, P.O.
Mediå School, Grong, Norway

Schild, P.
Jaer School, Nesodden municipality, Norway

Blomsterberg, Å., Wahlström, Å., Sandberg, M.
Tånga School, Falkenberg, Sweden

Van der Aa, A.
School Building Waterland, The Hague (Leidschenveen, The Netherlands

## Low Exergy Systems for Heating and Cooling of Buildings

**Background**

"Energy saving" and emission reduction are both affected by the energy efficiency of the built environment and the quality of the energy carrier in relation to the required quality of the energy. Taking into account qualitative aspects of energy leads to introduction of the exergy concept in comparison of systems, which is the key idea of Annex 37. Energy, which is entirely convertible into other types of energy, is exergy (high valued energy such as electricity and mechanical workload). Energy, which has a very limited convertibility potential, such as heat close to room air temperature, is low valued energy. Low exergy heating and cooling systems use low valued energy, which is delivered by sustainable energy sources (e.g. by using heat pumps, solar collectors, either separate or linked to waste heat, energy storage etc.). The reason for "energy saving" being in quotes in the first sentence, is that we actually are talking about saving exergy, not energy!

Future buildings should be planned to use or be suited to use sustainable energy sources for heating and cooling. One characteristic of these energy sources is that only a relatively moderate temperature level can be reached, if reasonably efficient systems are desired. The development of low temperature heating and high temperature cooling systems is a necessary prerequisite for the usage of alternative energy sources. The basis for the needed energy supply is to provide occupants with a comfortable, clean and healthy environment.

**Objectives**

The general objective of the Annex 37 is to promote rational use of energy by means of facilitating and accelerating the use of low valued and environmentally sustainable energy sources for heating and cooling of buildings.

Specific objectives are:

1. To investigate the technical and market potentials for replacing high valued energy (e.g. fossil fuels and electricity) by low valued energy sources and to assess its impact on global resources and environment;
2. To assess existing technologies and components for low exergy heating and cooling in buildings, to enhance the development of new technologies and to provide the necessary tools for analysis and evaluation of low exergy systems;
3. To develop strategic means for the introduction of low exergy solutions in buildings by case studies, design tools and guidelines.

**Strategy**

Four subtasks are carried out in order to reach the objectives.

1. *Subtask A:* Exergy Analysis Tools for the Built Environment
   The main objective of this Subtask is to assess and develop a comprehensive set of tools to enable an assessment of low exergy technologies, components and systems.
2. *Subtask B:* Low Exergy Concepts and Technologies
   The main objective of this Subtask is to create a comprehensive database of low exergy concepts, and to assess their advantages, requirements and limitations.
3. *Subtask C:* Case Studies and Market Potentials
   The main objective of this Subtask is to collect practical experiences gained from the installed low exergy systems and to analyse the market potential of low exergy systems in different countries.

4. *Subtask D:* Documentation and Dissemination
   The objective of this Subtask is to compile and widely disseminate the Annex research results and to identify the means of influencing the energy policies and regulations in order to promote the use of low exergy systems.

**Annex Beneficiaries**
An analysis of case studies together with the rationale of the exergy concept and recommendations concerning regulations in the building sector and energy tariffs are expected to be helpful for real estate builders, building maintenance managers, political decision makers and the public at large.

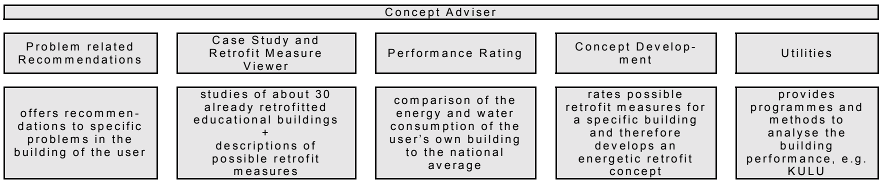
Designers of heating and cooling systems in buildings are the main target group and the most potential users of the guidebook developed in the Annex. The design guidebook will include: a database of low exergy components, developed system concepts for different buildings and climates and a comprehensive set of tools for analysis. All of these components, completed with the guidelines for selection of products, are expected to attract the interest of engineering firms, consultants and architects.

On the AIVC CD:
- Introduction to the Concept of Exergy
- Low Ex News n°5
- Low temperature heating systems

## α-Version of Energy Concept Adviser Tool of IEA ECBCS Annex 36 ready for first Tests

Website: *link is not available in web edition*

The IEA ECBCS Annex 36 "Retrofitting of Educational Buildings – REDUCE" aims at providing the decision makers in administrations and communities an easy to use computer tool that will help to find the most efficient energy saving measures and also to discourage them from exaggerated expectations. The adviser will be applicable during the entire retrofitting phase to ensure that both the calculated energy savings and the economical success will be achieved after retrofitting. The Annex is currently working on different parts of the tool, which is based on the structure hereafter.




The 5 different parts of the adviser will be partly linked to each other, so that the user can jump from a recommendation directly to a case study in which the chosen measure was applied as well as to the illustration of the measure in the measure viewer. Recommendations include evaluations like long, medium and short-payback times. The retrofit measures and the case studies are organized in a matrix that can be sorted to different criteria such as country of the case study, year of construction of the building, groups of retrofit measures, etc. By inserting the energy consumption of his building the user will find out whether it has a high or a low necessity to retrofit in comparison to similar buildings in his country or region. The concept development offers the possibility to design a suitable energetic retrofit concept by calculating the approximate energy savings and the investment costs for different measures and for combinations of measures. With the simple tools provided in the utilities part the energy consumption of any building can be tracked and analysed. Ventilation methods and indoor air quality are important chapters of the recommendations, the case studies and retrofit measures and the calculations.

The group of participants from 10 countries have produced a report on 26 case studies including ventilation strategies like demand control, hybrid ventilation, weather strapping and user behaviour managements systems and a working document on the basics of retrofitting of educational buildings such as national regulations, average energy consumptions, existing computer tools for retrofitting and the aims of decision makers as the first outcomes of the Annex. The Energy Concept Adviser itself is now in the status of being tested by the participants.

On the AIVC CD:
- Annex 36 Newsletter

## STANDARDS & REGULATIONS

### The new UK airtightness regulations

Website: *link is not available in web edition*

Non-domestic buildings consume a lot of energy, especially for space heating and cooling, and produce one-fifth of the UK's carbon dioxide emissions. Whilst an increasing number are now being constructed with energy efficiency in mind, the practice is still not sufficiently widespread. To help combat this, the UK government issued new Building Regulations earlier this year that will promote improvements in the way commercial buildings are built and operated. The AD Part L2 regulations, explained in Approved Document L2 (ADL2), came into effect on April 1$^{st}$ 2002 and covers U-values, thermal bridging, solar gain, HVAC, lighting and airtightness. This article summarises the regulations concerning airtightness.

Buildings are required to limit heat losses and gains through the fabric. One aspect of this is to limit unnecessary air infiltration by providing a building fabric which is reasonably airtight. All new commercial buildings should therefore be designed and constructed with appropriate air barriers, but in addition all buildings with a gross floor area of 1000 $m^2$ or more must be tested for air permeability by an accepted testing body. Up until now, air leakage has usually been calculated using the air leakage index, which includes only the walls and roof in the building envelope. ADL2, however, specifies using the air permeability formula, which measures the envelope of walls, roof and ground floor area. The new regulations specify that air permeability should not exceed 10 $m^3h^{-1}m^{-2}$ at an induced pressure difference of 50 Pascals across the extended envelope. Until 30 September 2003, the government is prepared to accept a standard of 'reasonable compliance'. If a building fails its first airtightness test, reasonable compliance will be demonstrated if it conforms to one of the following:

- air permeability on re-testing has improved by 75% of the difference between the first test and the target standard of 10 $m^3h^{-1}m^{-2}$
- air permeability on re-testing is within 15% of 10 $m^3h^{-1}m^{-2}$ (i.e. less than 11.5 $m^3h^{-1}m^{-2}$).

After 30 September 2003, a building will only comply with regulations if it meets with the standard of 10 $m^3h^{-1}m^{-2}$.

Responsibility for organising the test lies with the contractor, and in cases where the building fails, the contractor is also responsible for carrying out remedial work and arranging a re-test. It is therefore important that designers understand how to design for airtightness and that contractors and site workers understand the need for high levels of workmanship, particularly with regard to sealing around joints and at service entry points. For large and complex developments, BRE – the UK's leading authority on airtightness – recommends that the project team seek specialist advice on design strategies and construction techniques.
BRE has recently published *Airtightness in commercial and public buildings*, an outline guide to design that sets out the principles of providing an effective airtightness layer and advises on some common pitfalls.

It covers:
- the mechanics that cause air infiltration to occur and the benefits that result from increasing the airtightness of a building
- how to design and specify for airtightness
- site practice for airtight construction and testing a building to ensure that it meets the required standard.

The guide is available from the BRE Bookshop: *link is not available in web edition* priced £50.

BRE has also produced *Achieving Airtightness*, a leaflet that summarises the new regulations for contractors and designers (an electronic version is featured on the attached AIVC-CD). It describes clearly and succinctly the key issues and the roles and responsibilities of the different parties.

Readers may also find it useful to visit BRE's airtightness website.
For more information, contact BRE's Airtightness Centre +44.1923.66.47.64 or e-mail *link is not available in web edition*

## POLICY & PROGRAMMES

### Information Centres on Energy Technologies

Website:
*link is not available in web edition*

Since its creation in 1974, the International Energy Agency (IEA) has provided a legal framework, through IEA Implementing Agreements, for international collaboration in energy technology research and development (R&D) and deployment.

Effective dissemination of information is a crucial part of the process. The IEA Implementing Agreement programme's Information Centres provide an essential vehicle for communicating R&D results and achievements. They cover the broad spectrum of topics, from R&D to implemented technologies in the areas of fossil fuels, renewable energies and efficient end use.
The brochure describes these information Centres and explains how information can be obtained from them.

## BOOKSHOP

### Energy performance assessment of single storey multiple-skin facades

The desire for environmental friendly and energy conscious building design emphasizes the need to develop new facade technologies. In the search towards energy efficient, comfortable and visually attractive facades, multiple-skin facades are regularly presented as being valuable solutions to support the desires of modern architecture. Multiple-skin facades consist of two panes, in between which there is a cavity through which air flows by means of natural or mechanical ventilation. In the cavity, usually a shading device is provided. Generally, distinction is made between naturally and mechanically ventilated multiple-skin facades.

The general aim of this PhD research is to contribute to the energy performance assessment of single storey multiple-skin facades. To that aim, multiple-skin facades are studied by means of experiments and numerical simulations. Experimental work was done on naturally and mechanically ventilated single storey multiple-skin facades. Field experiments showed that good design and excellent workmanship are of crucial importance to obtain the desired performances. The measurements enables an insight into the complex nature of the airflow in naturally ventilated cavities. The measurements on a controlled experimental set-up located at the university provided data to develop and validate the developed numerical model.

The numerical model is based on a control volume method and is especially developed for single storey multiple-skin facades with integrated roller blinds. On the one hand, it needs a sufficient level of complexity to achieve reliable energy simulations. On the other hand, this complexity must be controlled to allow reasonable computation times in the energy simulation.

In order to evaluate the energy performance of multiple-skin facades, the numerical model was then implemented in an energy simulation tool. The results for a traditional facade solution with exterior shading device, a naturally ventilated double-skin facade and two mechanically ventilated multiple-skin facades are compared. The results are particularly sensitive to the modelling of the inlet temperature and the multiple-skin facade model complexity. The results show that by using multiple-skin facades it is possible to improve some components of the overall building's energy use. Unfortunately, most studied typologies are incapable of lowering the heating and cooling demand simultaneously. Only by combining typologies or by changing the system settings according to the particular situation, a substantial overall improvement over the traditional insulated glazing unit with exterior shading can be obtained. The results further indicate that evaluating the energy efficiency of multiple-skin facades can not be performed by solely analysing the transmission losses and gains. It is imperative to take into account the enthalpy change of the cavity air and to perform a whole building energy analysis.

As a consequence of the diversity of the results, designers should be aware that multiple-skin facades do not necessarily improve the energy efficiency of their designs. Nevertheless, it needs to be emphasised that energy is only one of the many design considerations multiple-skin facades are chosen for.

## WHO publications on AIR quality

Website: *link is not available in web edition*

The World Health Organization, the United Nations specialized agency for health, was established on 7 April 1948. WHO's objective, as set out in its Constitution, is the attainment by all peoples of the highest possible level of health. Health is defined in WHO's Constitution as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Despite significant reductions in the concentrations of many pollutants, adverse health effects still occur in most of the WHO European Region. A variety of outdoor and indoor sources contribute to the health risks, and the hazardous properties of many common pollutants are still under intensive research. International information exchange and collaboration are needed to evaluate the risks and promote the most efficient methods for their prevention, elimination or reduction, integrating health issues with sustainable development.

The WHO/Europe programme on air quality contributes to the ongoing struggle to protect health from harm caused by air pollution. Acting within the global WHO strategy on air quality and health, AIQ works to:

- foster knowledge on the disease burden of air pollution as a basis for making environmental policy;
- review the scientific evidence on health effects of air pollution; and
- help countries build their capacities to assess and manage health risks from air pollution.

Three publications of the World Health Organization are available on the AIVC-CD:

- Strategic approaches to indoor air policy-making;
- Policies to reduce exposure to environmental tobacco smoke;
- The right to healthy indoor air.

The second edition of Air Quality Guidelines for Europe has now been published as WHO Regional Publications, European Series, No. 91 and is available from WHO sales agents as well as on-line ( *link is not available in web edition* ).

It comprises the four introductory chapters together with the sections on "Health risk evaluation" and Guidelines" of the respective pollutants. The introductory chapters and the full background chapters on the individual air pollutants are available here, and can be downloaded in Acrobat format by clicking on the title of the appropriate chapter.


## Thermal comfort and air diffusion

Website: *link is not available in web edition*

A new book entitled *Thermal comfort in forced convection* (author : Daniel Marchal) has been published by CETIAT (French Technical Centre of the HVAC Industries).

Written in French, the book gives information about air jets in rooms, explaining for example the phenomenon by which cold air jets may remain close to the ceiling.

It also describes the airflow patterns that exist in a room according to the air diffusion system being used. It finally gives simple formulas, built up from many CFD calculations results, that allow the estimation of the level of thermal comfort in the occupied zone of the room for different air diffusers in cooling or heating modes.

## Indoor Air 2002's proceedings

Website: *http://www.indoorair2002.org/buy_proceedings.htm*

The Proceedings from Indoor Air 2002, held in Monterey, California are now available in both print and CD versions. Many advances have been made in indoor environment research. Indoor Air 2002 presented the latest knowledge from research on indoor air quality and climate. The Proceedings cover a wide variety of topics including: ventilation and energy, cleaning, maintenance and operation of HVAC systems, HVAC components and system performance, thermal comfort, indoor air chemistry, health effects of particle exposure, ETS, asthma and indoor air exposures, design and materials selection, microbials and much more.

The Proceedings contain 726 papers (more than 4,500 pages) and a complete author and keyword index is included. The CD version is completely searchable for any index term, author, or other word in the Proceedings, and is compatible with both PC and Mac. The print version consists of five separate volumes, one for each day of the conference. Each volume has a complete author and keyword index as well as its own table of contents.

## Air Diffuser Designer's Guide

Website: *link is not available in web edition*

A new *Designer's Guide to Ceiling-Based Air Diffusion* (authors : Brian Rock and D. Zhu) has been recently published by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). Its aim is to assist engineers and designers in proper selection of air diffusion equipment. It applies primarily to conventional ceiling-based air diffusion equipment, which is prevalent in most new commercial and institutional buildings in the United States.

The guide addresses thermal comfort, indoor air quality, sound, behavior of ideal air jets, room air diffusion, air outlets, and inlets and design methods.

## European Collaborative Action (ECA) on "Urban Air, Indoor Environment & Human Exposure"

Website:
*link is not available in web edition*

**Objective**

The focus of the activity is urban & indoor air pollution exposure assessment, seen as part of human health risk assessment and also considering the needs of urban and indoor air quality management. Specific examples of the working areas of ECA are:

- the relative importance of outdoor and indoor sources of pollution,
- the building-related interaction between outdoor urban air and indoor air,
- exposure to pollutants from the different urban outdoor and indoor sources and its relation to health and comfort,
- validation and harmonisation of methodologies and models for assessing human exposure to, and health impact of, stressors of high public concern.

ECA is a widely accepted scientific network at EU level concerning the field of indoor air pollution, human exposure and health for:

- preparing reports summarizing available knowledge of important issues in the aforementioned research fields
- identifying ongoing research within the participating countries and the major research needs
- establishing working groups for well defined tasks such as the development and/or validation of guidelines and reference methods for indoor human exposure related investigations and measurements or for measures to improve the quality of indoor environments and protecting human health.
- providing a forum to help the exchange centrally of information and collaboration with other national and international organizations active in the aforementioned field (e.g. WHO, NATO/CCMS, U.S. EPA, EEA).
- Organizing workshops, symposia, seminars and training courses, activities aimed at helping the transfer of knowledge in this scientific field within the EU MS and to the Accession Counties.

**Integration**

The inter- and multidisciplinary research area of indoor exposure and health in EU and worldwide covers practical and scientific aspects ranging from technical to medical research disciplines. The overall scientific area can be split into six areas of special focus: (a) exposure measurements, (b) health effects, (c) buildings sciences and design, (d) exposure modeling, (e) indoor air quality control and (f) exposure risk assessment and management.

There is an increasing demand for better integrating these activities at European level to design and perform an effective urban air quality management and to minimise human exposures to harmful pollutants. For 15 years, the ECA Network activities cover all the above topics through its multidisciplinary character and expert composition, therefore it offers a unique opportunity for further integrating these research activities, mainly at the European level.

**Co-ordination**

The ECA Steering Committee (coordinated and managed by the JRC/IHCP/PCE Unit) consists of 32 distinguished scientists from 15 EU countries States (plus Norway and Switzerland), WHO and the European Commission. During the 15 years of its operation more than 100 scientists of leading European Institutions contributed to its activities through their participation in different WGs who prepared and delivered 22 state of the art reports which have been distributed to more than 1200 addresses in Europe and worldwide. Specific actions such as, preparation and execution of joint scientific projects (e.g. SCAs), performance of Inter-laboratory comparison exercises, workshops and training courses have been also organised.

The ECA helped the activities in the field of indoor air pollution and human exposure and health to achieve already a good level of coordination at EU level. The coordination is expected to be much more enhanced through the potential inclusion of ECA in a Network of Excellence under creation in the FP6.

**Reference**

The ECA Network (which is managed and co-ordinated by the JRC) through its activities in the field of indoor human exposure and health: (a) provides scientific and technical reference for policy making in the EC, (b) contribute to the integration of research efforts in Europe, (c) ensures capacity building and knowledge dissemination and sharing in the EU MS, the Accession Countries and even beyond (for example in 2001 China setup guidelines concerning the formaldehyde emissions from wood based materials on the basis of the ECA Reports).

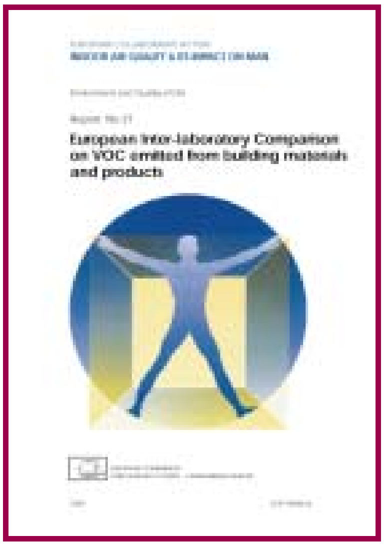
The creation and the continuation of the ECA Network for 15 years has been deemed important for two main reasons: (a) there are no scientific structures dedicated to indoor human exposure and health research similar to those existing for research on outdoor air or water quality. Therefore research is fairly scattered and often performed by small groups in a wide range of different institutions and (b) Indoor human exposure and health is a research issue which (more than any other) requires interdisciplinary collaboration.

**Enlargement**

In the last few years, the number of experts/trainees from the candidate/ accession countries is progressively increasing, which is included in some of the ECA activities designed to spread excellence (such as Workshops, Training Courses, etc) with the goal to create a capacity building, transfer of knowledge and training of those countries.

**Pubications**

More than 20 reports are now available. One of them is available on the AIVC-CD Report n° 21
"European inter-laboratory comparison on VOC emitted from building materials and products .



## MEETINGS & EVENTS

### Forthcoming conferences

**Details for the forthcoming conferences are available on the CD.**

## AIVC CONFERENCE 2002

The AIVC conference 2002 was held in October in Lyon, France. The conference was divided into 27 sessions and 12 workshops for a total of 185 different presentations. Some copies of the proceedings are still available in printed format (***epic2002aivc@entpe.fr***). A CD version of the proceedings will be available in a few weeks (information will be available on the website of the AIVC and in the next issue of AIR).

Different workshops were especially dedicated to ventilation:

- Indoor environment quality criteria for sustainable buildings;
- Distribution systems, health and energy;
- Natural ventilation in the urban environment;
- Hybrid ventilation.

A summing up of these 4 workshops is available below. Extended information is available on the AIVC-CD.

### Indoor environment quality criteria for sustainable Buildings

The first presentation was a summary of the results obtained in the working group WG4 of ISO TC 205. This group aims to define Indoor Air Quality criteria. The draft standard contains several methods for determining ventilation rates, based on these criteria. The ventilation rates obtained with some of these methods are compared for several premises: ASHRAE 62-1999, the method of perceived IAQ of CR 1752, and the prescriptive method of AS 1668.2. To improve the comparison, ventilation rates are also calculated with the prEN 13779 method.

A Finnish classification of indoor climate in buildings was presented. The objective is to improve indoor air quality with an integrated approach, to bring research results into practice, and to provide guidelines for designers and contractors. It also gives parameters for emissions for the building materials and HVAC components.

Healthy buildings not only reduce health costs but also increase productivity and are often cheaper to maintain. There are many possible causes for unhealthy buildings, including lack of regulations, of motivation and communication of stakeholders, and gaps in knowledge. Two European projects, HOPE and PeBBu aim to fill at least in part this knowledge gap.

The stakes of sustainable development is to ensure todays and future developments of a wealthy and healthy society in a nice environment. This is also valid for sustainable buildings, and includes, among other things, good indoor environment quality. This leads to numerous requirements, often contradictory, making any related decision difficult.

According to F. Flourentzou and C.-A. Roulet, the multicriteria methodology developed in Europe since 1990 to help in decision-making (Roy 1985) will help in choosing between several improvement scenarios, to decide if a building is good or poor, or to give a label.

*Photo: C-A Roulet (Swiss Federal Institute of Technology Lausanne) Honoured in recognition of his scientific contribution to energy efficient and healthy buildings*

### Distribution systems, health and energy

Several studies have shown that the prevalence of the SBS symptoms are usually higher in air conditioned buildings than in buildings with natural ventilation. One explanation for the association of SBS symptoms and mechanical HVAC-systems is VOCs and other chemical pollutants which are emitted by HVAC-components and ductworks.

The CLEAN VENTILATION Finnish project has focused on the origins of odours and harmful pollutants during the various phases of the construction of a ductwork system. The major outcome of this project consists in practical guidelines for cleaner systems, a labelling system, and new methods to measure and prove the cleanliness of the ductwork.

Measures to improve maintenance, inspection, and cleaning are very important. This is the main focus of prestandard ENV 12097. While it is clear that access doors and panels are critical, careful design is the key for cost-effectiveness. It appears that good accessibility can be achieved at lower cost than ENV 12097 recommendations.
In many countries, there is a striking lack of awareness of most of the elements involved in the construction of an air distribution system. Many owners do not even seem to care for ductwork performance and some funding institutions experience great difficulties driving the market towards better quality.

Other means for stimulating good quality ductwork (including all aspects, not only energy related issues) include education and dissemination of information on air distribution performance, to contractualize the quality requirements that are sought, to check that the requirements and needs are actually stated and met.

The EC-AIRWAYS source book ( & ***http://jbase150.eunet.be***) gives an overview of the issues that must be addressed when constructing an air distribution ductwork, as well as practical examples on specific issues.

## Natural Ventilation in the Urban Environment

Natural ventilation has recently developed new promising technologies. Creative combinations of these could open up enhanced possibilities for applications in a large percentage of urban buildings. Indeed, there are many examples of fruitful applications. The workshop discussed some of these developments together with barriers and future prospects.

The workshop included four short presentations on:

- Controllable airflow inlets by Willem de Gids, TNO. He outlined work carried out as part of the NatVent project on pressure controlled inlets and their applications.

- Case-studies of solar ventilation strategies in the UK by Maria Kolokotroni, Brunel University. She outlined work carried out as part of the SolVent project and presented case-studies of modern buildings with solar-assisted passive ventilation together with performance and relative capital costs.
- Operable windows in natural ventilation by Alice Andersen. She outlined the capabilities of operable windows and described case-studies on their integration and performance.

- Review of natural ventilation techniques in urban context and future prospects by Cristian Ghiaus, University of La Rochelle. He made a short presentation on a discussion paper presenting the main physical concepts and basic techniques for natural ventilation and highlighting the main challenges for its application in urban buildings. Proposals for the future integration of natural ventilation technologies and advances were presented to consider urban climatic conditions, building envelope, controls, lifecycle operation and the involvement of design stakeholders.

The last presentation opened an extended discussion with the participation of more than 30 delegates. Issues on the following points were debated:

- The role of building developers and investors.
- The difference between architectural and engineering language.
- The need for integrated design models.
- The lack of data that could lead to false assumptions about preferred operational conditions by users.
- The need for post occupancy evaluation of buildings.

It was concluded that there is a need for considerable work in the area if natural ventilation is to be applied routinely and successfully to urban buildings. The integration of developed technologies within specific urban microclimates and within buildings to take account of envelope construction and materials, controls, use, and lifecycle operation requires further research.

*Photo: W. de Gids*
*Chairman of the AIVC*

## Hybrid Ventilation

Willem de Gids (TNO-Bouw) gave an introduction to the definition and classification of hybrid ventilation.
The definition of hybrid ventilation is not clear to many. Annex 35 (HybVent) discriminates 3 types: mechanical/ natural alternating; natural fan assisted; mechanical stack and wind assisted. De Gids developed classification system from 18 types in 9 development stages. The following remarks are made: Many systems may be called hybrid but can have several stages in technical solutions for certain properties. If comparisons are made, do it in terms of objective performances.

Per Heiselberg (AAU) gave an introduction to IEA Annex 35 HybVent, completed by September 2002, and focuses on lessons learned in building and ventilation design. Hybrid ventilation is immature technology at the moment and its success depends on the utilisation of the benefits of natural ventilation and free cooling.

Considering sensor control strategies it appers that occupant control (override) is important, sensor technologies are poor and expensive. Moreover the complexity is a problem. In practice, differences in preferred temperatures for the same persons appeared depending on outdoor conditions, other conditions, i.e. this is a problem for designing a control strategy.
Energy performance in general showed a reduction 20-30% (to reference situation), mainly on transport and cooling.

Peter Op 't Veld (Cauberg-Huygen ) gave a presentation of the EC-RESHYVENT project: A cluster project on demand controlled hybrid ventilation in residential buildings with specific emphasis of the integration of renewables. In this project a team of scientific and research organisations collaborate with four industrial consortia in order to develop four domestic hybrid ventilation systems (concepts) for four different climates and applications in Europe. There is also a strong link with the coming EPD.

Viktor Dorer (EMPA) gave an introduction to the discussion by addressing the designs constraints for hybrid ventilation as part of the EC RESHYVENT (work package 5).

*Photo: O. Lewis*
*(University College Dublin)*
*Honoured in recognition of his scientific contribution to energy efficient and healthy buildings*

## AIVC 2002 Conference Keynote in closing session

*Solar and energy efficiency as an option for sustainable urban built environments*

*By Professor Matheos Santamouris*

Cities or urban areas are defined as the physical environment that it is composed by 'a complex mix of natural elements including air, water, land, climate, flora and fauna, and the built environment that is constructed or modified for human habitation and activity, encompassing buildings, infrastructure and urban open spaces'.

*The quality of urban agglomerations is mainly defined by the type and the strength of the anthropogenic activities, the existing infrastructures and the used resources, the generated wastes and emissions and the corresponding environmental impact, and by the efficiency and quality of the local institutions and governments.*

The second half of the last century was a period of the most intensive urbanisation that our planet has ever experienced. In fact, urban population has increased from 160 million to about 3 billion in just 100 years, and it is expected to increase to about 5 billion by 2025. Transfer of people to cities has mainly happened and will continue to happen in the so called less developed countries as the result of increased opportunities offered in the urban environment and the degradation of the rural economies and societies.

Urban citizens, in the developed countries, have benefited from the huge technological developments offered by the industrial revolution. Major problems of the 19th century have been solved, while the economic development has permitted the improvement of life standards both quantitatively and qualitatively. Social pressures and higher income, associated with the urban lifestyle increased the capacity and the tendency of urban citizens to consume. It is notable that the wealthiest 25 percent of the human population consumes almost 80 percent of the world's economic output. However, such an over-consumption has an important impact on the city's environment, as well as on the global environment. Approximately 64 percent of the world's economic production/ consumption and pollution is associated with cities in rich countries, while other environmental problems like heat island and indoor air quality have an important impact on the overall environmental quality of cities and health of city – dwellers.

Urbanisation in less developed nations, where cities have received a population tidal wave, followed a completely different pattern. Tremendous increase of the population, lack of resources, and small or zero development has resulted in poverty and deep inequalities. The expectations of higher incomes and life quality in urban areas were seldom realized and a tremendous number of city-dwellers are actually living in absolutely unacceptable conditions. It has been estimated that almost 600 million of urban citizens in the less developed countries live in shelters and neighbourhoods 'where their lives and health were continually threatened because of the inadequate provision of safe, sufficient water supplies, sanitation, removal of solid and liquid wastes, and health care and emergency services'.

The widely agreed set of priorities to improve cities and define an agenda of actions, is usually called the agenda of sustainable cities'. However, the term is quite misleading as there is no agreed and clear definition what the term 'sustainable cities' mean. In parallel, as cities are systems that just import energy and material from their immediate and host environment and then export back degraded energy, waste and pollution, can not be 'sustainable' by definition. Cities have to meet human needs in settlements without depleting environmental capital and poverty, inequalities and the very important depletion of the environmental capital these are emerging as problems that ask for immediate actions.

Appropriate strategies aiming to reduce over consumption, increase the use of renewable resources and reduce the production of waste and of the degraded energy up to a level not exceeding the assimilative capacity of local ecosystems or the ecosphere seems to be the high priorities in cities of the developed world.

*In parallel, sustainable strategies for cities in less developed regions focus mainly on the provision of basic human needs, such as appropriate dwellings, energy and water supply, sanitation systems, education, and health care services.*

Energy is one of the more important factor that define the quality of urban life and the global environmental quality of cities. The urbanisation process dramatically affects energy consumption. A recent analysis, showed that a 1 percent increase in the per capita GNP leads to an almost equal (1.03), increase in energy consumption. However, as reported, an increase of the urban population by 1 %, increases the energy consumption by 2.2 %, i.e., the rate of change in energy use is twice the rate of change in urbanization. Increase of the energy efficiency, use or renewable resources to supply cities, improvement of the urban thermal microclimate and adoption of sustainable consumption policies, seems to be the main tools to reduce the energy consumption in cities of the developed world.

References

1. Santamouris M : Sustainable Cities – Realistic Targets for an Utopian Subject. Paper presented at the Green Cities Conference, Westerloo, Belgium, 2002 and EPIC Conference, Lyon, France, 2002

2. Santamouris M. Solar and Energy Efficiency as an option for Sustainable Urban Built Environments. In 'State of the Art on Solar Thermal Technologies', M. Santamouris, (Editor), James and James Science Publishers, London, 2003.

*Photo: M. Santamouris*

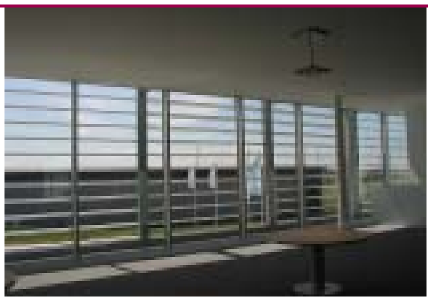
## Renson new head office : Healthy Building Concept

*New head office*
*( Architect: Jo Crepain)*

The design and the construction of present-day commercial buildings try to combine more and more a healthy and motivating working atmosphere as well as a minimum energy consumption. The awareness of these negative effects on the environment drives architects to minimise this burden.
The control of the quality of the internal climate is of major importance to create a healthy building. It is essential to provide fresh air and to generate a comfortable temperature level.

Studies have proven that there is a direct impact of the internal climate on the performance and productivity of people. A polluted environment will influence the capacity to perform and produce negatively. Moreover, insufficient ventilation may cause health complaints such as headache, allergies, …

In the first instance, you need to provide a basic ventilation allowing the supply of fresh air and achieving an acceptable level of indoor air quality.
Renson has developed a full range of natural ventilation products to reach this fundamental objective.



*Icarus (more info on CD—)*

In addition, people face new challenges to achieve a reasonable thermal comfort in summertime:

Offices without air conditioning don't seem to be comfortable during warm days. It causes health complaints and a poorer productivity. Secondly, one expects air conditioning to be the solution. However, research has revealed that health problems appear likewise and people even prefer not to work in an air conditioned building. The problems caused by air conditioning are well known as the sick building syndrome.

The high energy consumption is an additional disadvantage.

An alternative approach aims at the combination of an optimal internal environment and low energy consumption.
The challenge of a thermal comfort by means of a healthy and economical concept: intensive ventilation at night, effective ventilation during the day hand in hand with efficient sun shading. The office will cool down significantly at night and warm up in a controlled way during daytime.

The healthy building concept is based on this third approach.

*Eclips*

2 complementary principles are united:

**1. Nightcooling-principle**: louvers can be mounted either glazed-in or surface mounted on the window frames. Natural airflow ensures a complete cool down under the condition of sufficient transit and extraction possibilities.

**2. Eclips-system**: An external sun shading system with blades, reducing the solar heat and maximising the transit of daylight.
To achieve the desired shading effect, the Eclips-system can be fitted either horizontally or at an angle (max 45%).
All louvers and profiles are available in mill finish, anodised or powder-coated (in all RAL-colours) to integrate nicely with the existing construction.
The **Nightcooling-** and **Eclips system** can be installed in a variety of applications: appartment blocks, office, blocks, schools, shopping malls, …

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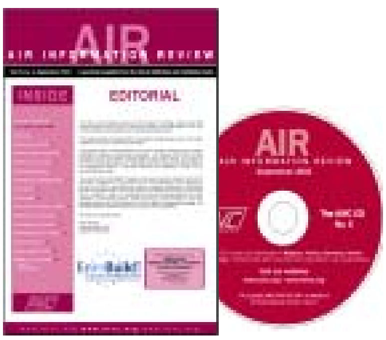


## Conference proceedings - CD

A CD-Rom with the proceedings of the last AIVC conferences is available. At present the CD contains the proceedings of AIVC conferences 1998, 1999, 2000 and 2001. Proceedings of 2002 conference will be included in a near future. See selling prices on the order form.


## AIVC publications – CD

A CD-Rom with all the guides (5), annotated bibliographies (11) and technical notes (45 – some old superseded ones are missing) published by the AIVC between 1979 and 2002 is available. See selling prices on the order form.

## The free publication of the month

One of the AIVC publications is available for free on the Internet (*www.aivc.org*). The publication is available for 1 month and afterwards replaced by another one.


## Printed version of old technical notes:

Since June 2001, the new publications of the AIVC are no longer produced in printed version.

However remaining printed copies of previous AIVC documents are still for sale at ECBCS Bookshop (£ 15 + postage).

An overview of the remaining stock is available at *http://www.aivc.org/Publications/clearance.html* (mainly : Technical notes 39 to 51; Guide to energy efficiency ventilation; Improving ductwork: a time for tighter air distribution systems; Annotated Bibliographies 5 to 10, Conference proceedings 1995 to 2000).

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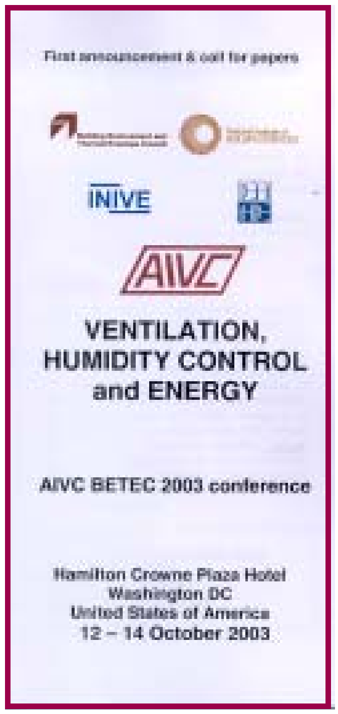

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