Air Infiltration Review

a quarterly newsletter from the IEA Air Infiltration Centre

Vol.3 No.2 February 1982

1981 – A Year of Progress

1981 was a successful year for the Air Infiltration Centre and one in which considerable progress was made in completing its initial programme of work. At the start of a new year, it is appropriate to review the achievements of the Centre to date and to highlight some of the ongoing and future work.

The preparation of the high quality datasets for the validation of numerical models of air infiltration is one of the key tasks of the Centre. During the course of 1981, 14 datasets compiled from data received from 5 countries were prepared. These datasets are currently being used to assess the performance and range of applicability of a number of mathematical models. To facilitate the collection and dissemination of further experimental data, the AIC has published the details of a standard reporting format recommended for the measurement of air infiltration in buildings. This publication is freely available to organisations in the AIC participant countries, and at a cost of £5 per copy to non-participating countries.

The AIC's bibliographic database *AIRBASE* has continued to grow. A subject analysis of the first 600 abstracts was published in January 1981 and, to keep participants informed of subsequent new entries, a bi-monthly publication entitled 'Recent Additions to *AIRBASE*' was introduced. The number of articles in the database is now approaching 900 and a revised edition of the subject analysis is in the course of preparation.

The AIC Handbook entitled 'Air Infiltration Control in Housing – A Guide to International Practice' was introduced at the 2nd AIC Conference held at the Royal Institute of Technology in Stockholm in September 1981. Preparation of this handbook is the responsibility of the Swedish participant and it is now approaching completion. It reviews the state-of-the-art on the design of dwellings to reduce extraneous air infiltration and contains sections specific to various countries.

To promote a more uniform usage of terms by those involved in air infiltration research, the AIC has prepared an air infiltration glossary. It contains approximately 750 terms and is currently available in English. Translations of the terms into French, Swedish, German, Dutch, Danish and Italian will be available shortly. The glossary also contains useful information on tracer gases and units.

Following the success of the 1980 Survey of Current Research into Air Infiltration in Buildings, an updated report, containing over 140 entries has been published. The completed document will be available to participants shortly.

In order to promote an interchange of information and experience, technical visits to research centres in participating countries have continued. Visitors from several countries have also visited the AIC at Bracknell. Opportunity has been taken on these occasions to gather information on the instrumentation and measuring techniques being used in air infiltration research. An annotated bibliography on instrumentation has already been published and technical literature on commercial instruments is available at the Centre.

The number of enquiries received by the Air Infiltration Centre has steadily increased and now averages 35-40 per month. Bibliographic enquiries are handled directly by the Centre but the more detailed technical enquiries should be directed via the nominated organisation of your country (see back page).

In 1982 we look forward to an increase in the number of participants to the Air Infiltration Centre with Norway expected to join in June. Other countries have expressed an interest in participating and it is hoped it will be possible to report on progress in this area soon.

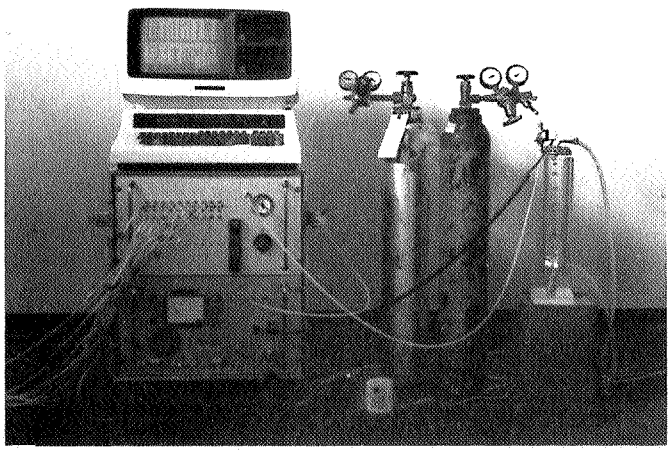
With an increase in the level of participation, it is hoped that our technical work programme and range of services may be further extended to meet the needs of those responsible for improving energy efficiency in buildings.

Technical Visit to Denmark

The AIC programme of technical liaison work continued with a recent visit by Martin Liddament to investigate air infiltration research in Denmark.

The first meeting was with Peter Collet at the Technological Institute in Gregersensvej, Tastrup. Two of the air infiltration projects taking place at the Technological Institute concern:

- the automatic monitoring of air infiltration in occupied dwellings.
- the monitoring of the energy consumption of 21 low-energy houses in Skive.



The automatic air infiltration monitoring equipment has been developed to enable continuous measurement of air change rate to be made over extended periods in an occupied building. The system is designed for measuring and monitoring a constant tracer gas concentration in up to 10 rooms. Nitrous oxide is used as the tracer gas and the constant concentration is set at 50 ppm.

The measurement system comprises a central computer controlled unit coupled to 10 3-way solenoid operated valves and a URAS 7n infrared gas absorption detector (see photograph). From the unit, 2 plastic tubes, one for dosing and one for sampling, are passed to each of the rooms to be monitored. The tracer gas in each room is sampled sequentially with the sampling period taking 30 seconds per room. The measured drift in tracer gas concentration is used to continuously update the necessary injection rate to maintain a constant concentration. Typical results for a 72 hour period are illustrated in Fig. 1.

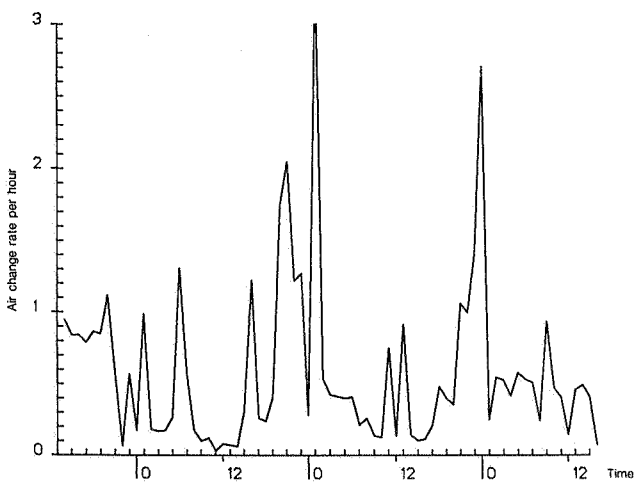


Figure 1

The Skive project relates to the design and construction of 21 low-energy houses. The design criteria are that energy consumption for space heating should not exceed 60% of the energy consumption stated in the Danish Building Code BR-77 and that the consumption of traditional energy should, for domestic hot water heating, not exceed 60% of a normal consumption of 14.4 GJ (4000 kWh)/year/dwelling.

All but two of the houses incorporate balanced mechanical ventilation systems with air-to-air heat recovery. For the efficient operation of these systems, the air infiltration rate must not exceed 0.1 ach. The houses also incorporate a variety of alternative energy systems including solar panels and heat pumps. The Technological Institute is operating an energy monitoring programme in which the performance of the alternative energy systems is being evaluated and the effect of occupants on energy consumption is being determined. Energy measurement equipment in each home is linked to an 'on site' central micro-computer with data storage facilities. The computer may be interrogated at the Technological Institute via a remote control terminal linked to Skive via a telephone line.

It is hoped that this project will reveal useful information on:

- the effect of using increased insulation.
- the operation of heating plant in low energy houses.
- the operation of combined heating systems.
- the heat gain from alternative energy systems.
- the influence of occupants on energy consumption.
- the need for mechanical ventilation.
- the performance of heat recovery systems.
- the heat loss from heating installations.

Martin's second visit was to the Thermal Insulation Laboratory at the Technical University of Denmark where Bjarne Saxhof described the various construction techniques of Danish dwellings and the air infiltration and leakage measurements he and his colleagues have made on 6 prototype low-energy houses in Hjortekær.

Bjarne described the type of Danish homes built prior to the 1960's as being fairly airtight, generally of solid or cavity wall brick construction with plastered interior walls. These houses normally had single glazed windows, no fireplace and were naturally ventilated. During the 1960's construction techniques changed with the introduction of timber frame dwellings. Many of these new buildings were not fitted with vapour barriers and often, when they were fitted, were installed incorrectly. This has resulted in high air infiltration rates, poor thermal performance and serious moisture problems. As a result of these problems, much work is being directed in the area of improved building design.

The low energy homes at Hjortekær form part of this building design work (details of this project were earlier reported in AIR Vol. 1 No. 3 May 1980). The houses each have an approximate floor area of 120m^2 and an expected annual fuel consumption for hot water and space heating of 18 GJ (5000 kWh). Low energy consumption is achieved primarily by tight building construction and high levels of thermal insulation.

Pressurization tests and air infiltration measurements have been made in each of these dwellings. The pressurization tests followed Swedish practice in that all purpose provided openings were sealed so that just the 'fabric' loss was determined. The air leakage at 50 Pa ranged from between 0.29 to 3.39 ach.

New AIC Publications

AIC-TN-5-81 AIRGLOSS: Air Infiltration Glossary.

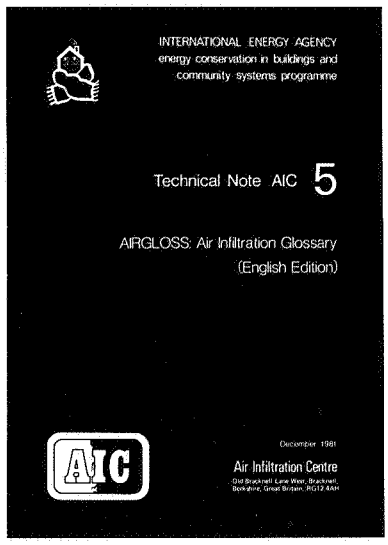
The AIC's 5th Technical Note is a glossary of terms related to air infiltration, intended to promote a more uniform usage of terms by workers in the subject of air infiltration.

Terms have been assembled concerning air infiltration, its description, detection, measurement, modelling and prevention. Also included are terms associated with the environment and relevant physical processes.

Topics covered include:

- experimental techniques
- instrumentation
- climate
- terrain
- building descriptions and components
- construction techniques
- ventilation requirements

Translations of the terms in the glossary from English into the languages of the participating countries will appear in due course.



AIC-TN-6-81 Reporting Format for the Measurement of Air Infiltration in Buildings.

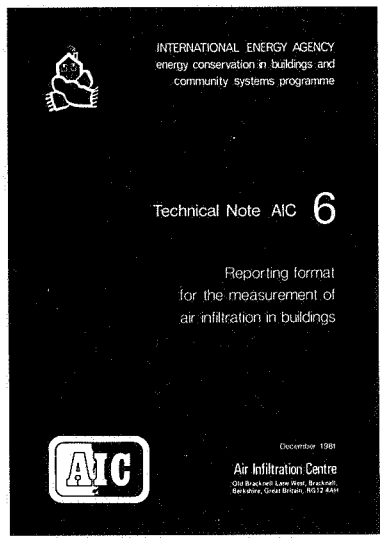
This standardized reporting format has been produced to provide a common method for research workers to set out their experimental data, so making the information easier to extract for subsequent analysis or mathematical model development.

The format may be used directly for entering results and should also serve as a useful checklist to aid those who are initiating projects.

The format contains sections covering:

- general information
- test site description
- climatic data
- building description
- building function
- measurement procedures and results
- models

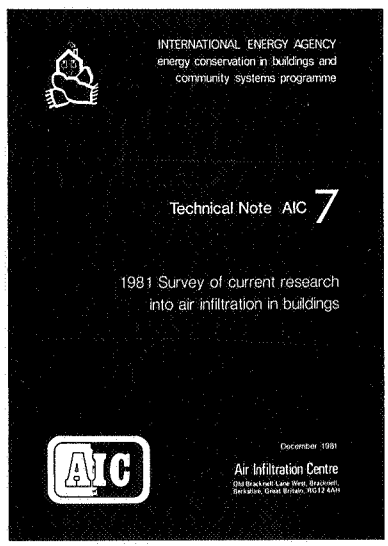
The contents of each section are amplified by a set of explanatory notes and an example of the use of the format is included as an appendix.



AIC-TN-7-81 1981 Survey of Current Research into Air Infiltration in Buildings

This is the second worldwide survey of current research into air infiltration undertaken by the AIC. With over 140 replies received from 20 countries, it is more than twice the size of the previous survey.

The report is presented in 3 sections. The first section contains an analysis, in tabular form, of the results of the survey. This serves as an index to the second section in which the research summaries are reproduced in full. The final section contains details of projects which were published in the 1980 survey and have since been completed. The names and organisation addresses of principal researchers are included in an appendix. Compared with last year, the replies to the survey indicate a growing interest in the fields of minimum ventilation rates for acceptable indoor air quality, the cost effectiveness of measures to reduce air infiltration and the development of methods to measure infiltration in industrial units and warehouses. The influence of air infiltration on the performance of ventilation and heat recovery systems also appears to be a growing research area, as does the effect of the behaviour of occupants on air infiltration.



These three Technical Notes are available free-of-charge from the AIC to organisations in participating countries. Copies of Technical Note 6 are available to non-participants for £5 sterling, inclusive of postage and packing (cheques should be made payable to BSRIA (AIC)).

Air infiltration measurements were made by the tracer gas decay technique, initially using nitrous oxide. Later tests were performed using radio-active tracer Kr-85. The measured air infiltration rates range between 0.02 to 0.12 ach.

The final visit was to the Institute of Hygiene at the University of Aarhus where Lars Mølhave and Paul Bisgaard described their work on indoor air quality and the emission of pollutants from building materials.

One of the Institute's projects is to determine the effects on indoor air quality of weatherstripping an occupied, naturally ventilated dwelling. The parameters being investigated include indoor temperature, temperature gradient, humidity, suspended particulate matter and the occurrence of house mites and fungi.

Measurements of organic gases and vapours are also being made in a number of new and old houses. It has been found that most of the pollutants result from emission from building materials. An investigation is currently taking place to relate the concentration of pollutants with emission rates and air infiltration rates. It is hoped that an outcome of this study will be to make inferences concerning minimum ventilation rates.

Much emphasis was placed at all the organisations visited on the effect that occupants had on both air infiltration rates and energy consumption. This is a particularly important area of study, as occupants could 'undo' much of the work of designers. The outcome of these projects should therefore be of significant importance to researchers and designers in all countries where there is a need to reduce energy consumption in buildings.

Let Others Know . . . . . .

Air Infiltration Review offers the opportunity for brief, informative articles relating to air infiltration research and its application. Contributions of general interest on, for example, new projects, developments in instrumentation, novel applications of energy saving, natural or mechanical ventilation systems, or behavioural effects on infiltration would be most welcome.

Why not prepare an item for the next issue? Last date for receipt of copy is 5th April 1982.

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).

Recent Additions to *AIRBASE*


AIC Recent additions to AIRBASE

NO.9 JANUARY 1982

#NO 841 Indoor pollutants.
AUTHOR
Committee on Indoor Pollutants.
BIBINF
National Academy Press, Washington D. C., 1981, 537 pp. #DATE 01:01:1981 in English AIC
ABSTRACT
The report was prepared, at the request of the Environmental Protection Agency by the Committee on Indoor Pollutants. It outlines the scope of the problems regarding indoor pollutants and discusses their sources, their effects on human health and welfare, the technologies available for their control or abatement, and concerns about the effects of energy-conservation strategies on indoor concentrations of pollutants. It approaches the subject of indoor pollutants from three viewpoints: 1. Physical factors, such as indoor pollutant sources and concentrations. 2. Biomedical evidence on the effects of several pollutants found in the indoor environment. 3. Engineering, air-handling and cleaning systems, and other control options for reducing indoor exposures to pollutants.
KEYWORDS
air quality, pollution, human comfort.

#NO 842 Thermography in detection of air leakages and thermal insulation defects in the building envelope. (Infrapunakuvaus rakennuksen ulkovaloan lämöneristyksenheiden ja ilmavuotojen määrittämisessä.)
AUTHOR
Viljanen M.
BIBINF
Report 13/1981, Technical Research Centre, Finland. #DATE 01:01:1981 in Finnish BSRIA sp

ABSTRACT
Until recently, natural ventilation was adequate for the indoor air environment of buildings. Today, with added insulation and tighter building envelope standards, indoor air quality is more dependent on mechanical means. The conventional and new control strategies for indoor environments are reviewed, and the point is made that good indoor air quality is attainable with cost effective means if the proper constraints are maintained. To improve control algorithms, suggestions are made: 1. Control algorithms should be developed for interactions among air quality, thermal, lighting, spatial and acoustic indoor environmental factors. 2. Standard methods for evaluating components and systems are needed. 3. Commercialization of appropriate sensors, controllers and controlled devices should be accelerated.
KEYWORDS
mechanical ventilation, air quality, cost effectiveness.

#NO 844 Development of hourly data for weather year for energy calculations(WYEC).
AUTHOR
Crow L.W.
BIBINF
ASHRAE Jnl.October 1981 vol.23 no.10 p.37-41 7 figs. 2 tabs. #DATE 01:10:1981 in English BSRIA J
ABSTRACT
Sets of hourly data, representing the long term mean of both temperature and solar radiation, have been prepared for 21 U.S. metropolitan areas. The 8,760 sequential hourly values for all weather elements, including solar data, have been placed on magnetic tape for use in computer calculations of energy requirements.
KEYWORDS
computer, climate, temperature.

Abstracts are continually being added to *AIRBASE* as new material is published and as the subject coverage of the database is broadened. These new abstracts are published in a bi-monthly bulletin 'Recent Additions to *AIRBASE*' which is available, free-of-charge, to interested organisations in participating countries. Copies of papers which are abstracted in 'Recent Additions' can be obtained from the AIC library.

If you are interested in obtaining future editions of this bulletin, please contact Jenny Elmer at the AIC to have your name added to the mailing list.

Advance Notice of Next AIC Conference

The 3rd AIC Conference 'Energy efficient domestic ventilation systems for achieving acceptable indoor air quality' will take place in London, UK from 20 to 23 September 1982 inclusive. The programme will include 23 presentations by authors from 7 countries on subjects ranging from measures to avoid condensation and mould growth to the efficiency of air-to-air heat exchangers. Many of the papers describe the results of carefully monitored field trials in naturally ventilated and mechanically ventilated dwellings.

The Conference will enable researchers, designers and housing managers to keep abreast of recent international developments in the ventilation of housing and to become fully aware of the progress made in the energy efficient application of systems of controlled ventilation.

Please reserve the dates 20 to 23 September 1982 in your diary.

More details will be presented in the May issue of AIR.

Forthcoming Conferences

1. 3rd ASTM/CIB/RICEM Symposium on the Performance Concept in Building.
   Lisbon, Portugal
   March 24 – April 2, 1982

2. 3rd International Symposium on Energy Conservation in the Built Environment.
   CIB Working Commission 67, Dublin, Republic of Ireland
   March 30 – April 1, 1982

3. ASHRAE Annual Meeting
   Royal York Hotel
   Toronto, Ontario, Canada
   June 27 – July 1, 1982

4. CIB/CIE Environmental Workshop on the Effect of International Differences on Design Criteria.
   Chester, Great Britain
   September 15-17, 1982

   The aim of this Workshop is to review current research on peoples' different reactions to the indoor environment and to examine how existing criteria for the indoor climate may be modified to accommodate these differences.

   The Workshop is sponsored jointly by the Congrès International du Bâtiment W77 Commission and the Commission Internation de l'Éclairage Technical Committee 3.3 'Fundamentals of the Physical Environment'.

   The venue is the Electricity Council Research Centre, Capenhurst, Chester, Great Britain and the conference fee will be £69 sterling (including 15% VAT). This will include tea, coffee and lunches during the Workshop and a set of preprints of papers.

   Further details can be obtained from:

   Mrs J Hughes
   ECRC
   Capenhurst
   Chester
   CHI 6ES
   Great Britain Telephone: 051-339 4181 Telex: 627124

Recent Additions

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

*1. Tielman, H. W., Akins, R. E., Sparks, P. R.
   A comparison of wind-tunnel and full-scale wind pressure measurements on low-rise structures.
   Journal of Wind Engineering and Industrial Aerodynamics, July 1981 p3–21

   Compares wind pressures measured on two low-rise experimental buildings and pressures measured on wind-tunnel models of those buildings.

2. Committee on Indoor Pollutants
   Indoor pollutants.
   National Academy Press, Washington DC, 1981.

   Reviews sources, measurement, health effects and control of indoor pollutants.

*3. Weier, H.
   Calculating the flow processes in multi-storey buildings (Berechnung der stromungsvorgange in mehrgeschossigen gebäuden)
   Luft und Kältetechnik, Vol. 17(2), 1981, p93–98

   Nomograms are given to calculate flows in low-rise and high-rise multi-storey buildings (in German).

*4. Woods, J. E., Maldonado, A. B., Reynolds, G. L.
   How ventilation influences energy consumption and indoor air quality
   ASHRAE Journal, Vol. 23(9), September 1981, p40–45

5. Vonier, F.
   Natural ventilation, passive cooling and human comfort in buildings. A comprehensive technical bibliography.
   Thomas Vonier Associates Inc., Washington USA, 1980

*6. Dickson, D.J.
   Mechanical ventilation.
   CIBS Symposium 'Developments in Domestic Engineering Services', 1st December 1981,
   pp 14-19.

   Discusses requirement and economics of a mechanical ventilation system as opposed to natural ventilation.

*7. Clarkson, T.S.
   Preliminary investigation of air infiltration into typical New Zealand timber frame dwellings – final report.
   Technical Information Circular No. 182, New Zealand Meteorological Service, November 1981.

8. Eyre, D.
   The Conservahome Project: Part 1 – an overview of the project.
   SRC Technical Report No. 119, September 1981.

   Reviews a project for the retrofitting of 6 houses in Saskatchewan, Canada.

9. Kusuda, T. and Saitoh, T.
   Simplified heating and cooling energy analysis calculations for residential applications.
   NBSIR 80-1961 National Bureau of Standards, July 1980

   Gives a simplified energy calculation procedure for the evaluation of energy conservation in home retrofitting.

10. Phaff, J.C., Ham, Ph. J. and Molenaar, J.
    An investigation of technical and hygienic aspects of energy saving by reducing mechanical ventilation in a tall building.
    Report C461, Institute for Environmental Hygiene-TNO, September 1981 (in Dutch).

11. de Gids, W.F.
    Natural ventilation and energy consumption of dwellings.
    Report C482, Institute for Environmental Hygiene-TNO, July 1981.

    Reports on an investigation concerning ventilation and energy conservation in single-family houses and flats in Holland.

Copies of the papers marked with an asterisk are available from the AIC to organisations in participating countries. The remainder are available on loan.

Representatives and Nominated Organisations

Participant	Steering Group Representative	Other Nominated Organisations		
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)	P. Favot, Technical Research Division, Canada Mortgage and Housing Corporation, Ottawa, Canada, K1A 0P7. (Tel: 614.748.2326) (Telex: 053/3674)	
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