Air Infiltration Review

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Vol. 3 No. 1 November 1981

Building Design for Minimum Air Infiltration — Successful AIC Conference in Stockholm

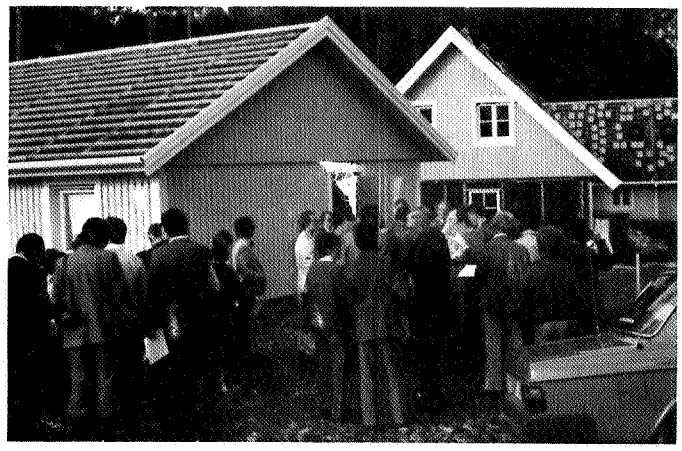
Conference Participants

The Air Infiltration Centre's 2nd Annual Conference entitled 'Building design for minimum air infiltration' was held at the Royal Institute of Technology, Stockholm on 21–23 September. It attracted over 60 participants representing a wide cross-section of the building industry.

The conference was opened by Ingrid Monroe, Head of the Swedish Building Research Council. In her introduction she emphasized the importance of air infiltration as a source of energy loss. In existing buildings in Sweden this amounts to between 30–40% of the space heating demand. However, it was stressed that some buildings were too tight and have inadequate ventilation. Also there was evidence linking a rising trend in allergy problems to a deterioration in indoor air quality. It is therefore necessary to develop cheap and effective methods to improve the airtightness and indoor air quality of both new and existing buildings.

The main objective of the conference was to introduce the topics appearing in the AIC Handbook entitled 'Air infiltration control in housing—a guide to international practice'. Contributors, drawn from the participating countries of the Air Infiltration Centre, presented papers on building design techniques, indoor air quality, air infiltration measurement and prediction methods, heat loss calculations and the retrofitting of existing buildings.

On the subject of building design, the most recent developments in airtightness and energy efficient construction techniques were illustrated. Many modern designs incorporate balanced ventilation systems with air-to-air heat recovery. It was shown that for these systems to perform satisfactorily, it is essential that the building is well sealed. Another need for airtight design in severe climates is to prevent moisture from penetrating the ceiling and freezing in the roof spaces of



Conference delegates during visit to a housing development.

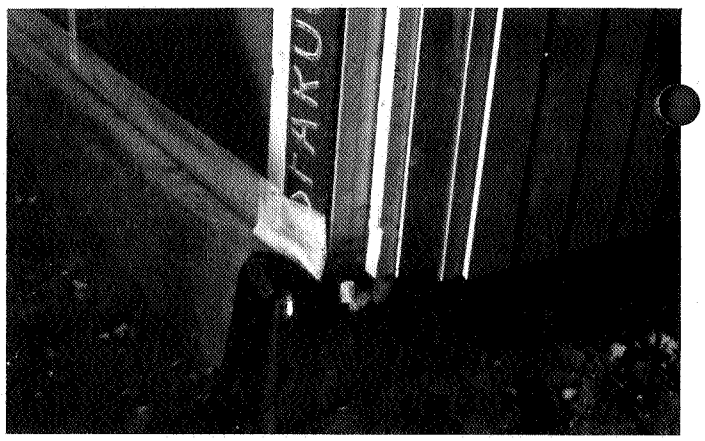
dwellings. The effect of this moisture problem was vividly demonstrated in a presentation by Howard Orr of the National Research Council, Canada.

Indoor air quality and the cost effectiveness of energy efficient buildings formed the main themes for discussion. Much interest was also expressed in the recent advances in air infiltration measuring techniques and in the 'House Doctor' retrofit program developed at Princeton University in the United States of America.

During the second day of the conference, a technical visit to a building site took place to inspect a number of semi-detached dwellings in various stages of construction. The dwellings were of traditional Swedish '1½ storey' design, constructed from prefabricated timber-frame panels. The houses were designed to comply with the latest Swedish requirements on air tightness of three air changes per hour at 50 Pascals internal/external pressure difference. Included in the itinerary was a visit to an exhibition of ventilation and heat exchanger products at the Fläkt Company in Stockholm.

On the final day of the conference, participants had the opportunity to tour the Department of Building Technology at the Royal Institute of Technology.

The proceedings of the 2nd AIC Conference are currently being compiled and will be available shortly. Preparation of the AIC Handbook is being co-ordinated by Arne Elmroth and Per Levin of the Department of Building Technology. This Handbook is scheduled for publication next year.



Detail of wall-to-floor jointing technique.

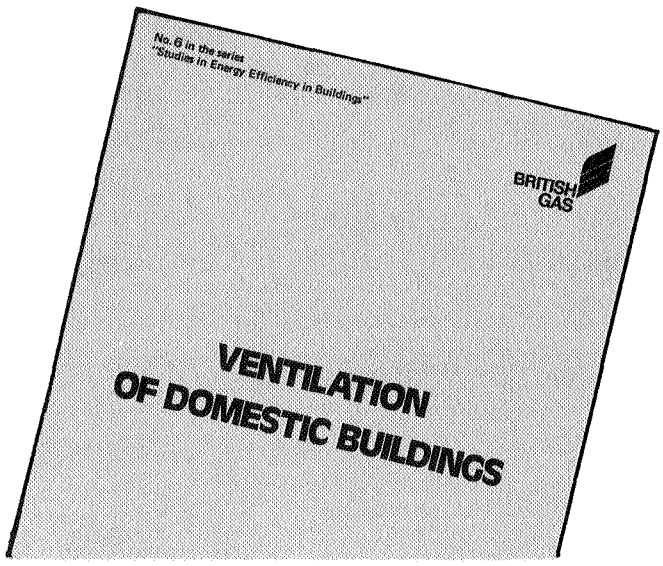
New AIC Librarian

Catriona Thompson takes over from Sheila Manning as Librarian to the Air Infiltration Centre.

Catriona, who likes to be known as Katy, graduated at the University of Southampton, UK in 1980 and went on to the City University in London to study for an M.Sc. in information science.

She is responsible for operating the AIC bibliographic database *AIRBASE* and will gladly respond to enquiries on specific subject matters related to air infiltration. Call her by telephone or telex, or write giving details of the scope of the information you require. The address and telephone/telex numbers are shown on the back page.

Domestic Ventilation



This is the sixth publication in a series entitled 'Studies in Energy Efficient Buildings'. It contains a compilation of seven technical papers on the subject of domestic ventilation compiled mainly by staff of British Gas at Watson House Research Station.

The contents are

Ventilation Design Considerations
by J. C. Tipping, J. Harris-Bass and D. Nevrala

Crack Flow Equations and Scale Effect
by D. W. Etheridge

Natural Ventilation and Well-Insulated Houses
by D. J. Nevrala and D. W. Etheridge

Theoretical and Experimental Studies of Heat Loss Due to Ventilation
by D. K. Alexander, D. W. Etheridge and R. Gale

The British Gas Multi-Cell Model for Calculating Ventilation
by D. W.Etheridgeand D. K. Alexander

Experimental Techniques for Ventilation Research
by D. K. Alexander, D. W. Etheridge and R. Gale

The Effect of Insulation, Mode of Operation and Air Leakage on the Energy Demand of Dwellings in the UK
by D. J. Nevrala

The other titles in the series are

No. 1 'Studies in energy efficiency in buildings'
No. 2 'Energy demand and system sizing'
No. 3 'Selection of boiler plant and overall system efficiency'
No. 4 'People and buildings'
No. 5 'Insulation heat services and housing design'

These publications are available free-of-charge by applying directly to:

Dr David Etheridge
British Gas Corporation
Watson House
Peterborough Road
London
SW6 3HN
United Kingdom

Forthcoming Conferences

Conference: Thermal Insulations, Materials and Systems for Energy Conservation in the 80's.
Oak Ridge National Laboratory/American Society for Testing and Materials, Clearwater Beach, Florida, USA.
December 8–10 1981.

ASHRAE Semiannual Meeting.
Houston, USA.
January 24–29 1982.

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

The Symposium is intended to provide an opportunity for the discussion of ideas and experiences on the setting of performance requirements for building materials, manufactured products and whole buildings; on methods which have been used for assessing how satisfactory particular designs or products are in the light of these criteria; and on the rather special problems of applying the performance concept to the rehabilitation of existing buildings.

Further details on this conference can be obtained from:

Local Organising Committee
ASTM/CIB/RILEM Symposium
Laboratória Nacional de Engenharia Civil
Avenida do Brasil 101
1799 Lisboa Codex
Portugal

Telex: 16760 P
Telephone: 88 21 31

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

The following are the topic areas covered by the Symposium:

- *Energy use in the built environment*
- *Prediction of thermal performance and energy use in buildings*
- *Energy conservation and the building envelope*
- *Building services and controls*
- *Experience with energy saving measures on practice*

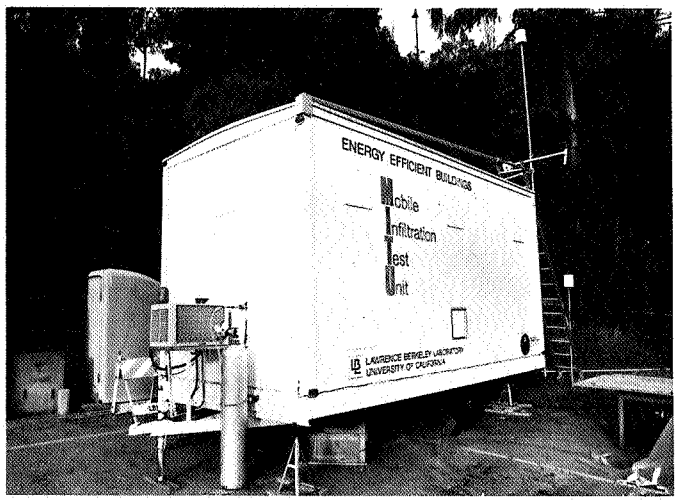
Papers on air leakage, ventilation systems, indoor climate and natural ventilation will be presented at this conference.

The Symposium is being organised by An Foras Forbartha, The National Institute for Physical Planning and Construction Research, St Martin's House, Waterloo Road, Dublin 4, Republic of Ireland. All correspondence regarding the Symposium should be sent to the Technical Secretary at this address.

The venue is the Burlington Hotel, Dublin and reservations can be arranged here and at other conveniently placed hotels. The Symposium fee will be IR£175 approximately. This includes admittance to the Symposium, one copy of preprints, one copy of proceedings, lunches and refreshments each day and a symposium dinner, but does not include accommodation costs. Attendance at the Symposium is open to all, but places are limited to 400 so early application is advised.

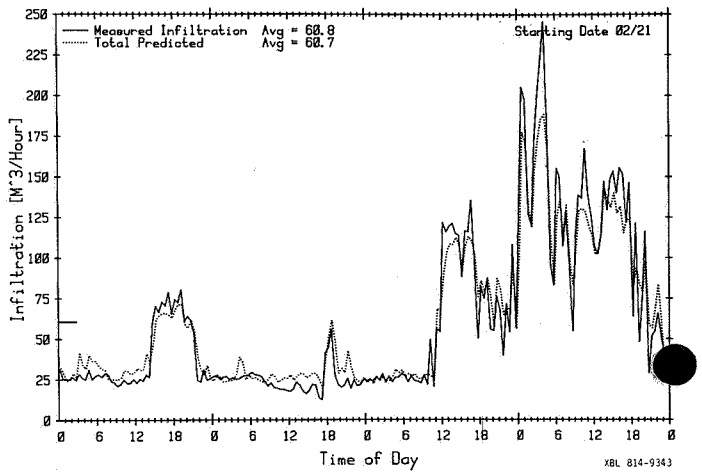
Mobile Infiltration Test Unit developed at LBL

The Mobile Infiltration Test Unit (MITU) is a commercially available construction-site office trailer that has been modified and instrumented for air infiltration research by the Energy Performance of Buildings Group at Lawrence Berkeley Laboratory (1). MITU, shown in the photograph below, is a wood-frame structure 4.9 meters long, 2.4 meters wide, and 2.4 meters high. The walls and floor of the trailer contain a total of sixteen window openings that can be fitted with interchangeable calibrated leakage panels. These panels allow us to study the effects of both the distribution and quantity of leakage on the infiltration of the trailer.



Air infiltration is measured with a controlled flow ethane tracer gas system. Wind speed and wind direction are measured 10 meters above the ground using sensors on a weather tower mounted on the trailer. Surface pressures from 82 taps located on the walls, floor and ceiling are measured with differential pressure transducers. Operation of the trailer (equipment control, data acquisition, data reduction and storage) is managed by a Z-80 microprocessor-based computer.

The small size of the MITU trailer allows investigation of infiltration in many terrain and shielding classes.. Figure 2, below, shows a comparison between the infiltration measured during a 96-hour period beginning at midnight 21 February 1981 and the predictions from a residential infiltration model developed in the group (2). The solid line shows the measured values while the dotted line represents the values predicted from the model.



Currently we are examining the relationship between surface pressures and terrain and shielding classes as well as the effect of mechanical ventilation systems on infiltration values. We encourage correspondence with others who are examining these phenomena.

The MITU trailer is the result of long hours of design and development by Richard Beerman, Åke Blomsterberg, Darryl Dickerhoff, Mark Modera, Max Sherman, and Brian Smith.

References

1. Blomsterberg, Å. K., Modera, M. P., Grimsrud, D. T., 1981. The mobile infiltration test unit. Its design and capabilities: Preliminary experimental results. Lawrence Berkeley Laboratory report, LBL-12259.

2. Sherman, M. H., Grimsrud, D. T., 1980. The measurement of infiltration using fan pressurization and weather data. Proceedings of 1st AIC Conference, 'Air Infiltration Instrumentation and Measuring Techniques' London, pp 277–322.

Recent Acquisitions

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

1. Bergqvist, B. et al.
A mechanically ventilated roof structure as heatexchanger and solar collector.
(Mekaniskt ventilerad takkonstruktion som värmeväxlare och solfångare)
Swedish Council for Building Research Report R111: 1980.

Describes a roof structure which can be used for several different purposes including that of a heat exchanger (in Swedish).

2. 'Building Energy Management'
edited by E. de O. Fernandes, J. E. Woods, A. P. Faist
Proceedings International Conference held at Poroa de Varzim, Portugal
12–16 May 1980, Pergamon 1981

*3. Fuller, W.
What's in the air for tight houses?
Solar Age, June 1981, Vol. 6, No. 6, p30–32

Reviews literature on the health effects of indoor air pollutants in energy-efficient homes with low ventilation rates.

*4. Gerdin, H., Olofsson, L.
Drastically reduced radon values in detached houses in Umea.
(Drastiskt sänkt radonvärden i smahus i Umea)
VVS Tidskrift, April 1981, Vol. 52, No. 4, p60–61 (in Swedish)

*5. Gezelius, G.
Heat recovery from ventilation air
(Varmeatervinning ur ventilationsluft)
VVS Tidskrift, June 1981, Vol. 52, No. 6, p27–35 (in Swedish)

*6. Machielsen, C. H. M.
Non tightness of cold room walls. Measurement of air leakage.
(Ondictheden in de wanden van koude ruimten. Het meten van luctlekken)
Koeltechniek, February 1981, Vol. 79, No. 2, p33–37

Describes different goals of air leakage measurements and the measuring methods which suit each goal (in Dutch).

*7. Melia, R. J. W. et al
Indoor air pollution and its effects on health
Royal Society of Health Journal, February 1981, Vol. 101, No. 1, p29–32.

Reports study of the indoor air pollution from gas cooking.

*8. Pattie, D. R., Kagio, N. K.
The reduction of ventilation heat loss by porosity
ASHRAE Trans. 1981, Vol. 87, Part 1.

Finds that an animal house with a porous ceiling performs better than an airtight building.

*9. Sandberg, M.
What is ventilation efficiency?
Bldg. Environ., Vol. 16, No. 2, p123–135.

Examines various definitions of ventilation efficiency and presents results of measurements which show that sometimes very low efficiency can occur.

*10. Sase, S. et al
Ventilation of greenhouses 1. Wind tunnel measurements of pressure and discharge coefficients for a single span greenhouse
J. Agr. Met., June 1980, Vol. 36, No. 1, p3–12 (in Japanese)

*11. ASTM
A standard practice for measuring air leakage by the fan-pressurization method.
Annual Book of ASTM Standards, Part 18, July 1981, p1–10

A standard technique for measuring air leakage rates through a building envelope under controlled pressurization or evacuation.

12. British Gas
Ventilation of domestic buildings
Report No. 6 in the series 'Studies in Energy Efficiency in Buildings', June 1981

Focuses on the ventilation requirement of domestic buildings. The effect of different methods of construction and methods of measuring ventilation rates are discussed.

*13. Elmroth, A., Logdberg, A.
Airtight houses and energy consumption
Building Research and Practice, March–April 1981, p102–117

Shows that houses built to the new Swedish National Code (airtight structures and extra insulation) achieved one third reduction in energy consumption.

*14. Huber, S., Wanner, H. U.
Air quality and ventilation
(Raumluftqualität und lüftung)
Sozial-und Praventiv-Medizin, Vol. 26(3), July 1981, p117–179

The air pollutants caused by man were measured in a test chamber of 30m^3.

*15. Hughes, J. R.
How to achieve an airtight vapor barrier in a super-insulated house. Proceedings of the Annual Meeting of the International Solar Energy Society 1981, p107–111

Reviews methods of making a super-insulated house airtight.

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

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 Mortgate and Housing Corporation, Ottawa, Canada, K1A 0P7.	
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Switzerland	P. Hartmann, EMPA, Section 151, Ueberlandstrasse, CH 8600 Duebendorf, Switzerland. (Tel: 01-8234251) (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)	G. J. Kennedy, ETSU, AERE, Harwell, Oxon, OX11 0RA, Great Britain. (Tel: 0235-834621) (Telex: 83135)	P. Robertson, BSRU, University of Glasgow, 3 Lilybank Gardens, Glasgow, Great Britain. (Tel: 041-334-2269) (Telex: 778421)	BSRIA, Old Bracknell Lane West Bracknell, Berks RG12 4AH, Great Britain. (Tel: 0344-25071) (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: 255 710 822 0176)	R. Grot, Building Thermal & Service Systems Division, Centre for Building Technology, National Bureau of Standards, Washington D.C. 20234, USA. (Tel: 301/921-3560)	D. T. Grimsrud, Energy & Environment Division, Building 90, Room 3078, Lawrence Berkeley Laboratory, Berkeley, California 94720, USA. (Tel: 415/486-4023) (Telex: 255 910 386 8339)	D. Harrje, Centre for Energy & Environmental Studies, Princeton University, Princeton, New Jersey 08544, USA. (Tel: 609-452-5190/5467)

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