AIR INFORMATION REVIEW

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Airtightness: the largest building ever tested

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Introduction

The gradual improvement in thermal insulation levels in buildings over the last thirty years has increased the relative proportion of energy losses associated with air infiltration. Consequently, it becomes more important to be able to design, test and seal buildings to have less leaky external envelopes. Studies in industrial countries have shown that unnecessary ventilation can account for over 60 % of building energy wastage, mainly through the loss of conditioned air.

The Megafan positioned in a loading bay

A recent article in the September 2003 issue of AIR ('Unravelling airtightness') described the new UK Building Regulations relating to the airtightness of large buildings. All new commercial and public buildings with floor areas over 1000 m^2 must attain a reasonable standard of airtightness for buildings. 'Reasonable' is defined as an air permeability of no more than 10 m^3/hr/ per m^2 of building envelope surface at a pressure differential of 50 Pascal. It is estimated that approximately 3000 buildings per year in the UK would need testing.

Testing large building

There is no upper limit on the size of new building that needs to be tested, but very large buildings (floor areas exceeding, say, 5000 m^2 floor area) have represented a particular problem for pressure testing using conventional steady state methods. Unsteady techniques (AC and pulse techniques) have been suggested as alternatives to the conventional steady state technique.

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AIR
AIR INFORMATION REVIEW

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

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1) *AIVC Member Countries: Belgium, France, Czech Republic, Greece, Norway, Netherlands, USA*
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3) A free version of AIR without any links is available at *http://www.aivc.org*

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GUIDE TO THE NEWSLETTER

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

In the document, links are represented by small red icons or by red text.
To follow a link: Position the pointer over the linked area on the page until the pointer changes to a hand with a pointing finger, then click the link.

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

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

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

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

Within Acrobat Reader, you can use the Search command (Edit > Search) for finding a word or phrase in the current PDF document or in other PDF documents.

WEBSITES

Promotion Energy Saving and Renewable energies

http://www.ManagEnergy.net

ManagEnergy promotes co-operation between local and regional energy actors in Europe through workshops, study tours and online events on energy efficiency, renewable energy and sustainable transport.

If you are working on energy issues at the local level, you can use the Manag
Energy website to find up-to-date information on events, case studies, funding, legislation and energy agencies across Europe.

The website features details of around 380 energy agencies. In total, the site includes 1700 organisations, who can provide valuable expertise and advice on energy activities at local and regional levels. In addition, more than 5000 individual energy actors in 65+ countries are registered to receive regular news and information from ManagEnergy.

The site also offers FREE internet broadcasts facilities and a partner search system, to help you find participants for new energy projects among energy agencies, municipalities, consultants, industry and other energy experts.

On the site, you can also find several interesting reports where ventilation related issues are discussed.

Ventilation information on OSHA website

http://www.osha.org

The mission of OSHA (US Occupational Safety & Health Administration) to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.

OSHA and its state partners have approximately 2100 inspectors, plus complaint discrimination investigators, engineers, physicians, educators, standards writers, and other technical and support personnel spread over more than 200 offices throughout the US.
This staff establishes protective standards, enforces those standards, and reaches out to employers and employees through technical assistance and consultation programs.

Inadequate or improper ventilation is the cause of about half of all Indoor Air Quality (IAQ) problems in non-industrial workplaces. Ventilation is therefore a topic of interest for OSHA. As a result, many OSHA health standards include ventilation requirements.

The OSHA website (*http://www.osha.gov/SLTC/ventilation/index.html#eTool*) provides ventilation related information, e.g.:

- What kind of standards apply?
- How to recognize ventilation deficiencies?
- What are some possible solutions for workplace hazards?
- Where to find additional information? (with links to American Conference of Industrial hygienists and American Industrial Hygiene association)

Technical notes on CETIAT website

http://www.cetiat.fr

CETIAT produced since 1964 about 3000 technical notes concerning HVAC appliances and systems, which were distributed to its 300 industrial members.

Access to a selection of 150 recent technical notes has been opened some months ago to all persons or firms interested, by making them available on line with a credit card purchase system and immediate downloading of selected documents.
Technical notes, mostly in French, cover topics such as: ventilation and indoor air quality, fans, heat exchangers, measurement techniques, thermal comfort, but also hydronic heating, combustion, air conditioning, refrigeration and thermal industrial processes like drying.

Every two months, a sample technical note is offered for free download.

The AIVC CD contains two of these documents, one about the "generation mechanisms for aerodynamical noise of fans", the other about the "characteristics of jets from axial ceiling air diffusers".

INFO FROM PROJECTS

URBVENT -

Natural ventilation in urban areas, Potential assessment and optimal façade design

Nicolas Heijmans -
Belgian Building Research Institute
http://www.bbri.be

Natural ventilation can be used to provide a good Indoor Air Quality, and to save energy. The main energy savings are not necessarily related to the absence of fans (required for mechanical ventilation), but to the decreased need for air-conditioning (thanks to e.g. free night cooling). Unsurprisingly, natural ventilation is more challenging in urban areas (where most of the buildings are located) than in the countryside, due to reduced driving forces (wind, temperature) and increased potential barriers (noise, pollution). To promote natural ventilation in urban areas, it was necessary to analyse these aspects: this was the aim of the URBVENT project.

The URBVENT project has been described in the AIR Newsletter of March, 2004. In this issue, the reader will find some of the results of the project:

- The URBVENT Brochure. In order to disseminate them to a large audience interested in natural ventilation, the main results of the project were summarised in a 16 page brochure.
- The WP final reports. The work carried out by each WP has been summarised in final reports. The reports for WP1: Natural Ventilation Potential Assessment and WP2: Optimal openings design are given here.
- A Roadmap, to give an overview of the aspects analysed by the project.

It must be mentioned that URBVENT has produced two pre-design tools and a Handbook. The first tools aims to assess the NVP of a site, and to evaluate the energy savings that natural ventilation can provide. The second tool aims to optimise the window sizing and to estimates the airflow inside a room. The Handbook will be published by the international environmental science publisher James & James (London), in 2004. It will include the URBVENT tools.

The participants would like to gratefully thank the European Commission, which financed the URBVENT project (Fifth Framework Programme).

Airtightness:

the largest building ever tested

Continued from page 1

However, uncertainties introduced by the inertia of the flow through imperfections in the building envelope add increased complexity and uncertainty to the calculations and results. Therefore, the steady state approach is preferable if it is technically feasible and practically possible to develop and use a very large and powerful portable fan-based pressurisation system.

The development, testing and calibration of such a system, called the Megafan, were undertaken by a UK based company, HRS Services Ltd., Sheffield. This was a major engineering task, taking nearly two years to complete. At the heart of the system was a 2m diameter fan driven by a 5 litre diesel engine capable of generating 90 kW. This fan was able to generate a volumetric flow rate of over 100 m^3s^{-1}. By comparison, existing UK testing facilities had maximum flow rates of around 30 m^3s^{-1}. A practical restriction on the Megafan system was that it had to be able to be mounted on a 7.5 tonne lorry (the largest lorry that can be driven by someone with a standard UK driving licence). Figure 1 shows the Megafan in position on the lorry.

Field trial of Megafan system

In December 2002 the opportunity arose to test the Megafan on an extremely large building (a distribution warehouse in the UK). The warehouse was a steel framed composite clad construction that measured approximately 359 x 160 x 15.5m high, with an envelope area of 128,400 m^2 and a volume of 746,720 m^3. These dimensions meant that this was the largest building in the world ever to have its air tightness examined.

The test would represent an enormous challenge to the Megafan's technology and reveal the practical problems associated with the testing of such a large building.

The Megafan was connected with a flexible duct to a wooden screen situated within one of the warehouse's loading bay openings. Figure 2 shows the fan and part of the building being tested. For the purpose of the tests all external doors and windows were closed, with internal doors to the offices left open. Mechanical ventilation openings on the building roof were sealed with impermeable sheet and adhesive tape. Large openings containing open louvres, constituting an area of around 40m^2, had been noted on previous site visits and were sealed during testing. Three 1m^2 openings in the building envelope remained unsealed to fulfil the requirement of ventilation to gas boilers. Personnel were required to operate the Megafan and record the observed pressure differentials.

Other observers were positioned around the building and on the roof to ensure that vents remained sealed and doors remained closed. Communications were maintained by two-way radio contact.

The pressure differential across the building envelope was raised to 81 Pascal and then lowered in ten stages to 23 Pascal. Measurements were also made of the internal pressure distributions at a regular 7 x 7 grid of points inside the building when the differential pressure across the envelope was set at 50 Pascal. The first grid point was 20 m from the fan wall and 45 m from the side wall. These measurements were taken using 5mm internal diameter plastic tube, up to 140m in length. The tubing was arranged in straight lengths and did not come into contact with sources of heat. Using tubes of this length resulted in a damping of the fluctuations in pressure.

Results and discussion

The initial measurements established the relationship between the airflow through the fans, Q, and the differential pressure, Dp, observed across the building envelope. Figure 3 shows a log-log analysis of the Q-Dp data points for the retail distribution warehouse. The air permeability of the building at 50 Pascal was calculated to be 2.25 m^3/hr/ per m^2 of building envelope surface, which easily passes the UK Building Regulations maximum value of 10 m^3/hr/ per m^2. There was an indication of a variation in pressure differentials across the inside of the building, due possibly to either fan pressure fluctuations or stagnation pressures being developed at the internal surfaces of the space.

Conclusion

The examination of the largest building in the world ever to be air tightness tested has shown that

- it is technically and practically possible to develop an air tightness testing facility for very large buildings
- it is possible for a very large building to meet the new UK Building Regulations for air tightness without the need for specialist construction and sealing techniques

For further information contact Ed Westgate at HRS Services on +44 (0) 114 272 3004, *info@hrsservices.co.uk* or visit *http://www.hrsservices.co.uk*.

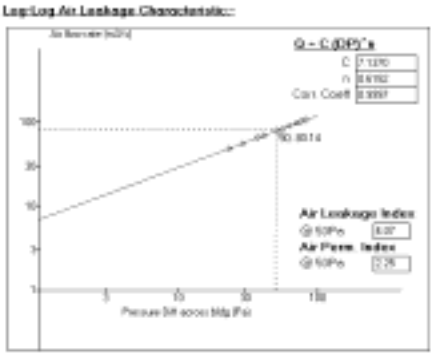


Figure -
Results of air pressurisation test

STANDARDS AND REGULATIONS

New European standards on ventilation for buildings

http://www.cenorm.be

Several new standards on ventilation for buildings, prepared by the Technical Committee 156, have been published by the CEN in 2004:

- EN 13142:2004 Ventilation for buildings - Components/products for residential ventilation - Required and optional performance characteristics
- EN 13141-1:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 1: Externally and internally mounted air transfer devices
- EN 13141-2:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 2: Exhaust and supply air terminal devices
- EN 13141-3:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 3: Range hoods for residential use
- EN 13141-4:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 4: Fans used in residential ventilation systems

- EN 13141-6:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 6: Exhaust ventilation system packages used in a single dwelling
- EN 13141-7:2004 Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 7: Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings
- EN 13465:2004 Ventilation for buildings - Calculation methods for the determination of air flow rates in dwellings
- EN 14134:2004 Ventilation for buildings - Performance testing and installation checks of residential ventilation systems
- EN 14239:2004 Ventilation for buildings - Ductwork - Measurement of ductwork surface area
- EN 14240:2004 Ventilation for buildings - Chilled ceilings - Testing and rating

Information about these standards is available in the new AIVC standards database which is available on the AIVC-CD (see at the end of this page).

Update on European Standards about ventilation ductwork

Several new European standards were published in 2003 and 2004 about buildings ventilation ductwork.

The updated collection of European standards concerning ducts is composed of the following references:

- Circular sheet metal ducts:
  - EN 1506 (1998): Ventilation for buildings – Sheet metal air ducts and fittings with circular cross section. Dimensions.
  - EN 12237 (2003): Ventilation for buildings – Ductwork – Strength and leakage of circular sheet metal ducts.
  - EN 12220 (1998): Ventilation for buildings – Ductwork – Dimensions of circular flanges for general ventilation.
- Rectangular sheet metal ducts :
  - EN 1505 (1998): Ventilation for buildings – Sheet metal air ducts and fittings with rectangular cross section. Dimensions.
- Other types of ducts:
  - EN 13403 (2003): Ventilation for buildings – Non metallic ducts – Ductwork made from insulation ductboards.
  - EN 13180 (2002): Ventilation for buildings – Ductwork – Dimensions and mechanical requirements for flexible ducts.
- Ductwork and all types of ducts:
  - EN 12236 (2002): Ventilation for buildings – Ductwork hangers and supports. Requirements for strength.
  - EN 14239 (2004) : Ventilation for buildings – Ductwork – Measurement of ductwork surface area.

In addition, two new ISO standards were also adopted as European standards:

- EN ISO 5136 (2003): Acoustics – Determination of sound power radiated into a duct by fans and other air-moving devices – Induct method.
- EN ISO 7235 (2003): Acoustics – Laboratory measurement procedures for ducted silencers and air terminal units – Insertion loss, flow noise and total pressure loss.

A Technical Report was also produced by CEN, which is not a standard but an information document:

- CR 14378 (2002): Ventilation for buildings - Experimental determination of mechanical energy loss coefficients of air handling components.

Current standardisation works (in CEN TC 156/WG3) mainly concern:

- Revision of EN 1506 (dimensions of circular ducts),
- Strength and leakage of rectangular sheet metal ducts (prEN 1507),
- Dimensions, strength and leakage of flat oval ducts,
- Requirements for ductwork components to facilitate maintenance of ductwork systems (prEN 12097 rev),
- Cleanliness of ductwork.

BOOKSHOP

AIVC standards database

A lot of standards related to air infiltration and ventilation for buildings are available worldwide. However it is quite difficult to have a clear picture of the whole since information is generally split up by organisations or countries and lost among other topics.

The AIVC has therefore started to build a database with information on these standards. It already contains the references of about 250 standards mainly from European countries, from the US, from the CEN and from ISO. It is the intention to add other references in the future (missing references or incomplete information can be reported to the AIVC – *aivc@bbri.be*).

The main fields of the database are the following:

- Name of the standard;
- Organisation which has published the standard;
- Title of the standard (in different languages if any);
- Summary of the standard (in different languages if any);
- Status of the standard;
- Normative references cited in the standard.

The database gives also information about the standardisation institutes: name, country, address, website and e-mail.

The database is now available on the AIVC-CD
(Microsoft Access version).

Displacement Ventilation

A new Ventilation Information Paper from the AIVC
AIVC VIP 05, 2004, 8 pp,
Peter G. Schild

The principle of displacement ventilation involves air supply and distribution in a room by upwards displacement, i.e. as direct as possible through-flow in the occupied zone in order to achieve high ventilation efficiency. In addition, air distribution by displacement generally makes it possible to supply a larger quantity of air than for conventional mixing ventilation, which requires concentrated supply at high velocity.

The air flow pattern differs greatly from that caused by conventional mixing supply jets. Air is supplied at low velocity to the occupied zone, often near the floor (see figure).

The new air is slightly cooler than the air in the room, and thus has a strong tendency to fall and spread out over the floor in a uniformly thin layer (approximately 20 cm), due to gravity, without mixing significantly with the room air above. This process leads to a continual upwards uniform displacement of air in the room, akin to filling a bathtub with water.

The air in the occupied zone is thus generally fresher than for mixing ventilation. Air is extracted from the room at ceiling level.

In addition, for localized pollutant sources that generate heat, such as humans, the released pollutants rise rapidly to above the occupied zone, due to buoyancy forces (an upwards flowing natural convection plume). This local upwards flow also brings up a steady stream of fresh air from the floor up to the breathing zone of occupants. The air in the breathing zone is thus slightly fresher than elsewhere in the room at the same height.

The supplied air flow rate and its cooling capacity are limited by the size of the air supply areas, and on the magnitude of the air flow rate that is technically/economically justifiable.
The cooling capacity is also limited by how cold the supply temperature can be without causing local discomfort (cold draught along floor).

For more information on displacement ventilation, read the new Ventilation Information Paper.

Air-to-Air Heat Recovery in Ventilation Systems

A new Ventilation Information Paper from the AIVC
AIVC VIP 06, 2004, 12 pp,
Peter G. Schild

A heat recovery unit transfers heat (some units also moisture) from the exhaust air stream over to the supply air stream, thus reducing the heat loss due to ventilation, and reducing the need to condition the cold supply air. Conversely, in hot and humid outdoor conditions, a heat recovery unit can keep heat (some units also moisture) outside, thus reducing air conditioning costs.
Heat recovery may be used in balanced ventilation systems (i.e. fan powered supply and exhaust air flows).

The building should be satisfactorily air-tight - air leakages constitute an extra heat loss since they do not pass though the heat recovery unit.

For dwellings, the infiltration rate should not exceed 10–20 % of the flow rate through the heat recovery unit.
Heat recovery is equally appropriate for buildings with any space heating system. Correctly dimensioned and maintained heat recovery units with high efficiency will pay for themselves in a few years, in terms of reduced ventilation & space heating costs. This profitability is higher if the exhaust fan is located before the heat exchanger. It should be possible to reduce the heat recovery efficiency outside the heating season, to prevent over-heating indoors. Some heat exchangers can also recover moisture.

It can be desirable to recover moisture this way in buildings with central humidification in winter, to reduce humidification costs. For AHUs with cooling (air conditioning) moisture recovery can be desirable in summer (when the outdoor air is hot and humid) to reduce the cooling energy needed for dehumidification. If the exhaust air has water-soluble odours/pollutants, one should nevertheless use a heat exchanger that does not recover moisture, i.e. totally separate air streams.
Heat recovery units require regular inspection and maintenance, though anyone with normal technical aptitude can do this, on the condition that a proper operation & maintenance manual is available.

For more information on air-to-air heat recovery, read the new Ventilation Information Paper.

VIPs in French

Two of the Ventilation Information Papers (VIP) published in 2003 by AIVC have been translated into French and are now available on the AIVC CD.

The translation of VIP n°1 “Airtightness of ventilation ducts” has been prepared by BBRI (Belgium) and CETIAT with the support of ADEME (France).

VIP n°2 “Indoor Air Pollutants – Part 1” has been translated by CETIAT (France) with the support of ADEME.

Translation should increase dissemination of these documents among French-reading persons interested in ventilation.

Design Guidelines for Displacement Ventilation

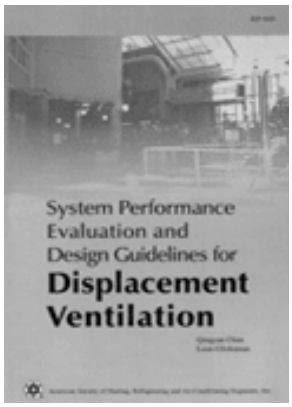
http://www.ashrae.org

This book recently published by ASHRAE (System Performance Evaluation and Design Guidelines for Displacement Ventilation) presents displacement ventilation system performance evaluation. It includes a 10-step design guideline for displacement ventilation systems for U.S. buildings.

These design guidelines present two important models:
1. to calculate the temperature difference between the head and the foot level of an occupant;
2. and one to determine the ventilation effectiveness at the breathing level.

The book notes that a displacement ventilation system can provide a thermally comfortable indoor environment at a high cooling load through careful design.
The indoor air quality in a space with displacement ventilation is better if the contaminant sources are associates with the heat sources. The displacement ventilation system can also save energy but requires a separate heating system if it is applied to building perimeter zones.

Its publication results from an ASHRAE research project by Purdue University and Massachusetts Institute of Technology.



CONSTRUIRE AVEC L'ÉNERGIE naturellement !

Transitional program towards the energy performance of buildings

http://energie.wallonie.be

Within the framework of the European Directive of 16 December 2002 on the energy performance of buildings, the Walloon Region (Belgium) has launched a transitional program called “Construire avec l’énergie” (which means “to build with the energy”).

The aim of the action is to help volunteers (architects and building contractors) in building dwellings with better energy characteristics than those strictly required by the law. The action focuses on thermal insulation, ventilation system, central heating installation and hot water production.

Three brochures have been produced for supporting the action; they are available on the AIVC-CD (in French):

1. Information brochure for the professionals;
2. Practical guide for the owner;
3. Technical brochure for architects and building contractors.

MEETINGS AND EVENTS

CLIMAMED '04 – Mediterranean Congress of Climatization

The first CLIMAMED – Mediterranean Congress on Heating, Ventilation and Air Conditioning - took place in Lisbon on 16 and 17 April 2004, under a theme of paramount importance: the application of the E.U. Directive on the Energy Performance of Buildings in Mediterranean Climate countries, where cooling issues are of particular concern.

It was organised by four Mediterranean Climate countries, through their associations in the HVAC field: Portugal (APIRAC); Spain (ATECYR); France (AICVF) and Italy (AICARR). Approximately 300 participants attended this first CLIMAMED, which is expected to be held every year from now on. It also counted with the presence of the President o REHVA, Mr. Dusan Petras and Dr. Peter Wouters, of INIVE, who presented an European view of the issues raised by the Directive.

One of the purposes of this conference was the creation and the strengthening of a task force organised by the Southern European countries, to protect and defend their own interests, regarding the importance of energy consumption for cooling, in contrast to the cold climate countries of North Europe.

Thirty seven Papers were selected by the Scientific Committee and presented in two auditoriums, on the ten themes initially proposed: (1) Solar Systems, Renewable Sources and their application to HVAC Systems; (2) Energy Efficiency in Buildings; (3) Environmental Impact and Protection; (4) Refrigerant Fluids of the 400' Series; (5) HVAC Systems and Production of Hot Water; (6) Indoor Air Quality; (7) Ventilation Systems; (8) Comfort Standards – their application and Control; (9) Quality of Installations; (10) European Union Guidelines and Directives.

The participants of CLIMAMED'04 considered it of great importance for the HVAC sector as it helped to stress to the Public Entities and Organisations the urgent need for putting new revised regulations into force as soon as possible.

At the CLIMAMED, the Spanish Association ATECYR, invited everybody to attend and take an active role in the next CLIMAMED, to be held in February 2005 in Madrid, together with the annual Fair "Climatizacion", hoping that the second edition of this series of events will have at least as much success as the first.

The AIVC Conference 2005 will be held in Brussels (Belgium) on 21-23 September.

More information will be available in the December 2004 issue of AIR.

Report on the 9th BlowerDoor-Symposium of e-u-[z]24.04.04 - Würzburg, Germany

Filip Dobbels -
Belgian Building Research Institute
http://www.bbri.be

Although the demand for a durable airtight envelope already dates from the middle of the last century (in Germany e.g. via the DIN 4108), practical realisation of this demand only began getting the attention it deserves in the 1990´s (in Germany e.g. through the establishment of the "prior technological art" in the DIN V 4108-7:1996, updated with the DIN 4108-7 in 2001). This evolution runs parallel to the strong development of adhesive technology in recent years. We are becoming progressively more aware of the necessity of applying airtightness systems in light structures and moreover a whole range of resources have now been put at our disposal. The number of their applications has therefore increased sharply in recent years.
A number of cases of damage remind us however that we still do not entirely control the airtightness of light structures. In particular the long-term behaviour is still an open question.
It was thus not surprising that at the 9th BlowerDoor-Symposium, which was held on 24 April 2004 in Würzburg, the ***durability of airtightness systems*** *(and the legal implications thereof) occupied a central place.*

The symposium could count on broad interest; around 140 persons made their way to Festung Marienberg in Würzburg.

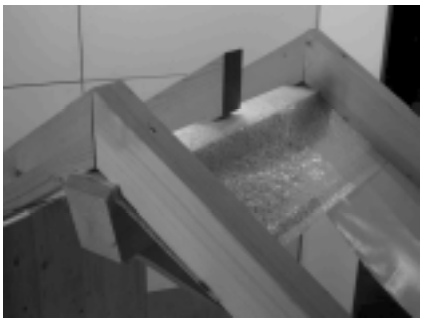
After a welcome by several key actors in the field of airtightness of buildings in Germany (Wilfried Walther of e.u.[z] (*Energie- und Umweltzentrum am Deister e.V.*)., Sigrid Dorschky of FLiB (*Fachverband Luftdichtheit im Bauwesen*), and Rolf Schmidt from the *Verband für Wohnungslüftung e.V.*, Dipl.-Ing. **Rolf Gross of the *Zentrum für Umweltbewusstes Bauen e.V.* at the Universität Kassel** gave a lecture on the current state of **research on the durability of adhesive bonds as part of airtightness systems**.
At present we still have no knowledge about the real behaviour of airtightness systems over the course of a service life of around 30 years, given that these systems only appeared on the market quite recently.

The main objective of this research is thus the protection of companies which install airtightness systems (often S.M.E.´s) against possible low-quality products or combinations of products (e.g. bonding with products from different producers) which could not guarantee airtightness in the long run. The warranty periods from the manufacturer appear to be quite brief (most producers state that their products will function for 30 or even 70 years, but most effective warranty periods are around 5 years, the longest are 10 years), which for many users raises doubts about the actual durability of these systems after around 30 years. In this study one first seeks to develop an objective *comparative methodology* for combinations of adhesive tapes (adhesives, e.g. acrylates, silicones, etc. on a support, e.g. paper, PE, etc.) and substrates (air screens but also e.g. OSB panels or masonry to which the air screen must be connected). On the basis of the chosen or developed methodology, one wishes to arrive at a *ranking* of the combinations which are frequently encountered presently. At this moment the study is in the beginning of the second phase. On the basis of a literature study one has compared the existing standards with test methods and criteria for the evaluation of adhesive bonds with one another and chosen a method with which one then tested a first selection of substrate/adhesive combinations.

It appeared that there was still no standardised method for testing the durability of adhesive bonds. One even proposed a method based on standardised methods (including from the medical sector) for the durability of adhesive tapes in unbonded state (e.g. during storage in a warehouse).

The strength of an adhesive bond is determined by the cohesion of the (generally visco-elastic) bonding agent and the adhesion between adhesive and substrate (and between adhesive and support). The adhesive force depends largely on the relation of the surface tensions: if the surface tension of the adhesive is less than that of the substrate (for PE e.g. minimum ca. 30mN/m), one generally has a good bond, including over the long term.

Generally the peal resistance is used as a measure for the strength of the adhesive bond. A normalised measuring method for peal resistance is described in FINAT No. 1 [ref. 1] and EN 28510-2 [ref. 2].



Test specimens are stressed to pealing off at a rate of 300 mm/minute. Because the stresses on air screen systems in practice act much more slowly (creep, shrinkage, etc.), the impact of the stress rate was studied and it was decided to perform the tests with a peal rate of 10mm/min. The results can be converted to even lower peal rates (as they occur in practice). *At lower peal rates, the peal resistance is lower.*

In the study the peal resistance was defined for several combinations of adhesives and substrates, whereby the types of substrates were limited to PE film and multiplex. Peal tests were performed before and after artificial ageing. The artificial ageing was carried out on the basis of ASTM D 3611-77 [ref. 3].

This American standard gives a method for evaluating the durability of adhesive tapes in unbonded state. In the study, however, one opted to work with test specimens composed of a substrate and an adhesive tape, on which a peal test can be performed. The method consists of placing the test specimens during a specific period in an environment with an air temperature of 65°C and a relative humidity of 80%. The link between natural and artificial ageing was determined on the basis of a publication of D. Satas [ref. 4] and was established as follows: "7 days of artificial ageing = 1 year of natural ageing". In the study, test specimens were subject to artificial ageing for 350 days, which thus corresponds to 50 years of natural ageing. In the first tests, whose results were presented at the symposium, the peal resistance declined from ca. 10 N (after 48 hours of curing) to ca. 1 N (after 48 hours of curing and 350 days of artificial ageing).

This means that after about 50 years an adhesive bond retains (only) around 10% of its original adhesive force. However it is not known whether or not such residual adhesive force in practice will give rise to the failure of the bond. For this, additional research is necessary on the stresses which in reality develop in air screens under the impact of (inter alia) creep and hygrothermic deformations of the supporting structure (carpentry, masonry walls, etc.). It can also be noted that in practice under normal use conditions the temperature and R.H. will never rise so high as under the ASTM test conditions. *Work thus remains to be done in order to develop test methods and accompanying criteria to evaluate the real behaviour of adhesive bonds over the long term. Such a test would be sure to attract great interest, since currently there is a major need for objective and reliable information on the durability of airtightness systems. In the long run, such a test, in combination with clearly defined criteria, could form the basis for certification of airtightness systems, which is one of the objectives of FLiB. After completion of this study, the researchers from Kassel intend to go further in this direction [ref. 5].*

If from research it appears that the adhesion of adhesive bonds decreases sharply over time, one can ask whether additional mechanical fastening is not advisable. According to **Dr. Kasper of Isover** Consult, given a correct interpretation of the standard (nailed or screwed) **pressure laths** are not **necessary** for connecting the sealant strips with one another (unless one combines products which are not harmonised with one another), but they certainly are **for connecting the airtightness screen to other building elements** (walls, floors, purlins, ridge beams, etc.), unless the conditions for the bonding have been perfectly fulfilled (dry, dust- and grease-free, adequately load-bearing substrate, appropriate temperature), which is almost never the case on construction worksites during the winter or in renovation projects. According to the SIGA company, by contrast, with their products one can omit the extra laths.

As the third speaker, **H.-E. Gallinat**, chairman of the "Konstruktionen" working group of FliB, presented the first **edition of the FliB-Beiblatt to the DIN 4108-7**.

This publication – similar to the FliB-Beiblatt to DIN 13829 on the performance of pressurisation tests to determine the airtightness of buildings - includes proposals for changes and supplements to DIN 4108-7 (August 2001)[ref. 6] and takes account of the *Energieeinsparverordnung*. ("EnEV" – Energy Savings Regulation) which was published in November 2001 and entered into force on 01.01.02. These proposals are formulated on the basis of a series of detailed drawings of construction components and nodes whereby the practical execution of a continuous air screen plays a central role. The Beiblatt will soon receive wide-scale distribution. At the same time, FliB will also publish a *CD-ROM with a collection of all structures currently known (in Germany) for the airtightness of buildings.*

The lively **podium discussion between producers and experts** to conclude the morning programme clearly demonstrated that a general **consensus** about the sustainable execution of airtightness systems still **cannot be expected for tomorrow**.
However, everyone agrees on the general principles.
Once again reference was made to the importance of proper compliance with the processing instructions of the producers and a very careful installation, with preliminary verification of the suitability of the substrate in combination with the chosen adhesives.
Precise instructions on this (e.g. with regard to the absence of dust) are difficult to establish, however. FliB is working on criteria for the application of adhesives, but as the contribution of Dipl.-Ing. Gross illustrated, it is virtually impossible to generalise about all possible combinations which arise in practice. For their part, the producers point to the possibilities for preparing the substrate, e.g. by applying a primer.

Dipl.-Ing. Kempkes (*Zentrum für Umweltbewusstes Bauen e.V.* Kassel) started off the afternoon programme by presenting the initial results of a **study on the moisture risk in the event of flowing air from air leaks in the building envelope**. It is striking that damage due to condensation as a result of exfiltration on the whole is still relative rare, if one considers that almost no building can be regarded as air-tight. The presented research seeks to find an explanation for this through simulation of the instationary flow of a number of types of leaks under different conditions. Under normal circumstances an air flow from inside to outside appears to have a drying effect on the structure. It is only with more humid indoor climates or when the air must travel a long way to the (cold) outside of the structure (e.g. *metal roof coverings!) that condensation can develop. The dimensions and form of the joints, as well as the developing pressure course (frequency of pressure changes) over the joint appear to play a role here.*

Dipl.-Phys. J. Zeller (*Ingenieurbüro für Niedrigenergie- und Passivhäuser*, Biberach) went into greater detail on the **impact of individual leaks on the total air flow through the building envelope** and the theoretical background thereof.

It can be interesting to know which leaks make the most significant contribution to the total air permeability of the building envelope, so that with a minimum of labour and costs one can attain the desired airtightness via extra measures. Addressed were inter alia the calculation of the total air flow on the basis of the measured or estimated surfaces of and air rates through individual leaks ("network measurement"), the use of air permeability coefficients and the role of serial leaks. It is interesting to mention that, with a double air screen (*e.g. PE film + gypsum-cardboard sheet, with an air cavity in between), only the most airtight plays a significant role.*
The uncertainty in estimating airtightness appears to be very great.

Mr. Köpcke, a lawyer from Freiburg closed the symposium with a lecture on the **legal aspects of airtightness**. In Germany as well the current building practice with regard to airtightness is still far away from the standard in this respect (DIN 4108-7).

No single airtightness system is generally applied and has proven itself in practice over the longer term. They therefore do not yet belong to the prior technological art according to §5 Abs. 1 of the German Energiesparverordnung (EnEV) [ref. 7], so that, from a legal perspective, making airtightness criteria legally obligatory is not realistic. Conclusion: "The answer, my friend.... is blowin´ in the wind" – criteria cannot be legally established, but the current systems and test methods are very useful to guarantee the quality of today's construction works.

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Adhesive force test (180°) at 300 mm/min
Published in October 1985, revised in May 2001

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[Peel test for flexible/rigidly bonded specimens]

[3] ASTM: D 3611-77 (reapproved 1981)
American Society for Testing and Materials
Standard Practice for Accelerated aging of pressure sensitive tapes

[4] Satas, D. (ed.) "Handbook of Pressure Sensitive Adhesive Technology"
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ISBN 0-442-28026-2

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[Research on the durability of adhesive bonds for airtightness layers]

[6] DIN 4108-7:2001 "Wärmeschutz im Hochbau. Luftdichtheit von Bauteilen und Anschlüssen", Beuth-Verlag GmbH, Berlin, 2001 [Thermal insulation in high buildings, airtightness of components and connections]

[7] EnEV ("Energieeinsparverordnung") - Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden, 16.11.2001 [Regulation on energy-saving thermal insulation and energy-saving installation technology in buildings]

Some useful websites

Organisations and research institutes

- *http://www.flib.de* (Fachverband Luftdichtheit im Bauwesen e.V. (FliB))
- *http://www.e-u-z.de* (Energie- und Umweltzentrum am Deister e.V. (e.u.[z]))
- *http://www.wohnungslueftung-ev.de* (Verband für Wohnungslüftung e.V.)
- *http://www.bpy.uni-kassel.de* (Fachgebiet Bauphysik, Fachbereich Architektur der Universität Kassel)
- *http://www.zub-kassel.de* (Zentrum für Umweltbewusstes Bauen e.V.)
- *http://www.ibp.fraunhofer.de* (Fraunhofer Institute of Building Physics)

Companies which offer (components of) air tightness systems

- *http://www.ampack.de* (Ampack Bautechnik GmbH)
- *htpp://www.doerken.de* (Dörken GmbH & Co. KG)
- *http://www.hanno.com* (Hanno Werk GmbH & Co. KG)
- *http://www.henkel.de* (Henkel Bautechnik GmbH)
- *http://www.isocell.de* (Isocell)
- *http://www.isover.de* (Isover)
- *http://www.otto-chemie.de* (Hermann Otto GmbH)
- *http://www.proclima.de* (Moll bauökologische Produkte GmbH)
- *http://www.siga.ch* (SIGA Cover A.G.)
- *http://www.trelleborg.com* (Trelleborg Building Systems)

Companies which offer measuring equipment for the evaluation of air tightness systems

- *http://www.blowerdoor.de* (BlowerDoor GmbH)
- *http://www.ltm.biz* (LTM Thermo-Lüfter GmbH)
- *http://www.woehler.de\mgkg* (Wöhler Messgeräte Kehrgeräte GmbH)

Emissions and odours from materials

http://www.certech.be

In November 2003 CERTECH organised a two-day conference on the subject of "Emissions and odours from materials" (19-20 November 2003, Brussels, Belgium).

More than 130 delegates from 13 countries attended this event, confirming an ever-growing interest of public and industry in this field. Representatives came mainly from the automobile industry, from the building sector and also from the major polymer producing Companies.

Six papers presented during the conference are available on the AIVC-CD:

1. Optimising the analysis of trace volatile and semi-volatile organic chemicals for monitoring odorous emissions from materials. Elizabeth Woolfenden
2. Approaches to harmonisation of emission tests for the huge variety of quality labels. Reinhard Oppl
3. Correlation between sensory evaluation, chemical emission and odour description of building materials using different size of chambers. Kristina Saarela, Tiina Tirkkonen and Kirsi Villberg
4. The role and reliability of the sensory tests in the emission tests for the emission classification of building materials in Finland. Esko Kukkonen
5. The effect of painting at home with a modern paint. Rosell, L., Ek-olausson, B. and Lundgren B.
6. PUR Foams as Sources of Emissions in the Vehicle Interior - Evaluation of the Present Situation and Modes of Reduction. Klaus Herrmann

The second edition of the "Emissions and Odours from materials" conference will take place at Brussels on 22-23 September 2004.
Please note that the deadline for submitting paper is June, 25th 2004 (see conference leaflet and form for submitting papers on the AIVC-CD).

15th International Building Trade Fairs FOR ARCH 2004

http://www.forarch.cz/2004/index-en.asp

September 14 - 18, 2004
Prague Letnany Exhibition Centre, Czech Republic

FOR ARCH is a general building fair whose nomenclature composition includes all what pertains to civil engineering and technical equipment of buildings. It regularly attracts both exhibitors and visitors from almost 20 countries of Europe, Asia, Africa and America. About 1200 firms take part in the Fair every year. This Fair with the high visitors´ attendance (about 110 000 people) takes the first place in terms of the number of visitors coming to building fairs, and in terms of the number of exhibitors it is the second largest trade fair in the Czech Republic. This year it is going to be held on 14-18 September.

See also information about the organiser on the AIVC-CD 🗐)

ICEBO 2004 - International Conference for Enhanced Building Operation

http://ddd.cstb.fr/icebo2004

October 18-19, 2004 Paris, France
A joint event organized by CSTB, Texas A&M University and IEA ECBCS Annex 40

Energy and environmental concerns, business evolution and technology development are setting new challenges for the operation of energy systems in buildings.

The 4th International Conference for Enhanced Building Operation (ICEBO 2004) aims at being a leading place for exchanges between engineers, energy managers, state energy agencies, industrial companies, contractors and scientists interested in continuous improvement of existing building energy usage.

Organized in connection with the closing meeting of the International Energy Agency ECBCS-ANNEX 40 on "Commissioning of Building HVAC Systems for Improved Energy Performance", it will include the presentation of results from this international research project.

Addressing the question of how to transfer results from research projects to the "day-to-day" practice of building managers will be one of the main emphases of this conference.

Healthy Buildings Conference Lisbon 2006

The HB 2006 conference will be held in Lisbon from 4 till 8 June 2006. It is the official conference of ISIAQ (International Society of Indoor Air Quality and Climate – *http://www.isiaq.org*). Practical information will become available on *http://www.hb2006.org* and information can be obtained from *hb2006@fe.up.pt*.
AIVC and INIVE EEIG are sponsors of this conference.

POLICY AND PROGRAMMES

The French permanent survey on indoor air quality

Exposure to indoor air pollutants is one of the major areas where lack of knowledge is a strongly limiting factor for health risk assessment and management. Created in 2001 and funded by the Ministries in charge of Construction and Housing, Environment and Health as well as by the French Agency of Environment and Energy (ADEME) and CSTB (Building Research Institute), the Permanent Survey on indoor air quality (in French: Observatoire de la Qualité de l'Air Intérieur) is one of the major parts of a multiyear governmental program on "building and health".

It aims to provide, on a continuous basis, the necessary data for risk assessment and risk management related to exposure to indoor air pollution.

State of the art and current surveys
Gathering nationwide data on Indoor air quality in France is one of the main tasks of the Permanent Survey.
A first review on national knowledge on IAQ (1990-2000) has been achieved in 2001 and is available on the OQAI website: *http://www.air-interieur.org* in order to identify existing data and gaps. This work is currently updated for the period 2001-2003.

National campaigns on indoor air quality
The first nationwide survey on indoor air quality conducted by OQAI has been focused on dwellings which are fairly diverse (in terms of built structures and conditions of occupancy) and where the magnitude of time spent by the individuals is the most significant. Started in 2003, October to achieve in early 2005, this campaign aims to provide a first general picture of general population exposure to the main indoor air pollutants and related risk factors in specific indoor environment.

About 700 dwellings will be investigated. The target population is the national housing stock of approximately 24 million permanently occupied housing units.

To optimise the study cost, the choice of the measured parameters has been based on a ranking method developed for prioritising 70 pollutants including chemical and biological agents. Questionnaires and time budget activity diaries are used to establish the characteristics of investigated sites and describe population and behaviour in the dwellings.

Read more on the AIVC-CD 🗐.

EC Information leaflet on "Improving the energy Performance of buildings"

http://www.managenergy.net/products/R210.htm

The EC has produced an information leaflet for explaining the context for and content of the so-called Energy Performance of Buildings Directive. On the AIVC-CD, you can find the pdf-file of this leaflet in 11 different languages (Danish, German, Greek, English, Spanish, Finnish, French, Italian, Dutch, Portuguese and Swedish.

AIVC Conference 2004: "Ventilation and Retrofitting" - 15-17 September 2004

Since 1980, the AIVC conferences have been the meeting point for presenting and discussing interesting developments and results regarding ventilation in buildings. For each conference a specific theme is selected and a substantial part of the presentations relate to this theme. **The 2004 conference is the 25th AIVC conference** and therefore the **"Silver Jubilee" conference**. The theme of this conference is **"Ventilation and Retrofitting"**. There are several reasons for selecting this theme:

- air quality is below standards and/or the energy consumption for ventilation is high to very high in many existing buildings
- improvement of the air quality and ventilation performances in existing buildings can be quite challenging
- substantial improvement of the overall energy consumption of the building stock requires implementing large-scale measures in existing buildings, and often requires attention, even when it was not an issue before the retrofit
- the retrofitting of existing buildings is a major theme in the EU 6th framework programme as well as in the 5-year plan of the US Department of Energy

Programme

The programme will cover the following topics (about 60 papers):

- performances of ventilation systems in existing buildings (air flow rates, acoustical performances, energy consumption, system characteristics)
- airtightness of existing buildings and ventilation systems
- retrofitting of existing buildings (dwellings or non-domestic buildings)
- air quality in existing buildings before and after retrofitting
- economic aspects of retrofitting measures
- occupant productivity and health
- standards or regulations for existing buildings (air quality, energy,...)
- development and application of innovative systems for the retrofitting market
- systems integration and synergetic effects
- demand-controlled ventilation in existing buildings
- ventilation retrofitting and improved security (anti-terrorism)
- retrofit case studies

Moreover, the topic of **hybrid ventilation in new and existing buildings** will be given particular attention; 2 sessions will be organized in close collaboration with the EC RESHYVENT project.

Venue

AIVC Conference 2004 will be held at the Hotel Dorint • Don Giovanni • Prague
Vinohradska 157a - 13020 Prague - Czech Republic
Tel.: +420 (0) 2.67.03.11.11- Fax: +420 (0) 2.67.03.67.17 - *http://www.dorint.com/prag*

Registration fees

	Before 1st July 2004	From July 1st 2004
Conference fee (without accomodation)	599 €	699 €
Conference fee for students (without accomodation)	349 €	399 €

One full registration fee by participant is required for each technical paper included in the programme. Papers submitted without payment of the registration fee will not be inserted in the Conference proceedings nor included in the technical programme.

The fees cover: Attendance at all sessions; welcome coffee, lunches (except on Thursday noon) and breaks throughout the conference; the guided tour, food and drinks on Wednesday evening; the proceedings.
A registration form is available on *http://www.aivc.org* or on the AIVC CD.

Conference secretariat

AIVC – c/o INIVE EEIG - Boulevard Poincaré 79, BE-1060 Brussels, Belgium
Tel.: +32.2.655.77.70 - Fax +32.2.653.07.29 - E-mail: *conferences.inive@bbri.be* - Contact: Stéphane Degauquier

AIR + AIVC CD

The Air Information Review (AIR) is a quarterly newsletter containing topical and informative articles on air infiltration and ventilation research and application. The newsletter is distributed with the AIVC-CD.

This set contains the printed version of the Air Information Review and a CD-Rom with :

- Current Air Information Review (with annex documents)
- Related newsletters;
- Airbase (AIVC bibliographical database);
- AIVC publications;
- AIVC conference proceedings.

The set is available through subscription. Subscriptions are for 4 consecutive issues of AIR (from September issue to June issue). See selling prices on the order form.

Enquirers in INIVE countries (Belgium, France, Greece, Norway) can obtain AIR and the AIVC-CD at preferential rates (even free of charge in some countries). Please contact INIVE for practical information (*inive@bbri.be*).

AIRBASE

The full version of AIRBASE, the bibliographical database of AIVC, is available on the AIVC CD Rom. It contains more than 15,000 references and abstracts of articles and publications related to energy efficient ventilation.

New additions to AIRBASE include references of numerous papers from the International Journal of Ventilation and from the recent Healthy Buildings conference (National University of Singapore – December 2003).

Conference proceedings - CD

A CD-Rom with the proceedings of the last AIVC conferences is available. At present, the CD contains the proceedings of AIVC conferences 1998, 1999, 2000, 2001, 2002 and **2003**. See selling prices on the order form.

AIVC publications – CD

A CD-Rom with all the guides (6), annotated bibliographies (12), ventilation information papers (2) and technical notes (46 – only some old superseded ones are missing) published by the AIVC between 1979 and 2003 is available.
See selling prices on the order form.

The free publication of the month

One of the AIVC publications is available for free on the Internet (*http://www.aivc.org*). The publication is available for 2 months and afterwards replaced by another one.

Printed version of old technical notes

Since June 2001, the new publications of the AIVC are no longer produced in a printed version. However remaining printed copies of previous AIVC documents are still for sale at ECBCS Bookshop (£ 15 + postage).

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

Send orders by e-mail at *essu@ecbcs.org* (for printed AIVC publications only), or by fax at +44(0)121.262.1994, marked for the attention of Malcolm Orme.

Mailing Address:
ECBCS Bookshop (ESSU)
C/o FaberMaunsell Ltd
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