Air Infiltration Review

a quarterly newsletter from the IEA Air Infiltration Centre

Vol. 5 No. 1 November 1983

4th Conference Report

• 'Air Infiltration Reduction in Existing Buildings

All participating countries were represented at the Centre's 4th Annual Conference held in Elm, Switzerland. In addition, invited authors from Japan and West Germany attended. The venue proved to be ideal, with its relative isolation limiting distractions from the task in hand!

The opening remarks were given by Jürg Gfeller of the Federal Office of Energy, Switzerland who outlined the current Swiss research strategy into energy conservation in buildings. This was followed by the keynote address entitled 'Potential and limits of energy savings in the Swiss building stock' presented by Conrad Brunner, an architect and energy consultant from Zurich. In his address, Conrad indicated that the greatest potential for energy conservation related to limiting air change rates, reducing internal air temperatures and introducing central heating controls. Air infiltration in particular was estimated to account for 26% of the total heat loss from all buildings. The greatest limit to savings was thought to depend on behavioural aspects. It was stressed that the user must be given the controls by which he can regulate the building environment.

The main thrust of the conference focussed on large buildings – a hitherto much neglected area of air infiltration investigation. In particular, developments in measurement techniques necessary to establish both the significance of air infiltration heat loss and the effectiveness of airtightness retrofits featured prominently.

On the industrial front, Jonathan Dewsbury from the Building Services Research and Information Association, UK described progress in the development and validation of a tracer gas technique to measure air infiltration rates in industrial buildings. As part of this investigation, it was necessary to draught seal a recently constructed 7,000 m^3 industrial unit by applying sealant to roof and wall joints. Before and after pressurization tests revealed that a significant improvement in building airtightness had been achieved. Tracer gas measurements in industrial buildings was also the theme of a presentation by John Lilly from the South Eastern Gas Central Laboratories, UK. The emphasis of his paper was on a comparison of techniques, including a relatively inexpensive method involving the continuous injection of sulphur hexafluoride supplied from a small gas bag. Both papers concentrated on the difficulties of achieving good mixing and on the positioning of injection and sampling points.

Swedish progress in the airtightness testing of industrial premises was presented by Leif Lundin from the Swedish National Testing Institute. He reported that buildings up to 6,100 m^3 in volume have been pressurized using a fan rated at 75,000 m^3h^{-1} at 60 Pa. Typically, airtightness values in the 1 to 1½ air changes per hour range at 50 Pa were observed.

Willem de Gids from the Institute for Environmental Hygiene-TNO, Netherlands indicated the concepts of air

Inside this issue:

Conference Participants

movement and infiltration in many large buildings, including industrial units. He highlighted a number of important case studies including a study on a 1,400,000 m^3 auction hall in which a mathematical model was used to assess the performance of roof ventilators.

Large office buildings came under scrutiny with contributions from Norway, the United States of America and the United Kingdom. Bjorn Vik from the Norwegian Building Research Institute presented the results of Norwegian investigations into the effectiveness of sealing the joints between concrete elements and windows of a 14-storey office building. Pressure tests, using the building's mechanical ventilation system, were carried out both before and after sealing. Air leakage was reduced from 6.3 to 3.0 ach at 50 Pa, resulting in a reduction in energy consumption of 705,500 kWh per year. The payback period of the retrofit measure (including project costs) was 1.2 years. Richard Grot of the National Bureau of Standards described American progress in this field, citing eight case studies on office buildings ranging in floor area from 3,000 m^2 to 45,000 m^2. Air infiltration and air leakage characteristics were measured in each using tracer gas, fan pressurization and thermographic techniques. The purpose of the measurement programme is to develop test procedures which can be used, both to verify the thermal performance of new buildings and to determine cost effective retrofits. Richard Walker from the Building Research Establishment, UK described the development and use of a multi-tracer gas technique for measuring intercellular air flow rates in naturally ventilated office buildings. The study arose following the identification of a number of high-energy consuming buildings in which air infiltration had been identified as a major problem. In addition to using the method in an office building, the instrumentation was being validated in a controlled multi-cell chamber operated under pre-set conditions.

The effectiveness of measures to reduce air leakage in schools was described by John Shaw of the National Research Council, Canada. Airtightness tests were conducted using an external vane axial fan with a capacity up to 23 m^{3}s^{-1}. Several schools were investigated and typical areas benefiting from retrofit treatment were found to include openings between wall and roof joists, cracks between walls and window frames, leaky windows and defective dampers.

Dwellings did not completely escape attention, with a number of papers being presented which concentrated on multi-family housing as well as smaller dwellings. Christoph Zuercher from the Institute of Building Technology, Switzerland, and Helmut Feustel from the Hermann-Rietschel Institute, West Germany presented a joint paper describing the results of tracer gas measurements and fan pressurization experiments in an eight-storey residence. The purpose of the experiments was to determine the influence of the wind and stack pressure components on air infiltration rates. The need was stressed for information on easy-to-handle local wind pressure coefficients, to enable the calculation of wind pressure. Interesting contributions on dwellings were presented by Mark Bassett of the Building Research Association of New Zealand, and Hiroshi Yoshino of Tohoku University in Japan. It was learnt that, while both countries experience a relatively mild climate, airtightness studies are important with regard to airborne moisture transfer and indoor air quality. In New Zealand, the major concern relates to condensation in modern dwellings – particularly in bedrooms, while the concern in Japan relates to the widespread use of flue-less space heating appliances. Both speakers presented results comparing the relative airtightness of houses in their respective countries with those of Europe and North America. Air infiltration investigations in dwellings was also the subject of a paper by Ian Ward of the University of Sheffield, UK. He presented the results of two case studies in which reductions in air leakage were proposed. The first concerned low cost 'starter' homes of timber frame construction, while the second dealt with the refurbishment of apartment buildings. Pressurization tests and tracer gas measurements were made to establish air leakage routes.

It was encouraging to note that the needs of the energy consultant had not been ignored. Arne Elmroth of the Royal Institute of Technology, Sweden introduced the Air Infiltration Centre's Handbook on air infiltration control in housing, while David Harrje from Princeton University, USA illustrated a number of examples of recommended retrofit actions based on case studies. Peter Hartmann from the Swiss Federal Laboratories for Materials Testing and Research (EMPA) also concentrated on this aspect, dealing with the transfer of information and technology from the research sector to the consultant. The scope of his presentation was to display and criticise existing planning methods for calculating air leakage in buildings and to put forward alternative strategies.

Finally, a well-attended evening workshop on instrumentation and measuring techniques enabled several speakers to put forward new ideas on measurement strategies and to discuss current problems. This opportunity was also taken to introduce the AIC's review and bibliography on instrumentation (AIC Technical Note 10).

In magnificent surroundings and with superb organisation by our Swiss hosts, the conference was a complete success. The wide range of case studies and practical applications of measurement techniques described served to indicate the steadily growing pace at which air infiltration research ideas are being developed and applied. A sense of confidence and progress was reinforced by the exceedingly high level of technical presentations and discussions that took place. Much of the material presented was of immediate practical value.

A total of 16 papers presented at the conference have been published in a bound volume, price £16 inclusive of post and packing, available direct from:

The Air Infiltration Centre
Old Bracknell Lane West
Bracknell
Berkshire
RG12 4AH
Great Britain

A supplement containing an additional paper and discussion notes will be available shortly at no additional charge.

Conference Venue: Hotel Sardona, Elm, Switzerland

. . . and the 5th AIC Conference

Tentative arrangements have been made to hold the 5th AIC Conference in Reno, Nevada, USA. The most likely dates are 1–4 October 1984 and the meeting will concentrate on airtightness standards – effectiveness and application. User reactions, case studies and air quality controlled ventilation approaches will also be within the scope of the conference. A 'Call for Papers' is currently being prepared for circulation to nominated organisations. If you would like to receive further details directly, please contact Martin Liddament at the Air Infiltration Centre immediately. Summaries of papers for possible inclusion in the 5th conference must be received no later than 17 February 1984.

Air Infiltration Energy Use and Indoor Air Quality – How Are They Related?

David T. Harrje
Princeton University, New Jersey, USA

Niren L. Nagda and Michael D. Koontz
GEOMET Technologies Inc., USA

In recent years there has been a growing trend to reduce energy consumption by tightening the building envelope. Although the practice cuts the use of energy, the resulting reduction in air infiltration rate can adversely affect the quality of indoor air. This is a description of an ongoing investigation of energy and air quality trade offs under way in the United States.

The 2-year study, sponsored by the Electric Power Research Institute (EPRI), focuses on the relationships among residential energy use, air exchange rates, and indoor air quality parameters. The study objective is to develop models to describe these relationships. GEOMET Technologies, Inc., is conducting the study of EPRI in association with Princeton University and Applied Management Sciences.

To meet the study objectives, a specific direction was chosen that enables the investigators to conduct the study under controlled but realistic conditions.[1] The setting consists of two homes (see Figure 1), that are similar to those normally occupied by the general population. These two homes are identical in design and have been built aftar a careful selection of the site so that both are oriented in the same direction with respect to the prevailing winds. One of the two homes (termed the experimental house) has been retrofitted and has an air-to-air heat exchanger. The other home (control house) will remain untreated throughout the study.

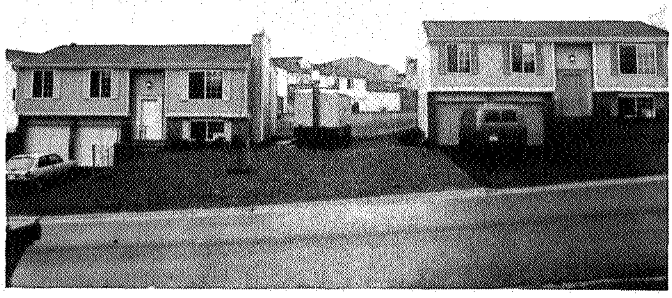


Figure 1.
Maryland test site showing experimental and control houses with mobile laboratory.

A mobile laboratory, situated between the houses, allows investigators to monitor both houses for various infiltration, indoor air quality, and energy use parameters. The table below summarizes the on-site measurement system. The measurements will be taken continuously for a period of 12 months. In addition to the continuous measurements, fan pressurization and depressurization measurements are conducted once a month.

The houses will be unoccupied throughout the study. The study is being conducted with a predefined protocol that includes simulation of occupant activities such as use of gas stove, wood stove, shower, washer, and dryer. Thus, duration and mode of operation for any occupant-related activities can be kept constant for the two houses and across different experiments.

The advantages of such a study design are many. The experimental setting allows for comparison of the two houses experiencing the same ambient conditions. Additionally, the controlled conditions and simulated occupant activities will enable the investigators to compare among many different time periods and operating conditions. Thus, for example, pollutant levels generated by a gas stove can be compared under a variety of situations such as between a summer day and a winter day, range exhaust fan 'on' vs 'off', circulation fan 'on' vs 'off', with and without use of the heat exchanger or any combination of these conditions. Similar comparisons will be conducted for other parameters (and effects of interest) for eventual quantification and modelling.

The study is anticipated to answer a variety of questions including the following:

- How does an air-to-air heat exchanger affect indoor air quality and energy use?
- How does building tightness retrofitting affect energy savings and indoor air quality?
- How do the seasons affect infiltration rates?
- How do climatic conditions affect the mixing of pollutants within the structure and thereby change concentration levels?

Although the experiments will continue for the next several months, some preliminary observations are noted below.

- Over the past 9 months, the variations in air leakage rate for the control house, as measured by the blower door, have remained within 5% of the mean value of 10 air changes per hour at 50 pascals. The seasonal effect on tightness of a building, seen in other investigations,[2] has not been observed to date in this study.
- When the circulation fan is not in operation, the upper and lower levels of both houses – control and experimental – behave like independent zones. This behaviour has an important effect on indoor air quality. For example, if the gas stove is operated when the circulation fan is not operating, the upper level (where the gas stove is located) tends to accumulate pollutants whereas concentrations in the lower level remain low and similar to outdoor levels. However, when the circulation fan is operating, due to either a heating or cooling demand, the whole house behaves as a single zone.
- Although blower door measurements have shown a 40% reduction in the air infiltration rate due to retrofit, preliminary observations indicate that infiltration rates based on tracer gas measurements conducted during the summer have not shown comparable differences. Thus, at least in this situation, seasonal changes have tended to overwhelm the structural differences between the two homes.
- Both houses have repeatedly demonstrated air infiltation rates as low as 0.1 – 0.2 ach under certain weather conditions, demonstrating that air exchange rates can be minimal even without making use of exceptionally tight construction practices.[3]

Table 1. Summary of the measurement system

Measurement Variable	Instrument/Method	Monitoring Zones[a]					Sample Acquisition Mode
		1	2	3	4	5	
1. **Air Pollutants**							
Carbon monoxide	Nondispersive infrared	x	x	x	x	x	Semicontinuous[b]; two analyzers
Nitrogen dioxide	Chemiluminescence	x	x	x	x	x	Semicontinuous[b]; two analyzers
Carbon dioxide	Nondispersive infrared	x	x	x	x	x	Semicontinuous[b]; one analyzer
Radon	Alpha scintillation	x	x	x	x	x	Continuous; five analyzers
Radon progeny	Gross alpha counting	x	x	x	x	x	Continuous; five analyzers
Formaldehyde	Pararosaniline	x	x	x	x		Integrated; 24-hour sampling
Inhalable particulates	Series filtration	x	x	x	x		Integrated; 24-hour sampling
	Virtual impaction/filtration					x	Integrated; 24-hour sampling
2. **Air Exchange**							
Sulfur hexafluoride	Gas chromatography	x	x	x	x		Semicontinuous[b]; one analyzer
3. **Environment**							
Barometric pressure	Aneroid cell					x	Continuous; one instrument
Relative humidity	Hair bundle	x	x	x	x	x	Continuous; five instruments
Temperature[c]	Thermistor	x	x	x	x	x	Continuous; nine sensors
Wind speed/direction	Cup/vane anemometer					x	Continuous; one instrument
Solar radiation	Pyranometer					x	Continuous; one instrument
4. **Energy**							
Energy consumption	Watt transducer[d]						Continuous; eight transducers
Circuit status[e]	Status tranducer						Continuous; 25 transducers

a Zones 1 through 4 encompass one floor in each of the two houses; zone 5 is outdoors. An 'x' in the column indicates that the particular zone is being monitored.
b Only one or two instruments with a valve sequencer are used to monitor multiple zones. Each zone is monitored once every 15 minutes.
c In addition to 5 zones, the temperatures of the attic and garage in each house are monitored.
d Not zone specific.
e Circuit status is the 'on' or 'off' status recorded for each appliance.

References

1. Nagda, N.L., Koontz, M.D., Rector, H.E., Harrje, D., Lannus, A., Purcell, G., Patterson, R.
Study design to relate residential energy use, air infiltration, and indoor air quality.
Presented at the 76th annual meeting of the Air Pollution Control Association, Paper No. 83-29.3, June 1983.

2. Persily, A.
Understanding air infiltration in homes.
The Center for Energy and Environmental Studies, Princeton University, Report No. PU/CEES, No. 129, 1982.

3. Elmroth, A. and Levin, P.
Air Infiltration Control in Housing – A Guide to International Practice, IEA Annex V, Swedish Council for Building Research.
Document D2: 1983.

AIRBASE – the AIC's bibliographic database

The AIC's bibliographic database continues to grow. It now contains abstracts of over 1,200 articles on air infiltration and related subjects. It covers all aspects of the uncontrolled flow of air through cracks and gaps in the building envelope, as well as natural ventilation, prediction methods, measurement techniques, measures for the reduction of air infiltration, relevant climatic data . . . and so on. Retrieval of references and their abstracts related to specific subject areas is easily achieved by structured searching using keywords or any word that may appear in the text.

All overseas participants are welcome to conduct their own searches via an international telephone modem linked to the computer. For more details of the local facilities required and the procedures to be followed, please contact Katy Thompson (AIC's Librarian) or your national Steering Group representative (see back page).

You may prefer Katy to conduct searches on your behalf. Just contact her giving brief details of the subject of interest, together with any restriction on the date of publication or language of the original papers. In return, she will supply a copy of the abstracts found in *AIRBASE*.

Overview of Research Work in Air Infiltration and Related Areas in Belgium

P. Caluwaerts, Belgian Building Research Institute, Brussels, Belgium

P. Nusgens, University of Liège, Belgium

Introduction

Although research in air infiltration and related areas has been carried out for many years in Belgium, it is only recently that activities have been increased in this field, especially at the two Institutes dealing with these topics in Belgium:

- The Belgian Building Research Institute.
- The Laboratory for Building Physics at the University of Liège.

Building Component Testing

As in many other countries, the airtightness of building components, and especially that of windows, has been greatly improved over the last ten years. This is partially due to more severe building codes and the related measurements. The Belgian codes STS 36 (metal window frames) and STS 52 of the National Housing Institute impose a classification of window performances as indicated in Figure 1. Figure 2 shows how a number of 100 recently tested windows performed with regard to these standards.

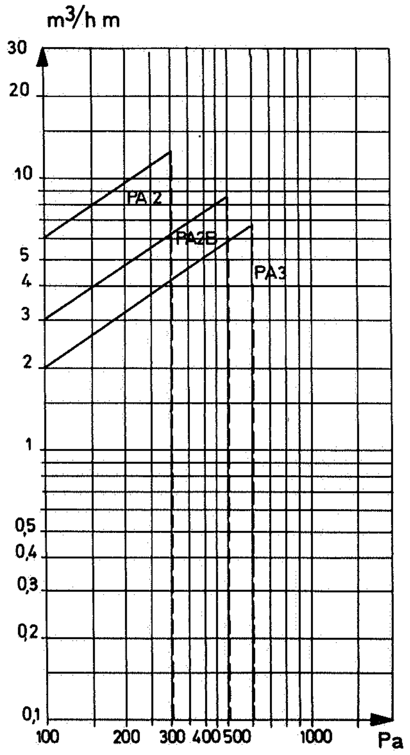


Figure 1. Performance levels for windtightness of window frames in the new Standard Technical Specifications.

Similar studies have also been undertaken in the field of building wall airtightness testing, especially unplastered concrete masonry. These measurements are generally performed in situ with similar pressurization equipment.

Condensation and Airtightness

As one can see from Figure 2 there is clear trend in Belgian window design (and not only in Belgium) to improve window airtightness to such a level that other problems arise. Condensation is one of the most evident. The relation between airtightness of windows, ventilation rates, thermal bridging and moisture generation in the house is now under continuous (mostly theoretical) study, since mould formation seems to have become one of the commonest results of building design errors in the Eighties.

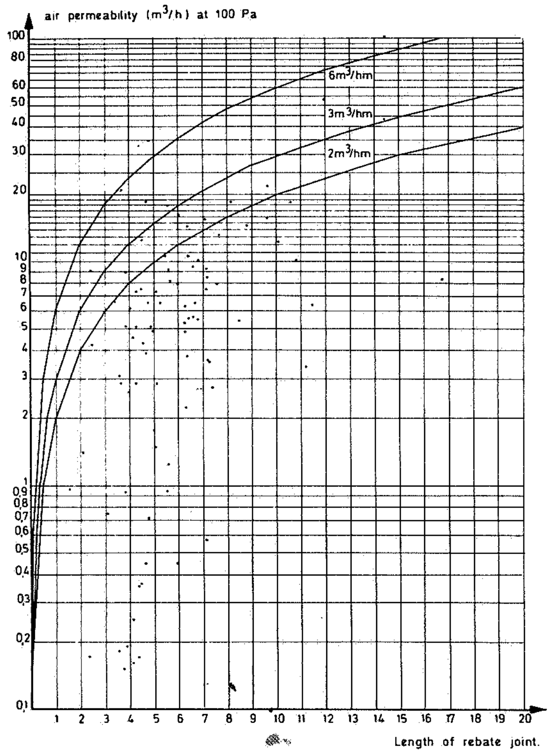


Figure 2. Airtightness results for 100 tested windows.

Also related to this same topic are the increasing number of practical studies on problems with convective moisture transfer through some building components (example of an area of difficulty: ventilated and insulated cold roof decks).

House or Room Pressurization

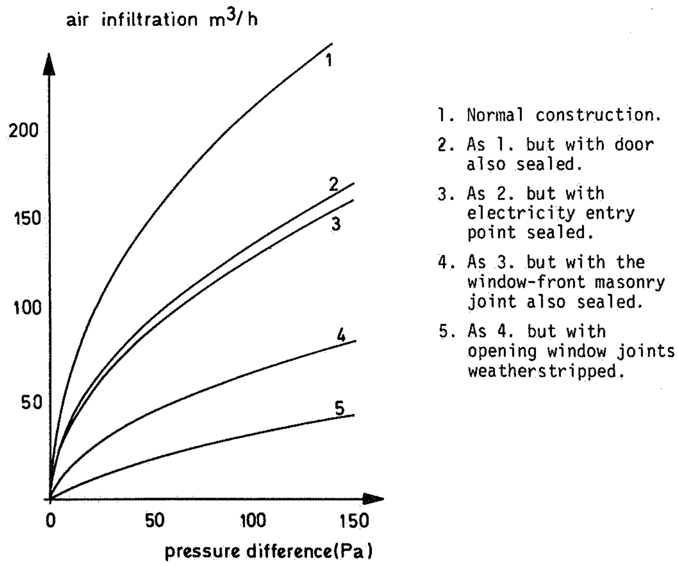


Figure 3. Field results showing infiltration through various elements of a masonry-constructed room under varying imposed pressure differences across the external walls.

Since the technique had been developed for windows, and window improvements made the background air leakage rather important, pressurization tests on houses or rooms also became popular in Belgium as a qualitative improvement test and as a means of making a quantitative comparison. Figure 3 provides an example of room improvement research. Figure 4 provides a comparison of equivalent leakage area (as derived from pressurization tests) for a number of Belgian and American single family houses.

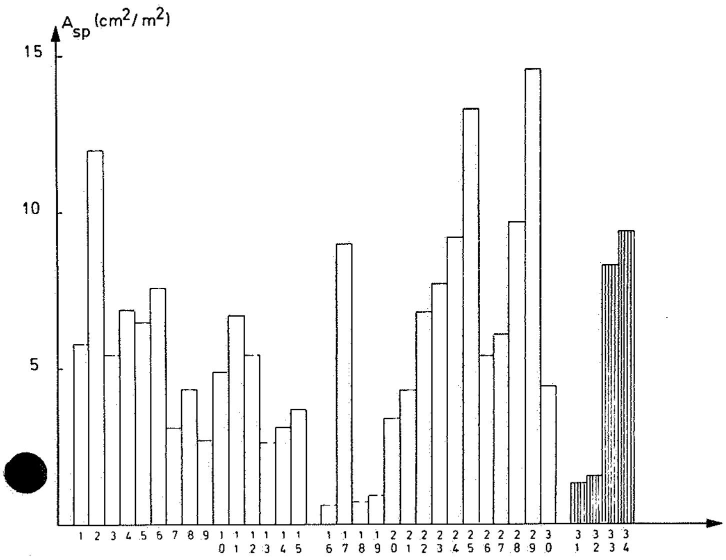


Figure 4. Specific infiltration surface area A_{sp} for 15 Belgian, 15 American and BBRI dwellings.

Air Infiltration Rate Measurements

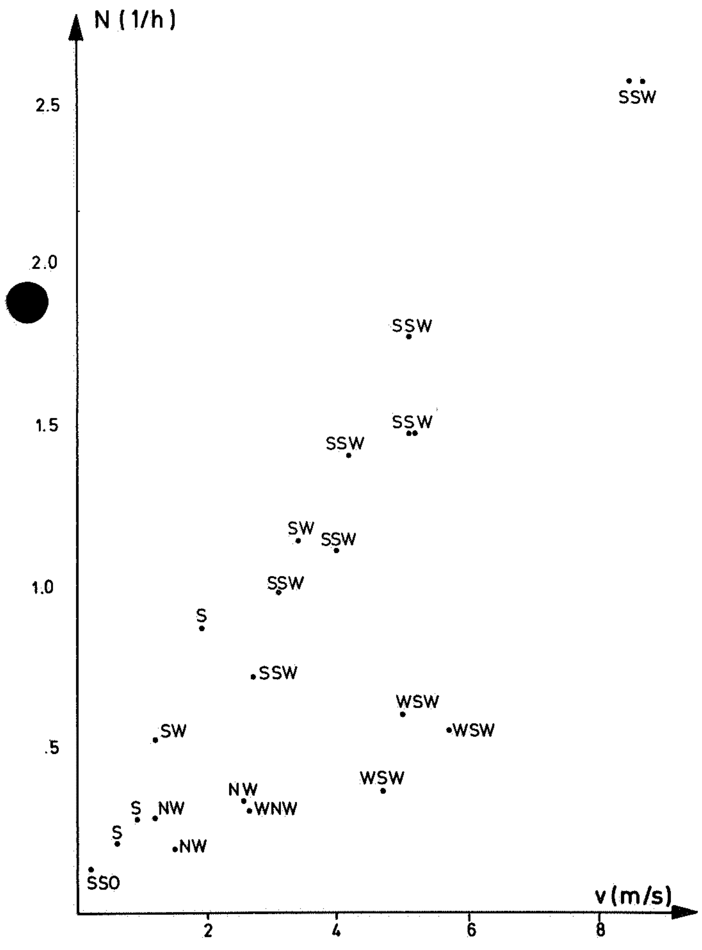


Figure 5. Results of tracer gas measurements in block 2 of BBRI houses.

Air infiltration rate measurements have been performed since 1977. Generally the technique used was a single decay measurement with a tracer gas (N_2O or CO_2). In most cases the technique was used in order to predict the air infiltration rate of the house as a single zone (some measurements were made for multi-zone analysis). Until now the measurements have been performed essentially in detached single family houses, or in parts of houses (attics, garages) and also in groups of identical houses. The influence of wind velocity, direction and temperature difference has been analysed more deeply in a few experimental unoccupied houses. An example is provided in Figure 5.

Some measurements have been performed with open windows and doors. Finally, work has recently been started on a comparison of results from measurements with some existing prediction techniques of the air infiltration rate. This work is still going on.

Other Related Areas

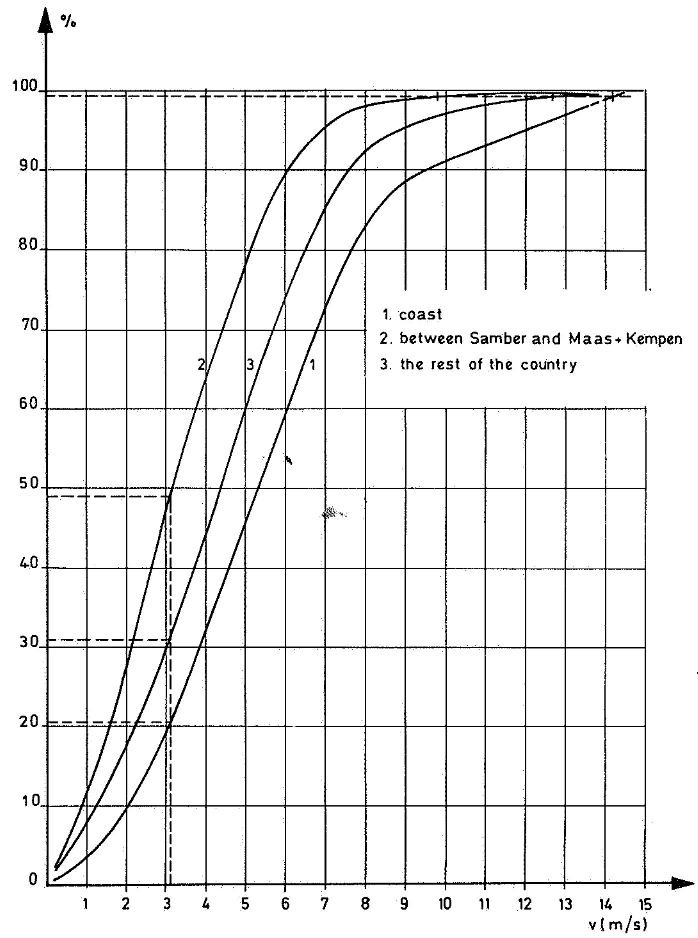


Figure 6. Percentage of the heating season during which the windspeed does not reach the speed indicated in the abcissa.

As should be evident from the previous topics, one should become interested in both human behaviour with regard to ventilation and also in statistical information about climatic conditions affecting air infiltration and ventilation. These areas will soon be, or are already, under study as Figure 6 shows. The results, when available, should improve our knowledge of mean seasonal air infiltration rates needed for more precise energy consumption figures (more accurate than the rough .75 vol/hr used so far as a common 'average' value).

Wind Pressure Workshop in Belgium (see page 9)

Forthcoming Conferences

1. ASHRAE '84
   Atlanta, Georgia, USA
   29 January – 1 February 1984

   Further information from:

   ASHRAE International Headquarters
   1791 Tullie Circle NE
   Atlanta
   Georgia 30329
   USA

2. Wind Pressure Co-efficient Workshop
   Brussels, Belgium
   21 and 22 March 1984

   Further information from:

   The Air Infiltration Centre
   Old Bracknell Lane West
   Bracknell
   Berkshire
   RG12 4AH
   Tel: 0344 53123
   Tlx: 848288 BSRIAC G

   Or from your local Representative (see back page of this newsletter)

3. ASTM Symposium on Measured Air Leakage Performance in Buildings
   Philadelphia, USA
   April 1984

   Further information from:

   Ms K. Greene
   ASTM Publications Division
   1916 Race Street
   Philadelphia
   Pennsylvania 19103
   USA

4. Energex '84
   Regina. Saskatchewan, Canada
   14–19 May 1984

   Covers energy conservation in residential, commercial and industrial buildings.

   Further information from:
   Professor F. Curtis
   Chairman – Technical Program & Publications
   University of Regina
   Regina
   Saskatchewan
   S4S 0A2
   Canada

5. Windows in building design and maintenance
   Gothenburg, Sweden
   13–15 June 1984

   Includes:

- *energy balance improvement of windows in existing buildings, windows in low-energy buildings.*

- *relationship between windows and room climate factors, e.g. temperature, air quality.*

   Further information from:
   RESO Congress Service
   S-10524 Stockholm
   Sweden

Recent Acquisitions

The following papers have recently been acquired by the Air Infiltration Centre's library.

1. Sodergren, D., Puntilla, A.
   A CO_2 controlled ventilation system Pilot Study.
   Swedish Building Research Council Document D7, 1983, 31 pp.

   Describes a CO_2 controlled ventilation system in an office building.

2. Merriam, R.L., Rancatore, R.J., Purcell, G.P.
   EMPS 2: A computer program for residential building energy analysis.
   Proceedings of the International Conference 'System Simulation in Buildings', Liège, Belgium, 6–8 December 1982, pp. 21–59.

   Describes a computer program developed for the analysis of residential building thermal loads, and space heating and cooling energy use.

3. Fish, W.J., Turcel, I.
   Residential air-to-air heat exchangers – Performance, energy savings and economics.
   Energy Bldgs. 1983, Vol. 5, No. 3, pp. 197–211.

   Discusses performance of residential heat exchangers and summarizes results from tests of several models.

4. Lyberg, M.D.
   Models of infiltration and natural ventilation.
   Pre-print National Swedish Institute for Building Research 1983, pp. 36.

   Investigates the efficiency of eight different models describing infiltration and natural ventilation in buildings.

5. Shaw, C.Y.
   The effect of mechanical ventilation on the air leakage characteristics of a two-storey detached house.
   NRCC Building Research Note No. 204, July 1983, pp. 27.

   Measures air change rates in a two-storey detached house with operation of various types of mechanical fresh-air ventilation systems.

6.* Kusuda, T.
   Indoor humidity calculations.
   Pre-print ASHRAE Trans. 1983, Vol. 89, pt. 2A & B, 12 pp.

   Describes a model that permits the evaluation of room surface moisture absorption capability.

*This paper is not available from the AIC. Copies of the remainder are available to organisations in participating countries.

Overseas Enquiries

The Air Infiltration Centre would welcome an increase in the number of bibliographic enquiries from overseas participants. For a speedy service, enquiries may be made any time of day via the AIC's telex or 24hr telephone answering machine. Such enquiries will receive prompt attention and every effort will be made to despatch replies by return.

Please telephone your enquiry on +44 344 53123 or telex us on 848288 (BSRIAC G).

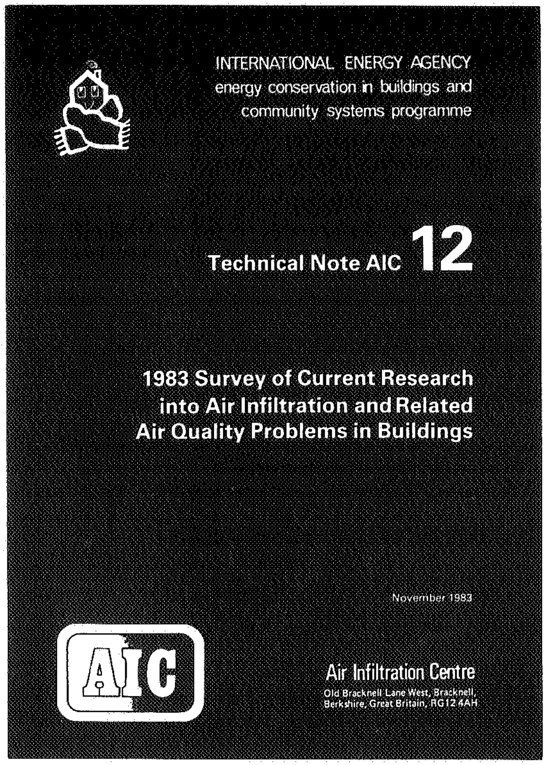
New Publication

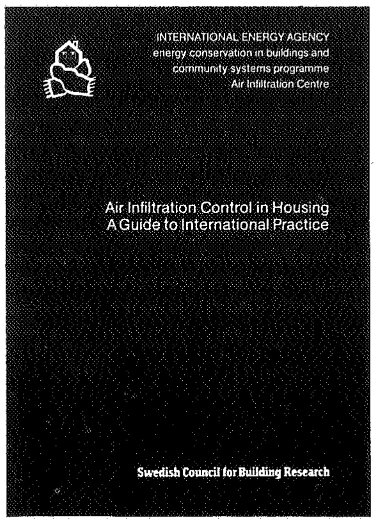
AIC-TN-12-83
1983 Survey of Current Research into Air Infiltration and Related Air Quality Problems in Buildings

The Centre's 3rd worldwide survey of research is currently being published and will be available in December. It contains over 180 entries received from researchers in 22 countries. As with the previous edition, the results are analysed in tabular form in the first section of the report; this serves as an index to the research summaries which are reproduced in full in the second section. The names and organisation addresses of principal researchers are included in an appendix.

In recognition of the constraints that indoor air quality places on ultimate airtightness levels, the subject area of the survey has been explicitly expanded to include this topic. Compared to the previous edition, the number of new entries is greatly increased and the quality of the project descriptions supplied by researchers remains high.

If you would like a copy of this new publication, which is available only to organisations in participating countries, please use the order form contained in this newsletter.





AIC Handbook 'Air Infiltration Control in Housing' is now available from . . .

The Air Infiltration Centre, price £12.00 inclusive of postage and packing. Please use the publications order form in this newsletter. . .

Svensk, Byggtjänst, Box 7853, S-103 99 Stockholm, Sweden, price Skr 95. . .

Your National Representative (as listed on the back page) at the current rate of exchange.

Wind Pressure Workshop

One of the conclusions of the AIC's model validation programme was that additional information on building wind pressure distributions would further increase the accuracy of air infiltration prediction techniques. In an effort to bring together available information, the Centre is organising a 2-day workshop to take place in Brussels, Belgium on 21st and 22nd March 1984.

The workshop will open with a presentation outlining the problem, followed by sessions on measurement data (both full-scale and wind tunnel models) and the application of data to air infiltration models. Further research needs will also be considered.

If you would like to contribute to this workshop, or receive full information regarding the content, please contact Carolyn Allen or Jenny Elmer at the Air Infiltration Centre.

The registration fee to cover attendance and lunch on each day will be £35.00

AIC Publications List

PERIODICALS

Air Infiltration Review
Quarterly newsletter containing topical and informative articles on air infiltration research and application. Also gives details of forthcoming conferences, recent acquisitions to *AIRBASE* and new AIC publications.
Unrestricted availability, free-of-charge.

Recent Additions to *AIRBASE*
Bi-monthly bulletin of abstracts added to *AIRBASE,* AIC's bibliographic database. Provides an effective means of keeping up-to-date with published material on air infiltration and associated subjects. Copies of papers abstracted in 'Recent Additions to *AIRBASE*' can be obtained from AIC library.
Bulletin and copies of papers available free-of-charge to participating countries only.*

TECHNICAL NOTES

AIC-TN-1-80 – Manning, S.
'The distribution of air leakage in a dwelling – a brief review', 4pps.
Contains a review of 15 papers describing measurements of the distribution of air leakage in a dwelling. The results of leakage measurements made in 81 buildings are summarized.
Available free-of-charge to participating countries only.*

AIC-TN-2-80 – Superseded by AIC-TN-7-81.

AIC-TN-3-81 – Superseded by AIC-TN-8-82.

AIC-TN-4-81 – Superseded by AIC-TN-10-83.

AIC-TN-5-81 – Allen, C.
'AIRGLOSS: Air infiltration glossary (English edition), 124pps.
Contains approximately 750 terms and their definitions. They are related to air infiltration, its description, detection, measurement, modelling and prevention as well as to the environment and relevant physical processes. Translations of the glossary from English into languages of participating countries will appear in due course.
Available free-of-charge to participating countries. Price: £10 to non-participating countries.*

AIC-TN-6-81 – Allen, C.
'Reporting format for the measurement of air infiltration in buildings', 56pps.
Produced to provide a common method for research workers to set out experimental data, so assisting abstraction for subsequent analysis or mathematical model development. May be used directly for entering results and as a useful checklist for those initiating projects. Example of use of format is included as an appendix.
Available free-of-charge to participating countries. Price: £6 to non-participants.*

AIC-TN-7-81 – Superseded by AIC-TN-12-83.

AIC-TN-9-82 – Liddament, M., Thompson, C.
'Mathematical models of air infiltration – a brief review and bibliography', 16pps.
Contains a brief description of 14 mathematical models of air infiltration with bibliography of relevant papers. The theory behind mathematical modelling is outlined and the advantages and disadvantages of the various types of models are described. Comments are given on the range of applicability of the models reviewed.
Available free-of-charge to participating countries only.*

AIC-TN-10-83 – Liddament, M., Thompson, C.
'Techniques and instrumentation for the measurement of air infiltration in buildings – a brief review and annotated bibliography', 60pps.
Four-section bibliography contains review papers, information on tracer gas techniques, pressurization methods and miscellaneous approaches. In addition the report contains list of manufacturers of instumentation currently being used in air infiltration investigations.
Available free-of-charge to participating countries only.*

AIC-TN-11-83 – Liddament, M., Allen, C.
'The validation and comparison of mathematical models of air infiltration', 124pps.
Contains analysis of ten models developed in five participating countries. These range in complexity from 'single-cell' to 'multi-cell' approaches. Also contains numerical and climatic data for fourteen dwellings compiled to produce three key datasets which were used in model validation study.
Available free-of-charge to participating countries only.*

AIC-TN-12-83 – Liddament, M.
'1983 Survey of current research into air infiltration and related air quality problems in buildings'
3rd worldwide survey by AIC, containing over 170 replies from 22 countries. Produced in two sections: an analysis in tabular form of survey results, followed by reproduction in full of research summaries, and appendix containing names and addresses of principal researchers.
Available free-of-charge to participating countries only.*

LITERATURE LISTS – Listing of abstracts in *AIRBASE* on particular topics related to air infiltration.

No. 1 Pressurization – Infiltration Correlation: 1. Models (17 references).
No. 2 Pressurization – Infiltration Correlation: 2. Measurements (26 references).
No. 3 Weatherstripping windows and doors (24 references).
No. 4 Caulks and sealants (24 references).
No. 5 Domestic air-to-air heat exchangers (25 references).
No. 6 Air infiltration in industrial buildings (14 references).
No. 7 Air flow through building entrances (22 references).
No. 8 Air infiltration in commercial buildings (28 references).
No. 9 Air infiltration in public buildings (10 references).

CONFERENCE PROCEEDINGS

No. 1 'Instrumentation and measuring techniques'.
1st AIC Conference, 6–8 October, Windsor, Berkshire, UK, 372 pps, £35.00 sterling.

No. 2 'Building design for minimum air infiltration'.
2nd AIC Conference, 21–23 September 1981, Stockholm, Sweden, 216 pps, £15.00 sterling.

No. 3 'Energy efficient domestic ventilation systems for achieving acceptable indoor air quality'.
3rd AIC Conference, 20–23 September 1982, London, UK, 432 pps.
Supplement to 3rd AIC Conference Proceedings (contains five additional papers, 1 amended paper, discussion) 160 pps. Total cost £23.50 sterling.

No. 4 'Air infiltration reduction in existing buildings'
4th AIC Conference, 26–28 September 1983, Elm, Switzerland, 342 pps, £16.00 sterling.

**The participating countries are: Belgium, Canada, Denmark, Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom and the United States of America.*

Order Form

Name . . . .

Organisation. . . . .

Address . . . .

. . . .

		Non-participating Countries £ sterling	Participating Countries £ sterling
Please add my name to your mailing lists as follows:			
Air Infiltration Review	. . . . copies (quarterly)	Free	Free
Recent Additions to *AIRBASE*	. . . . copies (bi-monthly)	Not available	Free
Please forward the following publications:			
Technical Note AIC-TN-1-80	. . . . copies	Not available	Free
AIC-TN-5-81	. . . . copies	10.00	Free
AIC-TN-6-81	. . . . copies	6.00	Free
AIC-TN-8-82	. . . . copies	Not available	Free
AIC-TN-9-82	. . . . copies	Not available	Free
AIC-TN-10-83	. . . . copies	Not available	Free
AIC-TN-11-83	. . . . copies	Not available	Free
AIC-TN-12-83	. . . . copies	Not available	Free
Literature List No. 1	. . . . copies	Not available	Free
No. 2	. . . . copies	Not available	Free
No. 3	. . . . copies	Not available	Free
No. 4	. . . . copies	Not available	Free
No. 5	. . . . copies	Not available	Free
No. 6	. . . . copies	Not available	Free
No. 7	. . . . copies	Not available	Free
No. 8	. . . . copies	Not available	Free
No. 9	. . . . copies	Not available	Free
1st Conference Proceedings	. . . . copies	35.00	35.00
2nd Conference Proceedings	. . . . copies	15.00	15.00
3rd Conference Proceedings (2 vols.)	. . . . copies	23.50	23.50
4th Conference Proceedings (2 vols.)	. . . . copies	16.00	16.00

I enclose a cheque made payable to BSRIA (AIC) for:

£ . . . . drawn on a UK bank.

Signed. . . . . Dated . . . .

Representatives and Nominated Organisations

Belgium

*P. Caluwaerts,
Belgian Building Research Institute,
Lombard Street 41,
1000 Brussels
(Tel: 02-653 8801/02-511 0683)
(Telex: 256 82)

P. Nusgens,
Université de Liège,
Laboratoire de Physique
du Bâtiment,
Avenue des Tilleuls 15-D1,
B-4000 Liège,
Belgium.
(Tel: 041-52 01 80)
(Telex: 41746 Enviro B.)

Canada

*R. Dumont,
Division of Building Research,
National Research Council,
Saskatoon, Saskatchewan,
Canada S7N 0W9.
(Tel: 306.665.4200)

J. Shaw,
Division of Building Research,
National Research Council,
Ottawa, Canada,
K1A 0R6.
(Tel: 613.993.1421)
(Telex: 0533145)

J.H. White,
Research Division,
Canada Mortgage and
Housing Corporation,
Montreal Road, National Office,
Ottawa, Ontario, Canada, K1A 0P7.
(Tel: 613.748-2309)
(Telex: 053/3674)

Denmark

*P.F. Collet,
Technological Institute,
Byggeteknik,
Post Box 141, Gregersensvej,
DK 2630 Tastrup, Denmark,
(Tel: 02-996611)
(Telex: 33416)

Netherlands

*W. de Gids,
Institute for Environmental
Hygiene—TNO,
P.O. Box 214,
Delft, Netherlands.
(Tel: 015-569330)
(Telex: 38071)

New Zealand

*H.A. Trethowen,
Building Research Association
of New Zealand Inc (BRANZ),
Private Bag,
Porirua,
New Zealand.
(Tel: Wellington (04) 357600)
(Telex: 30256)

Norway

*T.Ø. Ramstad,
Norwegian Building
Research Institute,
Box 322,
Blindern,
Oslo 3, Norway.
(Tel: 02-469880)

S. Uvsløkk,
Norwegian Building
Research Institute,
Högskoleringen 7,
7034 Trondheim—NTH,
Norway.
(Tel: 075-93 390)

Sweden

*L-G. Månsson
Swedish Council for
Building Research,
St. Göransgatan 66,
S-112 33 Stockholm,
Sweden.
(Tel: 08-540640)
(Telex: 10398)

F. Peterson,
Royal Institute of Technology,
Dept. of Heating and Ventilating,
S-100 44 Stockholm,
Sweden.
(Tel: 08-7877675)
(Telex: 10389)

Switzerland

*P. Hartmann, EMPA,
Section 176, Ueberlandstrasse,
CH 8600 Duebendorf,
Switzerland.
(Tel: 01-823 4276)
(Telex: 53817)

The Oscar Faber Partnership (UK)

*D. Curtis,
The Oscar Faber Partnership,
Marlborough House,
Upper Marlborough Road,
St. Albans, Herts, AL1 3UT,
Great Britain.
(Tel: 0727-59111)
(Telex: 889072)

H. Danskin,
Building Research Energy
Conservation Support Unit
(BRECSU),
Building Research Establishment,
Bucknalls Lane, Garston,
Watford, Herts, WD2 7JR.
(Tel: 09273 74040)
(Telex: 923220)

P. Robertson, BSRU,
University of Glasgow,
3 Lilybank Gardens,
Glasgow, G12 8RZ,
Great Britain.
(Tel: 041-334-2269)
(Telex: 778421)

BSRIA,
Old Bracknell Lane West,
Bracknell, Berks,
RG12 4AH, Great Britain.
(Tel: 0344-26511)
(Telex: 848288)

USA

*H. Ross,
Department of Energy,
Buildings Division,
Mail Stop GH-068,
1000 Independence Avenue S.W.,
Washington D.C. 20585, USA.
(Tel: 202/252-9191)
(Telex: 710 822 0176)

R. Grot, Building Thermal &
Service Systems Division,
Centre for Building Technology,
National Bureau of Standards,
Washington D.C. 20234, USA.
(Tel: 301/921-3470)
(Telex: 898493)

M. Sherman,
Energy & Environment Division,
Building 90, Room 3074,
Lawrence Berkeley Laboratory,
Berkeley, California 94720,
USA.
(Tel: 415/486-4022)
(Telex: 910 366 2037)

D. Harrje, Centre for Energy &
Environmental Studies,
Princeton University,
Princeton, New Jersey 08544,
USA.
(Tel: 609-452-5190/5467)

*Steering Group Representative.

Published by

Air Infiltration Centre,
Old Bracknell Lane West,
Bracknell,
Berkshire, RG12 4AH,
Great Britain.

Tel: National 0344 53123
International +44 344 53123

Telex: 848288 (BSRIAC G)

Head of AIC: Peter J. Jackman,
BTech CEng MIMechE FCIBS

Operating Agent: The Oscar Faber Partnership

ISSN: 0143-6643