AIR INFORMATION REVIEW

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New Technical Note 65 Recommendations on Specific Fan Power and Fan System Efficiency

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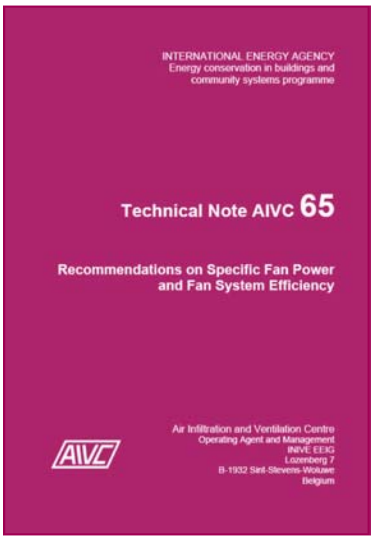
The AIVC has just published a new Technical Note giving up-to-date guidance on how to achieve substantial reductions in fan power and noise. The 38-page 'TN65' gives both a holistic overview and thorough coverage of the factors that affect fan power, together with concise and practical recommendations aimed mainly at HVAC professionals.

Topics covered include:

- Definition and measurement of specific fan power (SFP) and fan system efficiency (Figure 1a). Definitions include SFP_e, SFP_v, SFP_i, SFP_{AHU}, SFP_{FCU}, and SFP_{BLDG}. How to account for intermittently operated fans, e.g. kitchen hoods.
- New internationally harmonised rating schemes for motors (IE rating in International Standard IEC 60034-30) and fan systems (FMEG & FEG rating in International Standard ISO 12759/AMCA 205, see Figure 1b). These standards will provide a foundation for countries to implement Minimum Energy Performance Standards (MEPS) for fans, motors, and whole driven-fan systems.
- An overview of existing SFP requirements in different countries, together with AIVC's 'good-practice' recommended limit values.
- Calculating SFP and fan power at reduced flow rate. Figure 2 shows curves for estimating part load power for different control systems.
- Latest technological developments such as EC motors and fan speed control using Static Pressure Reset (SPR, see Figure 3b). Description and performance of different types of fans and motors.
- Rules-of-thumb for pressure drops and ductwork sizing.
- How to select correctly dimensioned components in air handling units, unit, air distribution systems, and controls, to achieve optimal overall performance with low pressure loss. This includes fans, motors, ductwork, air terminals, exhaust stacks, heat exchangers, filters, and silencers.
- Unambiguous description of the responsibilities held by different stakeholders, including authorities, manufacturers, HVAC designers, contractors and inspectors.


INTERNATIONAL ENERGY AGENCY
Energy conservation in buildings and community systems programme

Technical Note AIVC 65

Recommendations on Specific Fan Power and Fan System Efficiency

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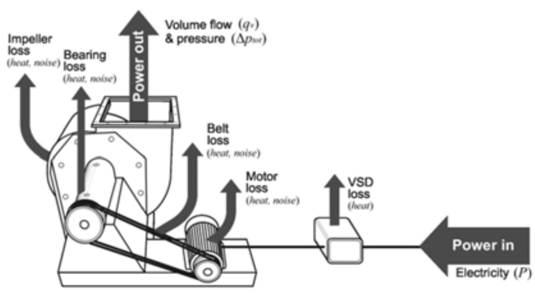

Figure 1a: Losses from a traditional belt-driven centrifugal fan. Fan system efficiency $\eta_{sys} = P_{out} / P_{in}$ - [Fig.©FMA]

Energy use for electrical fan operation is very significant. Fans account for 15~20 % of the total energy use in large buildings, and approximately 7~9% of the total energy use in temperate-climate industrial countries. Only a minor part of this fan energy is recuperated for useful space heating. As the building mass becomes gradually renewed with upgraded indoor climate standards, fan energy consumption could potentially double in the course of decades unless countries implement measures to limit fan power. Many countries have already done so by putting limits on maximum SFP in new buildings. Countries should also consider mandatory inspection schemes including SFP measurement.
Energy use for fan operation can be significantly reduced by a 3-flanked approach: (1) minimising flow rate, (2) minimising flow resistance, and (3) optimizing the efficiency of system components. This Technical Note focuses mainly on the latter two.

Although TN65 is mainly aimed at HVAC professionals (designers, contractors, manufacturers, and maintenance staff), it will also interest building authorities and other decision makers in the construction industry. It can serve as both reference and educational material.

The AIVC welcomes comments to this new publication, and will take these into account in future editions.

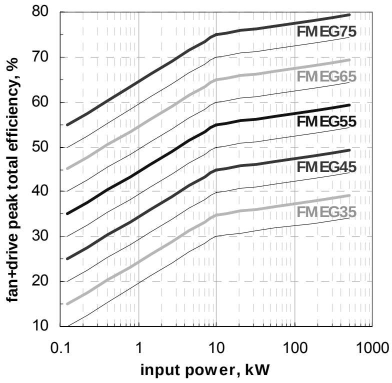

Figure 1b: Driven Fan efficiency rating system (FMEG) for backward-curved centrifugal fans, with or without fan housing, from ISO 12759 - [Fig. © SINTEF]

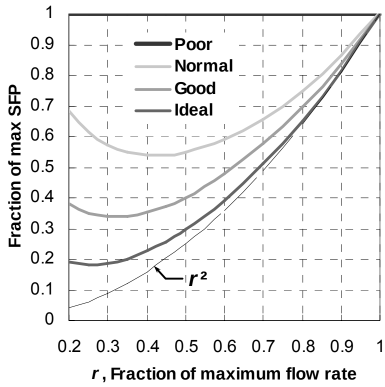

Figure 2: Fractional reduction of SFP as a function of fractional reduction of flow rate, for different control methods. 'Normal' represents systems for which the fan pressure drops marginally as flow rate is reduced, see Figure 3a. 'Good' represents systems for which the fan pressure decreases noticeably with flow rate, see Figure 3b. This includes best-practice VAV systems with fan speed regulated by a typical Static Pressure Reset controller via variable frequency drive (VFD) - [Fig. © SINTEF]

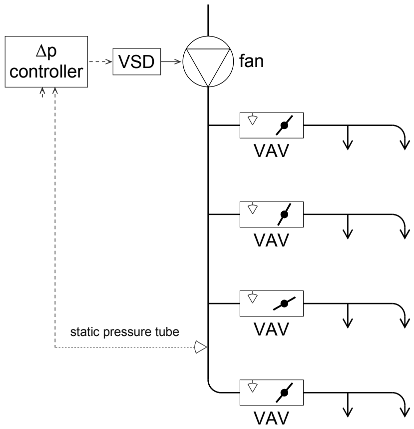

Figure 3a: Illustration of conventional constant static pressure control. Red denotes control system; black denotes duct system. The critical path VAV damper is in max position only at times of maximum flow rate demand

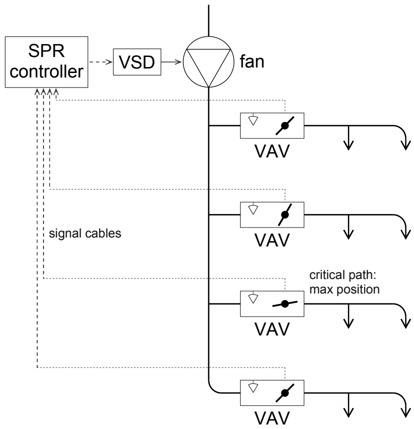

Figure 3b: Illustration of modern SPR control. At any time, at least one VAV balancing damper is in max position (the critical path). VAV control dampers cannot be 100% opened due to need for control authority, i.e. to prevent excessive servo motor wear due to 'hunting' - [Figs © SINTEF]

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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Ventilation and IAQ in New Homes With and Without Mechanical Outdoor Air Systems

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Concerns have been raised regarding whether homeowners use windows, doors, exhaust fans, and other mechanical ventilation devices enough to remove indoor air pollutants and excess moisture. Building practices and building standards for energy efficiency have led to more tightly sealed homes that rely on occupants to open windows for ventilation. However, there is very little information on current ventilation practices, indoor air quality (IAQ), or indoor pollutant sources in homes. In 2006-2007 we conducted a multi-season study of ventilation and IAQ in 108 new single-family, detached homes.

Methods

The methods employed are described in detail in the project final report (Offermann, 2009). We recruited 108 new homes (i.e. built after 2002), 54 in each of northern and southern California, including 26 homes with mechanical outdoor air ventilation systems.

We measured the outdoor air exchange rate with a PFT tracer gas technique during the 24 hour air contaminant measurements. We measured the concentrations of formaldehyde according to ASTM Standard D5197-03. Window and door usage was measured through a combination of dataloggers and written logs kept by the owners.

Two different types of mechanical outdoor air systems were encountered in this field study: ducted outdoor air to the return side of the forced air heating/cooling unit (DOA systems) and heat recovery ventilators (HRV systems). Operation of the DOA systems is paired with operation of the forced air unit (FAU), so the usage was collected by the ac-field logger that monitored the FAU fan operation. To measure the outdoor airflow rates of DOA systems, we measured the centreline average air speed in the outdoor air duct (i.e. typically 5 inch diameter metal flex duct) with a velometer.

HRVs are two fan systems with one fan/duct system typically exhausting air from bathrooms and laundry/utility rooms to outdoors and another fan/duct system supplying outdoor air to the living space. The exhaust and outdoor air streams are ducted through an air-to-air heat exchanger so that the outdoor air is warmed by the exhaust air during the heating season and cooled by the exhaust air during the cooling season. The HRVs were typically operated continuously, and for those HRVs that were reported to be operated intermittently, either a written log or an ac-field data logger installed to secure the data logger. The HRV outdoor airflow rates were measured at the single outdoor air supply air diffuser with a balometer.

Results

The median age of the 108 new single family homes was 3.4 years, with a range of 1.7 years to 5.5 years, and the median square footage was 2,703 ft^2. A total of 26 homes had mechanical outdoor air systems; 17 with DOA systems and 9 with HRV systems. Three of the DOA systems were disabled (i.e. damper closed) and one of the HRV systems was turned off by the homeowner.

Table 1 summarises the 24-hour PFT outdoor air exchange rate measurements in homes, with and without, mechanical outdoor air systems. The outdoor air exchange rates were significantly higher in the HRV homes, with a median of 0.66 ach, as compared to a median of 0.25 ach for the non-mechanically ventilated homes and 0.21 ach for the DOA homes. Table 2 summarizes the 24-hour indoor formaldehyde concentrations in homes with and without mechanical outdoor air systems. The indoor formaldehyde concentrations were significantly higher in the DOA mechanical homes, with a median of 66 $\mu g/m^3$, as compared to medians of 35 $\mu g/m^3$ and 37 $\mu g/m^3$ for non-mechanical homes and HRV-mechanical homes, respectively.

Discussion

A total of 75% of the non-mechanically ventilated homes, 75% of the homes with DOA mechanical systems, and 20% of the HRV mechanical systems had outdoor air exchange rates below the California Building Code recommended minimum of 0.35 h^{-1}.

A total of 64% of DOA systems failed to meet the mechanical ventilation rate requirements of the CEC's new 2008 Building Energy Efficiency Standards (California Energy Commission. 2008), which was adopted from ASHRAE 62.2-2004, even assuming the systems operated continuously. The very low outdoor air exchange rates for the DOA systems is a result of the combination of low outdoor airflow rates and low fractional on times. None of the HRV systems failed to meet the new 2008 Building Energy Efficiency Standards. We note that the poor performance of the DOA systems could be improved if the outdoor air flow rates were increased and if the fan fractional on times were increased by having a fan cycler to insure adequate operational time of the FAU fan.

The non-mechanically ventilated homes had a lower median formaldehyde concentration than the DOA systems, despite having a similar median ventilation rate, because the median formaldehyde emission rate was 35% lower in those homes (i.e. 9 $\mu g/m^3$-h vs. 14 $\mu g/m^3$-h). Similarly, the median formaldehyde concentration in the HRV homes was similar to that in the non-mechanically ventilated homes, despite having a substantially higher median ventilation rate, because the median formaldehyde emission rate was 139% higher in those homes (i.e. 22 $\mu g/m^3$-h vs. 9 $\mu g/m^3$-h).

Of the 3 DOA systems with fan cyclers, the outdoor airflow rates into the systems when the FAU fan operated, were all well below the intermittent flow rate requirements of the 2008 Building Energy Efficiency Standards, ranging from 3% to 8% of the minimum requirements. We also note that intermittent mechanical outdoor air systems, such as DOA systems, cannot perform equivalently to continuous systems such as HRV systems with respect to controlling the short-term exposures to indoor air contaminants, especially if the cycle times are long (e.g. greater than 2 hours). The new 2008 Building Energy Efficiency Standards requires a minimum operation time of one hour every 12 hours. During extended outdoor air ventilation off times, intermittent ventilation systems allow for air contaminants with indoor sources to increase substantially as compared to the increases that would occur with a continuous ventilation system.

For some indoor air contaminants, such as those that cause irritation and/or odour, the effects are initiated by the immediate exposure to the indoor concentration rather than the exposure to a concentration over a period of time.

In addition, the increased outdoor air ventilation for intermittent ventilation systems, as required by the 2008 Building Energy Efficiency Standards, and adopted from ASHRAE 62.2-2007, does not always provide equivalent long term average indoor concentrations, especially for systems with long cycle times (e.g. 12 hours). The long-term average air contaminant concentrations can be substantially higher (e.g. 30%), which is important for health effects such as cancer and cardiovascular disease. The recent ASHRAE 62.2 2008 addenda "b", which has not been adopted by the California Building Energy Efficiency Standards, further reduces the outdoor air ventilation rates for intermittent residential mechanical systems, which translates into higher exposures to indoor air contaminants**.** The ASHRAE 62.2 standards committee is currently working on correcting this error.

Conclusions

This study suggests that consideration should be given to installing mechanical outdoor air ventilation systems in residences to provide a dependable and continuous supply of outdoor air to the residence and to reduce indoor sources of formaldehyde in new homes. Two thirds of the non-mechanically ventilated homes and homes with intermittent DOA systems, had unacceptably low outdoor air exchange rates. These results show that, as encountered in this field study, continuous operating HRV systems are a more effective outdoor air supply strategy than the intermittently operated DOA systems. We recommend that the ASHRAE 62.2 requirements for intermittent ventilation be amended to provide equivalent long term average ventilation rates and with cycle times no longer than 2-3 hours.

References

- ASHRAE. 2007. ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- ASHRAE. 2008. ASHRAE Standard 62.2-2008, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings - Addenda a, b, c, and k. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- California Air Resources Board. 2005. Report to the California Legislature: Indoor Air Pollution in California. California Environmental Protection Agency, Sacramento, CA. Available at www.________________/____________
- California Energy Commission. 2008. Title 24, Part 6, of the California Code of Regulations: 2008 Energy Efficiency Standards for Residential and Nonresidential Buildings. California Energy Commission, Sacramento, CA.
- Offermann, F. J. 2009 Ventilation and Indoor Air Quality in New Homes, California Air Resources Board, Contract 04-310, California Environmental Protection Agency, Sacramento, CA.

	Number of Homes Tested	Minimum (ach)	Median (ach)	Maximum (ach)	Percentage [a] of HomesBelow CBC Code Requirement
Non-mechanically Ventilated Homes	72	0.09	0.25	5.3	75
DOA-mechanically Ventilated Homes	12	0.10	0.21	0.48	75
HRV-mechanically Ventilated Homes	5	0.33	0.66 *	4.3	20

0.35 ach; 2001 California Building Code (CBC), Appendix Chapter 12, Interior Environment, Division 1-Ventilation, Table A-12-A, Outdoor Air Requirements for Ventilation, Living
* statistically significantly higher mean ach (t-test, $p<0.05$)

Table 1: Summary comparison of 24-hour average outdoor air exchange rate PFT measurements to CBC-2001 minimum code requirements

	Number of Homes Tested	Minimum (µg/m3)	Median (µg/m3)	Maximum (µg/m3)	Percentage a of Homes Above ARB Indoor Air Guideline
Non-mechanically Ventilated Homes	72	8	35	126	57
DOA-mechanically Ventilated Homes	12	34	66 *	136	100
HRV-mechanically Ventilated Homes	5	8	37	63	60

a.) 2005 California Air Resources Board – 33 µg/m3.
* statistically significantly higher mean concentration (t-test, $p<0.05$)

Table 2: Summary comparison of the 24-hour average indoor formaldehyde concentrations and the ARB indoor guideline

Studying the effect of indoor sources and ventilation on the particulates concentrations in dining halls

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D. Sfihtelli Stathis Chrisafis and
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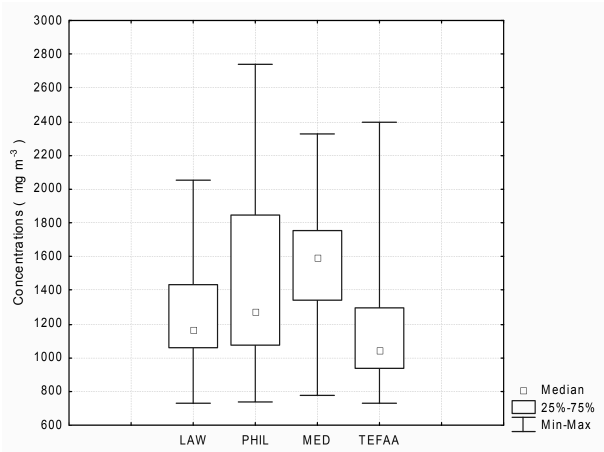
The dependence of the ventilation on the indoor particulate pollution is highlighted by numerous studies. A specific study has been carried out in Greece recently aiming to examine the influence of the ventilation on the levels of the particulate concentrations found in dining halls where a large number of students are accommodated. Indoor particulate sources were also quantified and their influence on the particulate concentrations was examined.

Measurements were conducted in four University dining halls, which are located in different parts of the city of Athens. Indoor and outdoor CO_2, PM_1, $PM_{2,5}$ and PM_{10} concentrations along with the number of occupants and smokers were measured in each dining hall during the accommodation of the students. Measurements were repeated for five working days in each dining hall. Ventilation rates were estimated by applying a methodology that involves the solution of the mass balance equation for the CO_2 concentrations. The indoor particulate production rates were estimated by performing consecutive numerical experiments with the Multi Chamber Indoor Air Quality Model (MIAQ).

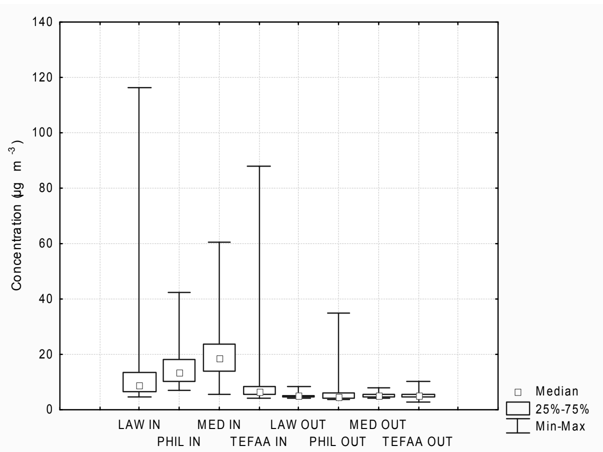
Median CO_2 concentrations ranged between 1043 µg m^{-3} and 1590 µg m^{-3} and ventilation rates ranged between 0.58 h^{-1} and 5.15 h^{-1}. The respective values for PM_1 ranged between 8.6 µg m^{-3} and 22 µg m^{-3}, for $PM_{2.5}$ between 17 µg m^{-3} and 60 µg m^{-3} and for PM_{10} between 24 µg m^{-3} and 78 µg m^{-3}. The Pearson correlation coefficient between the log transformed ventilation rates and the PM_{10} concentrations were found to be -0.6. Median values of the total production rates were found to range between 100 µg min^{-3} and 5500 µg min^{-3} and are highly correlated with the number of occupants (Pearson correlation coefficient 0.86).

Examination of the origin of the particulate sources indicated that in the majority of cases resuspension is more significant than combustion sources. Significant short-term variation (one hour time interval) of the various sources was also observed.

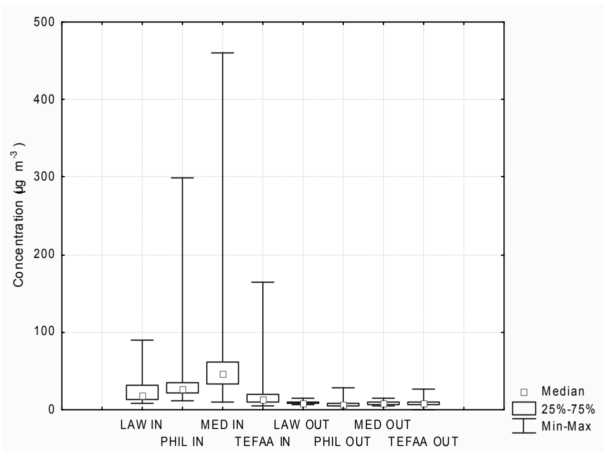
Even though the production rates were significantly elevated, the measured particulate concentrations were moderate due to the high air change rates obtained. These findings support the results of other studies that highlight the significance of ventilation in environments where indoor sources are prominent.



(a), PM_1 in µg m^{-3}



(b) $PM_{2.5}$

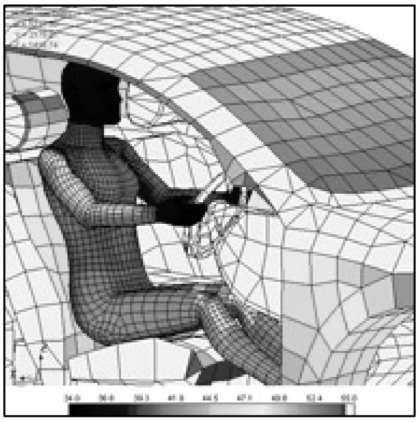


(c) and PM_{10} in µg m^{-3}

Figure 1: Box Plot of indoor CO_2 in mg m^{-3}

A dynamical version of the Fanger Thermal Comfort model

H. Phaff
TNO Built Environment & Geosciences



For indoors, Fanger's Thermal comfort equations [1, 2] with adapted Draft rate and Thermal adaptation are common use.

Therefore tools and models are available to evaluate the comfort of users.

They are for instance used in the car industry to asses the comfort of the passengers (the example is from thermoanalytics.com). The situation is mostly static whereby the subject and the surrounding doesn't change.

Real live situations are not static but dynamic. In particular for outdoors there are wind discomfort criteria [3] and other indices (coefficient fits and regression formulas of field studies).

Many spaces however are in between: semi outdoor, semi enclosed.

For example
- shopping malls with half covered shopping streets
- reception or check-outs near frequently opened shopping doors
- warehouse operators who frequently move between indoor and outdoors
- public transport where passengers and operators move between indoor and outdoors and may wait there
- urban street canyons

The question is: how to judge these areas? When are problems to be expected and how many days per year? The wind discomfort criteria will yield a (too) rough indication for problem areas, and fail completely when temperature changes are the problem. On the other hand the indoor office limits for thermal comfort would lead to a too large rejection rate when applied to semi outdoor spaces.

People are in constant transient, from a warm room, via a colder semi outdoor trajectory, to a next room. In these transients, clothing, metabolic rate, temperature and air velocity are likely to have a large variation. After how many minutes would the problem get serious?

DFanger, a dynamic comfort approach
The better way for this would be to use a human body model, but can it be done simpler?
As Fanger's thermal comfort model is based on a heat balance, that balance may well be used for these in between areas as metabolic rate, clo values, all are there, but the time duration is missing.

A dynamical version of Fanger's routines, called DFanger, is proposed to fill the gap for the indoors- outdoors transients to make a reasonable estimate of thermal discomfort. It is not claimed that this will lead to a perfect simulation of the real world, but is may solve say 90% of the practical problem here.

In the drawing the centre is the Fanger Thermal Comfort model, that calculates the PMV (predicted mean vote, in the sense of warm-cold, +2..,0,..-2) and PPD (percentage of the persons dissatisfied about their thermal situation, 5..100%). Inputs are local air and radiant temperatures, air velocity and turbulence intensity, humidity and for the person, the metabolic rate (activity level) and the clothing (thermal insulation).
On the left hand side is the in time varying input (only 4 of the actual 8 are drawn here, t=temperature, v=air velocity, met=metabolic rate). A network, like a neural network, but with fixed conditional coefficients and a series of digital time constants to get the best response. On the right hand side is the output processing. The time constants are in the range of 30 to 1000 s depending on the variable, and they change with the variation of the input as well.

The conditional coefficients are fitted versus lab experiments and literature experiments, and most of these are limited in time resolution, as test persons have to fill out their vote every few minutes.

In the middle, below, is the outdoor temperature adaptation that occurs in non-air-conditioned buildings with a time constant of about 3 to 5 days.

Here is a scaled back example from [4] with some colder hours in the middle. The red line is the DFanger PMV with a 12 minute time step. The current model can vary the time step from about 1 second to a few minutes.

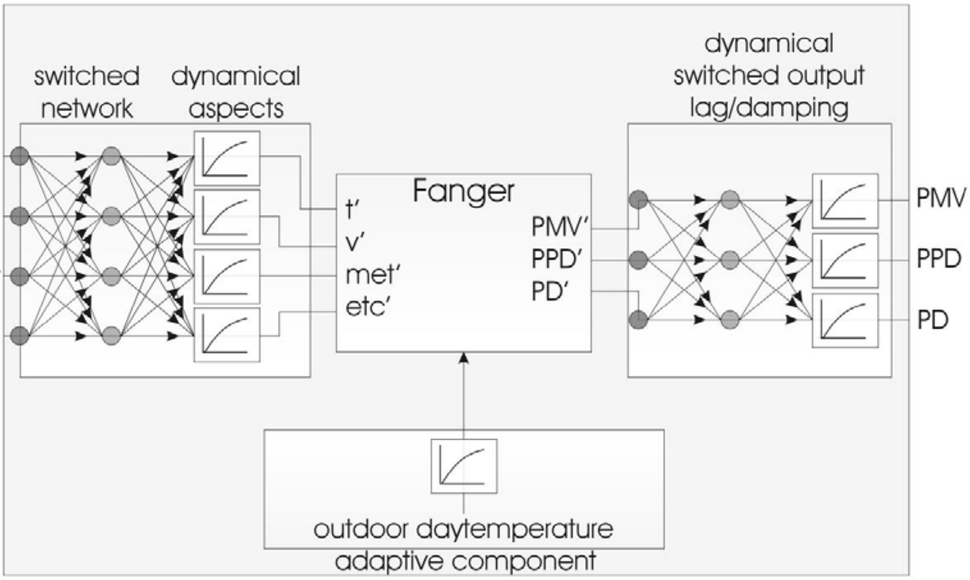
The approach can be used as post calculation for building simulation models, to optimise building designs and make them more robust for occupant behaviour.

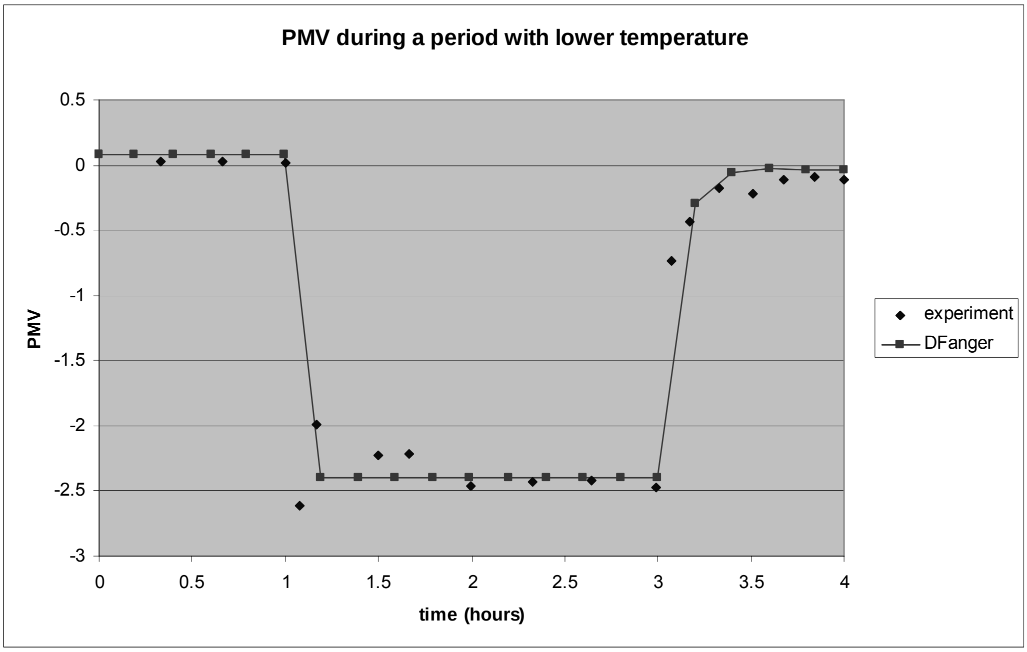
In a first trial the model has been used to evaluate the dynamic comfort for persons which are moving around a platform, building and shopping areas. The results have been used to optimize the design of the roof openings.

Discussion
At strong variation of metabolic rate, differences between persons just entered and persons who are more permanently indoors, differences in clo values, there will not be one optimal thermal climate, complaints are unavoidable unless local and personal measures are taken. Customers entering a warm shop from cold outdoors will find the shop too warm, while at the same time the check-out operator gets far too cold with draft from the opening shop doors.

Is it a complaint free optimal thermal comfort what humans need? Or do we need to flex and stretch occupants (in the thermal comfort sense). How does the ability to adapt to a wider (indoor) temperature range (20-28°C in non-air-conditioned buildings) develop (or vanish).

Why did indoor temperatures increase over the last century from about 16°C (61 F) up to 23°C (>73 F) nowadays. Partly because of higher clothing level and radiation temperature near the fire in the old days (no central heating), so occupants always had a very dynamic range of temperatures, coupled to the trajectory and home activities.





Next steps in model development

The model will be developed further, for longer periods (more than a few minutes up to hours) many literature experiments are available that can be used to fit the model. For air velocity the turbulence index, already in the Fanger model, covers the higher frequency range. If for instance temperature changes in the seconds to minute range would play a role, new lab experiments could be necessary.

The next step is to use the PMV, PPD signal in a building simulation model as one of the inputs for the simulation of occupant behaviour. Other inputs for the behaviour are task driven.

To limit this a bit: in our case it is only the behaviour that has an influence on building energy performance and comfort aspects. But the fact that so many (dis)comfort parameters are neatly integrated taken into account makes the behaviour simulation much easier. There are thoughts that other discomforts, like noise nuisance and maybe improper lighting and views can be added in some way.

Literature

[1] P.O. Fanger, 1967. "Calculation of thermal comfort: introduction of a basic equation"

[2] Marc E. Fountain, Ph.D.Charlie Huizenga. Using the ASHRAE THERMAL comfort MODEL, An ASHRAE Special Publication. ASHRAE Research Project 781-RP, Atlanta USA,1997

[3] NEN (Netherlands Standardisation Institute) 8100 Wind discomfort and danger in the built environment. Delft NEN, feb 2006

[4] Dusan Fiala · Kevin J. Lomas · Martin Stohrer.Computer prediction of human thermoregulatory and temperature responses to a wide range of environmental conditions. Int J Biometeorol (2001) 45:143–159

International workshop

Innovative products and systems for energy efficient building

Amsterdam, The Netherlands
3-4 March 2010

The International workshop on National trends of innovative products and systems for energy-efficient buildings, Barriers and strategies for an accelerated market uptake, is held in Amsterdam, the Netherlands on 3-4 March 2010. The location is the NEMO building.

The workshop is organized by TNO, in close collaboration with the AIVC and part of the European SAVE ASIEPI project (www.asiepi.eu). The workshop is supported by the European Union through its intelligent Energy – Europe Programme.

The aims of the workshop are

- Identify national trends and barriers for adoption of current and emerging energy-efficient technologies and products for buildings. The workshop will provide a forum of discussion and consensus development among policy and decision makers in government, industry, and research institutes . Specific attention will be paid to energy efficient ventilation and boundary conditions for a good indoor climate.
- To outline strategies and drivers for change to incentives to increase adoption rate of these technologies, and accelerate the transition process towards a comfortable, healthy energy efficient built environment. Emphasis will be more on cooling, heating,
- What are emerging technologies with high potential to realise energy efficient buildings and good indoor environment? Are there sufficient incentives to accelerate market introduction?
- Document success stories and best practices that facilitated effective uptake and implementation of energy-efficient and innovative technologies in buildings, while taking into account high quality and healthy environments.
-

The workshop will be held in English. No translation is foreseen.

More information
www.buildup.eu or
www.asiepi.eu

Wednesday 3 March 2010

12.30 Opening of registration

13.30 Opening of workshop
General welcome by TNO

- Welcome on behalf of AIVC and ASIEPI project
- IEA activities on supporting emerging technologies towards near zero primairy energy use and carbon emissions in building and communities
- The role of innovation in the Dutch Policy on Energy in the Built Environment
- Energy performance regulations and innovative systems: lessons learned from the EU SAVE ASIEPI project

15.30 Break

16.00 Market uptake of emerging technologies
Cool roofs: what are the possibilities and opportunities? What about challenges and difficulties for market uptake?

- Assessment of innovative technologies – Role of modern identification techniques
- Medium and long-term trends in national energy efficient targets for new buildings
- Industry presentation on experiences with innovation and market uptake

18.00 End of session

19.30 Walking dinner

Thursday 4 March 2010

9.00 Long term performance of energy efficient building and installations

- Commissioning as a driver for market uptake of innovative systems
- Quality of innovative systems: the role of technical approval schemes and successful examples
- Long term performances of building airtightness: importance and possibilities? What about challenges and difficulties for market uptake
- Dutch experiences on long term performances of ventilation systems

11:00 Break

11:30 Energy efficient communities

- City of the sun - Heerhugowaard (Netherlands)
- IEA ANNEX 51 - Energy efficient communities
- Smart grids and energy efficiency

13.00 Lunch

14.00 Overview of instruments for stimulating market uptake

- Role of standards
- Role of regulations
- Role of financial instruments, Incentives, Investment banks, national initiatives
- Are there research needs?
- Panel discussion - Representatives from industry and market
- Conclusions and next steps

16.30 End of workshop

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 ventilation system. We would like to come up with a way of developing 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 solution 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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- Dr. Yun Gyu Lee: yglee@kict.re.kr

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: 15 February 2010
- Notification of acceptance: 31 March 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		

National Research Council of Canada'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. As a start, a field study is being conducted to better understand how improved ventilation and airflows 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 many 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 our 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 studied and documented, using for example infrared imaging of rooms. Also, the indoor air quality and the ventilation conditions have been characterised by a thorough investigation of a series of chemical, physical and microbiological parameters.

These sets of measurements were repeated during three different periods throughout 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 will be monitored for another year to compensate for yearly variations of outdoor conditions.

Our 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 to this complex project, with members from relevant Canadian organizations including Health Canada and CMHC.

The Indoor Air Research Laboratory

The strategy of the interventions in 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, thus allowing a wide variety of Canadian house designs and constructions to be modelled, was built on the NRC Ottawa Campus and is now fully commissioned. NRC's research team is currently developing and optimizing the design of the interventions, such as the modifications to the homes by modeling and measuring the impact of different ventilation strategies.

The IARL reveals several key features. The most prominent one, visible from the outside, is the variability of air tightness of each room over the two storeys. This is achieved by electronically controlled dampers which are 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 our complex experiments is the variety of available ventilation and heating devices 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 airflow, temperatures, RH, and pressure differences. Furthermore, specialised equipment allows to measure ventilation rates and air flows by using different techniques such as tracer gas decay measurements (typically with SF_6), and tracer gas concentrations introduced by constant emitters of perfluorocarbons (PFT tracer gas technique). Air flow directions and speeds can also be 'visualized' by particle image velocimetry (PIV).

All acquired data is collected and processed automatically to gather the required input for numerical simulations. At the IARL, we also measure the IAQ parameters, which we are also measured in the field, 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 their families in the field.

Validation of 'Indoor Air Quality Solution' Technologies

Another project under the Indoor Air Initiative, called 'Indoor Air Quality Solutions', targets devices meant for improving Indoor Air Quality. These solutions and technologies could be 'stand-alone' devices aspirating, purifying and releasing air directly from and to the space, or 'in-duct' devices treating either the supply or the return air.

As a first step, a world-wide scan of technologies, commercial units, as well as related test protocols – currently available and used – were scrutinised, leading to 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, 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 this project. For the evaluation of the portable air cleaners, NRC-IRC's 55 m^3 full scale chamber is 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). This system is able to generate a multitude of VOCs in different concentrations at the same time. Residential heat recovery ventilation (HRV) systems and heating, ventilating and air-conditioning (HVAC)-mounted air modification systems for commercial buildings will be tested in the IARL. The airduct 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 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 will consist of 18 members, where representation will be 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)

CLIMA 2010 - Announcement

We have the pleasure to welcome you to Clima 2010, the leading 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. The e-announcement of the congress may be downloaded from
www.______________
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The congress theme is "Sustainable Energy Use in Buildings". Scientific Committees of Clima 2010 invite scientists, engineers, consultants, designers, architects, building operators, designers, industrialists and policy makers to submit abstracts either for oral presentation or poster sessions in order to exchange the knowledge and technical solutions in HVAC technology. Online abstract submission deadline has been postponed to 30 September 2009 and is available at www.____________

- Deadline for abstract submission: 30 September 2009
- Deadline for papers: 15 January 2010
- Acceptance and Rejection will be announced after: 28 February 2010

Contact
www.___________
info@___________

Organization
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BUILD UP, The European portal for energy efficiency in buildings

BUILD UP,
THE European portal for energy efficiency in buildings (www.buildup.eu), aims to serve the needs of building professionals, public authorities and occupants alike. The key aim is to reduce the energy consumption of buildings across Europe by transferring best practices to the market and fostering their uptake. BUILD UP also aims to keep you updated about EU energy policy for buildings.

In June 2009, the European Commission has launched its BUILD UP initiative to increase the awareness of all parties in the building chain of the saving potential which remains untapped. BUILD UP promotes better and smarter buildings across Europe by connecting building professionals, local authorities and citizens.

The BUILD UP web portal shares and promotes existing knowledge, guidelines, tools and best practices for energy-saving measures in buildings across Europe. At the same time, it informs and update the market about the European legislative framework in terms of goals, practical implications and future revisions.
After 6 months in operation, there are about 37 000 visitors per month.

In order to have a more focused information, the concept of communities is introduced, whereby information is filtered around a specific topic.

The following communities exist:
- Energy efficient ventilation for healthy buildings
- Minimum energy performance requirements
- Certification schemes
- Energy performance calculation procedures
- Leading examples of public buildings
- Requirements for experts and inspectors
- Inspection of boilers and air-conditioning systems
- Thermal bridges
- Passive house standards and very low energy buildings
- Software for building energy performance
- Energy efficient policies in 5 continents

Best Paper Award at the 30th AIVC Conference & 4th BUILDAIR Symposium

Berlin, Germany
1-2 October 2009

The Best Paper Awards of the 30th AIVC Conference & 4th BUILDAIR Symposium were awarded during the closing session and went to :

- Mrs Laure Schwenzfeier, researcher at CETIAT (France), for her paper on the use of compact balanced single room ventilation units with heat recovery in existing dwellings

Renovation of existing buildings, in order to reduce energy consumption, represents a big market in Europe. As the first efforts often concentrate in improving insulation and airtightness of the building envelope, important insufficiencies of ventilation can appear, generating health risks for the occupants and a degradation of the frame.

Taking into account the difficulties to insert ductworks in existing buildings, it can be easier to use distributed ventilation systems for room-by-room ventilation instead of centralised systems. In addition, balanced mechanical ventilation systems with heat recovery minimize the energy loss due to air renewal.

Single-room balanced mechanical ventilation units with heat recovery are used in European countries. They include an air-to-air heat exchanger, two fans and filters and they take place on a wall with air inlet and outlet through the building façade. However, the performance of such devices is not well known and questions remain about their ability to ensure good ventilation of the whole room.

In the research project VENTIL'RENOV, supported by ADEME, two representative products from the market have been tested in laboratory as well as in an experimental full scale dwelling. Numerical modelling has also been performed. This paper summarises the results of this project, showing the impact of such ventilation systems on indoor air quality, energy consumption and noise.

- and Mr Jelle Langmans, from the Catholic University of Leuven (Belgium), for his presentation on the potential of using windbreakers as air barrier in light weight constructions

This paper investigates the practical feasibility of an exterior air barrier for the construction of a recently constructed light weight passive house in Ghent, Belgium.

The paper discusses the results of pressurisation tests, conducted in the different construction stages of the building envelope. The windbreaker, which will also act as an air barrier, consists of bituminous mixed wood fibres plates with a watertight bitumen impregnated layer on the top face. Measurements have been performed with and without sealing the joints. In addition to in situ pressurisation tests of the entire building, laboratory measurements on specimens of the windbreaker including typical joints were carried out in order to quantify the influence of possible local air leakages.

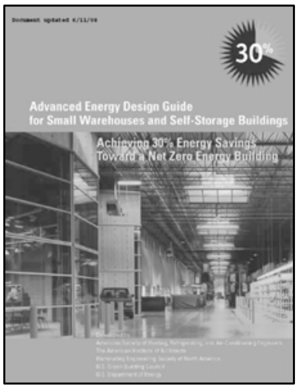
The measurements indicate that the external wind barrier contributes significantly to the final airtightness of the tested building. In this case study, sealing only the most critical joints of the outer shell already leads to a level of airtightness of the whole building envelope which fulfils the requirements of the passive house standard (less than 0,6 air changes per hour (ACH) at 50 Pa). The results presented in this paper indicate that the proposed solution has a potential to reduce labour costs required to reach a sufficient level of airtightness.

The next AIVC Conference will be held in Seoul (Korea) on 26-28 October 2010. See page 9 for more information and call for papers.

Advanced Energy Design Guides Free Download

ASHRAE has published a series of Advanced Energy Design Guides. This series provides a sensible approach to easily achieve advanced levels of energy savings without having to resort to detailed calculations or analysis.

The four-color guides offer contractors and designers the tools, including recommendations for practical products and off-the-shelf technology, needed for achieving a 30% energy savings compared to buildings that meet the minimum requirements of ANSI/ ASHRAE/IESNA Standard 90.1-1999. Of course, ventilation is one of the areas where energy improvements are possible.



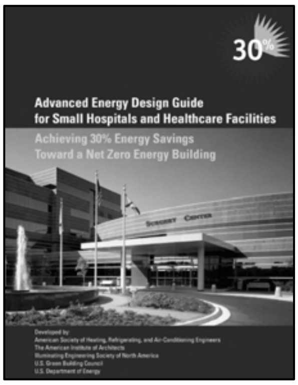
The following guides are available:

1. Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings
2. The ASHRAE Advanced Energy Design Guide for Small Office Buildings
3. The ASHRAE Advanced Energy Design Guide for Small Retail Buildings
4. The ASHRAE Advanced Energy Design Guide for K-12 School Buildings
5. Advanced Energy Design Guide for Highway Lodging

New ASHRAE Health-Care Facility Design Guide

www.

A new ASHRAE "Advanced Energy Design Guide for Small Hospitals and Healthcare Facilities" is available for free download at the ASHRAE website. It provides good design practices for integrating energy efficiency in a health-care environment, while maintaining indoor air quality and required airflow and pressurisation relationships. It covers a wide variety of heating and air-conditioning equipment as well as options for daylighting. The guide focuses on small health-care facilities up to 8400 m^2. The Advanced Energy Design Guide series provides recommendations for achieving 30% energy savings over ASHRAE Standard 90.1-1999.



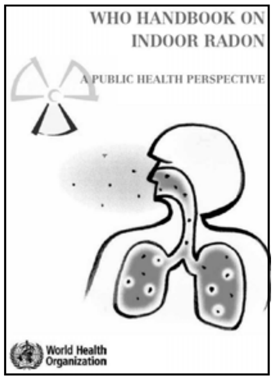
WHO handbook on indoor radon - a public health perspective

The WHO handbook on indoor radon is a key product of the WHO International Radon Project, which was launched in 2005. The handbook book focuses on residential radon exposure from a public health point of view and provides detailed recommendations on reducing health risks from radon and sound policy options for preventing and mitigating radon exposure.

The material in the handbook reflects the epidemiological evidence that indoor radon exposure is responsible for a substantial number of lung cancers in the general population.

The material is organised into six chapters, each introduced by key messages.

Usually, technical terms are defined the first time they are used, and a glossary is also included. Information is provided on the selection of devices to measure radon levels and on procedures for the reliable measurement of these levels. Discussed also are control options for radon in new dwellings, radon reduction in existing dwellings as well as assessment of the costs and benefits of different radon prevention and remedial actions (including ventilation). Also covered are radon risk communication strategies and the organisation of national radon programmes.



This publication is intended for countries planning to develop their national radon programmes or extend such activities, as well as for stakeholders involved in radon control such as the construction industry and building professionals.

The overall goal of this handbook is to provide an up-to-date overview of the major aspects of radon and health. It does not aim to replace existing radiation protection standards, rather it emphasizes issues relevant to the comprehensive planning, implementation and evaluation of national radon programmes.

This handbook, published in September 2009, can be downloaded as a pdf file free of charge.
http://

Alternatively, a copy of the handbook can be purchased from the WHO Book Shop:
http://

AIVC Conference Proceedings and Publications available on CD-Rom

A new AIVC Publications CD-Rom is now available.

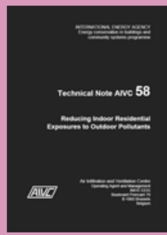
It contains:

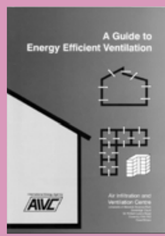
- 53 Technotes
- 6 Guides
- 13 Annotated Bibliographies
- 31 Information Papers and
- 12 Contributed Reports

published between 1981 and 2009.

The last AIVC conference papers are also available on CD-Rom (2002-2008) for a total of more than 700 papers.

See order form on page 15.





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- ORDER FORM -

v. 0912 - Replaces all previous order forms

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Information on AIVC supported conferences and events

INNOVATIVE PRODUCTS AND SYSTEMS FOR ENERGY EFFICIENT BUILDING
3-4 March 2010
Amsterdam, the Netherlands
www.buildup.eu or www.asiepi.eu

The International workshop on National trends of innovative products and systems for energy-efficient buildings, Barriers and strategies for an accelerated market uptake, is held in Amsterdam, the Netherlands on 3-4 March 2010.
The location is the NEMO building.
The workshop is organized by TNO, in close collaboration with the AIVC and part of the European SAVE ASIEPI project (www.asiepi.eu).
The workshop is supported by the European Union through its intelligent Energy – Europe Programme.

ADAPTING TO CHANGE: NEW THINKING ON COMFORT WINDSOR 2010
9-11 April 2010
Cumberland Lodge, Windsor Great Park, United Kingdom
www.nceub.org.uk/

The 6th Windsor Conference on Thermal Comfort which takes place at the Cumberland Lodge Conference Centre from 9-11 April 2010 will address many of these challenges. It will provide a platform for new thinking among leading world experts in a confidential, thought-provoking and agreeable setting. At Windsor topics are discussed and developed that reverberate in national and global comfort standards, strategies and approaches for teachers, designers and regulators alike. The key issues for consideration at the Conference centre on coping with the warming climate and new trends in buildings design and operation including the shift back towards natural ventilation and mixed mode buildings and window use and its simulation.

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

We have the pleasure to welcome you to Clima 2010, the leading 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.

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

KICT, AIK & AIVC invite you to the AIVC 2010 Conference in Seoul.
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 solution to our problems. So, we strongly encourage experts in these fields to attend the conference.

Submission abstract: 15 February 2010