AIR INFORMATION REVIEW

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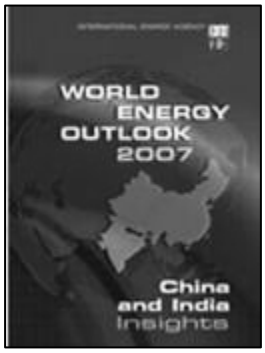
World Energy Outlook 2007

Dear reader,

Today, energy is on the top of the political and economic agenda for a wide range of reasons: very high energy prices (close to 140 $/barrel), increasing concerns about shortage of supply and, perhaps the most important, the growing evidence of climate change and the attendant need for drastic measures.



In the IEA World Energy Outlook 2007, the 450 ppm CO2 stabilisation scenario is described as resulting in a 2.4 °C global temperature increase. In order to achieve even this scenario, unprecedented strong and immediate policy action would be essential. The associated costs are very high - But is there a real alternative?

For this scenario, the present 27 Gt of CO2 emissions have to be reduced by 2030 to 23 Gt, which corresponds to a reduction of 19 Gt compared with the reference scenario.

How can this reduction be achieved? With contributions from all sectors:
- 3 % from Carbon Capture and Storage (CCS) in industry
- 9 % from CCS in power generation
- 13 % from nuclear
- 20 % from renewables
- 8 % from switching from coal to gas
- 47 % from increased energy efficiency of which:
  - 17 % end use electricity efficiency
  - 30 % end use fuel efficiency

This means that almost 50 % of the total reduction must come from improvements in **energy efficiency**. With 37 % of the world energy consumption, the building sector remains critically important. To reduce energy consumption in buildings means better insulation of buildings, more efficient heating and cooling installations and ... **more energy efficient ventilation and less uncontrolled air leakage**. Such measures are needed for new buildings, but also and more importantly for the existing building stock - not an easy task.

These challenges are huge and, in addition, one must achieve improved energy efficiency without sacrificing (and hopefully improving) the indoor environment. In particular for ventilation, finding the right balance between increased energy efficiency and good indoor climate (air quality, temperature levels, …) is far from easy.

As far as the AIVC is concerned, it is clear that its role of being the IEA information centre on energy efficient ventilation is more important than ever. The AIVC has the ambition to be globally recognised as the leading source of information on ventilation in the built environment. In order to achieve this, we strive for a combination of ventilation expertise, ventilation networking with other organisations and individuals, and advanced and innovative communication technologies.

We hope you enjoy the rest of this issue,

M. Sherman
Chairman AIVC Steering Group

P. Wouters
Operating Agent AIVC

Trends in the building ventilation market

With the aim of having a better understanding of the national building ventilation markets and trends, an international workshop was initiated by the AIVC in collaboration with the SAVE projects ASIEPI and Building Advent and with the support of REHVA. This workshop entitled “Trends in national building ventilation markets and drivers for change” was held in Ghent on 18 and 19 March. The aims of the workshop were:

- to inform interested parties (industry, regulators,…) of the latest changes in national building ventilation markets, with an attention not only for IAQ and energy issues, but also on airtightness and assessment of innovative systems issues,
- to identify the drivers for changes,
- to discuss the status in a round table with industry representatives.

In total 16 national presentations were given, among which also Korea, Brazil, Japan, …

On the second day there was a round table held with industry representatives. Finally their were 4 synthesis sessions on innovative systems issues, IAQ issues, airtightness issues and energy issues. All the presentations can be downloaded from the AIVC website.

For the AIVC workshop presentations: www.aivc.org > External publications

The March AIVC meeting in Ghent was the last meeting for Willem De Gids as the official Dutch representative in the AIVC.

The city of Ghent by night

AIVC International Workshop

Willem has been involved in the AIVC from its very beginning in 1979 and he has been for almost 30 years one of the strong drivers behind the AIVC.

Willem, many thanks for all your efforts!
As a major spin-off of this workshop, a series of Ventilation Information Papers (VIP) is foreseen whereby the first 10 VIPs are already available.

> *Ventilation Information Papers:*

- VIP 15 Report of the 2nd European BlowerDoor Symposium - 2007
- VIP 16 Air quality in passenger aircraft
- VIP 17 Trends in the building ventilation market in England
- VIP 18 Trends in the Belgian building ventilation market and drivers for change
- VIP 19 Trends in the French Building Ventilation Market and drivers for changes
- VIP 20 Trends and drivers in the Finnish ventilation and AC market
- VIP 21 Trends in the Norwegian building ventilation market and drivers for change
- VIP 22 Trend in the US ventilation market and drivers for change
- VIP 23 Trend in the Brazilian ventilation market and drivers for change
- VIP 24 Trend in the Polish ventilation market and drivers for change

For downloading the publications written by the AIVC, a password is needed. An automatic on-line password is available free of charge for citizens in Belgium, France, Germany, Greece, Netherlands, Norway and USA.

For more information: www.aivc.org > Bookshop

All documents marked with AIVC Online are available at www.aivc.org > Newsletter > 2008

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 is to encourage and increase information exchange among ventilation researchers and practitioners worldwide.

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Preparation: Christophe Delmotte, Sabrina Prieus & Peter Wouters - Editing: Erika Malu

Trends in the building ventilation market in England and drivers for change

AIVC VIP 17, 2008, 8 pp
M. Kolokotroni

This Information Paper has been written in the framework of the Building AdVent project and reviews recent changes in the Building Regulations in England and Wales introduced in 2006 to facilitate the implementation of the EPBD. The paper covers changes in building ventilation and energy performance including envelope air tightness and duct air leakage considerations.

AIVC Online *Download the new VIP 17*

Trends in the Belgian building ventilation market and drivers for changes

AIVC VIP 18, 2008, 10 pp
P. Wouters, N. Heijmans, C. Delmotte, P. Van den Bossche, D. Wuyts

Attention for and implementation of ventilation systems is a relatively new phenomena in Belgium (where the three Regions are in charge of regulations related to ventilation). It is clear that the energy performance regulations are a major driver for change. A specific feature of the Belgian legislation is a rather strict control scheme.
In order to stimulate the market uptake of innovative systems, a legal and technical framework is in development.

AIVC Online *Download the new VIP 18*

Trends in the French building ventilation market and drivers for changes

AIVC VIP 19, 2008, 8 pp
F. Durier

Building ventilation has been covered by French regulations for many years. Attention is paid to the general design of ventilation systems, air flow rates, energy consumption due to air renewal and fans, air tightness of building envelope and ventilation ducts, noise, fire risks. However there exists a large need for improved information and training of all the actors in the construction process, in order to increase buildings quality in the framework of this changing regulations landscape.

AIVC Online *Download the new VIP 19*

Trends and drivers in the Finnish ventilation and AC market

AIVC VIP 20, 2008, 9 pp
J. Kurnitski, O. Seppänen

Performance based indoor climate and ventilation regulations, having mainly been based on the requirements for the end result with fewer requirements for the system description, supported by a voluntary advanced indoor climate classification and labelling system, have arguably led to the best indoor climate standard in the world in both residential and commercial buildings. In this respect, the Finnish story is ultimately a success story. On the energy performance side, the primitive regulation based only on the requirements of U-values has caused some drawbacks.

AIVC Online *Download the new VIP 20*

Trends in the Norwegian building ventilation market and drivers for changes

AIVC VIP 21, 2008, 7 pp
M. Eriksson

IAQ and ventilation is given rather high attention in the Norwegian building industry. The new energy demands, basically an implementation of the EPBD, are a major driver for change. In practice it makes modern energy efficient ventilation compulsory in all types of buildings, which was not the case up to now.

AIVC Online *Download the new VIP 21*

Trends in the US building ventilation market and drivers for changes

AIVC VIP 22, 2008, 7 pp
M. Sherman

The residential ventilation market is changing rapidly in the United States. Dwellings are going from having no designed ventilation systems to have to meet specific requirements. The drivers are local codes and large scale programs being implemented by states and utilities and the federal government. Residential ventilation products are adapting to meet the evolving needs of the market. New products are coming out frequently and presumably more are in development.

By contrast the market for non-residential ventilation is reasonably mature.

AIVC Online *Download the new VIP 22*

Trends in Brazilian building ventilation market and drivers for changes

AIVC VIP 23, 2008, 4 pp
R. Lamberts

The paper presents an overview on building ventilation, indoor air quality and energy requirements in Brazil. Regulations, standards and market practices are reviewed.

AIVC Online *Download the new VIP 23*

Trends in Polish building ventilation market and drivers for changes

AIVC VIP 24, 2008, 9 pp
J. Sowa

The Polish ventilation market is changing rapidly. There are a number of key forces that drive the changes in the Polish ventilation market; the consumers, the rising energy costs, the incorporation of a great number of CEN standards into the set of Polish Standards and the implementation of the EPB Directive.

AIVC Online *Download the new VIP 24*

Report of the 2nd European BlowerDoor Symposium - 2007

AIVC VIP 15, 2008, 4 pp
B. Rosenthal
www_____

The 2nd European BlowerDoor Symposium "Airtight building envelope, thermography and dwelling-ventilation" took place on the 16 and 17 March 2007 in Kassel, Germany. 150 participants from 13 European nations, and 20 companies took part in the symposium and the trade fair. The contributions came from Belgium, Germany, Finland, Greece, Austria, Switzerland and the Czech Republic.


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Report of the 2nd European BlowerDoor Symposium - 2007
Bernd Rosenthal
Energie- und Umweltzentrum am Deister
Germany

The major outcomes of this conference are summarized in this VIP, together with links to interesting related projects. The full papers are to be found at the website or can be ordered. The 3rd European BlowerDoor symposium will take place 30 to 31 May 2008 in Kassel, Germany.

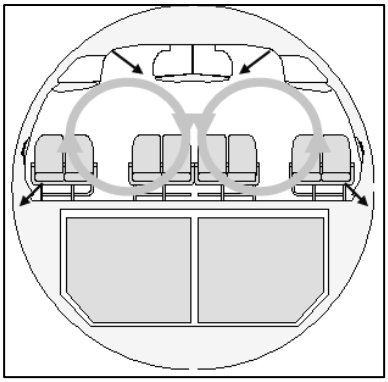
AIVC Online *Download the new VIP*

Air quality in passenger aircraft

AIVC VIP 16, 2008, 7 pp
J. P. Rydock

This VIP focuses on best practice, as well as challenges, for the conditioning of the indoor environment in passenger aircraft cabins, and their implications from a ventilation stand-point. This article is based largely on findings from EU's FP5 project "CabinAir".

In early commercial jet aircraft, passenger cabins were ventilated with 100 % outside air. In more recent jet aircraft, approximately 50 % of the ventilation air is outside air and the remaining 50 % is filtered recirculated cabin air. This development has allowed for fuel savings as well as a supposed improvement in the relative humidity of cabin air.


Example of airflow patterns in twin-aisle cabin

With typical passenger densities in modern airline cabins employing partial recirculation of cabin air, however, carbon dioxide concentrations have been shown to exceed 1000 ppmv (parts-per-million by volume) in some sections of the cabin on some flights. This has raised the question of whether air quality and ventilation are acceptable in modern jet airliner cabins.

AIVC Online *Download the new VIP*

ASHRAE Publishes Nation's First Airplane Cabin Air Quality Standard 161-2007

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) addresses cabin air quality in its new Standard 161-2007, Air Quality Within Commercial Aircraft. The standard, which covers issues such as temperature, cabin pressure, air contaminants and ventilation rates, can be voluntarily adopted by individual airlines or the Federal Aviation Administration (FAA), or advocated for by airline passenger and employee groups. The standard also addresses chemical, physical and biological contaminants that could affect air quality as well. Methods of testing are provided for ensuring compliance with the standard's requirements. Standard 161 applies to commercial passenger aircarrier aircraft carrying 20 or more passengers.

It is intended to apply to all phases of flight operations and to ground operations when the aircraft is occupied by passengers or crew members. To order, contact ASHRAE Customer Service at 1-800-527-4723 (United States and Canada) or 404-636-8400 (worldwide); or visit www_____

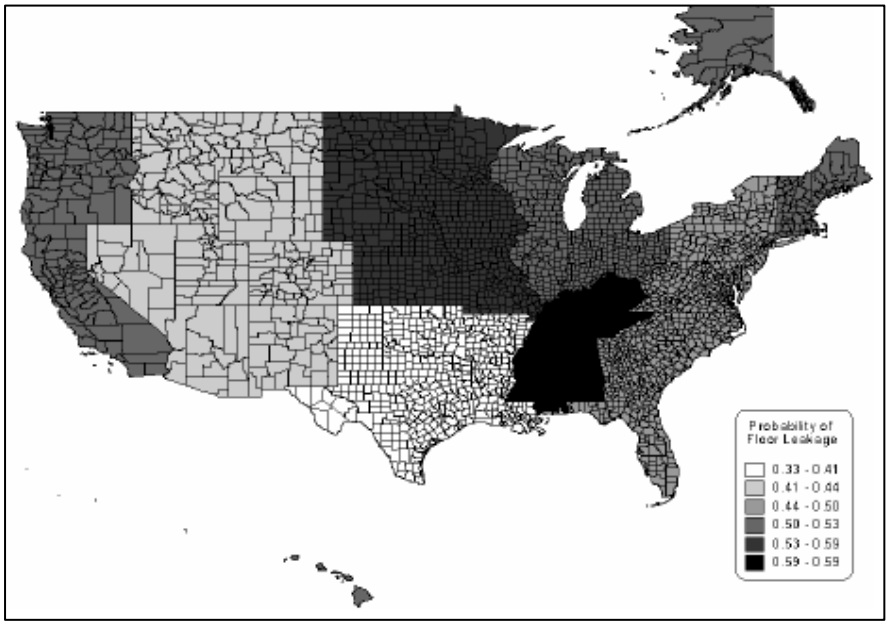
Ventilation Behavior and Household Characteristics in New California Houses

AIVC Contributed Report 10, 2008, 144 pp
P.N. Price and M.H. Sherman (Ernest Orlando Lawrence Berkeley National Laboratory)

A survey was conducted to determine occupant use of windows and mechanical ventilation devices; barriers that inhibit their use; satisfaction with indoor air quality (IAQ); and the relationship between these factors.
A questionnaire was mailed to a stratified random sample of 4,972 single-family detached homes built in 2003, and 1,448 responses were received. A convenience sample of 230 houses known to have mechanical ventilation systems resulted in another 67 completed interviews.

Results:
- Many houses are under-ventilated: depending on the season, only 10-50% of houses meet the standard recommendation of 0.35 air changes per hour.
- Local exhaust fans are under-utilized. For instance, about 30% of households rarely or never use their bathroom fan.
- More than 95 % of households report that indoor air quality is "very" or "somewhat" acceptable," although about 1/3 of households also report dustiness, dry air, or stagnant or humid air.
- Except households where people cook several hours per week, there is no evidence that households with significant indoor pollutant sources get more ventilation.
- Except households containing asthmatics, there is no evidence that health issues motivate ventilation behavior.
- Security and energy saving are the two main reasons people close windows or keep them closed.

Key words: Indoor Air Quality, IAQ, mechanical ventilation systems, ventilation standards, indoor pollutants, asthma, windows, natural ventilation, thermal comfort.



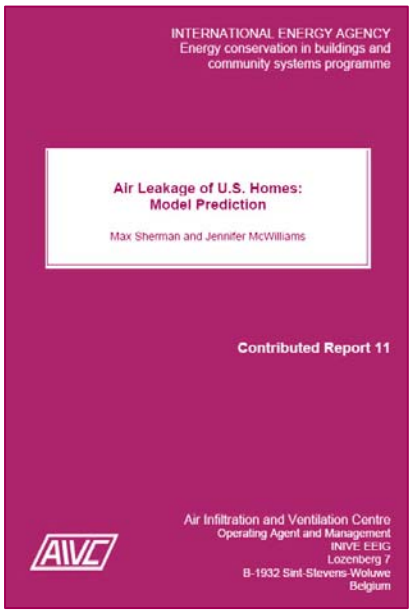
Probability of floor leakage by county

Air Leakage of U.S. Homes: Model Prediction

AIVC Contributed Report 11, 2008, 76 pp

J. McWilliams and M.H. Sherman (Ernest Orlando Lawrence Berkeley National Laboratory)

Air tightness is an important property of building envelopes. It is a key factor in determining infiltration and related wall-performance properties such as indoor air quality, maintainability and moisture balance.



Air leakage in U.S. houses consumes roughly 1/3 of the HVAC energy but provides most of the ventilation used to control IAQ.

The Lawrence Berkeley National Laboratory has been gathering residential air leakage data from many sources and now has a database of more than 100,000 raw measurements.

This paper uses a model developed from that database in conjunction with US Census Bureau data for estimating air leakage as a function of location throughout the US.

The EC REVIVAL project

Retrofitting for **E**nvironmental **V**iability **I**mprovement of **V**alued **A**rchitectural **L**andmarks is a five year project (started in April 2003) funded under the European Commission 5th Framework ENERGIE Programme. Its global objective is to demonstrate that tertiary buildings from the post-war, pre-energy conscious era can be refurbished economically, with improvements in energy performance that lead to lower life-cycle CO_2 emissions than the original building, or an equivalent new building. Thus refurbishment can make a significant contribution towards the EU policy of meeting the Kyoto protocol.

Information on the REVIVAL project can be found on www_____

Four interesting monographs have been published:

- Natural ventilation strategies for refurbishment projects
- Phase Change Materials in Buildings - Virtual Thermal Mass
- Adaptive thermal comfort and controls for building refurbishment
- High performance daylighting light and shade

The next article by Abena Poku-Awuah describes the major outcome regarding ventilation related performances.

REVIVING interest in sustainable refurbishment - role for ventilation

A. Poku-Awuah,
Sustainable Development Group,
Faber Maunsell UK.

In the UK, buildings are responsible for pumping 40% of the carbon emissions into the atmosphere every year. With reducing carbon emissions and mitigating the causes of climate change high on the European agenda, an obvious route to tackling this problem lies with refurbishing the 25 million existing buildings in the country to make them as energy efficient as possible. A similar picture exists in all European countries. A large proportion of the energy used in non domestic buildings is for ensuring that they provide acceptable indoor air quality and indoor temperatures. Temperature control necessitates a massive energy investment, with full air conditioning often the first solution considered. And it is not just the energy used for heating and cooling that must be accounted for. The pumps and fans that drive fresh air around a building contribute significantly to the energy demand of the building.

Nevertheless, there are many ways in which the energy used can be kept to a minimum.

Some of these were explored, demonstrated and monitored in the REVIVAL project, a European Commission supported demonstration project aiming to demonstrate that sustainable refurbishment and major reductions in energy consumption are possible for non-domestic buildings across Europe. Five buildings were targeted – a school and four office buildings. Six years later all of the REVIVAL buildings have been refurbished using sustainable techniques such as energy-efficient lighting, insulation, shading devices, new controls and passive and active ventilation systems.

The Greek Ministry of Finance in Athens (GSIS) was a demonstration building in the REVIVAL project that decided to move to a Demand Controlled Ventilation (DCV) system to reduce its overall energy consumption. Traditionally, industry has complied with the ASHRAE standards for indoor air quality, by specifying systems that maintain constant ventilation rates based on the design occupancy of the space, an assumed number that does not necessarily reflect true occupancy levels. Since most buildings have occupancy levels well below design standards, this often results in over-ventilation, wasting both money and energy.

The GSIS building in Athens is an unusual office building, as it was built as a factory in the 1960s and converted to offices in the 1990s. Before the current refurbishment, air handling units preconditioned the air from outside. These were distributed in zones, each of which served a number of office areas. The building is the workplace for 1400 permanent employees spread over 30,000 m^2. These include 800 data entry workers, 250 IT experts and technicians and 150 administrative staff, plus visitors. Offices were densely occupied and CO_2 concentrations were sometimes extremely high, and therefore in terms of ventilation, improving the air quality in the working areas was as much of a priority as energy efficiency.

As part of the REVIVAL project, motorised volume dampers were installed within each zone, controlled by a centralised system. The CO_2 concentration of each office area was monitored and the dampers were automatically opened and fresh air circulated through the area when the CO_2 concentration increased above a preset level.

The GSIS building in Athens

The ALBATROS building in the Netherlands

Daneshill House in the UK

Lycée Chevrollier in France

This strategy, where CO_2 sensors are used to control the supply of outdoor fresh air based on the actual occupancy of the room, is an effective way of saving energy. Significant amounts of energy were wasted before refurbishment, when the system brought in an unnecessarily large percentage of outdoor air and fed it into the system.

The new ventilation strategy uses less outdoor air, meaning that the annual energy required to heat or cool the office area decreases and the fan energy expended to introduce and expel the air from the building is also reduced.

A detailed monitoring campaign was carried out before and after the GSIS refurbishment, which measured levels of CO_2, CO and VOCs. This showed that with the DCV system in operation, CO_2 levels were between 600 and 800ppm on average, below the ASHRAE standard, though there were some days when CO_2 levels exceeded 1000pm. CO levels did not exceed the ASHRAE standards and VOC levels also remained very low.

Overall, the DCV system installed in Athens can be considered a great success. On the one hand these relatively simple measures contributed to a reduction in total energy consumption for the building of 31 %. However, on the other hand, answers to a questionnaire collected before and after the refurbishment suggest that although people were generally more positive about their indoor air quality, many workers in the building were not completely satisfied with their new system, especially in the densely occupied offices. This is an unexpected result, particularly as after the refurbishment, the city of Athens implemented a smoking ban for all indoor workplaces which probably had more of an effect on indoor air quality than any new ventilation system.

The Albatros building in the Netherlands, owned by the Royal Dutch Navy, took the concept of DCV a step further; energy losses due to ventilation were reduced by allowing occupants to vary their own indoor air quality during the day. A new second skin was fitted over the existing façade that was made airtight, with new air inlet openings to the offices fitted at floor level and above the windows. During the daytime, the occupants can open the vents to increase the ventilation rate. At night, the vents are automatically closed. During the summer months, the vents are kept open at night for cooling the structure, extra vents are opened and fans are used to draw the night air through.

The refurbishment works were completed at the end of 2006 and it was immediately apparent that the ventilation system was not functioning correctly. A mechanical defect with the ventilation grills meant that they did not close completely in winter, and even when they were closed, they were not as airtight as expected. This led to complaints from the occupants of feeling cold. In addition to this, the BEMS controlling the operation of the grills was not set up correctly. Despite these glitches, initial monitoring indicates that the CO_2 concentration in the refurbished Albatros offices is very low, typically below 600ppm and occupants are reasonably satisfied with the new building. These measures, in conjunction with using waste heat from the adjacent CHP plant for heating, energy efficient lighting, new windows and effective user controls, slashed the energy consumption of the building to 70% of an equivalent new-build office building in the Netherlands.

DCV ventilation works by setting a level of ventilation that is related to the number of occupants in an area. It follows that fewer occupants equals lower energy consumption for ventilation, and consequently, lower costs. However, a building's total energy performance can also be regarded in terms of the energy consumed per person per year, and a key objective of an energy efficient refurbishment should be to make this number as low as possible, whilst also maintaining a comfortable and productive working environment.

At Daneshill House, the main offices for Stevenage Borough Council, the REVIVAL contractors endeavoured to balance the need for adequate ventilation against the need to use office space effectively. They were determined to reduce the number of unoccupied desks in the office and switched to pole mounted, flat screen computer monitors instead of CRTs, to reduce the desk area needed by each employee.

They also chose to install an innovative, low cost passive cooling solution as an alternative to conventional air conditioning. CoolDeck is a unique conditioning solution for cooling using the "hidden" thermal mass in floor and ceiling voids. The thermal mass of a building stores the cooling introduced at night by circulating cool air through the building.

Phase Change Material (PCM) was integrated into the installation to provide additional thermal storage. This stored cooling is then released by circulating air the next day, to offset heat gains and limit internal temperature rises, mostly due to computers and other IT equipment.

During the extraordinarily hot summers of 2003 and 2005, concern arose that CoolDeck would not be able to meet the cooling requirements of the office. Top up cooling was introduced through small chiller units which were programmed to switch on when the office temperature rose above 27°C.

An important feature of the design was that the units were hidden within the ceiling, so that the occupants were not aware of their presence. This feature, together with the lack of any local control, enables the operating periods of these units to be restricted to the design criteria and helps to stop mechanical cooling being used as the first option for environment control by the occupants. The results are very successful; the 'mixed-mode' approach using passive cooling with the addition of some limited mechanical cooling leads to significant energy savings. Follow-up surveys show that after the Daneshill House refurbishment, those working on the floors with CoolDeck installed are very satisfied.

At the Lycée Chevrollier, a large secondary school complex in Nantes, France, a major aim for the refurbishment project was to improve indoor air quality and to provide night cooling, reducing the potential for overheating during the summer. Before refurbishment, the only way of getting fresh air into the building was by opening windows and doors. As part of the REVIVAL project, it was decided to install a combination of natural and mechanical ventilation systems. Hybrid ventilation takes advantage of natural ventilation forces, using mechanical forces only when natural forces do not suffice. In natural ventilation the forces of wind and air density differences are used to move air through the building.

As part of the Lycée Chevrollier school refurbishment, a new atrium was added as a meeting space for the students, which was naturally ventilated through openings in the roof and a huge door in one wall.

The classrooms were provided with a ventilation system with single flow mechanical extract, whereas in the workshops, mechanical ventilation with heat recovery was applied, combined with a high chimney to optimise the stack effect. Materials with low VOCs and zero other pollutants were used throughout the refurbishment.

Unfortunately, initial monitoring after the refurbishment showed that indoor CO_2 levels in the classrooms were far higher than acceptable, rising above 1900ppm in one classroom during a 45 minute lesson. This was thought to be due to malfunctioning of the dampers and control system. Energy use for heating was greatly reduced by the refurbishment but overall electricity use was increased due to more use of fans and equipment and possibly non-optimal lighting control.

The final demonstration building in the REVIVAL project, the Meyer Hospital refurbishment in Florence, Italy, chose a more conventional method of ventilation.

The hospital was founded in 1884 and is the oldest children's hospital in Italy, therefore any refurbishment had to be sympathetic to the historic characteristics of the building. Mechanical ventilation was introduced this is carefully managed by a BEMS to minimise energy consumption.

The REVIVAL case studies illustrate how difficult it is to maintain adequate indoor air quality whilst also striving to reduce energy consumption. The buildings achieved varying levels of success with their installations, with some occupant surveys indicating that indoor air quality had improved but was not yet considered completely satisfactory. But in all cases, energy consumption and associated carbon emissions were reduced, along with the costs associated with mechanical cooling and complex air distribution systems.

All of the REVIVAL buildings feature as case studies in a new Design Handbook on sustainable non-domestic building refurbishment, to be published by Earthscan in the spring of 2009. The results from the project will also be made available on the REVIVAL website, at www_____

Notes:
REVIVAL (www_____) is a five year, European Commission supported project set up with the aim of reducing energy consumption and other negative environmental impacts of existing non-domestic buildings.

Five case studies were chosen across five countries:

- Daneshill House, Stevenage Borough Council, UK
- Meyer Hospital administrative buildings, Florence, Italy
- General Secretariat of Information Systems, Athens, Greece
- The Albatros, Royal Dutch Navy, The Netherlands
- Lycée Chevrollier, Nantes, France

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Building Physics Symposium in honour of Prof. H. Hens
29-31 October 2008

The Laboratory of Building Physics of the Katholieke Universiteit of Leuven, Belgium, is organizing a symposium on recent developments in Building Physics in honour of Professor Hugo Hens.

His research and consulting activities are mainly dealing with the energy and performance analysis of building elements and of integral buildings. He is internationally renowned as a leading authority in building physics.

The objective of the conference is to provide researchers and PhD students a forum to share and discuss the most recent and significant developments in building physics.

Papers need to be submitted before 15 September 2008. Registration is open from 1 May until 15 September 2008. More info can be found on the http://www_____

Outcome of IEA workshop "Meeting energy efficiency goals: enhancing compliance, monitoring and evaluation"
Paris, 28-29 February 2008

Many policies now exist, both mandatory and voluntary, for improving energy efficiency and minimising greenhouse gas emissions, but there is frequently a gap between expectations of what such policies will achieve and their actual impacts. This gap represents a substantial lost opportunity to maximise saved energy, reduce the cost of energy services and greenhouse gas emissions, and enhance energy security.

This workshop, which was co-sponsored by the International Energy Agency (IEA) and the International Task Force for Sustainable Products (ITFSP), seeked to bring together public and private sector stakeholders to share information on effective frameworks for compliance, monitoring and evaluation in relation to energy efficiency measures.

The workshop had an opening and closing session that addressed common themes and concerns relating to compliance and evaluation. In between these sessions, three parallel working groups were held to focus on particular issues associated with:

- Energy Efficiency in the Buildings Sector;
- Energy Efficiency in the Equipment and Appliances Sector;
- Evaluating Energy Efficiency Measures.

It is clear that the issue of enhancing compliance, monitoring and evaluation is also a key challenge for ventilation systems in buildings, whereby different aspects have to be looked for, i.e. good indoor climate conditions (air quality, thermal comfort, acoustics …) and good energy efficiency.

The proceedings of the conference are available here: www_____

The Chair Report

EERB-BEPH 2009 AIVC-sponsored conference
27-29 May 2009

The Fifth International Workshop on Energy and Environment of Residential Buildings (EERB) and the Third International Conference on Built Environment and Public Health (BEPH) will be held from 27-29 May, 2009 in Guilin, Guangxi Province, China. It is jointly organized by the Hunan University, the University of Hong Kong and the Tsinghua University

EERB workshops were initiated in Sendai, Japan in 2000, followed by Shanghai, China in 2002, Xi'an, China in 2004 and Harbin, China in 2007. BEPH conferences were initiated in Changsha , China in 2003 and followed by Shantou, China in 2004.

Reducing energy consumption in buildings and improving built and indoor environment for health are two closely related and challenging issues. EERB-BEPH 2009 aims to improve indoor and built environment, energy utilization and health by means of an "integrated approach", considering the building and occupants as a coupled system. We hope to document the most recent research advances in indoor air quality, ventilation, energy conservation and public health related to indoor air; and to provide a platform for participants from around the world to exchange ideas. EERB-BEPH 2009 should be of interest to scientists, research students, government officials, engineers, architects, industrial hygienists, building owners, building consultants and facilities managers.

EERB-BEPH 2009 will be held in Guilin, a beautiful historical and cultural city in Guangxi Province. There is a Chinese saying "Guilin landscape tops elsewhere". In May, the mountains of Guilin are at their best and the lakes and rivers are spectacular.
The EERB-BEPH 2009 conference is an event co-sponsored by AIVC.

Professor Guoqiang Zhang (Chair), Hunan University
Professor Yuguo Li(Co-chair), University of Hong Kong
Professor Yinping Zhang (Co-chair), Tsinghua University

Further information:
____@____
Website: www_____

AIVC's Interview with Dr. Shuzo Murakami

It is honor for the AIVC steering committee to be able to interview Dr. Shuzo Murakami, one of the eminent leaders in its engineering field.

Dr. Shuzo Murakami graduated from the Department of Architecture, the University of Tokyo in 1965 and had been engaged in the research and the education as a professor at Institute of Industrial Science, the University of Tokyo until he moved to Faculty of Science and Technology, Keio University in 2002. He has acted President of several scientific societies, such as Society of Heating, Air-Conditioning and Sanitary Engineering (SHASE) and Architectural Institute of Japan (AIJ). He has been working also for activities of Japanese Government as a member of Science Council of Japan, Chairman of Environment Section of Infrastructure Council in Ministry of Land, Infrastructure, Transport and Tourism, and so on. Dr. Shuzo Murakami has just been inaugurated as Chief Executive of Building Research Institute since April 1st 2008. He is Chairman of Organizing Committee of AIVC2008 in Kyoto.

Dr. Shuzo Murakami, your research area is very close to that of ECBCS and AIVC in IEA activities. The name of the area might be different in country to country, but how do you call the research area?

In Japan, since the late half of 1950s, the research area has been called Building Environmental Engineering. Before that, it had been called Principles of Building Planning. Recently, its research themes are not limited only to buildings, but are also extended to cities and the scale of the earth. Therefore, our research area could be called Building, City and Earth Environmental Engineering.

During the 40 years since Dr. Shuzo Murakami came into this research field in the 1960s, what kind of remarkable changes do you think have taken place?

In the earlier stages of the Building Environmental Engineering, research had been focused mainly on the analysis of phenomena in each factor of the environment, such as thermal, visual and acoustic factors, in order to construct a scientific knowledge system by mining deeper into each phenomenon. During the earlier stage of the research field, the development of the Japanese economy was remarkable, and the country came into the status of Mass Production and Consumption, as other countries did. The role of building services had become quite important in building design and construction. However, since the outbreak of the Oil Crisis in 1973 as a turning point, society had had another viewpoint that the energy conservation in the buildings should have been promoted.

Afterward, somewhat extreme counter measures to improve energy efficiency induced so-called sick building syndrome and sick house problem, and the movement toward better quality of indoor environment emerged in society toward the Non Mass Production and Consumption, which has taken a much more crucial direction since the global warming issue became apparent in 1980s. Although research activities for each environmental factor were fragmented and oriented to fundamentals in the earlier stages, the outputs from the research have been used practically. Nowadays, the contribution to society is remarkable. For example, environmental labeling systems, such as BREEAM, CASBEE, LEED and so on, have great impact on decision-makings for the design of buildings. Such phenomena could not be anticipated in 1970s.

What kind of topics should be dealt with in our research field now or in the near future?

There are two special topics. One of those is energy conservation. Another topic is the technology to provide a better living environment, which is a basic right of people spending 80-90% of their time indoors. In other words, reduction of the environmental load and maintenance of environmental quality are the most important topics in our field.

Could you please give us more explanation of the two important topics?

The conventional approach to the maintenance of environmental quality consisted mainly of trying to eliminate and minimise uncomfortable factors in the environment. It is still necessary, especially in order to solve the health problem of asthma, which sometimes gives indoor environmental problem in the 21st century. Biological factors, such as mold and mite, are suspected as causes disease.

On the other hand, environmental quality, which is higher than the non-existence of disease, is a new target of the research and the development, namely, the improvement of health and intellectual productivity.

For the environmental load reduction, the most important key word is energy conservation. It is a part of the execution of Dematerialization, which is a goal set after reflecting on the Mass Production and Consumption in the 20th century.

The living environment and technology which adhere to the Civilization of Dematerialization should be proposed by our research field in the near future.

The role of our research field has become much more important than before, but it looks that competition in getting resources with so-called advanced and high technologies, such as life science, information & communication technology, supply-side energy technology, etc. is gradually becoming more severe. How can we deal with this situation?

I am not anxious about that. The importance of research on the living environment and life, as well as energy technology for demand-side is absolutely secure. In the Cap-and-Trade systems to limit the total emission of global warming gases, the technology in our research area will play an important role. However, the initiative of the role depends on how active we can be in raising important proposals and instructions for society. Such contributions sometimes have to be beyond specific research topics, which can be concluded inside our research field. Some researchers in such fields as chemical, electrical or material engineering have been active in contributing to the solutions for social problems. It is very important time for us to take an opportunity to obtain the initiative.

If you have any comments or instructions for researchers or other experts engaged in ECBCS or AIVC activities, please tell us.

Returning the fruits of R&D to society is very important. It is necessary to explain their activities and outputs to those outside of the research communities. Without visibility from the outside, it is almost the same as non-existence. I hope they extend their horizons to the possible proposals to the policy, as I mentioned earlier.

For the last question, please let us know your main goal in the rest of your career.

I am eager to open a route to the solution of the global warming issue.

Thank you so much to be here with us, today.

IBPSA conference

IBPSA, the International Building Performance Simulation Association, is organizing since 1985 a bi-annual international conference. As part of the collaboration agreement between IBPSA and AIVC/INIVE, the abstracts and proceedings will be soon included in our publications database. The simulation of ventilation related aspects (air flow rates, energy, indoor climate) is discussed in many papers.

At present, the following conference proceedings (abstracts and full papers) are available:
- 1985 (Seattle)
- 1989 (Vancouver)
- 1991 (Nice)
- 1993 (Adelaide)
- 1995 (Madison)
- 1997 (Prague)
- 1999 (Kyoto)
- 2001 (Rio de Janeiro)
- 2003 (Eindhoven)
- 2005 (Montreal)

The proceedings of 1987 and 2007 will become available in the near future.

The proceedings can be accessed via: www_____

Journal of Building Performance Simulation

The 1st Issue of the Journal of Building Performance Simulation – the official journal of the International Building Performance Simulation Association (www_____) – is now available free online at the Journal's homepage.

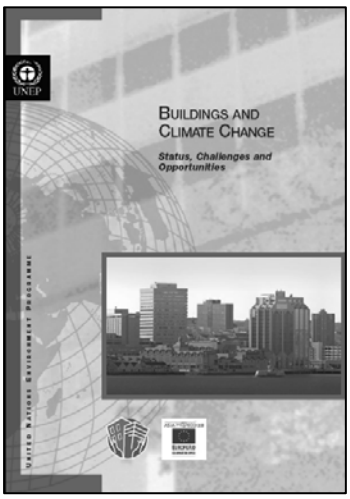
The wide scope of the Journal of Building Performance Simulation embraces research, technology and tool development related to building performance modelling and simulation, as well as their applications to design, operation and management of the built environment. This includes modelling and simulation aspects of building performance in relation to other research areas such as building physics, environmental engineering, mechanical engineering, control engineering, facility management, architecture, ergonomics, psychology, physiology, computational engineering, information technology and education.

Submissions are welcome on the basis that manuscripts have been submitted only to the Journal of Building Performance Simulation, that they have not been published already, and that they are not under consideration for publication or in the press elsewhere. All submissions should be in English. Papers for submission should be sent to the Editors Ian Beausoleil-Morrison, Carleton University, Canada at _____@_____ or Jan Hensen, Eindhoven University of Technology, The Netherlands at ___@___.
For full submission details, please visit the journal's homepage and click on the "Instructions for Authors" tab.
To visit the journal's homepage: www_____

New UNEP publication on buildings and climate change

The UNEP (United Nations Environment Programme – www_____) has published a report on entitled "Buildings and Climate change – status, challenges and opportunities".

The report contains a lot of interesting information about energy and buildings in general. Moreover, the issue of ventilation is discussed in various parts of the report, e.g. page 23. Click here to download: www_____



ASHRAE Meets in New York City

Chair of ASHRAE SSPC 62.2 'Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings'
S. J. Emmerich

More than 2700 people attended ASHRAE's Winter Meeting which was held in January in New York. The technical program (theme: Reaching new Heights in Net-Zero Energy Design) included well-attended sessions on net-zero energy design, designing for dehumidification and mold avoidance, and energy efficient data/communication facilities. In addition to the regular technical program, more than 900 people attended Professional Development Seminars and Short Courses including popular ones on commercial building ventilation Standard 62.1, health care facilities, and natural ventilation.

ASHRAE SSPC 62.2 *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings* met on 18 and 19 January. No addenda to the standard were approved at the meeting, but the committee discussed several important technical topics which may be proposed for future changes to the standard and considered public review comments to a proposed draft companion guideline to the standard.

One significant technical issue being considered by the committee is the possibility of addressing the differences among ventilation system types by including a system factor multiplier which would alter the required mechanical ventilation rate to a dwelling unit. Currently Section 4.1 of the standard requires all buildings to be continuously ventilated at a rate of:

$Q_{fan} = 0.05A_{floor} + 3.5(N_{br} + 1)$
Where
- Q_{fan} = fan flow rate in liters per second (L/s),
- A_{floor} = floor area in square meters (m^2), and
- N_{br} = number of bedrooms.

Alterations to this flow rate are currently limited to atypical applications such as known high occupant density, measured excess infiltration credit and intermittent ventilation systems.

The committee is considering a proposal that would modify the ventilation rate depending on mechanical system design factors such as exhaust vs. supply vs. balanced systems and provision of ventilation exhaust or supply to multiple points in a dwelling. A modeling study is being conducted to assist the committee in its consideration of this issue.

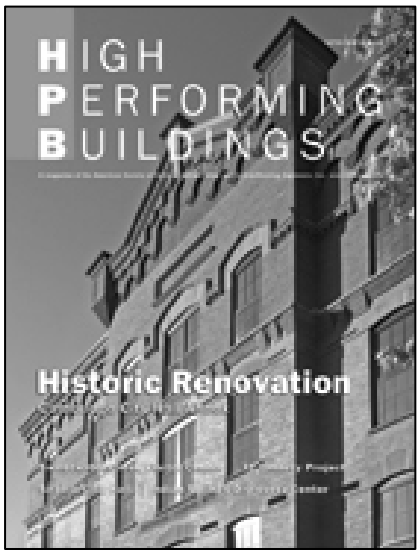
A second technical issue being considered is the development of specific requirements for low-rise multifamily buildings. Such dwellings have always been within the scope of the standard but, to date, have been treated identically to single-family detached houses despite important differences. The committee is considering a proposal that would change the treatment of multifamily dwellings in two ways – assume an occupant density for calculating the mechanical ventilation rate and add requirements for compartmentalising units in multifamily buildings. The committee is pursuing data on occupancy in multifamily buildings to determine whether it justifies modifying the current standard assumption of two persons in a studio or one-bedroom dwelling unit and an additional person for each additional bedroom. Note that the standard already requires increasing the ventilation rate when a higher occupant density is known. Requirements for compartmentalising dwelling units in multifamily buildings are being considered with the intention of minimising uncontrolled air and contaminant transfer between adjacent units. Such a requirement could include blower door testing to demonstrate that acceptable air sealing has been achieved or an alternative compliance methodology.

The content of Standard 62.2 is limited by the goal of creating a document that can be referenced or adopted by building codes. As a result, the 62.2 project committee feels that the standard by itself does not provide sufficient information on achieving good IAQ in low-rise residential buildings and is thus writing a companion guideline. The Standard's purpose limits it to defining the roles of and minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable IAQ in low-rise residential buildings while the proposed Guideline 24P has a much broader scope of providing information on achieving good indoor air quality.

This allows the guideline to provide educational background material and other useful information on issues not included in the standard. Topics addressed in the guideline but not covered in the standard include carbon monoxide alarms, air distribution, better air filtration and unvented combustion appliances. Guideline 24P completed a public review in the fall of 2007 and received very limited comments. At the New York meeting, SSPC 62.2 considered those comments and recommended the guideline be published with minor editorial changes to the public review draft.

New ASHRAE magazine on High Performance Buildings

This new quarterly magazine from ASHRAE helps decision makers in the building community learn about the benefits of innovative technologies and energy-efficient design and operation through case studies of exemplary buildings.



To learn more or to subscribe:
www_____

New book "Ventilation and Air flow in Buildings" by C.A. Roulet

Energy efficiency in buildings requires, among other things, that ventilation be appropriately dimensioned: too much ventilation wastes energy, and insufficient ventilation leads to poor indoor air quality and low comfort.

Studies have shown that ventilation systems seldom function according to their commissioned design. They have also shown that airflow measurement results are essential in improving a ventilation system. This key handbook explains why ventilation in buildings should be measured and describes how to measure it, giving applied examples for each measurement method.

The book will help building physicists and ventilation engineers to properly commission ventilation systems and appropriately diagnose ventilation problems throughout the life of a building. Drawing on over 20 years of experience and the results of recent international research projects, this is the definitive guide to diagnosing airflow patterns within buildings.

The author of the book is Claude-Alain Roulet, an international leader on the subject of the indoor environment quality and energy in buildings. He is Adjunct Professor at the School of Architecture, Civil and Environmental Engineering, Ecole Polytechnique Fédérale de Lausanne, Switzerland.

To order the book:
www_____

Claude-Alain Roulet was also one of the authors of AIVC Technote 34 "Air flow patterns within buildings – measurement techniques". This technote can be downloaded from the AIVC website.

PhD thesis on Single and Double Skin Glazed Office Buildings

H. Poirazis
@_____
www_____

The energy efficiency and thermal performance of highly glazed office buildings are often questioned. However, nowadays glazed buildings are increasingly being built around the world, mainly due to an architectural trend, followed by the preference of companies to a distinctive image that a glazed office building can provide. Due to insufficient knowledge concerning the performance as to energy use and indoor environment of glazed office buildings, a project was initiated, in order study their possibilities and limitations for Scandinavian conditions.

The aim of this PhD thesis is to
(a) determine how the energy and indoor climate performance can be analysed,
(b) clarify and quantify how highly glazed facades affect the energy use and thermal comfort and
(c) determine how the design can be improved with regard to energy efficiency, thermal and visual comfort.

The first part of this project involved establishing a reference building with different single skin glazed alternatives, choosing simulation tools and carrying out simulations for the determined alternatives. Results were obtained through varying the building's orientation, the interior layout and the type of glazing and solar shading devices. In the second part, the performance of various double skin façade cavity alternatives was studied, in order to study the possibilities and limitations of the system's performance. Simulations on an office zone and a building level were then carried out, in order to achieve optimal integration of the system.

The results showed that, unless designed carefully, highly glazed buildings tend to perform poorly, resulting in increased energy use and poorer thermal environment. For Swedish climatic conditions during winter months, windows with low thermal transmittance are essential, in order to improve the building's energy performance and thermal comfort, especially for highly glazed buildings. Low g and especially geffective values have a positive effect in lowering the cooling demand; externally placed shading or double skin facades can have this effect. In general, double skin façades result in improved energy and thermal performance of the building mainly when applied to the south façade, but their impact is limited since the cooling demand is usually rather limited, compared with the heating demand, for Scandinavian climatic conditions.

Achieving improved building performance when using fully glazed façades can be a great challenge. Individual building design that takes into consideration the type of façade including the size and type of glazing, the position of shading devices, the temperature set points, the building occupancy and plan type can definitely lead to improved building performance. If this is established, even in highly glazed cases, the building performance may reach reasonable levels as to energy use and indoor climate. However, a building with low energy demand cannot be achieved by a highly glazed building in a Scandinavian climate.

IAQVEC 2007 proceedings available

The IAQVEC 2007 conference on in Sendai, Japan, gave an overview of research results in the area of IAQ, ventilation and energy conservation in buildings.
For more information go to www_____

The IAQVEC proceedings are still available. For ordering the proceedings, you may order via e-mail via _____@_____

AIVC Online Information of IAQVEC 2007 Proceedings & Abstracts

EnVIE 2007 proceedings available online

The first EnVIE Conference on Indoor Air Quality and Health for EU Policy was held in Helsinki, Finland, from 12 to 13 June, 2007. It was organised as a satellite event to Clima 2007 WellBeing Indoors by the Co-ordination Action on Indoor Air Quality and Health Effects supported by the Sixth Framework programme of the European Union.

EnVIE defines a shortlist of indoor source - exposure - health chains and evaluates policy alternatives in order to identify a set of beneficial and feasible IAQ policies for Europe.

For more information about the project:
w w w _ _ _ _ _ _ _ _

For the conference programme:
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The proceedings are now available online at www.aivc.org > External Publications

2nd EnVIE Conference

16-17 September 2008

EnVIE is a European Co-ordination Action interfacing science and policy making in the field of indoor air quality. EnVIE is collecting and interpreting scientific knowledge from on-going research, in particular from EU funded projects and Joint Research Center activities, to elaborate policy relevant recommendations based on a better understanding of the health impacts of indoor air quality.

This project is funded by the European Commission 6th Framework Programme of Research.

The EnVIE project, which restarted from 1 March 2007, is coordinated by IDMEC (University of Porto – Portugal) and will last until 31 October 2008. More info can be found on www_____

A first conference was held on June 12-13 2007 in Helsinki in conjunction with the CLIMA2007 conference. The proceedings are available here:
w w w _ _ _ _ _ _ _

The 2nd conference will be held in Brussels on 16 and 17 September. The topics of the sessions are:

- EnVIE outcome for EU policies on IAQ & Health
- International and European actors views on IAQ & Health
- EnVIE results: context and fundaments
- Comments from stakeholders
- Experiences on IAQ policies and actions
- Policies for better IAQ & Health
- Policies regarding the role of 'Built Environment' on IAQ & Health

More information about the conference programme can be found on www_____

RESNET is seeking individuals to assist in developing a standard for infrared scanning

The thermal imaging technology has advanced significantly in the past few years and the price of equipment has grown more affordable.

To pave the way to achieving the potential of this technology, the US RESNET network (Residential Energy Services Network) is considering adopting a standard for conducting an infrared scanning standard. A draft standard is currently being developed by a RESNET standard drafting committee. The committee is basing its work on the experience of its members and the United Kingdom's standard for using the technology in measuring the quality of insulation installation.

It is anticipated that the standard will address:

- Moisture Intrusion
- Insulation Defects
- Air Infiltration
- Thermal Bypass

Contact person at RESNET:
Steve Baden, _____@_____
http://_____

Windsor Conference
Air conditioning and the low carbon cooling challenge

27-29 July 2008

The 2008 Windsor Conference will be held in 27-29 July 2008 at the Cumberland Lodge conference Centre in Windsor Great Park. Hosted by the Network for Comfort and Energy Use in Buildings (NCEUB) and the Low Energy Architecture Research Unit (LEARN) The theme of the conference will be "Air conditioning and the low carbon cooling challenge".

Further details and the Call for Papers can be found at the NCEUB website, the first draft timetable is available and the titles of the abstracts submitted and approved.

More info can be found on:
http://_____

Link to the draft programme:
http://_____

The list of accepted abstracts:
http://_____

6th Conference on Emissions and Odours from Materials

1-2 October 2008

The 6th Edition of the Emissions and odours from materials Conference for producers and end users will take place in Brussels, Belgium, from 1 to 2 October 2008.

The following topics will be discussed:

- Standards and regulatory issues: updating EU-legislation and labelling schemes.
- Comfort and impact on health (IAQ, workplace environment, odours and VOCs, off-flavours…)
- State of the art for measurement and evaluation (sampling, analysis and sensory evaluation).
- Remediation: optimisation of manufacturing and compounding processes, storage and transport conditions, new barrier properties…
- Recent developments in the packaging industry, building industry and automotive industry.

In addition to the oral presentations, company exhibitions and poster presentations provide an active forum for discussions among the participants of the workshop in the form of a supplier's showcase. During the breaks attendees can browse through table top displays presented by suppliers of equipment dedicated to emissions testing or new low emitting grades of products. Interested suppliers can contact _____@_____

This conference is organised by CERTECH, a research and development centre based in Seneffe, Belgium. It was created in1996 from the Catholic University of Louvain (U.C.L) to support the chemical industry in the field of polymers, catalysis and air quality.

The synergy of polymer sciences with air quality competencies has lead to the development of a R&D area in CERTECH: odours and emissions from materials. The centre studies gaseous emissions produced by materials in confined volumes such as institutional, industrial, residential, transportation environments and packaging media. In this context, CERTECH as a Belgian independent lab, can offer support from the materials emissions assessment to low emission products developments.

More info can be found on
www_____

AIVC Online Announcement and call for papers

AIVC Conference 2008

Kyoto, Japan, 14-16 October 2008

From 14 to 16 October 2008, the 29th AIVC Conference will be held at Kyoto International Conference Centre, Kyoto, Japan, where the Kyoto Protocol was negotiated in December 1997.
'The conference, entitled '**Advanced building ventilation and environmental technology for addressing climate change issues'**, will provide a valuable best opportunity for researchers and engineers worldwide to convene for 'Advanced building ventilation and environmental technology for addressing climate change issues'.

More than 200 abstracts were received. The submission of the full papers was closed 31 May 2008.

Photo of the Yase Shamenchi Dance Festival in Kyoto on the second Sunday of October

Don't forget to register now!
The registration fee is as follows:
- For participants from OECD countries: 90,000 JPY (about 844 USD or 543 EUR)
- For participants from non OECD countries: 70,000 JPY (about 656 USD or 422 EUR)
- For students: 45,000 JPY (about 422 USD or 272 EUR)

For more information on the conference and to register: www.aivc2008.jp

English information on the city of Kyoto: www.pref.kyoto.jp/visitkyoto/en/

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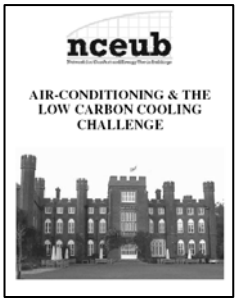
Information on AIVC supported conferences and events



Windsor Thermal Comfort Conference, Windsor, July 2008

The 2008 Windsor Conference will be held in 27-29 July 2008 at the Cumberland Lodge conference Centre in Windsor Great Park, hosted by the Network for Comfort and Energy Use in Buildings (NCEUB) and the Low Energy Architecture Research Unit (LEARN).
The theme of the conference will be “Air conditioning and the low carbon cooling challenge”.

More information: www_____

Indoor Air Conference, Copenhagen, August 2008

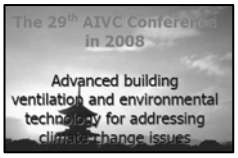
The 11th International Indoor Air Conference on Indoor Air Quality and Climate will be held in Copenhagen (Denmark) 17-22 August 2008. It is a multidisciplinary event involving participants from medicine, engineering, architecture and related fields. The congress covers all aspects of Indoor Air and Climate and the effects on human health, comfort and productivity.

More information: www_____

2nd EnVIE Conference, Brussels, September 2008

The 2nd conference of EnVIE on 'Policies for millions of indoor environments', will be held in Brussels on September 16 and 17. Some of the topics of the sessions are:
- EnVIE outcome for EU policies on IAQ & Health
- International and European actors views on IAQ & Health
- Experiences on IAQ policies and actions
- Policies for better IAQ & Health

More information: www_____



29th AIVC Conference, Kyoto, October 2008

The 29th AIVC conference will be held in Kyoto (Japan) 14-16 October 2008.
The conference will cover a wide range of ventilation related topics whereby specific attention will be given to building ventilation and environmental technologies addressing climate
change issues.

More information: www.aivc2008.jp

Building Physics Symposium, Leuven, October 2008

The Laboratory of Building Physics of the Katholieke Universiteit of Leuven, Belgium, is organizing the Building Physics Symposium on recent developments in Building Physics in honour of Professor Hugo Hens. The objective of the conference is to provide researchers and PhD students a forum to share and discuss the most recent and significant developments in building physics.

More information: www_____