Air Infiltration Review

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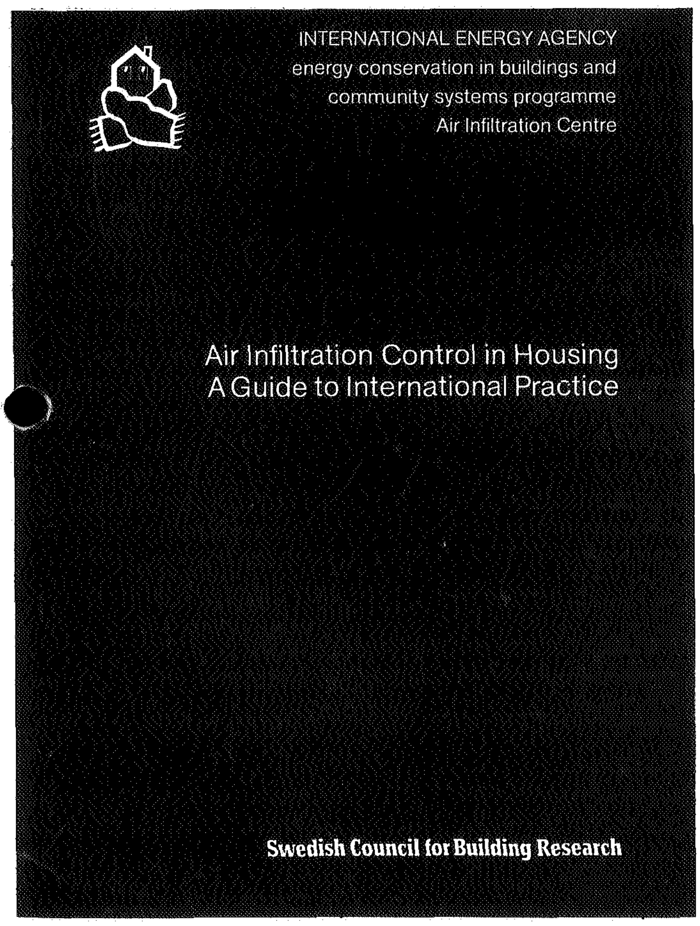
Air Infiltration Handbook – now available from Sweden



Air Infiltration Control in Housing – A Guide to International Practice

Arne Elmroth
Royal Institute of Technology, Stockholm, Sweden

Energy for heating and ventilating buildings constitutes a significant proportion of the total energy consumption in many countries. Traditionally, a building's energy status has been characterised primarily by the k-values – coefficients of thermal transmittance – of the various sections of the building. For this reason, there is a considerable amount known about thermal transmittance and detailed regulations exist in various countries as to how k-values should be calculated. Energy consumption resulting from transmission through the building envelope is therefore well-defined by the k-values of the structural components and the indoor-outdoor temperature difference.

In contrast to thermal transmission far more limited knowledge is available on the subjects of ventilation and airtightness. Standards and regulations are lacking. However, in recent research, efforts have been made to consider air leakage and ventilation in more detail. In many respects, the development of methods to save energy have led to a completely new construction technology. The aim of this construction technology is to make the building envelope so airtight that undesirable air leakage is minimized, and to do so in a safe manner.

Other main features in this issue – Air Infiltration Research in Poland (page 6)
Model Validation Progress Report (page 8)

Table 1. Properties of ventilation systems for dwellings

Ventilation system	Advantages	Disadvantages
Natural ventilation (N)	Simple, low-cost installations. No moving parts in the system No electricity cost	Ventilation dependent on many factors: – Wind and temperature. Highest ventilation in cold and windy weather – Human behaviour in opening windows or special ventilation provision – Airtightness of the house and leakage distribution. Leaky houses suffer from excess ventilation and draught. In airtight houses there is a risk of insufficient ventilation with eg, condensation and air pollution problems as a result – Length of ducts and height of building Space demanding ducting (wide ducts) especially in multi-storey buildings
Natural controlled ventilation (NC). Automatic control of supply or exhaust air flows due to wind and/or temperature conditions	Low-cost improvement of N-system	The effects of such systems on ventilation and energy consumption are not yet sufficiently documented. Problems could arise in controlling air flows and airchange rates especially when driving forces are small and building not airtight Space-demanding ducting especially in multi-storey buildings
Mechanical exhaust fan ventilation (E)	Ventilation depends mostly on speed of fan Depressurization of building which reduces the risk of moisture convection outwards in the structure Low-cost mechanical ventilation system Air airtight envelope with properly sized and placed air inlets could provide a well distributed and controlled ventilation Easy to fit with heat recovery on the exhaust air (eg heat pump for hot water production)	A risk of insufficient ventilation in parts of building if leakages are unevenly distributed with big leaks close to the exhaust Air inlets must be properly sized and placed to reduce the speed of air into conditioned space (draughts). Discomfort caused especially during cold weather Fan forces are dominating which means that sealing measures are only effective to a certain limit. Ducts must often be cleaned
Mechanical supply and exhaust fan ventilation (SE)	If airtight building excellent control of ventilation in whole dwelling Possibilities to treat supply air with preheating and filtering Supply air could be taken from a place where air pollution is low Easy to fit with heat recovery	Expensive installations, especially in existing buildings Needs a very airtight building to function as intended. Very sensitive to pressure disturbances Noise from fans could be a problem Supply air devices must be placed properly to avoid dirt on surfaces caused by the airstream. Ducts must often be cleaned

From an energy viewpoint, it is important to limit the ventilation to the amount required for maintaining acceptable indoor air quality because significant quantities of energy may be consumed in heating outdoor air. There is great potential for reducing the total energy consumption for heating and ventilating by making both existing and new buildings sufficiently airtight to minimize undesirable air leakage.

It is becoming more and more important to consider the interaction between building technology and ventilation technology. Calculation methods have been developed which explain the mechanisms that govern the air leakage into a building. The driving forces for air leakage and ventilation are air pressure differences. These are made up of components from temperature and wind effects and, when mechanical ventilation is used, the effects of the fan.

The amount of air leakage is dependent also on the leakage characteristic of the building envelope. This means that a sufficiently accurate calculation of energy losses resulting from air leakage and ventilation is relatively complicated. Attention must be paid to attaining an acceptable air quality in dwellings by ensuring that a certain minimum ventilation is maintained independent of the effects of the outdoor climate. This can be achieved with mechanical ventilation or to some extent with controlled natural ventilation.

An overview of different ventilation systems for residential buildings is presented in Table 1. This Table also contains a summary of advantages and disadvantages for each system.

Several new measurement methods have been developed to check the airtightness of a building envelope. Some of these methods can be applied to determining air leakage and ventilation during different climatic conditions. Some methods are suitable for production control, others for research purposes. A schematic overview and comparison of different methods is given in Table 2.

Table 2. Comparison of methods for air infiltration measurements

	Method	Advantages	Disadvantages	Result
Determination of air changes (ventilation) in whole buildings or part of the buildings (single rooms)	Tracer gas (instantaneous)	Gives information about ventilation rate under running conditions. Needs relatively cheap equipment	Indirect method. Result depends on actual weather conditions. Mixing is difficult. Needs special training	Simultaneous air changes per hour (ac/h), m^3/s or m^3/h at operating conditions
Determination of air changes (ventilation) in whole buildings or part of the buildings (single rooms)	Tracer gas (instantaneous)	Gives information about the ventilation rate over a longer period under different operating conditions	Indirect method. Expensive equipment. Needs specialists. Can only be used in research and development projects	Air changes at operating conditions (ac/h), m^3/h or m^3/s)
Determination of air changes (ventilation) in whole buildings or part of the buildings (single rooms)	Tracer gas (container sampling)	Simple to handle and cheap method	Indirect method. Low control of taking samples	ac/h
Determination of the airtightness of the building envelope	Whole house pressurization	Gives information about the leakiness of the building envelope. At difference in pressure between in- and outside, the method is mostly independent of weather conditions. Cheap equipment. Easy to handle	Gives no information about actual ventilation degree. Gives information about air leakage at other pressure differences than operating conditions	Air leakage at high pressure differences (ac/h, m^3/s or m^3/h)
Determination of the airtightness of the building envelope	Components pressurization	A possibility to quantify airleakage through building components. Simple equipment. Relatively easy to handle	Takes time to adjust the equipment to actual component	Air leakage in m^3/h, m^3/s, or $m^3 m^2 h$ at x Pa
Qualitative detection of air leakage sites	Thermography	Gives information about leakage sites and at the same time defects in the thermal insulation. Can be used as control of workmanship	Expensive equipment. Needs temperature difference of at least 10K between outside and inside. Needs specialist	Identifying leakage sites
Qualitative detection of air leakage sites	Smoke pencil	Gives information about leakage sites and air movements. Very simple and cheap method	Difficult to find leaks especially with internal over pressure	Identifying leakage si[illegible]

It has been considered a matter of urgency to consolidate available research results and other experience in the form of a handbook. This handbook, which forms part of the work of the Air Infiltration Centre, reviews the state-of-the-art with respect to air infiltration and leakage problems associated with housing in the countries which participate in the work of the AIC.

General principles, motives, standards, assumptions, climate, energy balance in a house and common recurring design solutions for both existing and new buildings are treated in the handbook's general section, *Part A.*

With regard to airtightness, lightweight types of constructions (wooden constructions, prefabricated lightweight elements, etc) present many more problems than do massive types of constructions (brick walls, site-mixed concrete, etc). However, all connections, joints and seams are critical, regardless of t[illegible] construction style, see Figure 1. It is important to pay attention to the fact that cracks or gaps can develop as a consequence of movement in the structure. Sometimes it is difficult to seal such openings permanently. For this reason, well-fitting joint packings must be used that can fulfil their function even with relatively large movements in the structure.

A structure must be designed in such a way and with such materials that satisfactory thermal insulation and airtightness

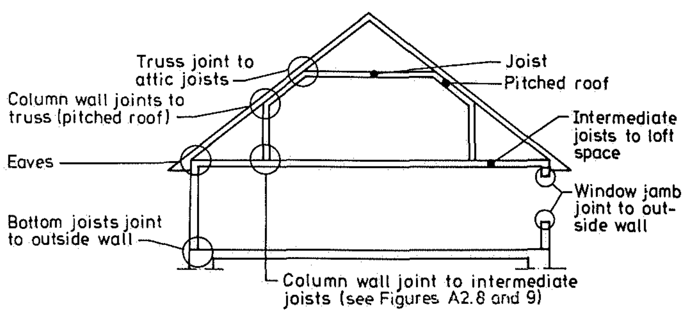


Figure 1. The structural sections which often give rise to complaints about draughts. The ways in which airtightness is achieved at joints between different building elements are seldom shown in building documentation.

can be achieved in a durable way. This is especially true in view of present working methods and associated rapid installation rates. It is desirable that well-tried and tested construction techniques should be used to avoid making costly errors.

Examples from the handbook giving different solutions for joints between window or door frames and walls are shown in Figures 2 to 6.

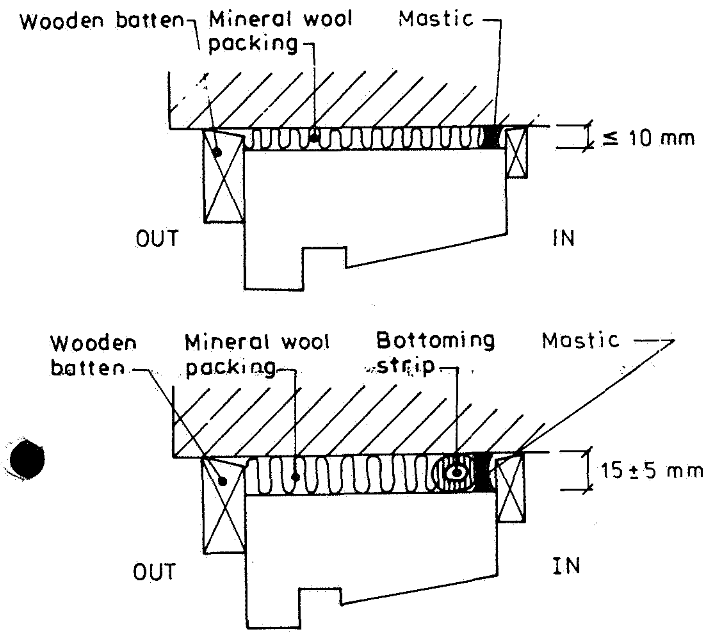


Figure 2. Two methods of jointing with mastic.

Figure 2 shows two methods of jointing with internal sealing using mastic and mineral wool packing. To facilitate good sealing, it is recommended that the joint dimension is 15 ± 5mm. It is the mastic which provides the seal and, if the correct type is used, it forms an elastic, tight joint. The purpose of the bottoming strip is to provide a limit to the compression of the mastic in the joint.

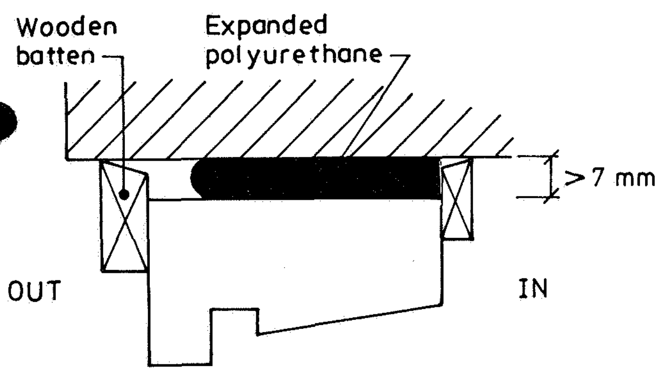


Figure 3. How a polyurethane foam joint should be made.

Figure 3 shows how a polyurethane foam joint should be made. The joint width should not be less than 7mm, bearing in mind the application of the foam. The joint has very good thermal insulation properties compared with frame timber and adjacent wall material. The joint is normally sufficiently diffusion-tight and airtight even when joints are relatively wide.

In figure 4 the thermal insulation in joints is provided by mineral wool. The actual airtightness (and diffusion seal) is achieved through the plastic film around the mineral wool strip. The thin plastic film adheres well to the frame and the wall. Good airtightness is achieved for joints between 10 and 20mm wide. Point leakage often occurs at window corners and around wedges.

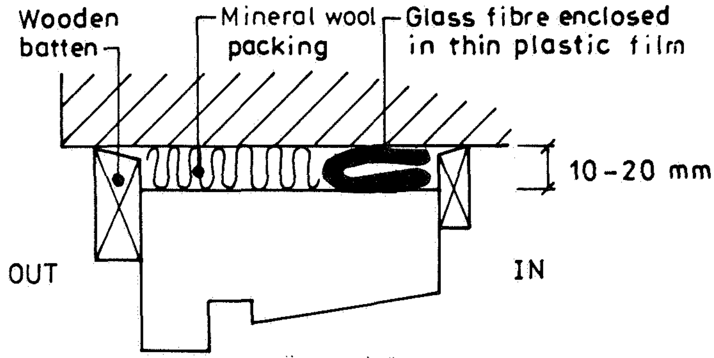


Figure 4. Sealing strips and plastic film.

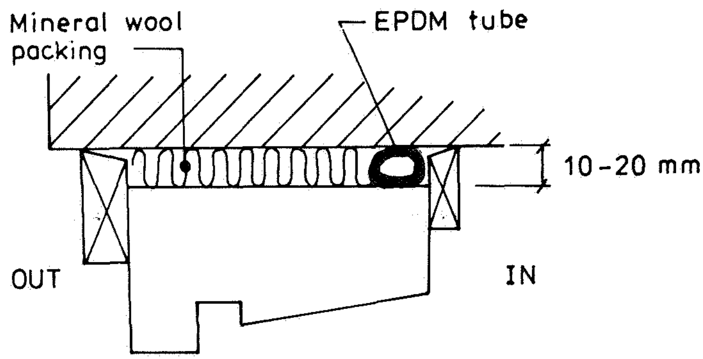
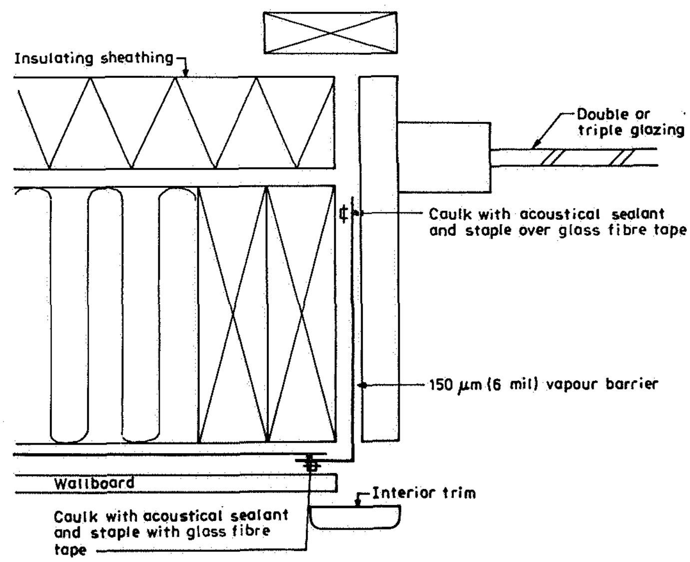


Figure 5. Tubular strip.

Joint sealing between frame and wall by using profiles of EPDM rubber to provide the actual airtightness in the joint is shown in Figure 5. The gap should be between 10 and 20mm. At least two different moulding sizes are required for installation, bearing in mind different tolerances. To achieve good airtightness, both frame and adjacent wall should be very smooth. The tube should not be stretched too much during installation. Plastic films in timber walls should be joined to the tubular moulding in the joint.



NOTE: Attach vapour barrier strip to window casing before being inserted into rough opening. Allow sufficient material at corners to fold vapour barrier.

Figure 6. Air/vapour barrier installation at window (Canadian example).

In Canada, a technique has been developed in which a plastic film strip is applied to the window frame with staples and using glass fibre tape and mastic. This plastic film strip is joined by overlapping and edge sealing to the plastic film in the wall. It is necessary to fit the plastic strip against the frame before it is installed in the wall. See figure 6.

Part B of the handbook contains detailed information about the climate in different countries and several design examples showing how building structures can be produced to achieve a reasonable degree of airtightness.

By tradition, building technology differs from country to country and thus the design and degree of airtightness are also different. In some cases, new building technology is necessary to minimize air leakage. Using other solutions, better airtightness can be achieved with relatively simple measures. Several examples are shown whereby improvements are possible using such simple methods.

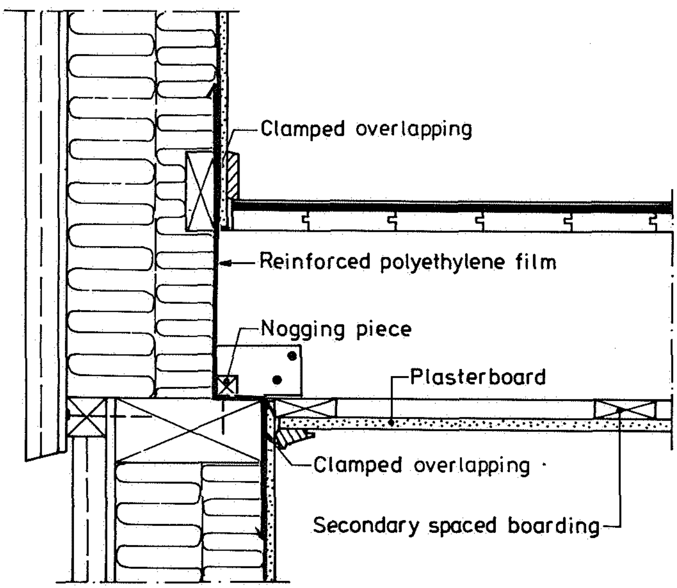


Figure 7. Joint between outer wall (facade wall) and intermediate joist structure.

Figure 7 shows a design example of a Swedish design construction joint between the outer wall and the intermediate joist structure. The Figure shows how good airtightness can be achieved by a continuous air/vapour barrier.

The continuity is achieved with a strip of reinforced polyethylene film which extends without a break between the intermediate joist structure even though the external wall in the upper floor is displaced outwards in relation to the external wall on the bottom floor. This strip, fitted when the framework is raised, is held in position between the joists with the aid of a nogging piece.

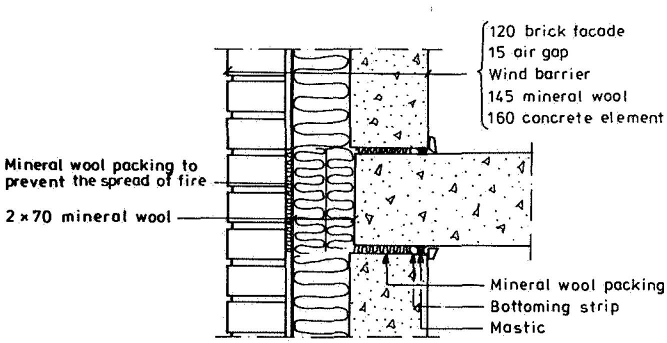


Figure 8. Joint between gable external wall of concrete elements and intermediate joist structure.

The joint between a gable external wall of load-bearing concrete and an intermediate joist structure is shown in Figure 8. Airtightness is achieved with mineral wool strips and internal mastic. The mastic must maintain its seal even after small movements in the joists. From an insulation aspect, the full thickness of mineral wool should be opposite the joist structure.

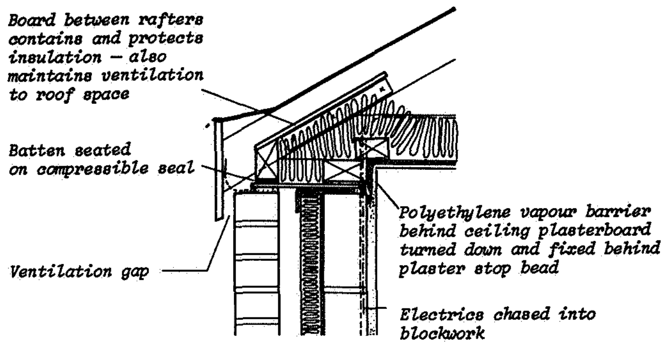


Figure 9. Roof junction with external wall (United Kingdom).

It is essential to improve airtightness at the ceiling/wall junction. Air leakage from the living accommodation to the attic can cause moisture problems in the structure. The example in Figure 9 shows a junction between the timber roof structure and a brick wall faced with plaster board. The polyethylene vapour barrier above the ceiling is turned down the wall and fixed behind a plaster stop bead. Insulation is retained by a board which maintains a ventilation gap to the roof space and protects the insulation from the ventilation air.

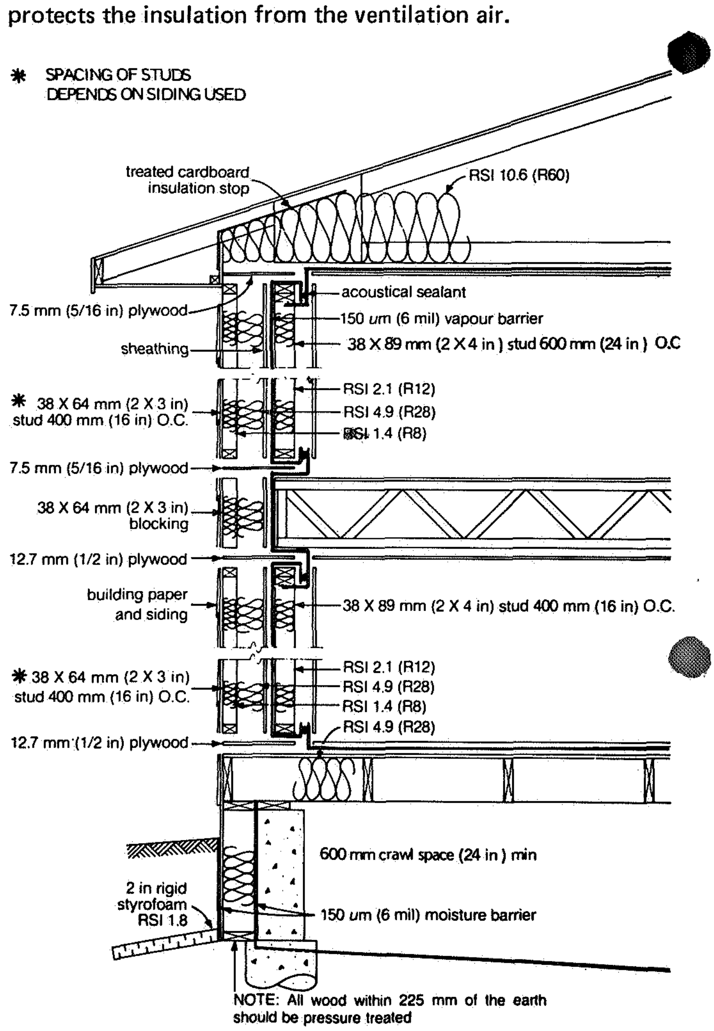


Figure 10. Wall section – grade beam and piling foundation.

Figure 10 shows a Canadian structural example. A unique double stud wall system has been developed which eases the installation of a vapour barrier. The air/vapour barrier is positioned in the outside of the inner stud wall. With this design the electrical wiring can be run on the inside of the air vapour barrier. Shown on the drawing are how and where joints in the polyethylene film can be made. Joints are not permitted elsewhere.

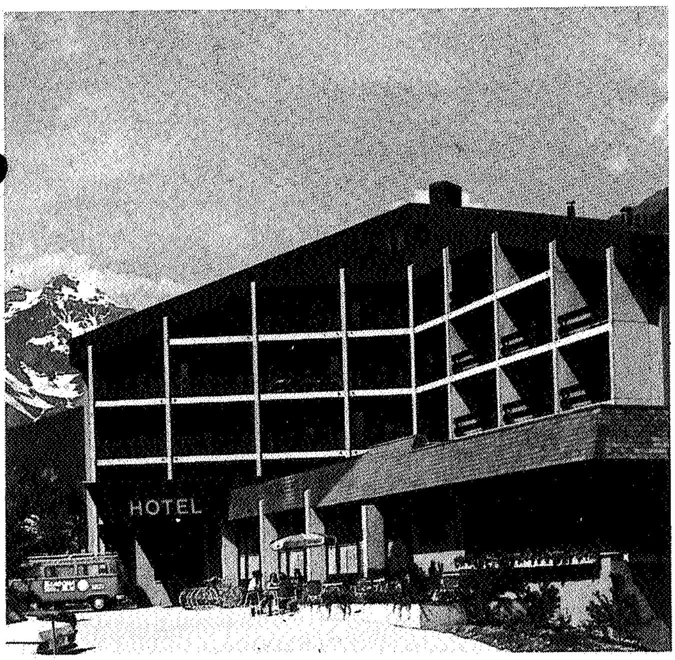
The examples given above are just a few of the design solutions which are illustrated and described in this 410 page reference book. It will be of great practical value to all those concerned with the design of problem-free dwellings with low energy demands and who recognise that design technology is being affected by new and more stringent requirements for building low-energy, well-insulated, well-sealed houses.

This handbook may be ordered direct from:

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

Price: Skr 95

4th AIC Conference - Preliminary Details



Title: 'Air infiltration reduction in existing buildings.
Venue: Hotel Sardona, Elm, Switzerland.
Dates: Monday 26 to Wednesday 28 September 1983.

Scope: The majority of existing buildings were constructed with little attention to energy consumption. These structures will constitute a high proportion of the building stock for many years to come and as such represent a prime target for energy conservation. As much of the energy consumption can be attributed to excessive air infiltration, more and more attention is being paid to its reduction as an effective means of saving fuel and running costs.

Much of this attention has been directed at domestic premises and both the theoretical and practical approaches to this subject have been widely discussed. This Conference will focus on *commercial, institutional* and *industrial* buildings and provide a forum for the consideration of the practical application of air infiltration reducing measures in these larger, more complex structures. However, domestic buildings will not be neglected altogether, so novel material relating to retrofit measures in dwellings will be discussed as well. The programme will also include a 'workshop' on instrumentation.

Action: Please reserve the dates 26 to 28 September in your diary. Contact your Steering Group Representative for further details.

Forthcoming Conferences

1. Second International Congress on Building Energy Management.
   Ames, Iowa, USA.
   May 31 – June 3 1983

   Further information from:

   Office of the Secretariat,
   c/o Prof. James E. Wood,
   Iowa State University,
   102 Scheman Building,
   Ames,
   Iowa 50011,
   USA.

2. ASHRAE Semi-Annual Meeting.
   Washington DC, USA.
   June 26 – 30 1983.

   Will include a symposium entitled 'Air infiltration model validation'.

   Further details from:

   R.S. Burkowsky,
   ASHRAE,
   1791 Tullie Circle N.E.,
   Atlanta,
   GA 30329,
   USA.

3. CIB '83 – 9th CIB Congress.
   Stockholm, Sweden.
   August 15 – 19 1983.

   Further details from:

   The National Swedish Institute for Building Research,
   PO Box 785,
   S-801 29 Gävle,
   Sweden.

4. 4th AIC Conference.
   'Air infiltration reduction in existing buildings'.
   Elm, Switzerland.
   September 26 – 28 1983.

5. 3rd International Indoor Climate Symposium.
   Stockholm, Sweden.
   June 4 – 8 1984.

6. Clima 2000.
   World Congress on Heating, Ventilating and Air Conditioning.
   Copenhagen, Denmark.
   August 25 – 30 1985.

   Further details from:

   Clima 2000,
   Copenhagen '85,
   Ordrup Jagtvej 42B,
   DK 2920 Charlottenlund,
   Denmark.

Tightness of Pre-fabricated Outer Walls and its Influence on Heat Demand in Apartment Dwellings

Dr Eng Marian Nantka
Institute of Heating, Ventilating and Anti-Air Pollution, Polytechnical Institute of Silesia, Gliwice, Poland

Marian Nantka has been involved in air leakage and air infiltration studies at the Politechnical Institute of Silesia for a number of years. During this time he has made extensive measurements in single family dwellings and apartment blocks and has developed a mathematical model of air infiltration. In this article, Dr Nantka describes the results of some of his measurements and theoretical studies on apartment buildings.

Introduction

The Institute of Heating, Ventilating and Anti-Air Pollution is one of the few institutions in Poland engaged in the study of air infiltration through external walls constructed of pre-fabricated blocks. The project, which began before 1978, covers the following aspects:

- air infiltration through gaps in laboratory and site studies
- research and estimation of the climatic parameters in dwellings
- research and theoretical analysis
- heat balances.

Much of the work has been centred on large apartment buildings of pre-fabricated construction (Figure 1).

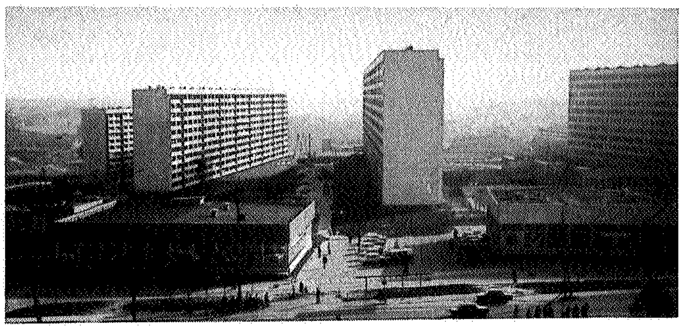


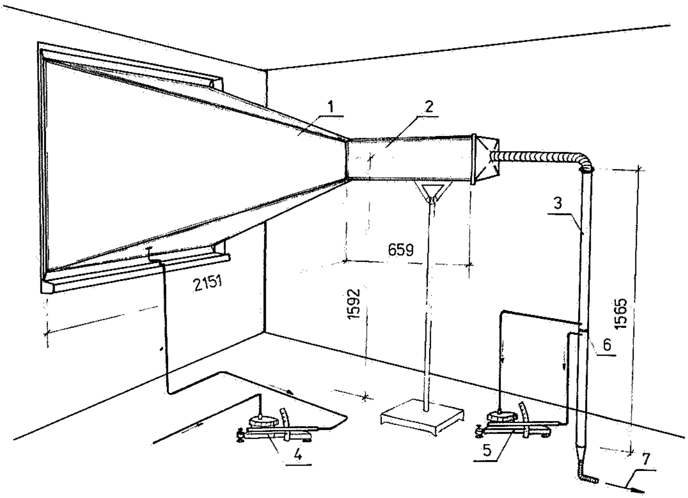
Figure 1. Types of buildings examined.

Air Leakage Measurements [1, 2, 3, 4]

Measurements of air leakage have been carried out in inhabited buildings using the pressurization test equipment illustrated in Figure 2. Particular attention has been focussed on the measurement of air leakage through cracks around windows and doors and through joints between pre-cast wall slabs. Similar tests have also been conducted in the laboratory at the Institute. The laboratory studies indicate a power law relationship between pressure acting across the opening and flow rate given by:

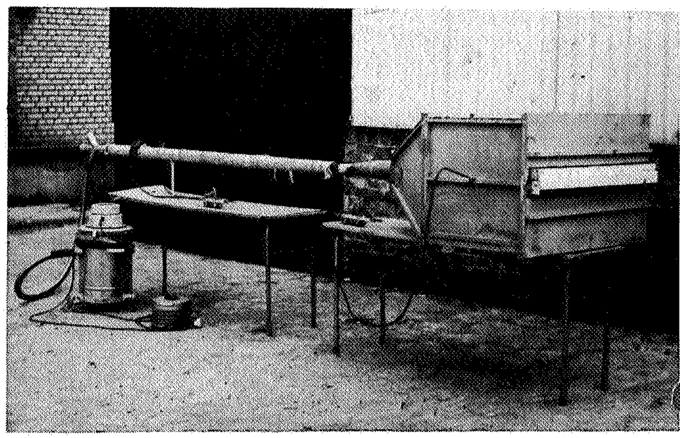
$$\dot{V} = a\Sigma\ell(\Delta p)^{1/n} \ \mathrm{m^3h^{-1}} \qquad (1)$$

where $\dot{V}$ = infiltration rate, $\mathrm{m^3h^{-1}}$
Δp = pressure difference across opening, Pa
$\Sigma\ell$ = sum of gap lengths, m
a = airflow coefficient, $\mathrm{m^3m^{-1}h^{-1}\,Pa^{-1}}$
n = power exponent



For windows in occupied blocks

1. *Airtight test chamber (1.8 x 1.5/0.2 x 0.2m)*
2. *Square-section duct (0.2 x 0.2m)*
3. *Measurements section (60mm dia.)*
4. *Micromanometer (for measuring pressure differences)*
5. *Micromanometer (for measuring air infiltration rate)*
6. *Gauge orifice (modulus m = 0.478)*
7. *To fan*



For laboratory tests on various components.

Figure 2. Experimental set-up for measuring component air leakage values.

Approximately 20 to 30 leakage measurements over a range of pressures were made on each component. The resultant combinations of Δp and $\dot{V}$ were analysed using the method of least squares to calculate *a* and *n*. Under these circumstances the precision of calculation was governed by the accuracy of measurement of Δp and $\dot{V}$ at the lowest range of measured values. Measurements of pressure down to 0.16 Pa were possible using a battery powered micromanometer and air flow measurements down to 0.6 x 10^{-3} $\mathrm{m^3s^{-1}}$ were achieved using an orifice plate or thermo-anemometer.

The results of these experiments are illustrated in Figure 3 and show that, at pressure difference of 50 Pa, the flow exponent for windows varies between 1.3 and 1.6. This has an important bearing on the calculation of air infiltration in rooms and can result in air infiltration overstepping expectation by an average of 30 to 50% for windows alone. In heat loss calculations, a similar allowance must also be made for leakages through joints in pre-fabricated elements even when they appear to be perfectly tight.

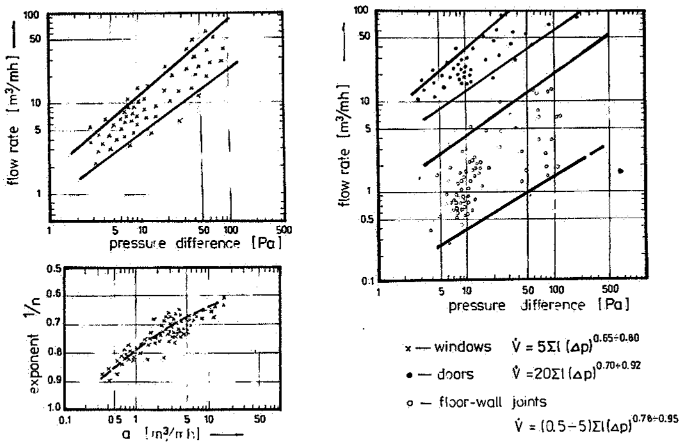
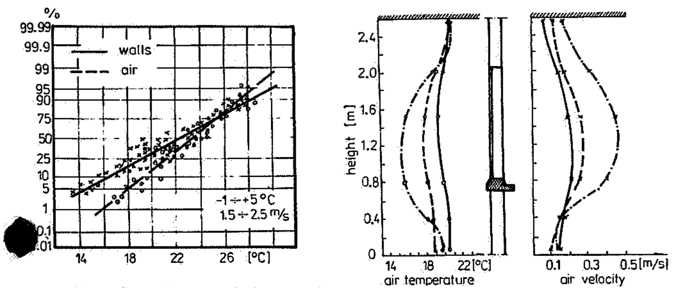


Figure 3. Comparison of air leakage rates through windows, doors and floor-wall joint in examined buildings and relation between exponents and coefficients for windows.

Estimation of Internal Climate Parameters[1,5]

In inhabited buildings, the essential parameters of climate are air temperature, wall surface temperature, humidity, and speed of air movement. These components have all been measured using traditional instruments. Many results were obtained over a two-year period, thus enabling a statistical analysis to be performed. Some typical results are illustrated in Figure 4. These show the wide variations in indoor climate that occur, with the result that it is difficult to make proper use of the rooms. The main reasons for the existing circumstances are lack of regulation of supply heat, insufficient tightness of building fabric and the existence of uncontrolled air infiltration.



(a) Variation of room air temperature and walls temperature in test dwellings

(b) Velocity and temperature profiles in a living room (for example). External temperature +1°C, mean wind speed 2 m/s.

Figure 4. Typical indoor climate data for flats located in test blocks.

Research and Theoretical Analysis of Ventilation and Air Infiltration[1,6,7,8]

A computer model was developed for studying the performance of natural ventilation in buildings. This was used to carry out a theoretical analysis of the performance of different kinds of ventilation system for a specific building throughout a one-year cycle of external climatic changes. The computer program calculates air infiltration by determining an internal pressure distribution such that air inflow is balanced by outflow. The accuracy of the calculation is dependent on precise measurements of internal/external air temperature, wind speed and direction, surrounding building obstructions, and the flow characteristics of ventilation shafts.

Results of these calculations (for example, Figure 5a) have reaffirmed the inferences of the experiments carried out in the inhabited buildings regarding the influence of uncontrolled air infiltration on room heat demand. It is only possible to eliminate such problems by installing mechanical ventilation to supply the necessary quantities of outside air (Figure 5b).

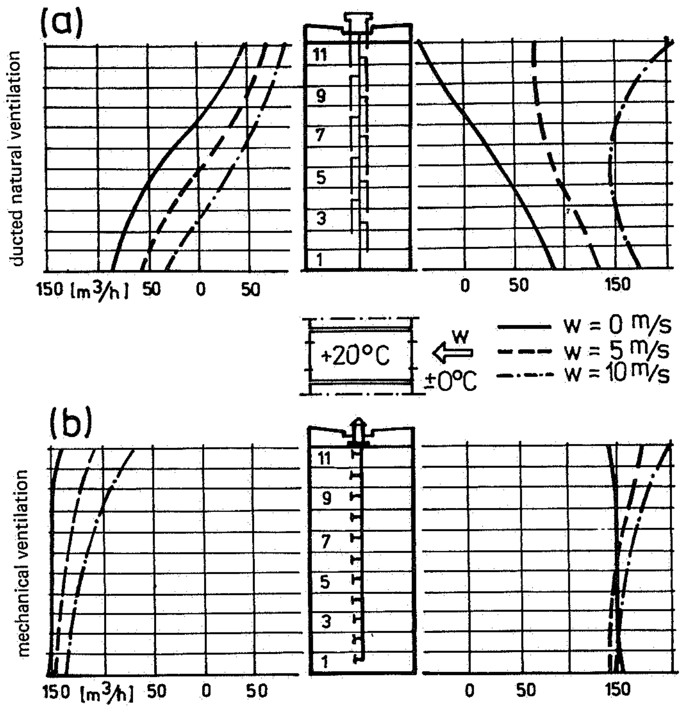
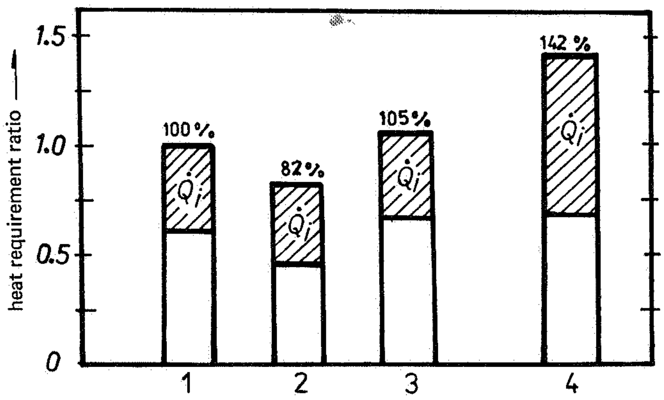


Figure 5. Influence of heat demand of types of ventilation systems in blocks of flats (results of computer calculated mean air leakage values).



Ventilation heat loss (including air infiltration)

Transmission heat loss

1. *Calculated according to the Polish Standards (k-values = max, air infiltration = min.)*
2. *k-values and air infiltration — based on technical data for buildings*
3. *k-values from measurements; air infiltration = min.*
4. *from measurements*

Figure 6. Heat losses for different conditions.

Building Heat Balance[8,9,10]

Excessive air infiltration is the reason for a need of extra heat in buildings. To assess the true value of heat loss through external wall elements, several measurements of heat transmission have been carried out. Continuous measurements have been made of the thermal resistance and internal/external temperatures of the slabs. These measurements have shown that the values of heat transmission fluctuate between limits of 1.2 to 1.5 $W/m^2 K$ for walls and 2.8 $W/m^2 K$ for windows.

Taking into account the air infiltration measurements, it was possible to determine the real heat requirement in buildings. The results of comparisons of these requirements with the calculated values are shown in Figure 6. These results show that the real heat requirement is about 40% larger than the calculated values. For natural ventilation systems the combined ventilation and air infiltration heat loss accounted for between 50 to 60% of the total building heat loss.

Summary

To date, this research has provided clear indications on how to overcome ventilation problems associated with air infiltration in apartment buildings. The Institute of Silesia in Gliwice is now preparing test rigs and measuring apparatus to monitor air exchange rates in apartment buildings as well as in other houses.

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Air Infiltration Model Validation - A Progress Report

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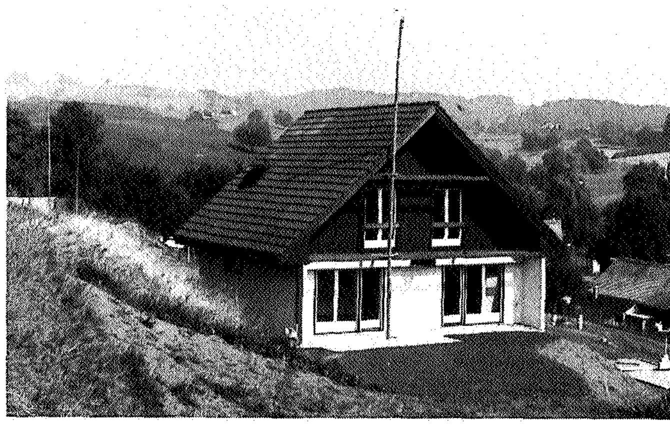
One of the fundamental tasks of the Air Infiltration Centre has been to undertake a programme to validate mathematical models of air infiltration. The principal objectives of this study are to use available data to assess the reliability and range of applicability of models, and to identify the key parameters that must be specified in order to ensure accurate results. Substantial progress has been made in this work and a brief review of the project is given below.

The validation programme has progressed in five stages, these being to

- select appropriate models
- establish the data needs of each model
- prepare suitable high quality datasets, based on the results of as wide a range of air infiltration and associated climatic measurements as possible
- use the available data to verify and assess the performance of the selected models
- identify key parameters by performing a sensitivity analysis.



Swiss dwelling

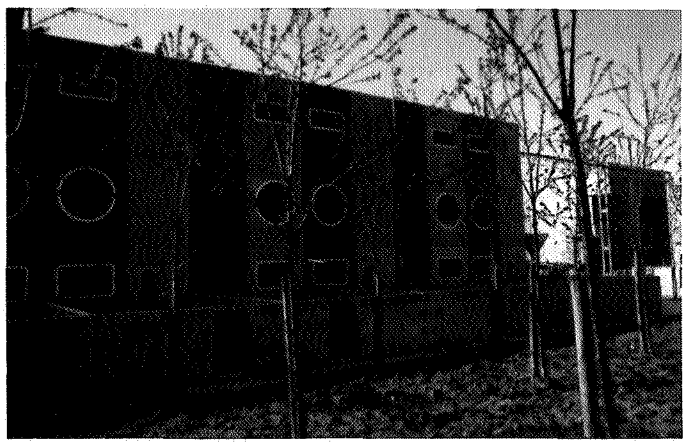
A wide range of modelling techniques has been developed to cope with the problems of estimating the rate of air infiltration in buildings. In general, these approaches may be divided into two categories — namely empirical methods in which the physics of air flow is treated in very restricted terms, and physical models which are based on a more fundamental approach involving the solution of the equations of flow for air movement through openings in the fabric of a building. Because they have a more general application, the validation programme has concentrated on the latter type of model. A total of eight models are currently being analysed; these range in complexity from relatively straightforward 'single-cell' approaches in which the interior of the building is assumed to be at a single uniform pressure, to 'multi-cell' techniques in which the interior is subdivided into zones of differing pressures interconnected by flow paths. Various methods of describing air movement are incorporated in these models, including power law, square root and quadratic formulations of the flow equation. Methods to include the influence of turbulent fluctuations are also being assessed.

Experimental data satistfying the minimum input needs of each of the models were received from five countries and comprised in excess of 300 air infiltration measurements and associated climatic data for fourteen dwellings. From these data, three key datasets, representing a wide range of climate, terrain and shielding conditions, were prepared. These were based on measurements made in an isolated detached dwelling in Switzerland, a partially shielded dwelling in Canada and a heavily shielded mid-terrace dwelling in the United Kingdom.

Canadian dwelling

Datasets for the remaining eleven dwellings have also been prepared to provide an opportunity for additional investigations at a later date.

The format of the datasets follows the guidelines recommended in the Air Infiltration Centre's Standard Reporting Format[1]. In addition to tracer gas measurements of air infiltration, against which calculations may be compared, the datasets contain the results of corresponding climatic measurements, construction details, terrain information and air leakage test data. In general, comparisons between the calculated and measured rates of infiltration have been found to be good and provide a valuable insight into the potential capabilities and accuracy of models.



UK dwelling

One of the most difficult parameters to quantify has proved to be the wind pressure distribution. In particular, it is important that the influence of local shielding on wind pressure is carefully considered. This problem is one that will be studied in much greater detail at the Air Infiltration Centre in the near future. Other essential data for reliable air infiltration estimates include air leakage data and hourly mean values of wind speed, direction and internal/external air temperatures.

To date, this work has concentrated on the calculation of air infiltration in domestic buildings, although it is hoped to widen the scope of this study to include commercial and industrial buildings as suitable data becomes available. The long-term outcome of the validation exercise will be to assess the suitability of each model for particular applications and to produce a guide or handbook indicating the appropriate algorithms for dealing with specific aspects. It is anticipated that this will be of direct relevance in both the design of new buildings and the planning of optimum retrofit measures in existing buildings.

A report describing in full the results of the AIC's programme of model validation will be published later this year.

Reference

1. Allen, C.
Reporting format for the measurement of air infiltration in buildings.
AIC Technical Note No. 6, December 1981.

AIRBASE – the AIC's bibliographic database

The AIC's bibliographic database continues to grow. It now contains abstracts of over 1,000 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*. Please use the *AIRBASE* Request Form overleaf.

Recent Acquisitions

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

*1. Shaw, C.Y.
A correlation between air infiltration and air tightness for houses in a developed residential area.
ASHRAE Transactions 1981, Vol. 87, pt. 2.

Uses the fan pressurization method to conduct air leakage tests and then translates the result into infiltration rates.

*2. Harrje, D.T., Gadsby, K., Linteris, G.
Sampling for air exchange rates in a variety of buildings.
ASHRAE Transactions 1982, Vol. 88, pt. 1.

Describes simple air infiltration measurement technique used in a range of buildings.

3. Macriss, R.A., Zawacki, T.S., Cole, J.T.
Development and field verification of a model of house air infiltration for single family residences.
NTIS Report PB82-141110.

4. Zarling, J.P.
Air-to-air heat recovery devices for small buildings.
University of Alaska, Report No. AK-RD-82-23, 1982.

Presents four basic types of heat exchangers and discusses their advantages and disadvantages.

5. Favre, P., Trachsel, C.
Measurement of hourly infiltration rate and air change rate in the apartment block La Chaumiere. (Mesures du taux horaire infiltration et de renouvellement de l'air sur l'immeuble La Chaumiere).
Ecole Polytechnique Federale de Lausanne, Report, 1981.

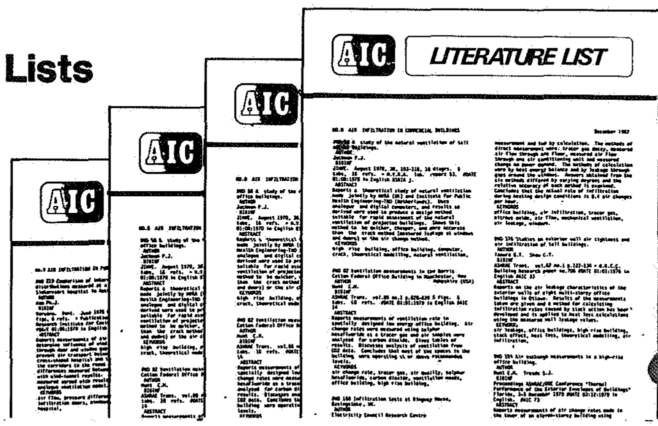
6. Sütonen, V.
Measurement of local air tightness in buildings.
VTT Research Note No. 125, 1982.

Uses the collector chamber method to determine the air leakage through part of the building envelope.

7. Sinclair, V.J., Croome, D.J., O'Cathain, C.S.
A review of possible techniques to measure ventilation in occupied spaces.
School of Architecture and Building Engineering Report, University of Bath, April 1982, 57pp.

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

Literature Lists



The AIC has produced two new literature lists on topics related to air infiltration. These are:

No. 8 Air infiltration in commercial buildings (23 references).
No. 9 Air infiltration in public buildings (10 references).

Organisations in participating countries may obtain copies by applying to the AIC library using the order form on page 12.

AIRBASE – REQUEST FORM

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Address: ______________________

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Date (I am not interested in papers published before . . .) ______________________

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