Air Infiltration Review

a quarterly newsletter from the IEA Air Infiltration Centre

Vol. 2 No. 3 May 1981

Results from Berlin's Conference sharpen IEA's focus on Positive Energy Conservation

The IEA Conference on New Conservation Technologies and their Commercialisation was held in Berlin from April 6 to 10, 1981. It was attended by over 900 people from 27 countries, and about 300 papers were presented.

The prime objective of the Conference was to identify options for maximising short to mid-term energy savings in the IEA countries so as to keep the energy supply/demand balance in equilibrium. Only by such an equilibrium can the economies of the Western industrialised countries prosper; increasingly expensive primary energy sources make it essential to use energy wisely and efficiently.

Energy conservation needs and markets for new technologies were identified by the Conference in these end-use sectors: residential and commercial, industrial and transportation. R&D results from various technologies were described in relation to these needs and markets. At the concluding session, the technology priorities emerged so that emphasis in R&D efforts and funds might be placed on those technologies which promised timely and substantial energy savings or, in some cases, substantial oil substitution. Policy measures to realise market penetration of conservation technologies were formulated with a sense of urgency by the participants, bearing in mind the continuing nature of the energy problem and the long lead times from technological innovation to market acceptance.

From these recommendations will follow an IEA strategy for developing energy conservation technologies. It will involve the means and timing of the introduction of technologies, and implementing measures which concern the whole fabric of society in the IEA member countries.

Nearly 90% of all buildings which are expected to exist in the year 2000 are already built in most IEA countries—building stock turnover is inherently low. The greatest potential savings in the Building Sector are therefore in the *retrofitting of existing houses and office buildings.* Savings of up to 50% can be achieved compared with the efficiency of housing stock existing in 1973, the year of the oil embargo. New buildings can achieve 50 to 75% energy efficiency gains, and in some particular cases 90% is quite feasible. Since one third to one half of the total energy used in IEA countries is consumed in this sector, this is clearly a target for prime attack. Approaches have to be regional in nature, taking into account specific social, political and climatic conditions. Governments have a significant role to play, especially through the revision of building codes which are frequently behind the technical and economic achievable levels of today. The need was stressed that an authoritative and comprehensive data base was required to achieve significant penetration of conservation technolgies—this data base is required by builders, governments and users alike, and it was suggested that the IEA give this urgent attention.

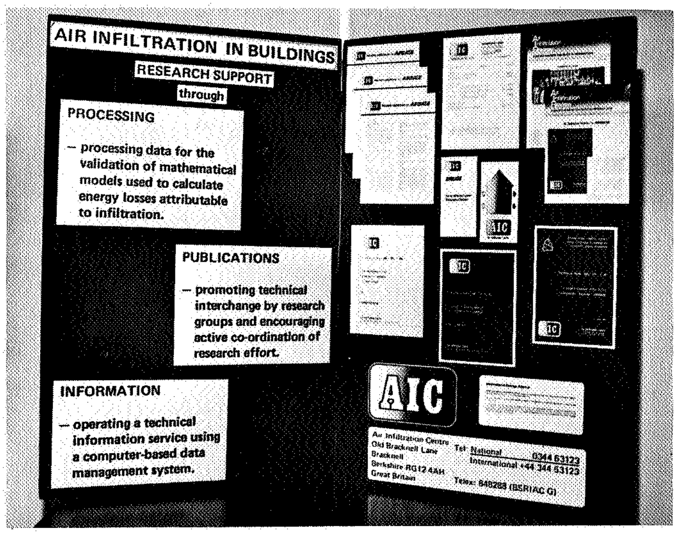
About 35% of energy consumption is in industry, and because of strained profit margins in recent years, much initial progress has already been made in the efficient use of that energy. Pay back period was a recurrent theme in the industrial sector, with government encouragement in some form being thought necessary for periods greater than three years. Since energy efficiency is only obtained by optimising the entire system in a given industry, an improvement in systems analysis technologies, as well as the use of specific technologies was urgently required. Technologies highlighted by industry included the use and further development of heat pumps, combustion systems and overall control systems.

The Transportation Sector, besides being the largest user of petroleum, is almost totally dependent upon it. It is very vulnerable in times of crisis. The largest user by far is the private automobile where existing technologies result in over 80% of the available petroleum energy being lost without useful work being done. Therefore the recommendations in this area called for the continued reduction of petroleum use in transport by increased efficiency and substitution technology.

More efficient engines, automatic controls, reduced weight and metal substitution, improved aerodynamic designs and drive trains will continue to be pressed with vigour. Petroleum substitutes must continue to be sought, and extenders such as gasohol used to the full. Electric cars still depend for wide market penetration upon further advances in batteries. While the latter have been impressive recently allowing cars to have greater range and flexibility, it was thought that little real substitution might be made from this technology in the next ten years.

While it is sometimes tacitly assumed that information is abundant in the conservation area, the Conference participants were heavily of the opinion that this was largely an illusion. Standisation of measurement was poor and little follow-up on the results of experiments and demonstrations had taken place.

The IEA was urged by the Conference to attack this fundamental shortcoming with some urgency. The IEA will review this and other recommendations with a view to accelerating the introduction of new technologies and practices into the market place. The Conference felt strongly that only by taking vigorous measures in conservation at this time, could future costly energy supplies be able to meet the needs of economies with even a modest growth rate.



AIC Display Material on show at IEA Conference

Forthcoming Conferences

1. ASHRAE Semiannual Meeting
Cincinnati, USA
June 28–July 2, 1981.

2. Building Design for Minimum Air Infiltration
2nd AIC Conference
Royal Institute of Technology
Stockholm, Sweden
September 21–23, 1981.

3. International Symposium on Indoor Air Pollution, Health and Energy Conservation
University of Massachusetts, Amherst, USA
October 13–16, 1981.

In the 4-day symposium, scientific papers will be presented on:

- *Emission characterizations of indoor pollution sources*
- *Monitoring of indoor contaminants*
- *Instrumentation*
- *Modelling indoor air pollutions*
- *Air pollution exposure studies*
- *Health effects*
- *Air cleaning equipment and control technologies*
- *Building ventilation and indoor contaminants*
- *Energy conservation*
- *Policy issues*

Proceedings will be available for attendees and reviewed papers will be published.

Further information from:
Dr John D. Spengler
Dept. of Environmental Health Sciences
Harvard School of Public Health
665 Huntingdon Avenue
Boston, Mass. 02115, USA.

4. 3rd International Conference on Energy Use Management
Berlin, West Germany
October 26–30, 1981.

Further information from:
ICEUM-III
PO Box 64369
Los Angeles, CA 90064, USA.

5. ASHRAE Semiannual Meeting
Houston, USA
January 24–28, 1982.

6. CIB Working Commission W67
3rd Annual International Symposium on Energy Conservation in the Built Environment
Dublin, Republic of Ireland
March 30–April 1, 1982.

Topics include:

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

Further information from:
Miss F. Curran
Information and Training Centre
An Foras Forbartha
St Martin's House
Waterloo Road
Dublin 4, Republic of Ireland.

Air Leakage in Residences in Canada

R. S. Dumont, National Research Council of Canada

Air leakage research in Canada has been closely connected over the years with the problems of excess interior moisture and damage from condensation. A 1949 paper by Hutcheon and Legget[1] stated the problem as follows:

> 'The use of insulation is not without its attendant difficulties, largely associated with need for control over the flow of water vapour from the inside to the outside of a wall or ceiling in winter, in order to prevent condensation of the vapour within the wall or in the cold attic space.'

Rising energy prices have added impetus to research efforts to reduce air leakage from buildings while maintaining air quality.

Ventilation of Residences

Stack effect and wind pressures are usually sufficient to provide air exchange through normal leakage routes. Typically, in new construction exhaust fans are located in bathrooms and usually also in the kitchen, although they are activated only intermittently.

In more air-tight houses natural ventilation may not provide sufficient air exchange to limit moisture build-up and condensation on windows during the colder months. In such cases a 125 mm diam. duct to the outside can be connected to the return air duct on the warm-air furnace.[2] When the furnace fan is running the negative pressure caused by the fan is sufficient to draw in fresh air, which is exhausted by the chimney if the house has a combustion heating system.

In very air-tight residences, an air-to-air heat exchanger is used to provide outside air at low energy cost. Flow rates of the order of 40 l/s are normal in houses with an average occupancy load. In early 1981 approximately 250 Canadian houses are using air-to-air heat exchangers.

There is no Canadian standard for over-all tightness of buildings such as exists in Sweden. An air tightness standard for new housing is, however, being considered for inclusion in the revision of the model energy conservation standard for new buildings.

Pressure Tests

A number of pressure tests have been conducted on Canadian houses.[3–5] The air tightness level in 67 houses built in Ottawa in 1978 averaged 4.4 air changes per hour at 50 Pa (0.2 in. water) with chimneys and vents blocked. A 1981 report[6] on houses in the Saskatoon, Saskatchewan, area presented the following pressure test results:

Construction Year	Average Air Changes/h at 50 Pa	No. of Houses
Pre–1945	10.4	19
1946–1960	4.6	20
1961–1980	3.6	97

In addition, tests have been conducted on a group of 40 houses in which special air-tightness measures were used. The results for these averaged 1.5 air changes per hour at 50 Pa, the tightest house having a value of 0.37 air changes per hour at 50 Pa.

Retrofitting

As may be seen from these figures, older houses are particularly leaky, and a number of firms are now involved in providing air-tightness retrofits with before and after pressure tests.

Air-Tight Construction

A comprehensive publication on the subject of improved techniques for reducing air leakage is *Low Energy Passive Solar Housing,*[7] which has been re-issued as *Energy Efficient Housing —A Prairie Approach.*[8]

In the conventional Canadian woodframe construction of 1980 the standard vapour barrier used was 50 µm (2 milli-in.) polyethylene. In conventional installation there is some attempt to provide continuity of the vapour barrier, but there are numerous locations where it is difficult to achieve.

In airtight construction polyethylene sheeting (preferably 150 µm, 6 milli-in.) is used as the membrane, and great care is taken to achieve a continuous barrier. The above-mentioned booklets provide a wealth of design detail intended to provide greater air tightness. (In the group of 40 houses employing these air-tightness techniques air leakage was reduced to a value of 1.5 air changes per hour at 50 Pa.)

As normal pressures due to wind and stack effect on a house are of the order of 5 Pa or less, the natural leakage in air-tight houses has been reduced to a very small value. To provide sufficient ventilation air and humidity, most of the air-tight houses use controlled ventilation with an air-to-air heat exchanger.

With the emphasis on air tightness and controlled ventilation the approach in many Canadian centres closely resembles that pioneered in Sweden. Continuing escalation in energy prices will doubtless bring about widespread adoption of such energy saving techniques.

References

1. Hutcheon, N. B. and Legget, R. F., Fuels for Space Heating in Canada, Division of Building Research Technical Report No. 4, National Research Council of Canada, 1949.

2. Veale, A., Here's a Simple and Inexpensive Way to get Automatic House Ventilation, National Research Council of Canada, Division of Building Research, HN 13, 1963.

3. Beach, R. K., Relative Tightness of New Housing in the Ottawa Area, National Research Council of Canada, Division of Building Research, BR Note 149, 1979.

4. Tamura, G. T., Measurement of Air Leakage Characteristics of House Enclosures, ASHRAE Transactions, Vol. 81, Part 1, 1975, pp. 202–208.

5. Stricker, S., Measurement of Air Tightness of Houses, ASHRAE Transactions, Vol. 81, Part 1, 1975, pp. 148–167.

6. Dumont, R. S., Orr, H. W., Figley, D. A. and Makohon, J. T., Air Tightness Measurements of Detached Houses in the Saskatoon Area. To be published.

7. *Low Energy Passive Solar Housing,* Dept. of Mechanical Engineering, University of Saskatchewan, Saskatoon, Canada, 1979. (Available from U-Learn, Extension Divison, University of Saskatchewan.)

8. *Energy Efficient Housing—A Prairie Approach,* Office of Energy Conservation, Government of Saskatchewan, Regina, Saskatchewan, S4P 4V4.

Recent Acquisitions

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

1. Bolon, P.
Listening for air leaks.
Popular Science, February 1981, p. 38, 40.

Describes the use of a simple acoustic method, developed by Keast to detect air leaks.

2. Benedetto, G., Brosio, E.
A relation between transmission loss and air infiltration characteristics in windows.
Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin, 1981, 4pps.

Reports tests on four windows of air leakage and sound transmission loss.

3. Berk, J. V. et al.
The effects of energy-efficient ventilation rates on indoor air quality at an Ohio elementary school.
Lawrence Berkeley Laboratory Report LBL-10223, April 1980.

4. Evans, R. D. et al.
Estimate of risk from environmental exposure to radon-222 and its decay products.
Nature, Vol. 290, 12 March 1981, p. 98–100.

Reviews data on radiation exposure and compares estimates of the risk from radon gas.

5. Fisk, W.J., Roseme, G. D., Hollowell, C. D.
Test results and methods: Residential air-to-air heat exchangers for maintaining indoor air quality and saving energy.
Lawrence Berkeley Laboratory Report LBL-12280, February 1981.

Presents test result of the performance of five different residential air-to-air heat exchangers.

6. Höglund, I.
The Ulvsunda project—energy saving in existing housing.
Royal Institute of Technology, Sweden, Report 1980:6.

Gives results of a project to assess energy conservation measures in blocks of flats.

7. Korsgaard, J., Lundqvist, G. R.
Changes of indoor climate because of renewal of windows and tightening of joints.
(Indeklimaforandringer i boliger efter vinduesudskiftninger og fugetaetning.)
Varme. December 1980, Vol. 45, No. 6, p. 111–116 (in Danish).

8. Kusuda, T., Silberstein, S., McNall, P. E.
Modelling of radon and its daughter concentrations in ventilated spaces.
Jnl. APCA, Vol. 30, No. 11, November 1980, p. 1201–1207.

Describes computer program which predicts radon and daughter concentrations, total potential alpha energy concentration and equilibrium factor.

9. Payne, G.
Shut that door!
Energy Manager, Vol. 4, No. 1, January 1981, p. 14–15.

Discusses the choice of industrial doors to minimise energy losses.

10. Shaw, C. Y.
Air tightness: Supermarkets and shopping malls.
ASHRAE Jnl., March 1981, p. 44–46.

Reports pressure tests of air leakage in several supermarkets and an enclosed shopping mall.

11. Stricker, S.
Ventilation: State-of-the-art review.
Ontario Hydro Ltd., June 1980.

Reviews ventilation requirements for dwellings, indoor air pollutants, methods of measuring air leakage and air infiltration and heat recovery devices.

12. Wanner, H. U.
Air quality in living and working places.
(Luftqualität in Wohn—und Arbeitsräumen.)
Sozial u. Praeventivmedizin 1980, Vol. 25, p. 328–332.

Discusses pollutants of indoor air, reported levels of pollution in Swiss buildings and methods of removing pollutants from the air (in German).

Photocopies of the above papers are available from the AIC to organisations in participating countries.

New Translations

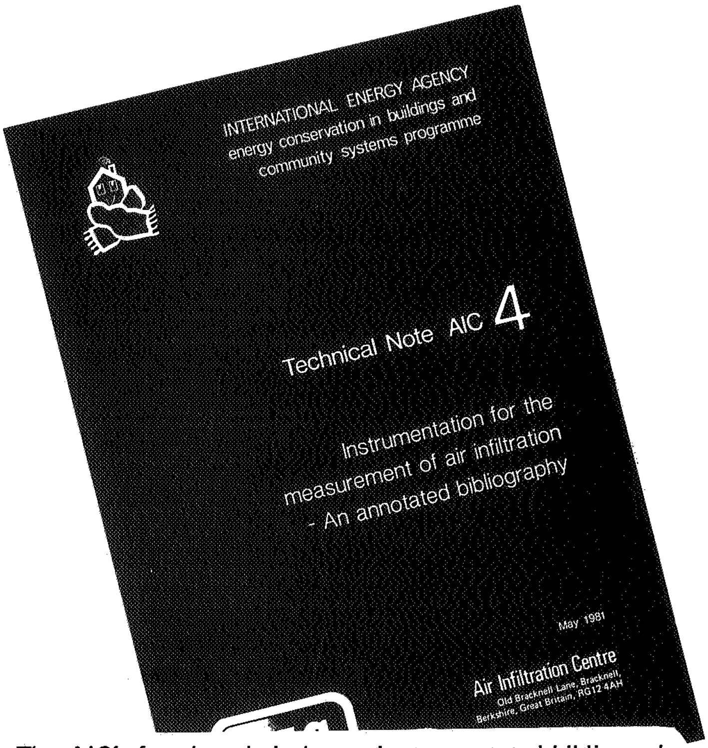
The following two papers have now been translated into English:

Esdorn, D. E.
Development of an acoustic method of determining air flow through building elements in situ.
(Entwicklung einer akustichen Messmethode zur ermittlung der Luftdurchlässigkeit von Bauelementen im eingebauten Zustand)
Kurzber. Bauforsch. 1978, Vol. 19, No. 7, p. 521–527
= AIC Translation No. 11.

Nusgens, P., Guillaume, M.
Natural ventilation of single family houses.
(Ventilation naturelle des maisons individuelles)
CSTC Revue, No. 1, March 1980, p. 4–16
= AIC Translation No. 12.

Copies of the above translations are available free-of-charge to organisations in participating countries.

New Bibliography on Instrumentation



The AIC's fourth technical note is an annotated bibliography entitled 'Instrumentation for the measurement of air infiltration'. It contains 89 references to papers selected from the AIC's library. This bibliography is intended to be selective rather than comprehensive and includes references only to papers entirely or substantially concerned with instrumentation, or that contain significant information about a particular technique. The references are divided into three sections according to subject. The first section covers tracer gas methods of measuring air infiltration, the second covers pressure tests of both entire buildings and building components, and the final short section covers the associated techniques of thermography and the acoustic detection of leakage paths.

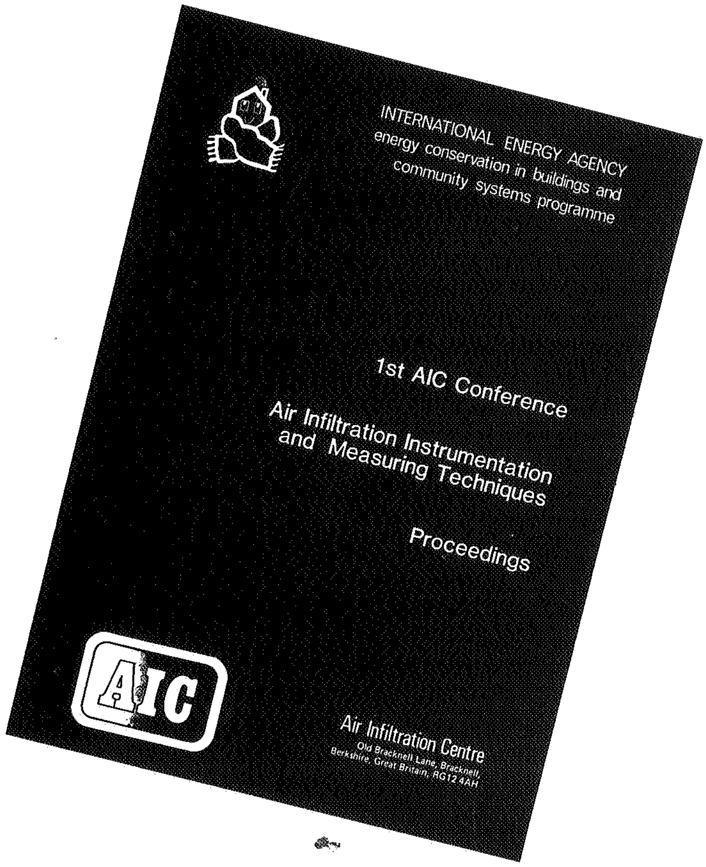
In addition to the above major bibliography, a number of short 'literature lists' have been compiled. These lists give references to papers on specific topics. The first four titles in the series are:

No. 1 Pressurization—infiltration correlation: models.
No. 2 Pressurization—infiltration correlation: measurements.
No. 3 Weatherstripping windows and doors (includes a list of manufacturers in the UK).
No. 4 Caulks and sealants.

Copies of both the bibliography and the literature lists are available free-of-charge from the AIC to organisations in participating countries.

Air Infiltration – Instrumentation and Measuring Techniques

Proceedings of 1st AIC Conference
Windsor, UK
6–8 October, 1980



The proceedings of the above conference are now available from the Air Infiltration Centre. They contain nineteen papers with discussions, presented by fifteen internationally renowned contributors from eight different countries. The most recent developments in the measurement of air infiltration and natural ventilation are fully described and the subjects covered include tracer gas systems, pressurization test methods, the correlation of tracer gas and pressurization tests and the measurement of air flow.

Copies of the proceedings may be ordered direct from the Air Infiltration Centre.

Price: £35 sterling (US $90) inclusive of postage and packing *(cheques payable to BSRIA (AIC)).*

AIRBASE Now Available Online

An international modem has now been installed at Bracknell and organisations outside the UK may log in and conduct their own database searches. Please contact Sheila Manning at the AIC for details.

This online facility is in addition to the same-day-service already provided by the AIC to enquirers. Readers in participating countries will have received, with this newsletter, a leaflet containing a tear-off application form on which they may request a database search. Enquiries are normally answered by return of post and this service is completely free-of-charge.

AIRBASE is, of course only available to organisations in participating countries.

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