AIR INFORMATION REVIEW

VOL 31, No. 2, March 2010 A quarterly newsletter from Air Infiltration and Ventilation Centre

International workshop on

"Large scale national implementation plans for building airtightness assessment: a must for 2020!"

"We should start now to be ready in 2020"

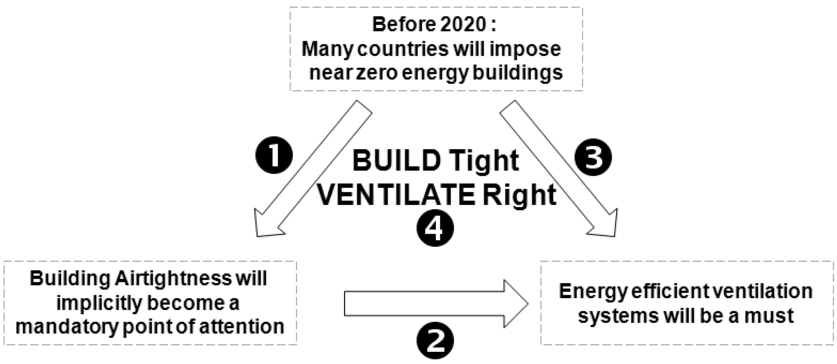
14-15 June 2010 - Hotel Crowne Plaza - Brussels (Belgium)

An initiative of AIVC and INIVE

Context for the workshop

It is expected that many countries between 2015 and 2020 will have regulations imposing requirements for new buildings which are **near-zero energy targets**. This has major consequences:

- Such strategies will for most climates automatically lead to specific attention to **building airtightness** (❶), including large scale measurements, challenges in terms of design and execution, quality issues, long term performances, ... This is a tremendous challenge.
- As a result of the increased attention on building airtightness, the need for appropriate, energy efficient, **ventilation systems** (❷) will grow. Issues such as correct air flow rates, air quality, acoustics, draught, energy optimisation, economics, ... will have to be handled on a large scale. At present, we know that many countries are faced with poor performances of most systems.
- So, indirectly, the move towards near-zero energy buildings will lead to a greater need for ventilation systems (❸).
- As a result, the expression, already used in the eighties, i.e. 'Build Tight – Ventilate Right' is becoming a big reality (❹).
- In addition, there are the tremendous challenges for the existing building stock. Although there will be in most countries more time for implementation and, in absolute terms, probably less severe targets, more or less similar challenges are found for the existing building stock.



This international workshop aims to give a good overview of all the issues involved in building airtightness, with specific attention to planning aspects (session 2), execution (session 3) and evaluation (session 4).In session 5, attention will be given to the point of view of key stakeholders.

During the workshop, the Platform on Building Airtightness will be launched and it is planned to have follow-up sessions on specific topics.

The programme can be found on page 2

 www.aivc.org

Continued from page 1

"Large scale national implementation plans for building airtightness assessment: a must for 2020!"
"We should start now to be ready in 2020"

Programme

Monday 14 June 2010

12.30	Opening of registration
13.30	Session 1: Welcome and context for building airtightness
15.30	break
16.00	Session 2: Planning of airtight envelopes
18.00	End
19.30	Walking Dinner in hotel Crowne Plaza with keynote speaker

Tuesday 15 June 2010

9.00	Session 3 : EXECUTION of airtight envelopes
10.30	Break
11:00	Session 4 : EVALUATION of the airtightness
12:30	Lunch
13.30	Session 5: Challenges and opportunities for the stakeholders
15:00	Break
15:30	Session 6 : Summing up and launch of Platform on Building Airtightness
17:00	End of workshop

For more information and updated programme: www.aivc.org

In order to have an efficient preparation and follow-up of this initiative and to allow a large number of interested parties to participate at this workshop, sponsoring is foreseen.

At this moment, there is committed financial sponsoring of

- AIVC
- INIVE
- EURIMA
- Lindab
- Proclima
- Soudal and
- Tremco Illbruck

Several other organisations have expressed interest. Please contact Peter Wouters (peter.wouters@bbri.be) in case of interest.

AIR Information Review is the quarterly 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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New publications from ASIEPI available at www.________ and www.________

12 ASIEPI Country reports on Impact, compliance and control of EPBD

As a part of the ASIEPI project funded by European Community's Intelligent Energy Europe programme, a survey was done on the impact of EPBD on national regulations, compliance and control on energy performance requirements and certification systems approach in 12 EU States (Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, The Netherlands, Norway, Poland, Spain and Greece).

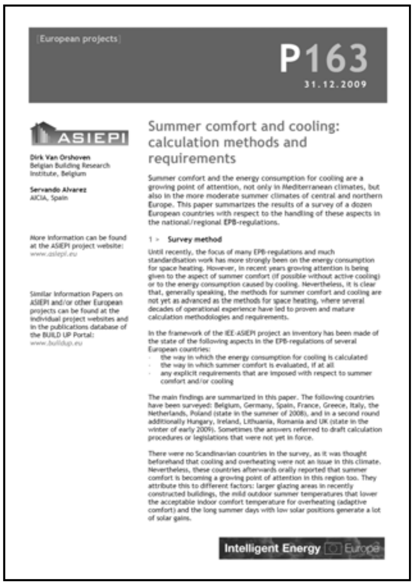
The national approaches are described in the following information papers. The country reports are available at the EU portal www.________. They can be found easily by using the filtering function of portal with keyword ASIEPI, or/and country, or directly the addresses listed below.

- P 166 Czech
www.________
- P 167 Finland
www.________
- P 168 Italy
www.________
- P 169 The Netherlands
www.________
- P 170 Norway
www.________
- P 171 Poland
www.________
- P 172 Spain
www.________
- P 173 Greece
www.________
- P 174 Belgium
www.________
- P 175 Denmark
www.________
- P 176 France
www.________
- P 177 Germany
www.________

4 ASIEPI Synthesis reports on Impact, compliance and control of EPBD

The papers aim to obtain a good overview of how the EPBD implementation has changed (or is changing) the national requirements in terms of energy efficiency and indoor climate and to describe what has been the impact of the EPBD on national requirements. The synthesis reports also deal with compliance and control in the different member states, barriers and good practice examples as well as bottlenecks for compliance and control of regulations.

- P 178
Approaches and possible bottlenecks for compliance and control of EPBD regulations
www.________
- P 179
Evaluation of compliance and control in different member states
www.________
- P 180
Evaluation of the impact of national EPBD implementation in MS
www.________
- P 181
Barriers and good practice examples identified during early implementation of the EPBD
www.________


[European projects]

P163
31.12.2009

Dirk Van Orshoven
Belgian Building Research Institute, Belgium

Servando Alvarez
AICIA, Spain

More information can be found at the ASIEPI project website:
www.asiepi.eu

Similar Information Papers on ASIEPI and/or other European projects can be found at the individual project websites and in the publications database of the BUILD UP Portal:
www.buildup.eu

Summer comfort and cooling: calculation methods and requirements

Summer comfort and the energy consumption for cooling are a growing point of attention, not only in Mediterranean climates, but also in the more moderate summer climates of central and northern Europe. This paper summarizes the results of a survey of a dozen European countries with respect to the handling of these aspects in the national/regional EPB-regulations.

1 > Survey method

Until recently, the focus of many EPB-regulations and much standardisation work has more strongly been on the energy consumption for space heating. However, in recent years growing attention is being given to the aspect of summer comfort (if possible without active cooling) or to the energy consumption caused by cooling. Nevertheless, it is clear that, generally speaking, the methods for summer comfort and cooling are not yet as advanced as the methods for space heating, where several decades of operational experience have led to proven and mature calculation methodologies and requirements.

In the framework of the IEE-ASIEPI project an inventory has been made of the state of the following aspects in the EPB-regulations of several European countries:
- the way in which the energy consumption for cooling is calculated
- the way in which summer comfort is evaluated, if at all
- any explicit requirements that are imposed with respect to summer comfort and/or cooling

The main findings are summarized in this paper. The following countries have been surveyed: Belgium, Germany, Spain, France, Greece, Italy, the Netherlands, Poland (state in the summer of 2008), and in a second round additionally Hungary, Ireland, Lithuania, Romania and UK (state in the winter of early 2009). Sometimes the answers referred to draft calculation procedures or legislations that were not yet in force.

There were no Scandinavian countries in the survey, as it was thought beforehand that cooling and overheating were not an issue in this climate. Nevertheless, these countries afterwards orally reported that summer comfort is becoming a growing point of attention in this region too. They attribute this to different factors: larger glazing areas in recently constructed buildings, the mild outdoor summer temperatures that lower the acceptable indoor comfort temperature for overheating (adaptive comfort) and the long summer days with low solar positions generate a lot of solar gains.

Intelligent Energy Europe

New ASIEPI information paper on summer comfort

Summer comfort and the energy consumption for cooling are a growing point of attention, not only in Mediterranean climates, but also in the more moderate summer climates of central and northern Europe. This paper summarises the results of a survey of a dozen European countries with respect to the handling of these aspects in the national/regional EPB-regulations. Until recently, the focus of many EPB-regulations and much standardisation work has been on the energy consumption for space heating. However, in recent years growing attention is being given to the aspect of summer comfort (if possible without active cooling) or to the energy consumption caused by cooling.

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- P 163 Summer comfort and cooling: calculation methods and requirements
www.________

New Initiatives in Building Simulation Education (the BEMP and the BEMBOOK)

L. Degelman - PR Chair, IBPSA, Prof. Em., Texas A&M University

As seen by recent conferences in the building simulation community, there seems to be an increased interest in certifying the reliability of persons doing simulations as well as the simulations tools themselves. Developing or applying simulation models used to be enough; but now, more attention is being brought to bear on the responsibility of the modelers. Some giant strides are starting to emerge in this direction in the way of education. Evolving over the past year, the USA Affiliate of IBPSA has become involved in efforts toward education and certification of building simulators. Long active in certification testing, ASHRAE has recently developed a Building Energy Modeling Professional (BEMP) certification program in collaboration with IBPSA-USA and the Illuminating Engineering Society of North America (IESNA). The purpose of this certification is to certify individuals' ability to evaluate, choose, use, calibrate, and interpret the results of energy modeling software when applied to building and systems energy performance and economics and to certify individuals' competence to model new and existing buildings and systems with their full range of physics. The program was first launched on 27 January 2010 with a pencil and paper examination in conjunction with ASHRAE's Winter Conference in Orlando, Florida. Following that inaugural test, certification examinations will now become available in testing centers located throughout the United States and worldwide beginning in March 2010.
See www._______.

In support of the efforts toward certification and possible training of responsible building simulators, IBPSA-USA has started a Building Energy Modeling Book of Knowledge (BEMBOOK) wiki. The BEMBOOK wiki is a web-based, free content project to develop an online compendium of the domain of Building Energy Modeling (BEM). The intention of the wiki is to delineate a cohesive body of knowledge for building energy simulation, and it will be undergoing intensive initial development in the upcoming months.

The wiki can be found at http://_______.

IBPSA-USA invites all interested members of the community of building energy modelers and related disciplines to contribute to developing, maintaining and refining the BEMBOOK compendium on this wiki. Individuals or groups interested in contributing to the effort should contact Joe Deringer at _______@_______. Initially, two BEM training workshops are being developed – one with thermal / HVAC emphasis, and one with lighting / daylighting emphasis.

On the efficiency of night ventilation techniques applied to Greek residential buildings

M. Santamouris - University of Athens

Energy data from two hundred and fourteen air conditioned residential buildings in Greece using night ventilation techniques have been analysed. The selected buildings present a very large spectrum of cooling needs and applied night air flow rates. All performance data have been homogenised for the same climatic and operational conditions, It has been found that night ventilation applied to residential Greek buildings may decrease the cooling load up to 40 kWh/m2/y with an average contribution close to 12 kWh/m2/y. Given that the usability of the energy offered by night ventilation techniques increases as a function of the initial cooling needs of the buildings, those with high cooling loads benefit a much higher absolute contribution than buildings presenting a low cooling demand.

The correlation between the cooling needs of the buildings and the energy contribution of night ventilation is found to be almost linear. Given that the global usability of the energy stored during the night increases as a function of the air flow rate the tilt of this regression line increases significantly with the air flow rate applied although the energy contribution per unit of air flow is decreasing. In parallel, the uncertainty associated to the evaluation of the energy contribution of night ventilation decreases seriously for higher air flow rates.

Given the dissimilarity of the energy amount stored in buildings and the variability of the night ventilation usability function for each individual building, the percentage energy contribution of night ventilation is independent of the initial cooling load of buildings.

The whole analysis allows us to better understand and evaluate the expected energy contribution of night cooling techniques while it may contribute to the need to consider average statistical contribution data, at least at the conceptual phase.

Air change rates in a house with demand controlled hybrid ventilation

P. Charvat, M. Jicha -
Brno University of Technology

Demand controlled ventilation as a way to reduce ventilation rates in buildings has been studied intensively in the last decade. Though the discussion is still going on as to whether the carbon dioxide concentration is a suitable measure of indoor air quality in buildings, the CO_2 concentration as the main control parameter in demand controlled ventilation is more and more often used in ventilated spaces like classrooms or lecture halls were people themselves are the main source of air pollutants. And even though the CO_2 concentration by itself is an insufficient measure of the IAQ, the direct monitoring of air pollution in ventilated spaces is a step in the right direction in demand controlled ventilation.

A demand controlled hybrid ventilation system with the CO_2 level monitoring was installed in an experimental house of the Brno University of Technology several years ago as part of the EU 5^{th} framework project RESHYVENT (Residential Hybrid Ventilation). The system employs natural air supply through the self-regulating inlets located in the window frames and a hybrid air exhaust. The CO_2 sensors are located in the living room, two bedrooms and the study and the air flow rates through the air supply inlets are controlled with regard to CO_2 concentrations in rooms. The concentration thresholds for opening and closing of the inlets are adjustable. The basic setting is 800 ppm for opening and 600 ppm for closing of the inlets. The exhaust air is extracted from the kitchen, restroom and bathroom.

The floor plans of the house with the location of the main components of the hybrid ventilation system can be seen in Figure 1.

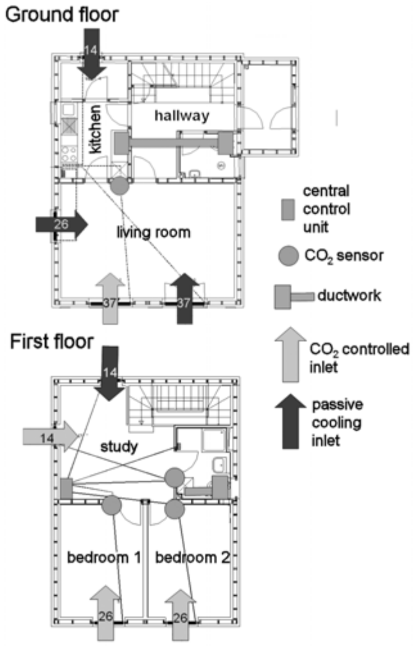


Figure 1 - Floor plans of the experimental house

The experimental house is a two-storey wood frame building with a flat roof. The air-tightness of the house was the main concern with regard to application of demand controlled ventilation. The on-site built wood-frame houses are quite rare in the Czech Republic and the lack of craftsmanship could lead to high air leakage. The fan pressurisation test performed after the commissioning of the house showed acceptable air-tightness of n_{50} = 2.5 hour^{-1}.

Beside the airtightness measurements with a fan-pressurisation technique a set of air change measurements with the tracer gas method (perfluorocarbon tracer gas) was carried out. The first experiment involved simulation of occupancy by a release of CO_2. Two CO_2 sources consisting of cylinders with CO_2, constant flow rate valves and flow meters were installed in the living room and the bedroom 1. The volumetric flow rate of CO_2 was 50 dm^3/hour in the living room and 30 dm^3/hour in the bedroom 1. The duration of experiment was 405 hours. The CO_2 concentrations in a selected 24-hour period can be seen in Figure 2.

The CO_2 concentration in the living room did not exceed 1000 ppm while the peak concentrations in bedroom 1 were reaching to 1200 ppm. The average CO_2 concentrations in the rooms were as follows: 786 ppm in the living room, 768 ppm in the bedroom 1, 595 ppm in the bedroom 2, and 691 ppm in the study. The increased concentration of CO_2 in the study was caused by the arrangement of air supply and air extraction in the house. The contaminated air from bedroom 1 flows through the study on its way to the extraction point in the bathroom.

The study opens to the staircase and the hallway on the ground floor and thus the CO_2 concentration in the study was lower than in the bedroom 1.

The second experiment was aimed at the investigation of air change rates in the unoccupied house. There were no CO_2 sources in the house and the air change was only caused by infiltration. The duration of the second experiment was 386 hours. Windows and the entrance door were closed and the internal doors were ajar in both experiments. The results of the air change rate measurements are in Table 1.

The total air change rate in the experimental house obtained by the tracer gas measurements during the simulated occupancy was n = 0.34 hour^{-1}.

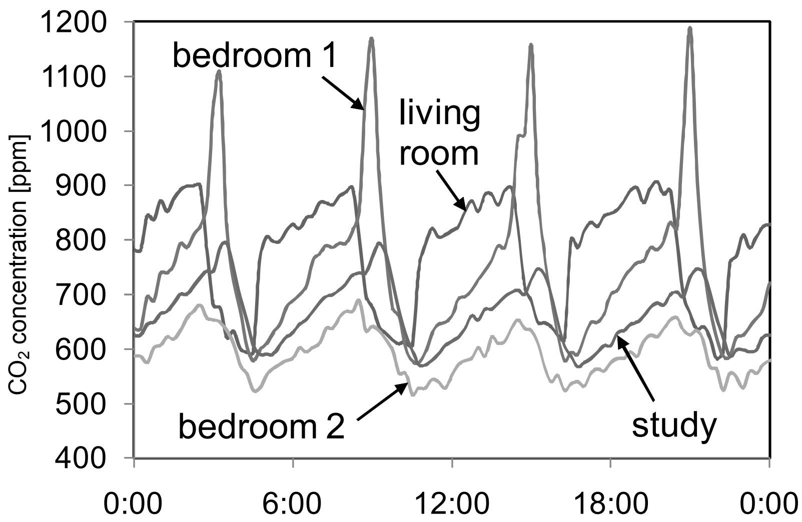


Figure 2

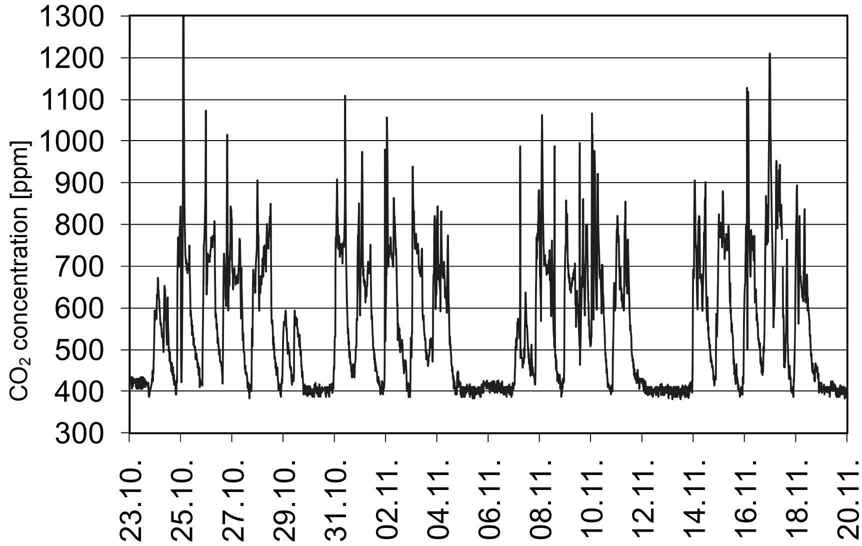


Figure 3

Room	Air change rate [hour^{-1}]	
	simulation of occupancy	infiltration only
living room	0.33 ±0.03	0.20 ±0.02
bedroom 1	0.30 ±0.03	0.11 ±0.01
bedroom 2	0.29 ±0.03	0.13 ±0.01
study	0.36 ±0.03	0.22 ±0.02
hallway	0.37 ±0.03	0.26 ±0.03
kitchen	0.45 ±0.04	0.28 ±0.03
house	**0.34 ±13%**	**0.18 ±13%**

Table 1 - Air change rates in rooms

That is a relatively low value considering the total flow rate of CO_2 released in the simulation of occupancy. The total air change rate in the unoccupied house was n = 0.18 hour^{-1}.

The experimental house has been almost regularly occupied by three people, mostly PhD students, in the last few years. The analysis of the records of CO_2 concentrations in rooms during a heating season (the occupants keep the windows open almost all the time in summer) revealed rather low average CO_2 concentrations during occupancy.

Since there is no occupancy monitoring system installed in the house it was assumed that a room is occupied only when the CO_2 concentration is above 420 ppm. The average concentrations calculated from the values exceeding 420 ppm were as follows: 486 ppm in the living room, 653 ppm in the bedroom 1, 610 ppm in the bedroom 2 and 613 ppm in the study. Figure 3 shows CO_2 concentration in the bedroom 1 between 23 October and 20 November. The occupants usually do not stay in the house over the weekends as can be seen from CO_2 concentrations.

Energy efficiency, indoor thermal comfort and influence of user habits in retrofitting of social housing blocks: Case study in the Metropolitan Area of Barcelona

X. Cipriano, J. Carbonell, J. Cipriano, D. Pérez - CIMNE

AIVC Online The full article with all figures and tables is available at www.aivc.org

The Mediterranean seaside cities like the towns in the Metropolitan region of Barcelona have soft winters and variable summers which change from hot to very hot. Historically, summer comfort in dwellings was reached through passive cooling strategies and reducing the activity of the citizens during the hottest hours (the siesta). At the beginning of the 20th and until the building regulations appear, most of the constructed buildings were designed without any energy saving criteria, therefore, summer and winter passive were scrapped.

Since the 90's, the mechanical air conditioning systems replaced the deficit of summer comfort strategies on buildings and caused a huge increase of the energy consumption and the peak loads in the summer season. In 2007 a new Spanish Building Code (CTE, 2007), aiming to improve the rational use of energy in new buildings and assuming the requirements defined in the EPDB [1] and [2], was officially set up. Along 2010 this new building regulation is supposed to be extended to the existing building stock. This extension aims at becoming a driver for the revival of the construction sector and for the uptake of innovative systems and cost effective energy services linked to retrofitting.

This article aims to present a valid methodology to evaluate the existing summer comfort, the annual energy demand and the influence of tenant's behaviour in 820 households of a working class district that will be retrofitted within the next two years. The methodology combines dynamic energy hourly simulations and monitoring of real energy consumption data. Moreover, a comparison of several passive retrofitting measures is then carried out.

Methodology for valid energy demand and comfort analysis

Six apartments in one of the fifteen storey towers of the district were modelled and monitored. Their annual energy loads for heating and cooling as well as their indoor thermal comfort and electricity consumption levels were assessed. Two of the studied dwellings were air-conditioned in the summer and have gas boilers for heating, while the others had no cooling systems and gas or electrical stoves for heating. After literature review, two different methods will be used within this study: the (ASHRAE)[5] for energy modelling and calibration of existing buildings, and an application example reported by Pedrini, Westphal and Lamberts [6]. The model calibration was carried at the indoor temperature level. A comparison of the measured indoor temperature and the simulated one was carried out. The difference between them is used as the parameter for model acceptance. The requirement for model acceptance was defined in ASHRAE [4]. The available calibrated computer models allowed for the comparison of eleven simulation scenarios of retrofitting measures with seven orientations and several users' behaviour scenarios.
Concerning the energy consumption analysis, a combination of electricity consumption monitoring of 6 dwellings and monthly electricity and gas bills collection of 50 dwellings was carried out.

Results

Calibration Model of the non air-conditioned dwellings
Energy audits, on–site tests and monitored electricity consumption data provided reliable data which were used to refine internal gains rates as well as sources of heat losses. Additional refinements of the model provided accurate ventilation rates as well. Results for indoor temperature and error accuracy simulation are shown in figures 1 and 2. Results show that error was above 10% only for 0.94% of the total monitoring time. As shown in Figure 2 there is a large decrease of error accuracy when considering afternoon and night ventilation in summer. The adjustment of night ventilation rate was finally 1,5 ACH for May, June and September; 3 ACH for July; 1,5 A CH for August , and 4 ACH from October to April. The averaged indoor temperature in summer is around 26 ºC for the day and 23 ºC for the night. In winter, the averaged measured temperature is 20ºC for all the day.

Calibration Model Air-Conditioned Dwellings

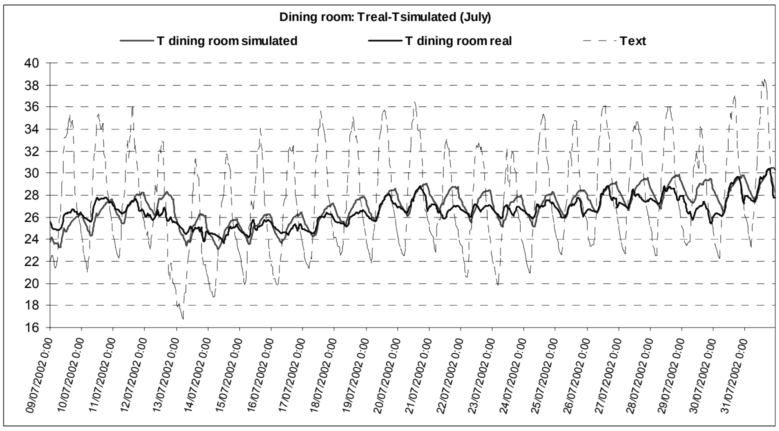
The monitoring devices installed in each dwelling only measured overall electrical consumption. A segregation of the total consumption in permanent (PC), air conditioning (AC), and electrical equipment consumption (GC) was undertaken. PC was estimated by calculating the average consumption of non occupied days; the GC was obtained considering the hourly consumption curve for a representative day without AC use.

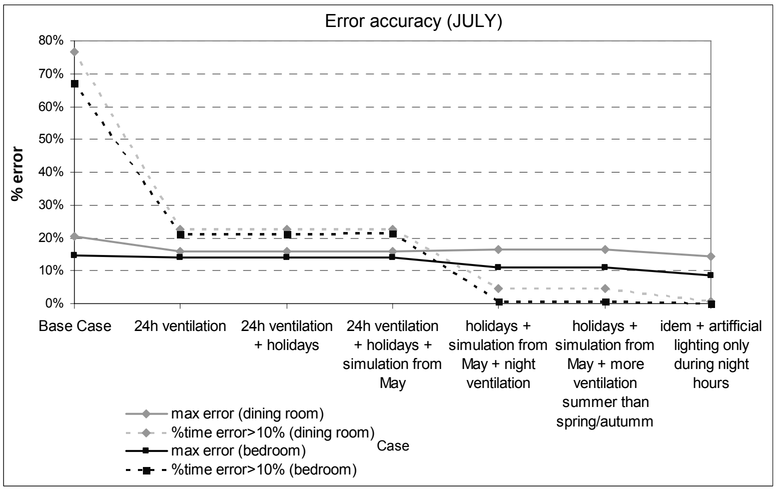
After analysing summer season data, the conditions defining the AC working schedule were: if indoor temperature (T)>24ºC, or ΔT(out-in)> 3ºC, and electricity consumption is higher than a typical daily electricity consumption. Based on these boundary conditions, an automated step by step method to segregate the energy consumption was implemented. The cases when the method could not well identify cooling consumption represented 3.8% of the whole monitoring period, therefore results were representative enough for AC dwelling use.

Conclusions

After data analysis and results processing the conclusion can be drawn that the calibration method developed within this study is a quite simple and reliable method. Calibrated models allowed for the evaluation of the suggested retrofitting measures and impact of tenants' behaviour. Results showed that good use of balcony's protection and air-crossed night ventilation achieves much lower cooling demand than increasing insulation. Only heating demand and comfort in winter improvements justify envelope retrofitting measures implementation.

Design parameters scenarios and analysis of the user's behaviour revealed that other actions such as innovative ventilation systems may represent significant improvements with low or even negligible economical costs. Taking into account the high cost of the envelope retrofitting measures proposed, further research work is needed in finding other more cost effective measures such as boilers replacement and a good energy practice campaign.





Figures 1 and 2
Simulation Results and error accuracy for
the Non Air-Conditioned Dwelling's Calibrated Model in July

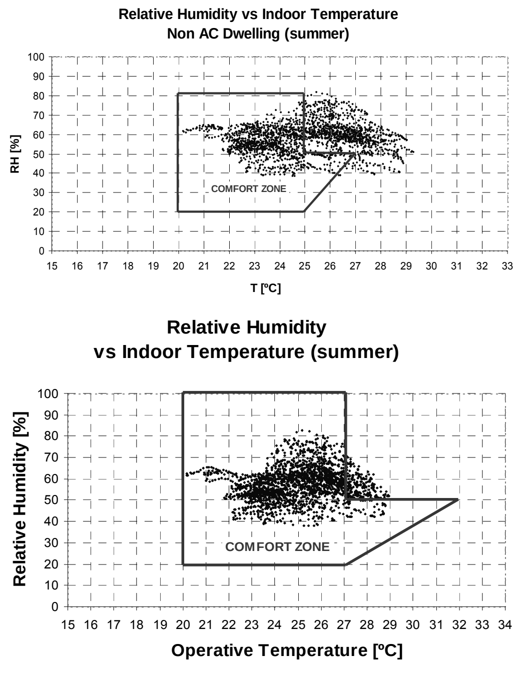


Figure 3 - Comfort result in summer: First: non AC dwelling, right: AC dwelling

Ventilating Existing Homes in the US

Dr. Iain S. Walker - Lawrence Berkeley National Laboratory Berkeley, CA. USA.

In the U.S. the focus of the current administration is on reducing energy use in homes. The US Federal government is providing substantial financial support for energy savings in existing homes over the next two years: low income weatherisation programs will have $5 billion with an additional $3.5 billion in grants for states to administer. There are also significant utility program efforts – including almost $1 billion in California alone. Finally, there is a proposed program to develop a home energy conservation industry with potential funding of more than $20 billion. With that level of financial support we expect to see millions of homes subject to air tightening and subsequently requiring mechanical ventilation.

For many years the focus was on new construction where the mantra of "build tight and ventilate right" was followed, at least by progressive builders and designers (including the US DOE Building America efforts (www1.________ ______________). In these new homes it was relatively simple to include air retarders in walls, floors or ceilings and to seal the major envelope leaks at sill plates and around plumbing and electrical penetrations. To do this in existing homes, however, presents a significantly tougher challenge.

Air sealing has historically (e.g., in US DOE weatherisation programs: http://_______ _ _ _ _ _ _ _ ______________) confined itself to weather-stripping windows and doors and using foam seals on electrical outlets – with dubious results. More extensive work has involved inspecting attics, crawlspaces, around internal building service stacks, heating/cooling duct systems and other locations where surprisingly large holes can be found on a regular basis. Most successful air sealing contractors focus their efforts in this second category of air tightening and achieve significant results, with typical reductions of 20-30% (Measured air leakage of buildings. ASTM. 1986. Eds: Heinz R. Treschel, Peter Lagus).

However, there is a limit to air tightening. Below a certain level we can no longer rely on natural infiltration to provide sufficient ventilation. In which case, whole house mechanical ventilation systems are required. In the US, most retrofit programs refer to ASHRAE Standard 62.2 – or its predecessor 62-89 (www.ashrae.org). These standards provide algorithms for sizing whole house mechanical ventilation systems by specifying a minimum air flow requirement based on the floor area of the home and the number of bedrooms (or occupants).

A credit can be obtained for downsizing the whole house fan if the air leakage of the envelope is measured and the natural infiltration rate estimated based on the local climate. ASHRAE 62.2 refers to the weather factors in ASHRAE Standard 136 to make this estimate of natural infiltration that relates the measured envelope air leakage to an annual average infiltration rate. To allow for the temporal variability in natural infiltration in a very simple way, the credit obtained is only half of the annual average natural infiltration.

Most air leakage reduction in existing US homes is done as part of Federal and Local Government sponsored weatherisation programs that operate under tight budget limits for each house (historically $2500/home but now increased to $6500/home (www._ _ _ _ _ _ _ _ ______________), where the expense of adding a whole house mechanical ventilation fan leads to reductions in other measures, such as adding insulation. This has led to the practice of tightening to a limit such there is just enough estimated natural infiltration to avoid installing a whole house fan - the usual target is 0.35 ACH. This is not quite what was intended by the writers of the standard and leads to lost opportunities for energy saving.

However, this is not the major difficulty in complying with ASHRAE 62.2. ASHRAE 62.2 also includes provisions for local exhaust ventilation of kitchens and bathrooms. This has proven to be difficult to comply with in cost-limited weatherisation programs. Particularly if these rooms or the cooking appliances are not adjacent to an outside wall.

In an attempt to encourage adoption of ASHRAE 62.2 in existing homes the standard committee has written an alternative compliance path for existing homes that allows for an increase in the whole house system air flow rate if exhausts are not installed in kitchens and bathrooms. This compliance path includes credit for openable windows. These changes have been enthusiastically embraced by the weatherisation community and will allow much more flexibility (as well as compliance with codes and standards) in existing homes.

The US DOE is also beginning work to provide energy use labels on all homes - like those that already exist in Europe and some other countries.

These labels will require that building air tightness be measured in order to estimate energy use. They will also include estimates of energy savings for different retrofit measures, including air tightening. Proposed new US Federal Government programs (www.________) that are just starting are aimed at middle-income occupants are going to include air tightening as one of the first things done to a retrofitted home.

So we are about to start a whole new world of air tightening in US homes, and with it comes the challenge to ensure that energy savings predictions from tightening are delivered and that the homes are comfortable and healthy after the retrofit by complying with the newly revised ASHRAE 62.2.

31th AIVC Conference 2010
Seoul, Korea, 26-28 October 2010

Low Energy and Sustainable Ventilation Technologies for Green Buildings

Call for Abstract

KICT, AIK & AIVC invite you to the AIVC 2010 Conference in Seoul. Nowadays, indoor air quality of buildings is getting worse and the term "sick building syndrome" even became a word on everybody's lips. This problem has occurred in the process of pursuing air-tightness of building envelopes for energy conservation and the harmful substances emitted from poor building materials and products.

Indoor air quality affects not only the health and safe of occupants but also their working productivity and efficiency. This is because modern people spend most of their time in the built environment. Thus, improvement of indoor air quality must be taken into deep consideration since it influences occupants' health and quality of life.

As you may already know, the most effective way of improving such indoor air quality is through the ventilation system. We would like to come up with a way of developing a ventilation system that is environmentally friendly, energy efficient and low cost.

We can assure you that AIVC conference will be a good opportunity to discuss and learn about the low energy and sustainable ventilation technologies for green buildings related to healthy indoor air quality. Exchanging research information among nations can help bring realistic solutions to our problems. So, we strongly encourage experts in these fields to attend the conference.

Conference website

for online registration:
www.aivc2010.org

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Host

- KICT (Korea Institute of Construction Technology) &
- AIK (Architectural Institute of Korea)

Theme & Topics

- Natural Ventilation
- Mechanical Ventilation
- Hybrid Ventilation
- Air Filtering for Ventilation
- HVAC System
- Standard and Regulation for Ventilation
- Commissioning (TAB)
- Envelope Air Tightness
- Condensation Prevention
- Energy Retrofitting
- Computer Simulation
- Case Study Building
- Air Distribution
- Chemical pollutants & Particles
- Sustainable Technologies for Building Ventilation
- Health Indoor Air Quality and Productivity
- Environmental Impact of Energy Efficient Ventilated Buildings
- Control Technology for Ventilation System
- Integration Performance of Building Envelope and Services
- Post Occupancy Evaluation and Surveys in Building Ventilation

Time Schedules

- Submission abstract:
  30 April 2010
- Notification of acceptance:
  3 May 2010
- Reception full paper:
  30 June 2010
- Notification of review results:
  31 July 2010
- Submission of reviewed paper:
  31 August 2010
- Early registration:
  30 June 2010
- Late registration:
  31 August 2010

Conference Venue

COEX is a major landmark in Seoul, Korea.
Located in the central business area in Seoul, COEX is a destination for business, shopping, entertainment and more. With a world-class convention and exhibition center, Asia's largest underground shopping Mall, restaurants and entertainment facilities, COEX is a great place to go in Seoul.

Programme

	Start	Close	Room A (main)	Room B (Sub)	Room C (Poster)
Oct. 25 Monday	15:00	18:00		Registration	
26th Oct Tuesday	8:30	13:00	Keynote speech	3 Lecture	
	9:00	10:30			
	10:30	10:50		Coffee break	
	10:50	12:00	Session 1A	Session 1B	
	12:00	13:00		Lunch	
	13:00	16:30	Session 2A (poster)	Session 2B (poster)	Poster display
	16:30	16:50		Coffee break	
	16:50	18:00	Session 3A	Session 3B	
	18:30	21:00		Welcome Party	
27 October Wednesday	8:30	10:00	Session 4A	Session 4B	
	10:00	10:20		Coffee break	
	10:20	12:00	Session 5A	Session 5B	
	12:00	13:00		Lunch	
	13:00	15:30	Session 6A (poster)	Session 6B (poster)	Poster display
	15:30	15:50		Coffee break	
	15:50	17:00	Session 7A	Session 7B	
	18:30	21:00		Banquet	
28 October Thursday	8:30	10:00	Session 8A	Session 8B	Workshop
	10:00	10:20		Coffee break	
	10:20	12:00	Session 9A	Session 9B	Workshop
	12:00	13:00		Lunch	
	13:00	15:30	Session 10A (poster)	Session 10B (poster)	Poster display
	15:30	15:50		Coffee break	
	15:50	17:00	Session 11		
	17:00	17:30	Closing session		

New Ventilation and IAQ criteria for housing performance grading indication system in Korea

Yun-Gyu Lee - KICT Korea

Background and Objective

The Korean Ministry of Land, Transport, and Maritime Affairs has been implementing the Housing Performance Grading Indication System that grades and publishes the key features of apartment houses since January 9, 2006, as per the Housing Act.

This System responds to consumers' demand for a general improvement of quality and features in newly built apartment houses, contributes to the development of construction industry by allowing the government to provide high quality houses, and helps consumers identify the exact performances of houses they wish to live in thereby assisting them in making right decisions.

- Secure a comfortable and safe residential environment
- Provide consumers with standards based on which they can choose houses
- Induce the production of high quality houses

Target and Scope

In Korea, All apartment houses are subject to evaluation where apartment houses with over 1,000 households must receive mandatory evaluation and display it. Inspection and evaluation of grades are conducted across 28 criteria in 14 areas from 5 sectors including noise, structure, environment, living environment, and fire safety where each criteria is given stars that range from □□□□ being the highest to □ being the basic.

The indoor air quality criteria is included in the living environment sector that has recently gathered much attention where it is consisted of 'application of products with low emission of indoor air pollutants' and 'security of effective ventilation for unit households'. The new revision in December of 2009 is as follows. First, the current system only evaluates the amount of pollutants emitted by construction materials but the revised version stretches this out to built-in furniture installed before move-ins. Also, the evaluation of natural ventilation and hybrid ventilation systems has been added to what has been focused on mechanical ventilation. Details to the new revision are as follows.

- Application of products with low emission of indoor air pollutants
  - ❑ Evaluation Index
    - ° Application of low HCHO & VOCs emission materials on walls as finishing materials: 2 points
    - ° Application of low HCHO & VOCs emission materials on ceilings as finishing materials: 1 points
    - ° Application of low HCHO & VOCs emission materials on floors as finishing materials: 2 points
    - ° Application of low HCHO & VOCs emission materials on walls as adhesives: 2 points
    - ° Application of low HCHO & VOCs emission materials on ceilings as adhesives: 2 points
    - ° Application of low HCHO & emission materials on floors as adhesives: 2 points
    - ° Application of low HCHO & VOCs emission materials on walls as other interior materials: 1 point
    - ° Application of low HCHO & VOCs emission materials on ceilings as other interior materials: 0.5 point
    - ° Application of low HCHO & VOCs emission materials on floors as other interior materials: 0.5 point
    - ° Built-in furniture installed in the kitchen: 1 point
    - ° Built-in furniture installed in the bedroom: at most 1 point (partitioned addition for multiple cases)
    - ° Built-in furniture installed in the entrance hall : 0.5 point
    - ° Built-in furniture installed in the living room: 0.5 points (partitioned addition for multiple cases)
  - ❑ Evaluation Method : Inspection of the design manual, blueprint, material specifications, and certified test reports for amount of pollutants emitted by building materials and built-in furniture for unit households. The pollutant emission rate standards for each product are as follows.
- Security of ventilation feature for unit households
  - ❑ Evaluation Index
  - ❑ Evaluation Method
    - a. Examine the system design specifications for the applied ventilation systems and methods
    - b. Verify that the applied ventilation system satisfies the ventilation standard of at least 0.7 times per hour. Evaluate the volume of a target household with ventilation rate by dividing it by the hourly air exchange rate
    - c. Verify, by testing according to KS B6141, that a high performance air purifying filter has a dust filtering effect of at least 90%
    - d. For heat exchangers, verify that they are capable of securing a heat recovery rate of at least the certification standard of high efficiency products
    - e. Test reports for each case must be included when ventilation systems of different volumes are installed within a complex

By enforcing such a system, Korea will not only improve the air quality in newly built apartment houses but also see a significant increase in consumer satisfaction level. As per consumers' requests, this system will be applied to all newly built houses on a mandatory basis with plans to add more criteria to the indoor air quality evaluation such as condensation and mold going forward.

- Building materials: VOCs and HCHO emission rate of under 0.10 mg/m^2h and HCHO 0.015mg/ m^2h, respectively, after 7 days (KS M 1998-1, KS M 1998-2, KS M ISO 16000-1, 16000-3, 16000-6, 16000-9, 16000-11)
- Built-in furniture: VOCs and HCHO emission rate of under 0.25 mg/m^3 and HCHO 0.03mg/m^3, respectively, after 7 days (KS I 2007: test method using the large chamber)

Grade	Grading Standard
□□□□	When received the grade □□□ + Natural and mechanical ventilation systems are integrated into a single system as a hybrid ventilation system is installed to operate on a complementary and as-needed basis
□□□	▪ Natural Ventilation: When received the grade □□ + a certain level [*] of insulation capability have been secured ▪ Mechanical Ventilation: When received the grade □ + high performance air purifying filter and heat exchanger or ventilation device that uses floor heat have been installed
□□	▪ Natural Ventilation : When received the grade □ + the anti-surface condensation feature of ventilation system has been secured in a certain level of condition [**] ▪ Mechanical Ventilation : When received the grade □ + one of high performance air purifying filter, heat exchanger, or ventilation system using floor heat has been installed
□	When a ventilation system (natural ventilation or mechanical ventilation) that is capable of securing a ventilation rate that corresponds to 0.7 times per hour is installed in a unit household

* The overall heat transmission rate is below 2.632W/(m^2.K) as per the KS F 2278

** A constant temperature and humidity room with air temperature of 20□ , relative humidity of 50%, and low temperature room at -10□ as per the KS F 2295

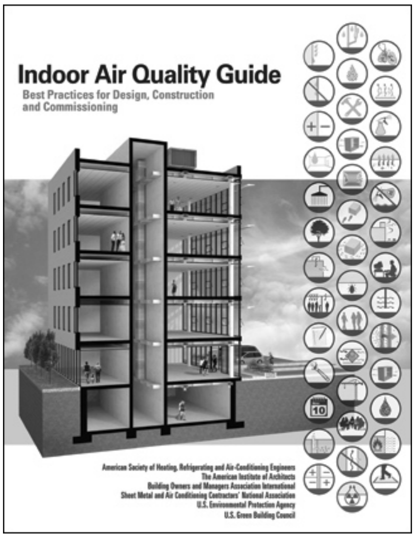
Note: For natural ventilation filters, high performance air purifying filters, heat exchangers, and ventilation systems using floor heat, only those installed for all households within a complex are acknowledged

Indoor Air Quality Guide

F. Durier - CETIAT - France

The book "Indoor Air Quality Guide: Best Practices for Design, Construction and Commissioning" was recently published in the USA. Together with a CD, it provides strategies needed to achieve good indoor air quality using proven technologies and without significantly increasing costs.

It is a collaboration between ASHRAE, the American Institute of Architects, the Building Owners and Managers Association International, U.S. Environmental Protection Agency, the Sheet Metal and Air Conditioning Contractors' National Association and the U.S. Green Building Council.



The book describes 40 strategies for achieving critical IAQ objectives related to moisture management, ventilation, filtration and air cleaning and source control. It also highlights how design and construction teams can work together to ensure good indoor air quality strategies are incorporated from initial design through to project completion.

A summary document of the Indoor Air Quality Guide can be downloaded for free at www.____________. The full publication complete with a CD that contains detailed guidance essential for practioners to design and achieve good IAQ is available in hard copy or electronically at www._______.

REHVA HVAC Dictionary for professionals by professionals

K. Mast - the Netherlands
D. Braham - UK

The REHVA (the Federation of European HVAC Associations) has worked some years for a Pan European HVAC Dictionary. In this freely accessible, webbased dictionary a list of approximately 12500 English words/terms is the core of the translation software. The words/terms are selected applicable to the field of building services.

The "mother list" is a combination/abstract from sources such as the CIBSE glossary of terms, CEN and ISO standards, ASHRAE terminology and standards and the 2nd edition of the (printed) REHVA dictionary. Having 19 languages on the internet, of which 9 are at the same level, within the one framework is unique.
This result can be considered a milestone for an established, well organised sector in Europe. It is an important tool for REHVA members, supporters and companies and organisations working on international projects.
In the next phase of the REHVA dictionary project, the "mother list" will be the core of a Wiki project to encourage direct communication and discussion about the glossary, and start extending the terminology and descriptions. Other translators/languages can more easily link up, and a useful platform function can be investigated in a practical/working situation.

Danish, Dutch, English, Finnish, French, German, Hungarian, Italian, Polish, Portuguese, Russian, Spanish, Swedish, Turkish

For more information contact the REHVA Office in Brussels or the members of the task force, Derrick Braham and Koos Mast.

You can find the dictionary at
www._______
www._______
www._______

REHVA Workshops at Clima 2010 conference in Antalya

9-12 May 2010

10th REHVA WORLD CONGRESS
"Sustainable Energy Use in Buildings"

The REHVA workshops will take place parallel to other sessions at Clima 2010 conference. There will be 6 workshops which will focus on ventilation. See the short descriptions below. The intention is to discuss the topic, and formulate a result which is useful for participants. The result of the workshop could be an international action plan, a list of research needs, outline for a guideline, a policy statement, etc. More information of the conference and registration at www._______.

WS 1: Presentation of the guidebook from REHVA concerning HVAC air filters and future actions
Sunday, May 9, 16.30-18.00
Co-sponsors: *Camfil, REHVA Task Force*
Organisers: Ulf Johansson, Jan Gustavsson
The workshop presents the contents of the new REHVA Guidebook on air filters in air handling systems and discusses the need of the future actions in the area of air cleaning and filtering in respect of indoor air quality and energy efficiency of buildings.

WS 2: Reinventing of mixing ventilation: how to provide good measured and perceived indoor conditions?
Monday, May 10, 10.45-12.30
Co-sponsor: *Halton*
Organisers: Maija Virta, Risto Kosonen
The workshop presents the contents of the new REHVA Guidebook on air distribution system and discusses the need of the future development work in the area of air flows in the buildings in respect of indoor air quality and energy efficiency. The workshop focuses on thermal comfort, element affecting the flow patterns, also in large scale and design practices.

WS 5: Demand Controlled Ventilation (DCV); the art of reducing energy needs whilst maintaining a healthy indoor climate
Monday, May 10, 9.00-10.30
Co-sponsor: *Swegon*
Organisers: John Woollett, Ulf Hörman, Per Fahlén
Demand controlled ventilation (DCV) aims to reduce the energy used by ventilation systems while maintaining the prescribed indoor air quality (IAQ). Buildings are often occupied at much lower levels than the designed maximums, so adapting the ventilation needs to suit is logical. Today's DCV systems will be discussed together with areas being researched now and with a specific focus on what is required in the future.

WS 14: Practical AC System Inspections to fulfil the EPBD's intentions
Wednesday, May 12, 9.00-10.30
Co-sponsor: *Harmonac project*
Organisers: Ian Knight, Jorma Railio, Vincenc Butala
The objective of the workshop is to obtain delegate feedback and thoughts on the proposed final outputs of the project and the implications these might have for the future of the AC Inspection Industry. The participants will have an opportunity to influence the tone of the final output of the HARMONAC and to debate the major points arising. It is also hoped that that this workshop will help towards producing REHVA guidebook for professionals undertaking AC Inspections.

WS 17: Health based ventilation criteria
Wednesday, May 12, 10.45-12.30
Co-sponsor: *REHVA Technical and Research Committee*
Organisers: Pawel Wargocki, Olli Seppänen
The objective of this workshop is to establish methods and network to collect data on ventilation standards and guidelines in Europe, and their implementation in practise. The collected information will be used to develop common European guidelines for health based ventilation. The information will be made available for CEN and European Commission for future actions.

WS 21: The microenvironment around persons in ventilated spaces
Wednesday, May 12, 14.00-15.00
Organiser: Peter V Nielsen
This workshop discusses the flow and transport processes in the microenvironment around a person and between persons in a room. The flows considered are for example the thermal boundary layer around a person, the inhalation and exhalation from a person as well as speaking, sneezing and coughing. A person's movement is also considered as a source of flow in the microenvironment. The workshop is primarily for researchers and related industry. The workshop should identify new research areas.

REHVA, the Federation of European Heating, Ventilation and Air-conditioning Associations represents 100 000 HVAC experts in 28 European countries.

REHVA is the leading professional organisation in Europe, dedicated to the improvement of health, comfort and energy efficiency in all buildings and communities (www._______). REHVA´s multilingual dictionary for heating, ventilation and air conditioning is available at www._______.
REHVA journal is available at www._______

Ventilation and Indoor Air Quality in Retail Spaces

David Grimsrud

Ventilation standards provide guidance for designers and building operators about minimum ventilation rates required for occupants' safety and comfort. Standards evolve slowly following well-established review procedures. Many factors are considered in specifying minimum rates. Typically, standard-setting organisations consider research results from field studies of air quality and ventilation in buildings types coupled with the engineering judgment of those who write the standards. External factors such as a sudden spike in energy costs in the late 1970s have been known to cause a sudden change in minimum ventilation rates.

Minimum requirements for some building types (e.g., commercial office buildings) have been studied extensively throughout the world. Rates for other, related building types are often set by extrapolations form experience with similar buildings. An example is in commercial retail stores. This category has changed significantly in the past 30 years as retail merchandising has changed. Stores have become larger with a broader mix of merchandise. Often a large retail corporation (Wal-Mart, Home Depot, or Best Buy to use US examples) will build near-identical buildings in different parts of the country. Similar merchandise lines are sold in their stores adjusted to some extent by local needs in different locations. Using this strategy creates great efficiencies.

How should these stores be ventilated? Should the rates be similar to commercial office buildings – or to schools – or to hospitals? This note describes a project that is nearing completion investigating ventilation and IAQ in three stores located in different climate regions of the United States.

Large general retail (Target) stores with ventilation heating and cooling designed to satisfy the ASHRAE Standard 62.1 Indoor Air Quality (IAQ) Procedure (a performance-based approach) are shown in this study to satisfy the requirements of this procedure using ventilation rates that are smaller than the prescriptive Ventilation Rate Procedure of the Standard (ASHRAE, 2007).

This note describes an investigation of air quality and ventilation rates in three Target stores located in (1) Mount Dora, FL, (2) Rockville, MD, and (3) Roseville, MN. It uses the IAQ Procedure of ASHRAE Standard 62.1-2007 to determine ventilation rates required to maintain concentrations of indoor pollutants below recognise concentration limits for Target customers and staff in their stores. The research was based on three different but representative floor plans for buildings located in three different climate regions of the United States with critical air contaminants measured throughout weather conditions present in a one-year monitoring period.

The study is a follow-up and an expansion of an investigation of air quality and ventilation rates in a Target store located in Stillwater, Minnesota in 1995-96 (Bridges et al., 1997, Grimsrud et al., 1999). The results of the Stillwater study have been applied to approximately 800 stores since then.

ASHRAE has revised their IAQ Procedure for determining the appropriate ventilation rates for selected buildings. The objectives of this study were (1) determine how three stores designed based on the Stillwater study are performing and (2) to assess the ventilation requirements for a group of stores located in different climate zones of the United States using the new version of the ASHRAE IAQ Procedure that is included in ASHRAE 62.1-2007. The stores chosen for the study represent three standard designs currently used by Target Stores:

a. a general merchandise format found in a cooling climate in non-metropolitan area with a sales/display area of 9100 m^2 (Mt Dora, FL),
b. a two-storey format found in a mixed heating/cooling climate in a large metropolitan area with a sales/display area of 10,200 m^2 (Rockville, MD) and
c. a larger configuration in a heating climate containing retail and groceries located in an inner-ring suburb of a major metropolitan area near a busy highway with a sales/display area of 12,100 m^2 (Roseville, MN).

The study was performed over three years with each building monitored one year (four one-week periods each separated by three months) to sample seasonal variations in each store.

Major pollutants monitored for 48-hr periods were formaldehyde (HCHO), fine particles ($PM_{2.5}$), carbon monoxide (CO), and total volatile organic compounds (TVOC). Two different ventilation rates and two separate 48-hr pollutant monitoring periods were completed in each weekly measurement.

Ventilation rates were determined continuously using CO_2 concentration measurements from monitors distributed throughout the store. Each monitor sampled an area of approximately 1400 m^2 of retail area at 5-min. intervals. Information about indoor and outdoor concentrations of CO_2 in the air, together with occupancy information and other CO_2 sources were used in a mass-balance equation to calculate the ventilation rate in the store. These values were compared to tracer gas decays and agreed within ±7%.

The study introduces the term "dilution factor" to discuss the ability of ventilation to dilute pollutants in the space. The dilution factor has several interesting properties that are important for spaces such as these stores. Its value is always less than or equal to the value of the ventilation in the space. When ventilation is constant the two quantities are equal; when they change in time the average ventilation is always larger than the average dilution factor. The energy cost of ventilation is proportional to the average ventilation; ventilation's ability to dilute pollutants is proportional to the dilution factor. Thus, the most efficient use of ventilation in stores that are open or re-stocked continuously is to equate the two, i.e., by using constant ventilation 24 hours per day. Readers familiar with ventilation measurements will recognise that the dilution factor is the "ventilation rate" measured using constant injection PFT sources and samplers (Dietz, 1988; Sherman, 1989).

Measurements of the average ventilation rates and average pollutant concentrations during 48-hr monitoring periods allow a calculation of the source strength of different pollutant groups for that time period. Knowing the pollutant source strength allows us to calculate the dilution factor required to dilute that pollutant group to values that are smaller than recognised limiting concentrations for that pollutant group. The repeated measurement of the pollutant source strength gives a distribution of results for each pollutant group.

Assuming that these are normally distributed, the value given by the mean plus 1.65 standard deviations about the mean will include 95% of the values that will be seen if the experimental conditions are repeated. Therefore, the dilution factor required to maintain pollutant concentrations below the limit values shown in Table A, below, give the ventilation requirements for each store for each pollutant group.

Comments about Table A. The total volatile organic concentrations are larger in the MN store than in stores in FL or MD. This is likely the result of bakery activity in the MN store that is not present in the other stores. The formaldehyde concentrations listed in Table A are remarkably consistent among the stores while the carbon monoxide values are quite low with the exception of the MN store. Fine particle concentrations, $PM_{2.5}$, are an issue in the MD store.

Pollutant Group	Source Strength (Avg. + 1.65 standard dev.) (mg/h-m²)	Concentration Limits (mg/m³)	Dilution Factor Required (m³/h – m²)	Dilution Factor Required (L/s- m²)
Carbon monoxide (CO)	4.3	10	0.43	0.12
Formaldehyde (HCHO)	0.125	0.10	1.25	0.35
Total volatile organics (TVOC)	1.08	1.0	1.08	0.30

Table A - Pollutant Source Strengths and Ventilation Rates Required to Maintain Pollutant Concentration Standards in Target Stores that were studied

However, built into this calculation procedure is an assumption that the pollutant sources are within the store and that ventilation using clean, outdoor air removes this pollution. Comparisons of indoor and outdoor fine particle concentrations show this assumption to be incorrect. The outdoor fine particle concentrations are often larger than the indoor values. Thus the solution for particle problems is probably a filtration issue for the rooftop ventilation units rather than by increasing the ventilation rates.

In summary, stores with three different designs located in three different climate regions of the United States performed well when measured throughout weather conditions present in a one-year monitoring period. Ventilation rates required to dilute pollutant concentrations to recognised concentration limits are lower than those specified in ASHRAE 62.1 for this type of space.

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Information on AIVC supported conferences and events

CLIMA 2010
9-12 May 2010
Antalya, Turkey
www.clima2010.org/announcement.pdf

clima 2010
9 - 12 May, Antalya - Türkiye
WOW Hotels - Topkapı Palace
10th REHVA WORLD CONGRESS
"Sustainable Energy Use in Buildings"

Clima 2010 is the leading 3-annual international scientific congress in the knowledge domain of HVAC (Heating, Ventilating and Air Conditioning) in year 2010. The 10th REHVA World Congress will be held on 9-12 May 2010 in Antalya, Turkey. The congress will offer a platform for the exchange of scientific knowledge and experience on applications and technical solutions for scientists, consultants, engineers, architects, contractors, facility managers, building owners and policy makers for the HVAC Industry and Building Services.

For more information, please see page 12

INTERNATIONAL WORKSHOP ON "LARGE SCALE NATIONAL IMPLEMENTATION PLANS FOR BUILDING AIRTIGHTNESS ASSESSMENT: A MUST FOR 2020!"
"WE SHOULD START NOW TO BE READY IN 2020"
14-15 June 2010
Brussels, Belgium

This international workshop aims to give a good overview of all the issues involved in building airtightness, with specific attention to planning aspects (session 2), execution (session 3) and evaluation (session 4).
In session 5, attention will be given to the point of view of key stakeholders.
During the workshop, the Platform on Building Airtightness will be launched and it is planned to have follow-up sessions on specific topics.

For more information, please see page 1

PALENC 2010
29 September - 1 October 2010
Rhodes Island, Greece
http://palenc2010.conferences.gr/

The joint 3rd Palenc, 5th EPIC and 1st Cool Roofs Conference focus on the application of passive cooling techniques in the urban environment and in buildings with emphasis on heat mitigation techniques.

31TH AIVC CONFERENCE 2010
LOW ENERGY AND SUSTAINABLE VENTILATION TECHNOLOGIES FOR GREEN BUILDINGS
26-28 October 2010
Seoul, Korea
www.aivc2010.org

"During this 3 days AIVC conference, a whole range of topics related to low energy and sustainable ventilation technologies for green buildings will be presented and discussed, in the form of keynote presentations, short and long oral presentations, poster sessions and workshops.

Topics include: natural and mechanical ventilation systems for near zero energy buildings, air filtering and cleaning, HVAC systems, ventilation standards and regulations, building airtightness, condensation and mould growth, retrofitting, performance prediction, case studies, commissioning, ventilation performances in practice, air quality, healthy buildings, sustainable technologies for building ventilation, environmental impact of ventilation systems".

For more information, please see page 9