AIR INFORMATION REVIEW

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# Ventilation in French Buildings

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Established by the French authorities, the Observatory for Air Quality ("OQAI" in French) aims to develop a better knowledge of indoor pollution, sources and consequences (via measurement campaigns) and to provide adapted prevention and control solutions (professional training, public information, regulation updates, etc). Between 2003 and 2005, OQAI undertook a national survey to assess the air quality in French dwellings by evaluating 567 dwellings. The results were published in a contributed report in the previous AIR Issue (vol. 30, N°3, June 2009).
Among the analyses undertaken, a specific study on ventilation and IAQ was carried out by a working group which includes various labs and technical centres (CSTB, CETE Lyon, CETIAT, LEPTIAB), as well as public authorities such as MEEDDAT /DHUP (Ministry of Housing), ANAH (housing agency) and ADEME (French environment and energy management agency).

When the first results of the dwelling measurements, which targeted about 30 pollutants, were published in 2006, they clearly showed a specific situation of indoor pollution (including pollutants either not present at all outdoors or appearing in higher concentration indoors). However, the indoor pollution was not equally distributed in the building stock 5 to 30% of the dwellings showed above average concentrations. This is the result of multiple pollutant sources (materials, equipment, furniture, cleaning products, human activities, outdoor environment, etc.) as well as of the air change rate in these dwellings. The study focused on this aspect.

The following data are included in the study, in order to characterise the ventilation:
- Visual inspection of the dwellings (ventilation system of dwelling, air inlets and outlets in each room, etc.) and meteorological data;
- Description of occupancy conditions and occupant behaviour via a questionnaire comprising: window opening frequency, bedroom door opening frequency, etc. );
- Measurement of exhaust air flow rate at the outlets;
- CO2 measurements in one bedroom.

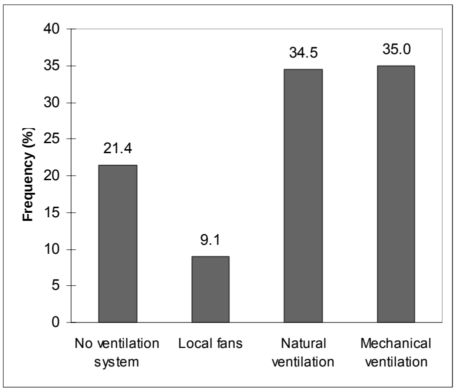


*Figure 1 -*
*Distribution of ventilation systems in the French dwellings building stock*

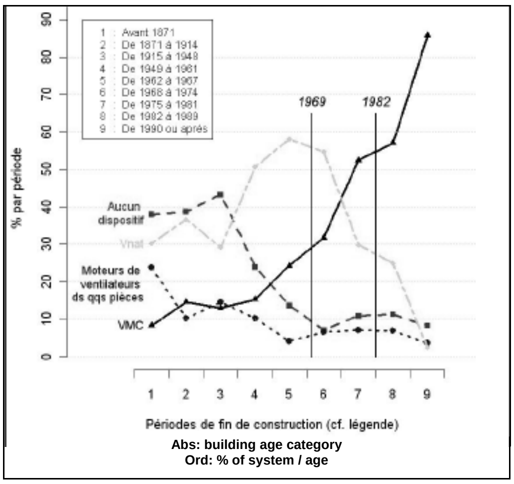


*Figure 2 -*
*Change in ventilation systems installed, by building age*

*Continued on page 7*

## Estimating energy demands - Information on degree days - www.____________

Degree Days.net is an on-line Internet tool that calculates the degree days using temperature data from Weather Underground, a weather data service with thousands of weather stations worldwide.
When analysing energy consumption, you will generally want to find the weather station in the location closest in climate to the building you are evaluating. This should give a better representation of the weather at the building than any "reference" station for the larger region in which the building sits.

However, there is an important caveat: many weather stations have missing or erroneous data. This is particularly true of "personal weather stations" (those that aren't marked as airports). The quality of data from these stations varies considerably: some have years of apparently flawless temperature readings, whilst many others have lengthy periods when they clearly weren't working properly.

Degree Days.net has been programmed to tolerate a certain amount of problem data making estimates where necessary and then marking each estimated degree-day figure with a "% estimated" value so that you know where the detected problems lie. This works well when a station has just a few days of problem data here and there, but there comes a point where Degree Days.net will suggest that you try to find another station nearby.

The airport weather stations tend to go further back in time than the personal weather stations (many of which were set up only recently).

Degree Days.net will generate degree days to any base temperature you choose.

## 2009 ASHRAE Handbook - Fundamentals

The new edition of the handbook is an important information source for all HVAC&R professionals, its content covers basic principles, indoor environmental quality, load and energy calculations, HVAC design, building envelopes, materials and more, including sustainable design. Hundreds of leading HVAC&R practitioners reviewed and updated the 2009 Fundamentals for accuracy, practicality and relevance. The end result is a valuable resource for reliable guidance and data, incorporating recent research by ASHRAE and others.

Important new material in this volume includes:

- Non-residential Cooling and Heating Load Calculations: New research results on climate data and heat gains from office equipment, lighting and commercial cooking appliances.
- Residential Cooling and Heating Load Calculations: Revised coefficients to agree with new climate data.
- Climatic Design Information: Extensively expanded data (increase from 4422 to 5564 stations).
- Sustainability (new chapter): Defining the concept for HVAC&R and describing the principles, design considerations and detailed evaluations required.
- Thermal Comfort: Guidance from laboratory and office environment studies on task performance.
- Psychrometrics: Revised table data for the thermodynamic properties of water.
- Sound and Vibration: New, clarifying text on sound rating systems and vibration calculations.
- Ventilation and Infiltration: New detailed examples of building ventilation, updates from ASHRAE Standards 62.1 and 62.2-2007 and discussion of LEED® aspects.
- Duct Design: New data on round and rectangular fittings from the ASHRAE Duct Fitting Database.
- Insulation for Mechanical Systems: Added tables from Standard 90.1-2007 and a new section on wiring.
- Heat, Air and Moisture Control in Building Assemblies - Material Properties: Extensively reorganised, with updated content throughout.
- Fundamentals of Control: New content on dampers, adaptive control, Direct Digital Control (DDC) systems architecture and specifications and wireless control.

The 2009 ASHRAE Handbook - Fundamentals is available in either I-P or SI units. Its companion CD contains searchable PDF versions of the entire volume in both I-P and SI units, making it incredibly easy to quickly find and print essential information.

More information:
http://_____________

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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## Online Standards Actions & Public Review Drafts

The following public review drafts are currently available for review and comment on the ASHRAE website. For additional information or to download a copy of the public review drafts, please visit the ASHRAE website at https://

These drafts are scheduled for a 30-day public review from 11 September to 11 October 2009:

1. BSR/ASHRAE Addendum j to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). This proposed change is only to clarify the intent of the standard that fans used for whole-house ventilation should be relatively quiet (1 sone) compared to those that are manually controlled for local exhaust needs (3 sones).
2. BSR/ASHRAE Addendum l to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). Carbon monoxide (CO) poisoning leads to hundreds of deaths and many thousands of injuries every year in homes. This proposed change to Standard 62.2-2007 brings the standard into closer alignment with the 2009 International Residential Code (IRC), but expands the protection to all homes, regardless of fuel type or garage configuration, reflecting the potential for high CO exposure events in any home. It also requires the alarms be hard-wired with battery backup, to address the increased likelihood of high CO exposure events during power outages.
3. BSR/ASHRAE Addendum o to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). This proposed addendum deletes the provision limiting pressure drop through the HVAC system filter. Filter manufacturers typically do not make this type of pressure drop information available, so it is difficult to enforce this requirement. In addition, excessive filter pressure drop would have a bigger impact on energy efficiency or equipment reliability than indoor air quality.
4. BSR/ASHRAE Addendum p to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). Builders and code authorities using 62.2-2007 are unsure which systems can use the prescriptive sizing approach and which systems need to measure air flow. For some systems the current requirements are ambiguous as to which air flow must be measured. This proposed addendum moves the requirements to the relevant sections to help clarify the application of the air flow measurement requirements.
5. BSR/ASHRAE Addendum q to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). Builders and code authorities are unsure what is required to comply with the current language of Section 6.1. The proposed changes clarify the requirements.
6. BSR/ASHRAE Addendum r to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). The proposed change clarifies the language without changing the intent. The added text inserts language to the standard consistent with an interpretation provided in 2007.

These drafts are scheduled for a 45-day public review from 11 September to 26 October 26 2009:

1. BSR/ASHRAE Addendum m to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). This proposed addendum revises and extends duct tightness requirements. It moves the duct-tightness requirements for ducts in garages to a new subsection 6.5.2 and expands its coverage to all unconditioned spaces. It keeps the original prescriptive language regarding the air-tightness of the garage-house interface in subsection 6.5.1. In order to clearly identify when this new provision applies for ducts in unconditioned crawlspaces, subsection 6.5.2 refers to the pressure boundary and an additional clarification was added to the definition of pressure boundary.
2. BSR/ASHRAE Addendum n to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). The proposed addendum corrects an error in the values of Table 4.2 that were published in Addendum b to Standard 62.2-2007 currently posted on the ASHRAE website. Ventilation Effectiveness is a function of the ceiling height and occupant density (bedrooms per unit volume) of a dwelling. The values in current Table 4.2 in Addendum b were unintentionally based on a 3-bedroom house with 2500 $ft^2$ of floor area and 8-foot ceilings but was intended to be based on a small dwelling to be sufficiently conservative. The table is being corrected based on a more "typical" 3-bedroom house with 1764 $ft^2$ and 8-ft ceilings.
3. BSR/ASHRAE Addendum s to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). This proposed addendum adds coefficients to account for the effect of system types and operation. The coefficients are based on three factors: the difference between balanced and unbalanced systems; the difference between fully ducted and not fully ducted systems; and the effect of mixing. It increases mechanical ventilation system flow rates for systems that are unbalanced and not fully ducted. It does not increase mechanical ventilation system flow rates for systems that are balanced and fully ducted or systems that are balanced and not fully ducted that have a provision for mixing and systems that are unbalanced and fully ducted that have a provision for mixing.
4. BSR/ASHRAE Addendum t to ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (First Public Review Draft). This proposed change updates the normative references in Section 9 of the standard.

## The final REVIVAL project brochure, including results and conclusions, is now available

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The REVIVAL project addresses one of the main challenges facing cities across Europe.

How do we deal with our existing building stock and make it suitable for the 21st century?

Across Europe, numerous tertiary buildings constructed in the post-war, pre-environmentally-conscious era now seem out-of-date and uncomfortable places to work and live. The obvious solution is to replace them with newer versions, often with environmental consequences. REVIVAL represents an alternate approach, using sustainable techniques to demonstrate that existing tertiary buildings can be refurbished economically, with significant improvements in energy performance that will lead to reduced CO2 emissions and contribute towards the EU goal of meeting the Kyoto Protocol.

For the REVIVAL project supported by the European Commission, five buildings across as many countries were targeted. The buildings span a range of types:

One school;
- Lycée Chevrollier, Angers, France (constructed in 1959)

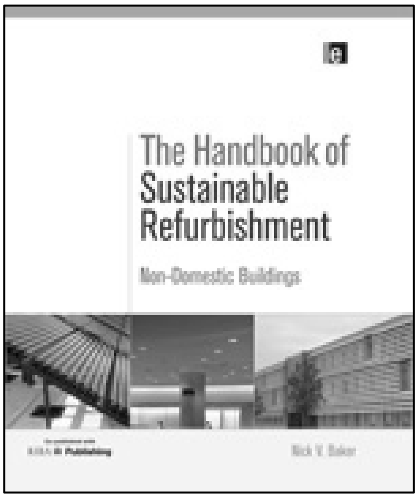
Four office buildings;
- Daneshill House, Stevenage, UK (constructed in the 1950s)
- General Secretariat of Information Systems, Athens, Greece (renovated in the early 1990s)
- Meyer Hospital administrative buildings, Florence, Italy (constructed in 1936)
- The Albatros, Royal Dutch Navy, The Netherlands (constructed in 1972)

All shared the common characteristics of poor insulation standards, an over-provision of uninsulated and unshaded glazing, inefficient lighting, poor internal comfort conditions, inefficient HVAC plant and degraded fabric.

All were refurbished using innovative, sustainable techniques in combination with more established methods to improve energy performance and provide an environment with high standards of comfort and pleasant surroundings.

Examples of the principles incorporated in the refurbishment include the use of phase change material to improve the thermal capacity, passive cooling systems, innovative passive ventilation systems, solar shading, improved HVAC controls, improved lighting, a double skin façade and the installation of solar thermal panels to provide hot water for the building occupants.

The lessons learnt from REVIVAL, together with lessons from other refurbishment projects, will be brought together in a Handbook to Sustainable Refurbishment of Non-Domestic Buildings, to be published by Earthscan in summer 2009. It will fill an important gap in the market for information on this topical subject.




For more information, please contact Abena Poku-Awuah at

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www.__________

## Developing IAQ sensors and network communication systems: Survey on commercial IAQ sensors as a first step

*D. Won and H. Schleibinger*

There is no doubt that environmental sensors will have an increasingly important role within building automation systems designed to create and maintain energy-efficient, comfortable and healthy buildings. From the perspective of ventilation and indoor air quality (V&IAQ) controls, temperature sensors are currently the most dominant sensor, followed by RH sensors. For the future, more versatile systems featuring multiple sensors such as $CO_2$ and other indoor air quality (IAQ) sensors are desirable for the automated control of indoor air quality in buildings.

There are various issues to be resolved regarding more advanced IAQ control systems, including developing adequate sensor technologies and sensor network communication systems. Consequently, in 2008, the National Research Council of Canada (NRC) launched a multi-institute[1] and multi-year project with the goal of developing advanced IAQ sensor and communication system technologies. A scan [2] of commercial off-the-shelf (COTS) sensors for IAQ parameters was conducted by the Institute for Research in Construction of NRC (NRC-IRC) as part of the project.

Three IAQ parameters were selected as candidates for V&IAQ controls: volatile organic compounds (VOC), formaldehyde and radon, based on the existence of guidelines and prevalence indoors in Canada. Our survey revealed that commercial VOC sensors (< CDN $5,000) are neither sensitive nor selective enough to meet the requirements developed by NRC-IRC, which include a detection range of 0.1 to 5 $mg/m^3$ and a resolution of 0.02 $mg/m^3$. Most commercial VOC sensors are based on photo ionisation detectors (PID) and metal oxide sensors (MOS), which perform poorly at differentiating individual chemicals unless they are used in arrays of detectors, and which are not suitable to measure the typically low levels of VOCs indoor without any pre-concentration steps.

On the other hand, several COTS sensors were identified as having the potential to measure typical formaldehyde and radon concentrations in buildings. The formaldehyde COTS detectors identified by NRC-IRC have a price range between CDN $1,000 and $ 7,000, a resolution of 5 to 10 ppb, a detection range between 0 and 1 ppm and a response time of a few to 30 minutes. These detectors are based either on electrochemistry or photoelectric photometry. Several COTS radon detectors (real-time continuous digital sensors), which are available for between CDN $300 and $1,100, were identified as sensitive enough to measure typical indoor radon levels. According to the information provided by the manufacturers, they can meet the NRC-IRC requirements, i.e., a detection range between 20 and 5,000 Bq/m$^3$, a resolution of 10 Bq/m$^3$ and a response time of two days. However, their performance at lower level needs to be investigated, as the detection range indicated by the manufacturers is very broad and typical indoor concentration is low (~ 28 Bq/m$^3$ on average in Canada), with a Health Canada guideline of 200 Bq/m$^3$.

The next step is to verify the performance of the identified COTS sensors in laboratory settings. A series of bench-top scale tests is planned to characterise the selectivity and sensitivity of the COTS formaldehyde sensors. Electrochemistry-based formaldehyde sensors will be scrutinised in for selectivity, which is a well-known weakness of these sensors. The practicality and improvement associated with using colouring tapes for photoelectric photometry formaldehyde sensors will be investigated as well. After the bench-top tests, a full-scale test with one selected COTS formaldehyde sensor will be conducted in a 50 m$^3$ chamber, where a wide range of environmental conditions in terms of relative humidity and ventilation rate can be run.

The main goal of the test is to determine the applicability of the sensor to V&IAQ controls before it is further expanded to a building-scale test. The bench-top and full-scale test will be repeated when the development of advanced formaldehyde sensors by three NRC institutes is completed, in late 2010.
More detailed information on the market survey of COTS IAQ sensors will be available as a NRC-IRC report.

Note:
1. The following five NRC institutes are involved in the project: the Steacie Institute for Molecular Science (SIMS), the Institute for Chemical Process and Environmental Technology (ICPET), the Institute for Microstructural Sciences (IMS), the Herzberg Institute of Astrophysics (HIA) and the Institute for Research in Construction (IRC).
2. COTS sensors were identified mainly through Google Search and occasionally through industry literature. Subsequent email or phone contacts to the manufacturers followed when more detailed information was desired.

## Industrial Ventilation – the Way to Optimum Performance

*V. Krejčí and J. Košner*
*Brno University of Technology, Czech Republic*

When considering ventilation, it is usually the health and/or comfort-related aspects that cross the mind. This is because people spend significant amounts of their lives indoors, where the amount of fresh air plays an important role in how the quality of the indoor environment is perceived. To control air quality, ventilation systems are employed. Efficiency has become another aspect that must to be taken into account when designing the system. The term efficiency is somewhat vague in its meaning, as it may reflect the system's ability to establish good indoor air quality, or it may relate to the system's operational cost. The optimum ventilation design should account for both.

There are two approaches to reaching the required parameters for indoor air quality within a space. The first is intended to control the air quality over the whole space. This concept is called total ventilation. Systems integrating this concept maintain the required air quality over a great part of the ventilated space: but they do so at a high operational cost, due to the large amount of delivered and removed air they have to cope with to meet the target. On the other hand, local exhaust ventilation focuses on air delivery and removal only at the source of the contamination. This may lead to a significant operational cost reduction, as much lower air flow rates can be expected. However, one might argue that there is an energy saving potential associated with total ventilation that can be realised by changing the ventilation strategy from mixing to displacement.

The design of an industrial ventilation system usually combines both concepts, depending on the pollution localisation. Local ventilation systems are preferred when the contaminant source is easy to localise, does not change its location and is rather small in size. In order to design an efficient system based on local exhaustion, one has to consider the main drawback of the concept: the rapid change of the capture efficiency caused by the distance between the air terminal device (an exhaust hood in most cases) and the contaminant source. As a rule of thumb, industrial ventilation designers say the air speed drops to a tenth of its initial value at a distance equalling the exhaust opening diameter away from the hood face. The suction effect may be enhanced with various adapters mounted to the duct ending. A bell shaped adapter, although not amplifying the suction effect noticeably, may lead to substantial energy savings because of the reduced entry pressure drop.

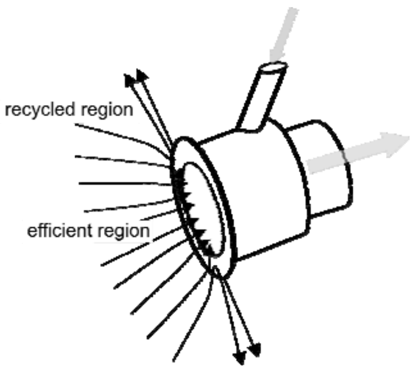


*Figure 1*
*Aaberg exhaust hood generated flow pattern*

Another way to reduce the operational cost is to use new technologies such as the Aaberg exhaust hood, named after Danish engineer CP Aaberg.

The device is depicted in Figure 1 along with the flow pattern it generates. The way the hood combines air supply with extraction causes the flow pattern to become directional; the supplied air constrains the space available for extraction to a hemisphere; and the generated jet entrains the surrounding fluid. This results in an enhanced suction effect that gives the system its other name: REinforced EXhaust System (REEXS). The hood operation depends on the momentum fluxes ratio of supplied and extracted air, denoted as " I ". This ratio has been identified as the hood's main operational parameter. When around 0.1, the hood-generated flow pattern collapses due to a hydraulic short-circuit flow, meaning the radial jet is completely captured by the extraction flow, and thus not present. An optimum value has been identified to lie in the range between 0.5 and 0.6.

Greater values, despite their positive effect on the capture distance, result in a very narrow efficient region where the contaminant may be captured.

Despite the fact that the Aaberg hood requires an additional duct and fan, its operation may be beneficial compared to a hood that employs a flange to enhance the suction effect. Figure 2 summarises the performance of the two different hoods.

Figure 2a compares the power input to the particular device that generates air speed of 0.25 m/s or 0.5 m/s at the distance x/d from the hood face where x is the distance (m) and d is the exhaust opening diameter (m). Clearly, a critical distance can be identified below which the flanged hood is energetically more efficient but not significantly so. Within this region, both devices operate at rather comparable expenses. The critical distance is about 1.3x/d. By locating the contaminant source at the distance of 2d, the power input more than doubles for the flanged hood. These results apply to a rather poor installation of the Aaberg hood.

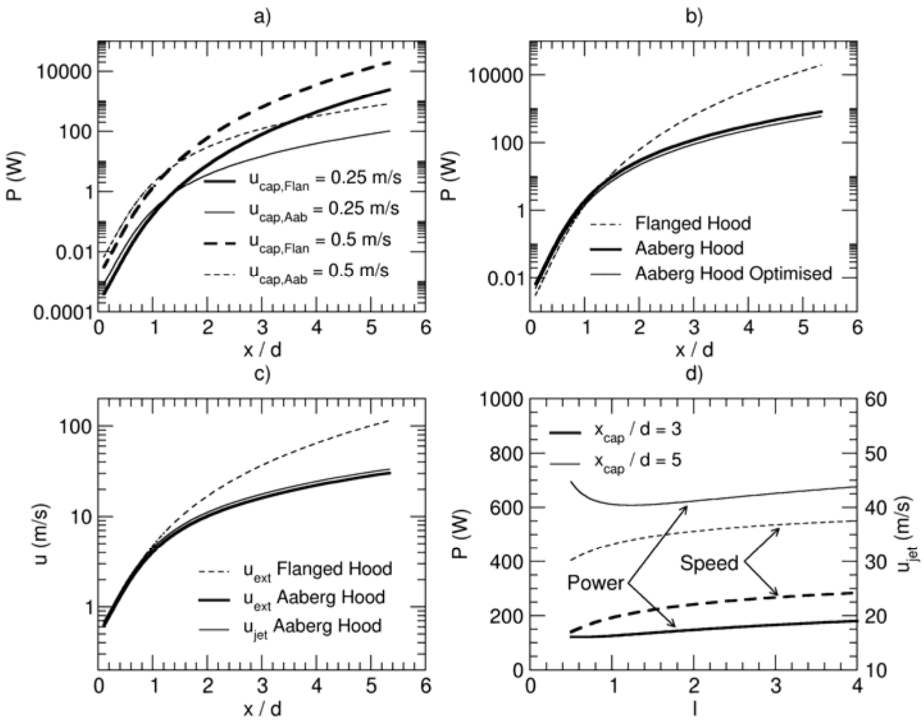


*Figure 2 - Comparison of flanged and Aaberg hoods*

*a. power inputs for different capture velocities (Aaberg hood operated at I = 0.6)*
*b. power inputs to reach the capture velocity of 0.5 m/s (I = 0.6)*
*c. air speeds required to reach the capture velocity of 0.5 m/s (I = 0.6)*
*d. power input of the Aaberg hood to reach the capture velocity of 0.5 m/s at two distances by changing momentum fluxes ratio I*

When the Aaberg hood installation is optimised so that the pressure loss of the supply part drops to half of that in the unoptimised case, the figures change a little, as can be seen in Figure 2b. There, a shift towards a smaller critical distance is depicted. With the critical distance changed from 1.3 to 1, the range of Aaberg hood superiority has broadened.

Figure 2c demonstrates the air speeds at the device when reaching 0.5 m/s at a particular distance. As air speed correlates strongly with noise generation, the chart gives the reader an overview of how noisy the devices in question are. Here, the Aaberg hood compares favourably with the flanged hood.

The last performance results are given in Figure 2d, where the variations in power input and air speed at the hood are plotted against the momentum fluxes ratio. The already-mentioned optimum range seems to move as the distance to generate a velocity of 0.5 m/s changes. The results were not calculated at low values of I in order to avoid the short-circuit regime.

Note that the change in both power input and air speeds is moderate; therefore, if there is a need to focus the suction effect and extend the distance between the hood and the contaminant source, the momentum fluxes ratio can be raised, with an acceptable operational cost increase.

Although the Aaberg hood may seem superior to the flanged, it does demonstrate an important drawback: the jet stability. When violated, the jet stability will deteriorate the hood's performance up to such a level that no contaminant is captured at all. Consequently, the ventilation system design which employs the Aaberg hood is quite elaborate.

*Continued from page 1*

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*Ventilation requirements have evolved over time*

Half of the building stock was built before 1967, i.e. before the first regulations requiring whole-house ventilation, in 1969. 70% of the buildings have mechanical ventilation and natural ventilation installed (ventilation through lower and higher openings in the walls, passive stack ventilation by ducts or shunt ducts). Only 1.1% of the buildings have balanced ventilation systems.

Natural ventilation is present in older or retrofitted dwellings, while this system has almost disappeared from new buildings. It is present in 41% of collective dwellings (apartment buildings) but only 29% of individual houses.
Mechanical ventilation is equally present in individual houses (35.7%) and collective dwellings (34%). Around 8% of the buildings were built before 1968 and later retrofitted with mechanical ventilation.
Around 20% of buildings built after 1975 do not respect the regulation requirements of 1969 or 1982 (i.e. they provide local or no ventilation, instead of whole-house ventilation).

*We spend various amounts of time in our bedrooms*

At home, people spend most of their time in their bedroom on average. In order to determine the confinement levels in the bedrooms, $CO_2$ concentrations (representing occupant breathing) were continuously monitored in the Master bedroom. $CO_2$ levels varied considerably: in 40% of dwellings, they reached values higher than 1500 ppm during the night (from 1 to 5h10 each night).
On the basis of $CO_2$ levels, an equivalent air change rate has been calculated. Regardless of the door and window opening conditions, the air change rate remains close to 18 $m^3$/h. But if both doors and windows are closed, the rate decreases to 10 $m^3$/h.

In post-1982 buildings, with mainly mechanical ventilation installed, the air change rate at night was less scattered. It also corresponded to the lowest air change rates required by current regulation.

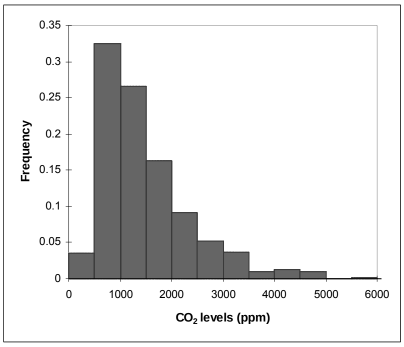



*Figure 3 - Distribution of the greatest $CO_2$ levels in bedrooms (at night, between 1 and 5h10)*

When doors remained closed in the bedrooms at night, CO2 levels increased, together with the risk of stuffiness. Scandinavian countries have regulated on minimum air flow per main room and per occupant to solve the problem from the IAQ point of view, but this goal can only be achieved without an associated increase in energy cost by improving air flow control. The technique is to supply air flow primarily where people are spending their time (bedrooms at night and living rooms in the day, generally).

*The occupant's role in a dwelling's air change*

Window opening data, obtained here by face-to-face surveys of the occupants, was almost systematic outside heating season (94% of occupants declare that they open windows for more than half an hour every day) and still considerable during the heating season (49%).

These values should be considered with caution, however, as other studies show that declaration is always higher than the real, measured frequency of window opening.
The equivalent air change rate is greater when windows or doors of the Master bedroom are opened frequently at night compared to situations with little window opening. The latter was not significantly different, regardless of the ventilation system installed.

*Mechanical ventilation provides better control but reliability has still to be improved Mechanical ventilation is a system associated with smaller scattering but reliability has still to be improved.*

In dwellings with mechanical ventilation, exhaust air flows rates measured varied considerably from one dwelling to another. For instance, for dwellings with four main rooms, measured values of minimum total flow rate (French regulations includes both minimum and peak flow rates in the kitchen) varied from 8 to 269 $m^3$/h (sum of minimum flow rates in each service room), with an average of 85 $m^3$/h and a standard variation of 51 $m^3$/h).

These air flow rates have been compared to the mandatory air flow rates from the period they were built. Dwellings built before 1969 were assumed to have been retrofitted; they were therefore compared to current values, which they are supposed to achieve. This comparison showed that 56% of these dwellings provided lower air flow rates. In the kitchen, the minimum air flow rate was not achieved in 46% of the cases, and the peak air flow rate was very rarely achieved (84% of cases too low). In the bathrooms and toilets, as well, the air flow rates did not reach the desired levels (63.5% and 62% too low, respectively).

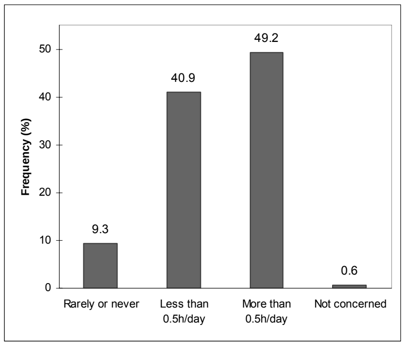
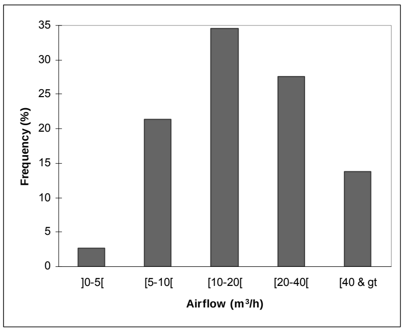


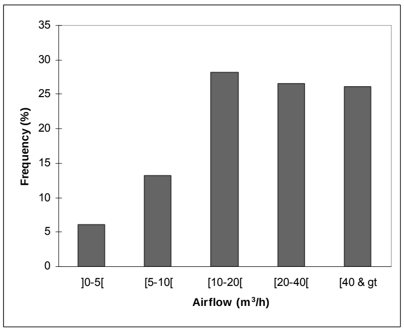

*Figure 4 - % of declared window opening in bedrooms during heating season*

These values to not differ significantly between individual houses or collective apartment buildings. Systems in dwellings built between 1969 and 1982 are more generally considered as providing a too low exhaust air flow rate.

The too-low air flow rates were generally around 20% below the desired level, mainly due to poor design and maintenance:

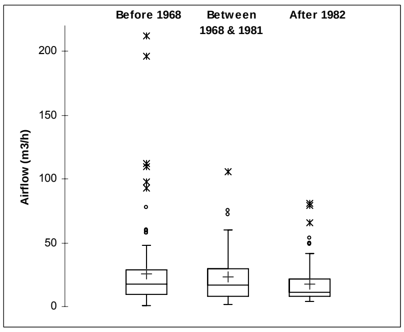


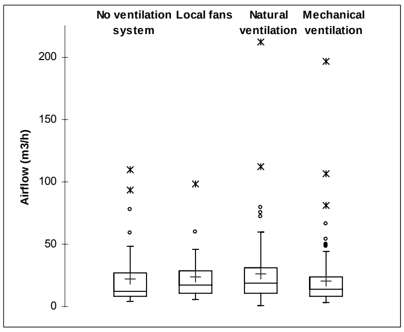

*Air flow (m3/h) - heating condition*




*Air flow (m3/h) - non heating condition*

*Figure 5 - Equivalent air change rate at night in bedrooms*




*a) Figure 6 - Equivalent air flow rate in m3/h in bedroom according to*
*a) building age category,*
*b) ventilation system installed (during heating period and when bedroom windows are closed)*

outlets missing in some rooms, fans stopped, etc. In some cases, retrofits installed directly on old ducts, without tightening them before installing mechanical ventilation system, may be to blame. It is essential in the future to improve the training of professionals in the field to improve the results and achieve better IAQ.

### *Finding a compromise to find between IAQ and energy savings*

These first elements will be supplemented by an analysis of the relationship between ventilation and IAQ. Based on the first results, it appears that ventilation alone is not enough to remove all measured pollutants. A source control is needed, as well as any reduction of possible contamination (air cleaning). In France, mandatory labelling of volatile organic compound emissions from construction materials is now planned and should reduce indoor exposure in the future.

Air management is a central and important part of the energy objectives targeted in new and retrofitted buildings. It is therefore a double challenge to preserve IAQ while reducing energy consumption. Improving building air tightness and reducing energy losses from ventilation must be achieved while taking into account acceptable IAQ criteria. This can be done only with appropriate regulation, source control of construction materials, labelling of cleaning products, efficient ventilation systems with an appropriate design and good quality installation. Savings must be considered as an overall result, i.e. not only by calculations, but also by improved training in the field of ventilation.

Many more results are still to come from this very large field experiment. They will be published (in French) on www.________________
(www.________________
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An additional analysis of cases involving large amounts or very small amounts of certain pollutants is planned, and will evaluate the ventilation status in those situations.

## Integrated energy design for a comfortable indoor environment with low energy consumption – A process favouring natural ventilation

*Dr. Afroditi Synnefa*
*Group Buildings Environmental Studies*
*National and Kapodistrian University of Athens, Greece*

Integrated energy design (IED) is a prerequisite for achieving high-performance buildings with low energy consumption, and a good indoor environment without sacrificing architectural quality or creating excessive costs. The basic principle of IED is to make use of all the passive features of the architectural elements in order to create the best possible indoor environment from the building design itself, favouring the use of natural ventilation.

This reduces capital expenditure on fire ventilation, minimises technical installations and saves on electricity, which would otherwise be used for mechanical ventilation.

In the simplest of terms, the IED process:

- calls for a different approach from the very early stages of design,
- requires a high level of general skills (energy knowledge in a broad sense) and communication within the project team,
- leads to a superior level of integration and synergy of systems and
- involves modern simulation tools where suitable.

INTEND-IED in public buildings (www.intendesign.com) is an EU-supported project looking at the processes of IED. An IED guide has been developed for practical use by the design teams, with 12 building projects serving as examples to show how IED can be used in planning and design. An Internet database has been created based on the "wiki" concept to spread knowledge and experience of high-energy performance buildings. The project results have been disseminated through a number of workshops, lectures and an international conference in Oslo, 24 September 2009.

## Canadian National Research Council's Indoor Air Initiative

The Canadian Government has identified the health and well-being of Canadians as a key priority. Consequently, in support of the government's Clean Air Agenda, the National Research Council's Institute for Research in Construction (NRC-IRC) has initiated an 'Indoor Air Initiative' comprising several major projects to contribute to occupants' health through improved air quality in buildings. To start, a field study is being conducted to better understand how improved ventilation and air flows in homes can positively influence the indoor air quality and health outcomes for occupants. This field study is supported by an Indoor Air Research Laboratory which mimics ventilation scenarios in typical Canadian homes. A second project deals with the development of methods targeted to the assessment of technologies which claim to improve air quality. In addition, a national forum and clearinghouse on issues related to indoor air and buildings has been created to bring together major stakeholders.
For this multifaceted Indoor Air Initiative, the Canadian government is investing $ 8 M over four years to provide sound scientific solutions for different stakeholders and the Canadian industry, and increase general awareness on indoor air quality, with the ultimate goal of improving the health of Canadians.

*Field Intervention Study on Ventilation and Respiratory Health in the Greater Québec City Area*
Started in 2008, the field study is being carried out in the homes of approximately 100 families with asthmatic children in the Québec City area. The study will increase the understanding of the impact of ventilation and air distribution on indoor air quality in buildings. In a very comprehensive approach, the occupants' behaviour and the physical characteristics of the homes are being examined and documented, using for example, infrared imaging of rooms. In addition, the indoor air quality and the ventilation conditions are being characterised by a thorough investigation using a series of chemical, physical and microbiological parameters. These sets of measurements are repeated during three different periods over the year.

A specific task force, led by Don Fugler from the Canadian Mortgage and Housing Corporation (CMHC), was created to select the homes in which an intervention will take place after the first year of measurements. The selection is based on air tightness/air leakage of the homes and the ventilation rates, all determined by different methods. The objectives of the interventions are primarily to improve the ventilation rates, but also include the optimisation of air flows within the home, especially towards a child's bedroom. Fifty percent of the homes will be kept as a control, and monitored for another year to compensate for yearly variations in outdoor conditions.
The health research partner for the field study is the Institut National de Santé Publique du Québec (INSPQ), with Principle Investigator Dr. Pierre Lajoie. INSPQ is in charge of the medical and environmental health aspects of the study. A scientific committee was created to provide guidance for this complex project, with members from relevant Canadian organizations including Health Canada and CMHC.

*The Indoor Air Research Laboratory*
The intervention strategy for the field study homes will be modelled in the Indoor Air Research Laboratory (IARL). This laboratory, created and designed to be inherently flexible in its physical configuration, to allow the modelling of a wide variety of Canadian house designs and constructions, was built on the NRC Ottawa Campus and is now fully commissioned. NRC's research team is currently developing and optimising the design of the interventions, such as modifications to the homes, by modelling and measuring the impact of different ventilation strategies.

The IARL reveals several key features. The most prominent, visible from outside, is the variability of the air tightness of each room over the two storeys. This is achieved by electronically-controlled dampers located around the exterior walls. Natural ventilation can also be incorporated into the experiments by controlled intake and exhaust ducts. Equally important, the flexibility of the interior partition arrangement allows the size and height of the rooms to be modified. Even interior walls and windows can be relocated in the non-structural zones.

At the core of the complex experiments is the variety of ventilation and heating devices available which currently include several types of heating and air conditioning systems, and heat recovery ventilators. The IARL is set up to accommodate further advanced systems as our current and future research evolves. This research laboratory is fully automated, not only for varying the air leakage and infiltration room by room, but also for running the experiments and monitoring environmental parameters like air flow, temperatures, RH and pressure differences. Furthermore, specialised equipment makes it possible to measure ventilation rates and air flows by using different techniques such as tracer gas decay measurements (typically with SF6), and tracer gas concentrations introduced by constant emitters of perfluorocarbons (PFT tracer gas technique). Air flow directions and speeds can also be 'visualised' by particle image velocimetry (PIV).
All acquired data is collected and processed automatically to gather the required input for numerical simulations. At the IARL, the IAQ parameters also determined in the field – are measured, in order to predict the effectiveness of the developed strategies. All interventions are carefully and optimally designed and validated to reduce the amount of adjustments in the field as much as possible, ensuring minimal disturbance to the children and families.

*Validation of 'Indoor Air Quality Solution' Technologies*
Another project under the Indoor Air Initiative, called the 'Indoor Air Quality Solutions' project, targets devices meant to improve Indoor Air Quality. These solutions and technologies can be 'stand-alone' devices that aspirate, purify and release air directly from and to the space, or 'in-duct' devices that treat either the supply or the return air. As a first step, a worldwide scan of technologies, both commercial units and related test protocols – currently available and used – were scrutinised, leading to a sample of more than 50 technologies and related test protocols. The key task of this project is to identify the most relevant solutions for the Canadian context.

In order to achieve this in an inclusive and a pluralistic way, a Technical Advisory Committee (TAC) was created, with key stakeholders from Canadian scientific institutions and stakeholders from the private sector. Based on the TAC's recommendations, the following technologies will be scientifically assessed: (i) stand-alone portable air cleaners, (ii) air duct cleaning systems and (iii) heat recovery ventilation systems (HRV) with several modifications.
Currently, the protocols for these methods are being evaluated and improved where applicable, allowing a comprehensive and useful assessment and test facilities are being upgraded for the project. For the evaluation of the portable air cleaners, NRC-IRC's 55 $m^3$ full-scale chamber has been retrofitted with improved environmental controls, allowing test runs at a range of RH measures (35 to 90 %) and temperatures (17 to 27 $^0$C). Additionally, equipment to challenge the portable air cleaners is being installed, including generators for micro- and nano-particles and volatile organic compounds (VOC). The system can generate many VOCs in different concentrations at the same time. The residential HRV systems and heating, ventilating and air conditioning (HVAC)-mounted air modification systems for commercial buildings will be tested in the IARL. The air duct cleaning technologies will be assessed in laboratory and field tests.

*Canadian Committee on Indoor Air Quality and Buildings (CCIAQB)*
The CCIAQB was created in 2008 as part of the Indoor Air Initiative under the hospices of NRC with the participation of Health Canada as part of the Indoor Air Initiative. The CCIAQB is the primary Canadian national stakeholder forum and operates to gather the 'best-of-knowledge' information on the design and operations of buildings related to IAQ. This activity will provide guidance to governments, industry and consumers based on reliable and unbiased information on IAQ solutions and technologies. Furthermore, the CCIAQB will seek input from all provinces and territories to define knowledge gaps and will thus play an active role in catalyzing new research in those identified areas.

The CCIAQB was created in 2008 as part of the Indoor Air Initiative under the auspices of the NRC and with the participation of Health Canada. It is the primary Canadian national stakeholder forum and operates to gather the 'best of knowledge' information on the design and operations of buildings related to IAQ. This activity will provide guidance to government, industry and consumers based on reliable and unbiased information of IAQ solutions and technologies. Furthermore, the CCIAQB will seek input from all provinces and territories to define knowledge gaps, and will thus play an active role in catalysing new research in those identified areas. The CCIAQB will consist of 18 members, with representation balanced between regulatory bodies (e.g. provincial and territorial health departments or building code authorities), industry (e.g. associations related to the construction, design and maintenance of buildings, and the ventilation/air conditioning industry) and general interest groups (e.g. consumer support groups). Additionally, the committee will be technically and scientifically supported by experts from Health Canada and NRC. The CCIAQB is positioning itself to play a significant role in improving indoor air quality in buildings and, ultimately, the health of occupants.

The Project Managers are:

- Indoor Air Initiative:
  Dr. Hans W. Schleibinger
- Ventilation Field Study:
  Dr. Pierre Lajoie (Principle Investigator, INSPQ) for health sciences; Dr. Hans Schleibinger, Dr. Daniel Aubin, Dr. Doyun Won (all NRC) and Denis Gauvin (INSPQ) for building sciences
- Indoor Air Research Laboratory:
  Dr. Iain Macdonald (NRC)
- Indoor Air Quality Solutions:
  Dr. Zuraimi Sultan (NRC)
- CCIAQB: Heather Cannon, Chair (Westeinde Group Inc.), Luc Saint-Martin, Secretary (NRC)

## CDC and HUD Recognise Benefits of ASHRAE Ventilation Guidance

Call to promote healthy homes mentions ASHRAE Standard 62.2-2007 as resource

ASHRAE has long said that proper ventilation levels can lead to healthier, more productive environments.

Now the Centers for Disease Control (CDC) and the U.S. Department of Housing and Urban Development (HUD) recognise ASHRAE guidance as a means for creating healthy homes.

On 9 June, Acting Surgeon General Steven K. Galson released The Surgeon General's Call to Action to Promote Healthy Homes, calling for Americans to prevent disease and promote healthy environments in homes. ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, was recommended as an effective way to reduce indoor air pollution through ventilation in the CDC's and HUD's supporting guidance for builders and homeowners.

"The citation of Standard 62.2 by the Surgeon General highlights the relevance of this standard to the national need for safe and healthy housing," says Andy Persily, Chair of ASHRAE's Technology Council. "ASHRAE members should be proud to be able to contribute to such an important goal."

ANSI/ASHRAE Standard 62.2 helps ensure air inside homes is clean and safe, by limiting sources of pollutants and requiring enough mechanical ventilation to provide dilution of any unavoidable contaminants. The standard ensures that heating, ventilating, air conditioning and refrigeration systems work together to effectively ventilate homes and minimise sources of indoor pollution.

The standard applies to spaces intended for human occupancy within single-family houses and multi-family structures of three stories or fewer, including manufactured and modular houses. It does not apply to transient housing such as hotels, motels, nursing homes, dormitories or jails. The standard applies to both new and existing buildings and renovations.

ASHRAE, founded in 1894, is an international organisation of some 50,000 persons. ASHRAE fulfils its mission of advancing heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world through research, standards writing, publishing and continuing education.

Contactperson is W. Angel,
w______________

## ASHRAE's Annual Meeting Includes Technical Session on Residential Ventilation Standards

*Louisville Kentucky, USA,*
*24 June 2009,*
*John Talbott, P.E.*

A technical session on "Issues with Ventilation and Indoor Air Quality in ASHRAE Residential Standards" was held as part of ASHRAE's three days of technical programs. This session was sponsored solely by the Standards Project Committee (SPC) on residential ventilation, ASHRAE Standard 62.2. Usually an ASHRAE SPC would not solely sponsor a technical program; however this SPC is involved in substantive developments that are of interest to many in ASHRAE. The session outlined the issues currently under analysis and consideration within the ASHRAE's ventilation standards.

Max Sherman presented a paper on the valuation of infiltration towards meeting residential ventilation needs. The paper outlined the various ways infiltration has been included in a number of ASHRAE standards. It was reported that the underlining premises and mathematical expressions within these standards are founded on the knowledge base of 20 years ago. Sherman suggested there is a need to update these standards to reflect the latest in our collective understanding of the interactions involved. Both improved mathematical expressions and enhanced committee consensus are needed. Specifically, the author pointed out that the various committees' needed to determine for indoor air quality reasons the relevant exposure periods for the key pollutants of concern and the extent to which infiltration is of sufficient quality as a dilution medium. Once this is established, the improved mathematical expressions can be used to establish and compare ventilation performances of various systems. Examples of performance differences would include: intermittent vs. continuous operation, balanced vs. unbalanced and exhausts only vs. supply only.

Aaron Townsend presented two papers which reflected the ongoing research currently supported by ASHRAE Standard 62.2. The overall objective of this research is to develop the analytical basis for adjusting the Standard 62.2 ventilation rate requirement based on the type of ventilation system installed. It is envisioned that the adjustment would be in the form of a multiplier applied to the existing ventilation requirement.

The first paper by Townsend described the creation of a calibrated computer model that would extend the results obtained in previous field research on residential ventilation. The previous research was based on tracer gas techniques. The computer model was based on the CONTAM software developed by the National Institute of Standards and Technology. CONTAM is a multi-zone air flow network model which is commonly used in ventilation research. In CONTAM, the user specifies the attributes of the building's zones, air flow pathways between zones, contaminant sources and sinks and other relevant inputs. Numerous runs were presented that compared the tracer gas decay plots with the computer generated plots. Results were evaluated using standard statistical techniques, and the conclusion was that good agreement was achieved. Best agreement was obtained for cases with mixing, and least agreement for the natural infiltration case.

The second Townsend paper presented the application of the calibrated model. Specifically, the model was exercised over a range of parameters in order to cover a reasonable subset of the new and existing houses in the United States. The range of parameters and the input assumptions used came about through consensus agreement working directly with ASHRAE 62.2 committee members over the course of a number of meetings from 2006 to 2009. Several rounds of parametric simulations were performed. In the initial rounds, parameters were varied to determine their effect on the resulting yearly average exposure. These results helped guide decisions regarding the appropriate parameters for the final simulations. Thirty-six ventilation systems -- all of which could comply with the current ASHRAE 62.2 standard minimum mechanical ventilation rate -- were simulated. These systems were selected based on those commonly seen in practice, as well as those specifically requested by the participating Standard 62.2 committee members. The result of the simulations is a suite of system multipliers, termed system coefficients, which reflect the relative differences in exposure for each of the 36 identified systems.

(It is noted here that the Standard 62.2 committee has considered these results and issued an addendum that includes system coefficients in the Standard. The proposed addendum presents the adjustments in a generalised format with only three different adjustment factors. This format captures the major findings of the study without overly complicating the standard with numerous adjustment factors.)

Paul Francisco presented the final paper of the session, which reported the results of a field study of unvented gas fireplaces. Currently, the ASHRAE 62.2 Standard specifically mentions in its scope that unvented appliances are not addressed. This is not to say there are no possible IAQ problems with these products, but rather that the committee knowledge of these products is not developed to a point where specific recommendations or requirements can be elucidated. The paper focused on the possible moisture problems associated with the appliances. An analysis of the indoor moisture levels in 30 homes with unvented gas fireplaces was performed using measurements from multiple locations in each home. Several different metrics were considered, including relative humidity (commonly used in assessments of comfort), vapour pressure (a temperature-independent metric) and dew point (important for potential surface problems). There was a median increase in vapour pressure of about 0.1 kPa for the sample of homes. Vapour pressures were typically fairly uniform within each home, with the most distant rooms often showing a slightly lower vapour pressure. The direction and magnitude of changes in relative humidity depended on the proximity to the fireplace, with locations further from the fireplace having higher relative humidity levels because of a lesser temperature influence. Dew point levels rarely exceeded 15.5 ºC, which is approximately the dew point required for condensation on a double paned window when the indoor temperature is 21 ºC and the outdoor temperature is -12 ºC.

Taken together, these papers represent a glimpse of the issues facing ASHRAE residential ventilation standards. Simplifying assumptions and formats are being challenged as residential ventilation design becomes a more established discipline of building science. To some, it appears residential ventilation is starting to approach the sophistication of commercial ventilation.

## The implementation of energy efficient buildings policies in 5 continents

14 October 2009
Brussels, Belgium

The seminar is focused on the implementation of energy efficient buildings policies in 5 continents.

The objectives (decreasing energy consumption, diminishing Green House Gases emissions, increasing renewable energy) are well known. The big issue is now: how to do in a practical way to meet those objectives?

Policies instruments of central and local governments are:

- control and regulatory instruments,
- fiscal instruments and incentives,
- economic and market-based instruments,
- support, information and voluntary action.

What are the policies implemented not only in Europe but also in other continents?
What are the property and construction actors concerned by those policies?
What about indoor climate?
What is the cost and the impact of the policies?
What are the main success factors, the main failure factors?

The seminar will bring some answers, dealing with the implementation of energy efficient buildings policies in Europe, the USA, China, Brazil and South Africa.

Contributions by **the** International Energy Agency, United Nations Environment Programme, World Business Council for Sustainable Development and the European Commission will highlight the world wide vision of the seminar.

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## AIVC's Interview with Prof. dr. ir. Jan L.M. Hensen, (Eindhoven University of Technology) President of ISIAQ

**You have dedicated yourself to the research, development and application of computational building performance modelling and simulation for high performance buildings. What are your general beliefs about this field based on your expertise?**

I believe that computational simulation is one of the most powerful engineering tools in our world today. It is used to simulate everything from war to economic growth. Modelling and simulation of building thermal performance using digital computers has been done since the 1960s. While the early work focussed on load calculations and energy analysis, current tools integrate simulation of heat and mass transfer in the building fabric, air flow in and through the building, daylighting and a vast array of system types and components. At the same time, graphical user interfaces that facilitate the use of these complex tools have become more and more powerful, and more and more widely used. Thus, the building simulation discipline has matured into a field that offers unique expertise, methods and tools for building performance evaluation. When used appropriately, it has the potential to improve competitiveness, productivity, quality and efficiency in buildings and in the construction industry, as well as facilitating future innovation and technological progress. It is much easier and cheaper to simulate than to build (or operate) structures incorrectly.

**What opportunities do you see in simulation and computational building performance modelling and in particular in relation to ventilation and indoor climate?**

The indoor climate (temperature, air flow and quality) results from various interactions between the building and the heating, ventilation and air-conditioning (HVAC) system under the influence of both occupants and the outdoor climate. These are all quite complex and dynamic sub-systems in their own right. In order to analyse and predict (future) overall behaviour, we need to properly account for this complexity in an integrated fashion. This is possible with computational building simulation. It is not a trivial exercise in any way, and I strongly feel that the quality of the results depends more on the knowledge and diligence of the user than on the features of the simulation software.

**You are a professor at the Technical University of Eindhoven, a part-time professor at the Czech Technical University and, in 2007, a visiting professor to Kyoto. What are the main differences and similarities between these countries in terms of energy efficient building and, in particular, ventilation.**

In general terms, I think that there are more similarities than differences. Most differences seem to stem from local conditions and/or regulations. Most similarities can be found in commercial buildings. Natural and hybrid ventilation is, however, more common in The Netherlands than in either the Czech Republic or in Japan, as far as I know. Of course, this is related to the climate. The Netherlands has a mild, maritime climate, whereas the Czech Republic has a continental climate. The climate in Japan ranges from quite cool in the north to subtropical in the south. The Netherlands and the Czech Republic are heating-dominated, whereas cooling and its associated systems are very important in most of Japan. In all three countries, the interest in green building design is increasing. From what I could observe, there is, however, more interest in the commissioning, operation and management of ventilation systems in Japan than in the other countries.

In residential buildings, the differences appear larger. In The Netherlands and the Czech Republic, the vast majority of houses use natural ventilation and mechanical extract systems without heat recovery. Only the newest houses have balanced ventilation with heat recovery. As far as I know, most houses in Japan have mechanical extract ventilation systems, but they also have split air conditioning systems for air temperature regulation.

**Are there significant differences in how to teach students, and in the interest of the students towards ventilation and indoor climate, in The Netherlands, Japan and the Czech Republic?**

In general, I don't see many big differences. Teaching in English (with or without a Dutch accent!) is not yet very common in either the Czech Republic or Japan, which makes it a bit harder for the students. I also notice that in Eindhoven we emphasise the relationship and interaction between building physics and building services, whereas in most other places the study focuses on either the one or the other.

**Over the almost 30 years since you came into the research field in the 1980s, what changes have you found most remarkable?**

Computer power and accessibility! We used punch cards in the Numerical Methods course in the 1970s, but nowadays computers are everywhere. Looking back there has been a huge increase in hardware capabilities (Moore's law), but it is remarkable that progress in software in general, and in building performance simulation in particular, is much slower than what we expected in the 1970s and 1980s.

The main reasons for this are that

1. building performance prediction is not so trivial after all,
2. not many people use this software, so software development is not profitable, and
3. buildings and systems keep on changing. For example, over the last decade, "new systems" have included displacement ventilation, cooled ceilings, chilled beams, personalised ventilation, atria, fully-glazed facades, hybrid ventilation, concrete core conditioning, phase change materials, etc.

As a researcher, what areas most interest you, and what are you most proud of? What should young researchers be looking for?

As a researcher, I am most interested in better practical applications, quality assurance and rapid software prototyping using combinations of existing and new building performance modelling and simulation tools. All in view of improving the sustainability of the built environment.

What am I most proud of? My students!

Young researchers should take into account the increasing awareness that in design practice, as well as in the building simulation research community, there is no need for "more of the same". However, there is definitely a need for more effective and efficient design decision support applications.

We should try to expand the scope of the current tools and applications, which are mainly oriented towards the final design stages. There are few tools for early design. Urban level modelling is very relevant and interesting. There are huge issues in properly modelling how wind and buildings (the urban environment) influence air flow and temperature around a building, and thus affect ventilation.

Another very interesting and relevant development area is in post-design applications such as commissioning and model based operation and management.

What topics should be dealt with in ventilation and indoor climate research now and in the future?

From my point of view, the influence of people, especially their stochastic behaviour, should certainly be dealt with.

Other stochastic effects, such as wind forces, should also be properly accounted for. We need to decrease the gap between predicted and real energy use, as well as be able to identify confidence intervals for our predictions.

We need to think about the robustness of building and systems in view of future changes in usage and climate. We need better early phase design tools. In other words, there is lots of work for the future!

Finally, what are your goals for your career in the future?

In a nutshell, that would be to continue to do interesting and (I hope) relevant research together with pleasant people, and to disseminate our findings via publications and organisations such as IBPSA.

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## The 3rd International Workshop on Natural Ventilation

*T. Kurabuchi and T.Ogasawara*

The Third International Workshop on Natural Ventilation on 16 March 2009 at the Architectural Institute of Japan hall (Tokyo, Japan) was hosted jointly by four institutions: the Tokyo University of Science, the Tokyo Polytechnic University Global COE program, the National Institute for Land and Infrastructure Management and the Building Research Institute of Japan. The goals of the workshop were to bring together researchers and practitioners in the field of natural ventilation to meet and exchange information on the latest research trends and results regarding natural ventilation and cross-ventilation, and to build interest in natural ventilation research among young researchers and students.

The first workshop was held in 2003, with six leading researchers invited to present. The results were published in the March 2004 edition of the International Journal of Ventilation. The papers presented in the second workshop in 2005 were published in the June 2006 issue of the International Journal of Ventilation.

For this third workshop, 12 presentations were made by eight invited researchers and four researchers from the host organisations. The titles of the presentations were:

*Policy and strategy-related presentations*

- W.de Gids (TNO, The Netherlands) - "Advanced Ventilation Systems for Classrooms"
- Yuguo Li (Univ. of Hong Kong, China, Hong Kong) - "Natural Ventilation for Infection Control in Healthcare Facilities"
- T. Sawachi (BRI of Japan) - "Estimation of Energy Consumption for Cooling and Ventilation in Houses, -A Newly-Introduced Japanese Regulation to Evaluate Energy Consumption for Heating, Cooling, Ventilation, Hot Water and Lighting"
- M. Liddament (VEETECH Ltd., Univ. of Warwick Science Park, UK) - "The Applicability of Natural Ventilation"

*Presentations on ventilation mechanics and thermal comfort*

- T. Kurabuchi (Tokyo Univ. of Science, Japan) - "Domain Decomposition Technique Applied to the Evaluation of Cross-ventilation Performance of the Opening Positions of a Building"
- P. Heiselberg (Aalborg Univ., Denmark) - "Buoyancy-Driven Natural Ventilation through Horizontal Openings"
- H. Kotani (Osaka Univ., Japan) - "Paper Review of Cross-ventilation Research"
- R. de Dear (Univ. of Sydney, Australia) - The Theory of Thermal Comfort in Naturally ventilated Indoor Environments: "The Pleasure Principal"

*Presentations related to heat load & application*

- M. Ohba (Tokyo Polytechnic Univ., Japan) - "Study on the Reduction of Cooling Loads in Detached Houses by Cross-Ventilation Using Local Dynamic Similarity Model"
- S. Nishizawa (NILIM, Japan) - "Verification of effect of cross ventilation on energy conservation by the experiment simulating occupant behaviour"
- M. Santamouris (Univ. of Athens, Greece) - "The Efficiency of Night Ventilation Techniques"
- Y. Takemasa (Kajima Technical Research Institute, Japan) - "Natural Ventilation with Dynamic Facades – Japanese Example"

This workshop attracted more than 90 participants, with active discussions and information exchanges not only between researchers but also with building designers and manufacturers of building components. The papers for the workshop are scheduled to be published in the December 2009 issue of the International Journal of Ventilation.

## Information on AIVC supported conferences & events

**30th AIVC conference and BUILDAIR, Berlin, 1-2 October 2009**

The combined conferences "30th AIVC conference and Buildair - Trends in high performance buildings and the role of Ventilation" and "International Conference on Building and Ductwork Airtightness" aim to focus on key items of the present ventilation challenges.
More information: www.aivc.org and www.buildair.de

**Emissions and odours from materials, Brussels, 7-8 October 2009**

2 Day Conference on emissions and odours from materials for producers to end users.
More information: www.certech.be

**Ventilation 2009, Zurich, 18-21 October 2009**

The 9th International Conference on Industrial Ventilation Clean Industrial Air Technology Systems for Improved Products and Healthy Environments
More information: www.ventilation2009.org

**Adapting to change: new thinking on comfort**

The International Conference will be held on 9-11 April 2010 at Cumberland Lodge, Windsor Great Park, UK
More information: www.nceub.org.uk/

**3rd International Conference PALENC 2010 – Cooling the Cities the Absolute Priority** Jointly organised with **5th European Conference on Energy Performance and Indoor Climate in Buildings, (EPIC 2010) and the First Cool Roofs Conference**
**29 September - 1 October 2010, Rhodes Island, Greece**
More information: http://palenc2010.conferences.gr