Air Infiltration Review

a quarterly newsletter from the IEA Air Infiltration and Ventilation Centre

International Energy Agency - AIVC Vol. 13, No. 2, March 1992

AIVC Future Approved

Martin Liddament, Head of AIVC, reviews the future programme of the AIVC

Introduction

The IEA Executive Committee on Energy Conservation in Buildings and Community Systems has approved a further extension to the AIVC, commencing in June 1992. This follows the preparation by the Centre of a Strategy Plan for ventilation research and programme of future work. It also follows substantial growth in the use of the Centre's information services which has increased by a further 33% in 1991.

The Present

Over the current three year operating period, the Air Infiltration and Ventilation Centre has undergone substantial development. At the start of this period it moved to its new home at Warwick University Science Park in the West Midlands of the United Kingdom. Since this time, the Centre's independent and international stature has grown considerably, with the AIVC now being represented on many international committees and groups. These include ASHRAE in the United States, the European Commission, the organising committee for Indoor Air 93 in Finland and the Organising Committee for Ventilation Effectiveness in Japan.

Further internationalisation has been achieved by the introduction of visiting overseas specialists to the AIVC. During the present operating period, specialists, on three month visits, have come from Canada, Germany, the Netherlands, New Zealand and the United States.

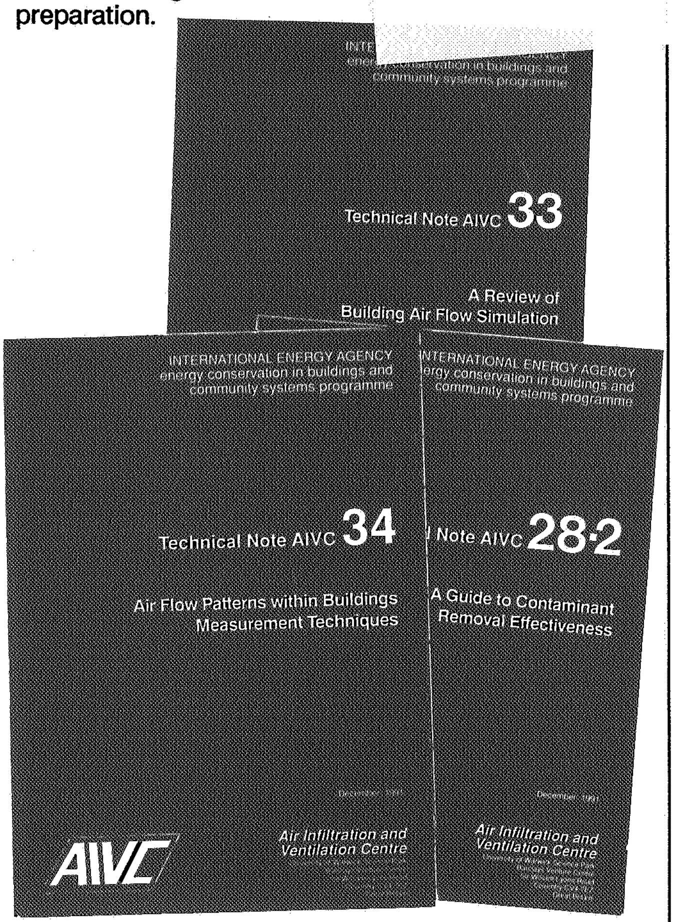
As the Centre approaches the completion of its current period, its work programme is also well established with the major intended tasks proceeding on schedule. On the technical front, the AIVC's numerical database has grown. Sample copies of its air leakage database are now being evaluated and versions of the data are being used by a number of groups. Wind Pressure data, which is vital for the correct prediction of wind induced air change, has been collated and analysed. Preliminary results derived from this analysis have proved to be very encouraging.

The Centre's interaction with related annexes is also working well and much useful data from these tasks and other similar activities have been published in the form of a series of related Technical Notes.

Technical Reviews covering air flow simulation, air change efficiency, advanced ventilation systems, measurement techniques and multizone modelling have been published, while reviews on ventilation strategies and combined ventilation and thermal heat

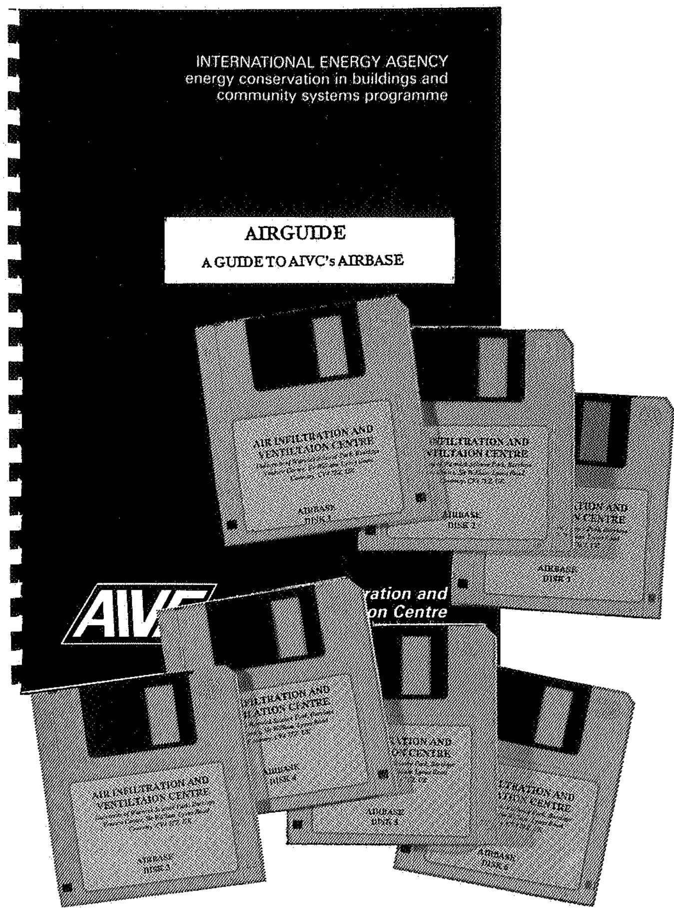
In this issue

loss modelling are in an advan preparation.



Recent AIVC Technical Notes

On the information front, enormous growth has taken place with substantial demand being placed on our services. The operation of an international information and library service has proved to be very successful. AIRBASE, the AIVC's bibliographic database is now available on floppy disk and may readily be inserted into 'PC' based computers. "Recent Addition", the AIVC's quarterly update on information entered into AIRBASE has more than doubled in size over the last three years, reflecting the extensive growth in publications and literature concerned with the impact of air change on both energy use and indoor air quality. In addition, the 's worldwide Survey of Ventilation and Related ality Research is now stored as a separate chapter within AIRBASE.



"Airguide" guide to AIVC's AIRBASE database with diskettes

"Air Infiltration Review", the AIVC's quarterly journal and newsletter has also grown in terms of both content and distribution. "AIR" continues to publish short technical articles which are intended to reflect current ideas and progress. Its particular niche is in being able to publish articles very quickly, without the delay caused by an extensive review process. Many researchers in all participating countries contribute regularly to this journal. "AIR" is sent to organisations in over 40 countries. Every effort has been made

Air Infiltration Review

Editor: Janet Blacknell

Air Infiltration Review has a quarterly circulation of 3,500 copies and is currently distributed to organisations in 40 countries. Short articles or correspondence of a general technical nature related to the subject of air infiltration and ventilation are welcome for possible inclusion in AIR. Articles intended for publication must be written in English and should not exceed 1,500 words in length. If you wish to contribute to AIR, please contact the Air Infiltration and Ventilation Centre.

Conclusions and opinions expressed in contributions to Air Infiltration Review represent the author(s)' own views and not necessarily those of the Air Infiltration and Ventilation Centre.

during the present operating period to ensure that AIR is distributed to those who wish to receive it.

The Centre's conferences and workshops continue to provide a forum for the world's experts to meet and exchange ideas. Selected papers from these meetings have recently been published in "Indoor Air". There is no doubt that the results of these conferences and the results of the Centre's other activities are beginning to influence the direction of future ventilation developments in many countries.

The Future

Air change and air movement may be expected to become the dominant heat (and cooling) loss mechanism in buildings of the next century. Furthermore, its impact on global energy use will increase substantially. Improving living standards throughout the world, for example, will mean that occupants of buildings will demand an ever increasing standard of comfort. The proposed technical goals for the next operating period are to evaluate the energy impact of ventilation, to quantify the precise role that ventilation has in meeting air quality requirements and to set the conditions needed for cost effective ventilation. Thus full focus will be given to the energy implications of ventilation. This technical programme will be supported by a continued information and dissemination service. Above all, the future programme will be motivated by a clear need to achieve an energy efficient, high quality indoor environment.

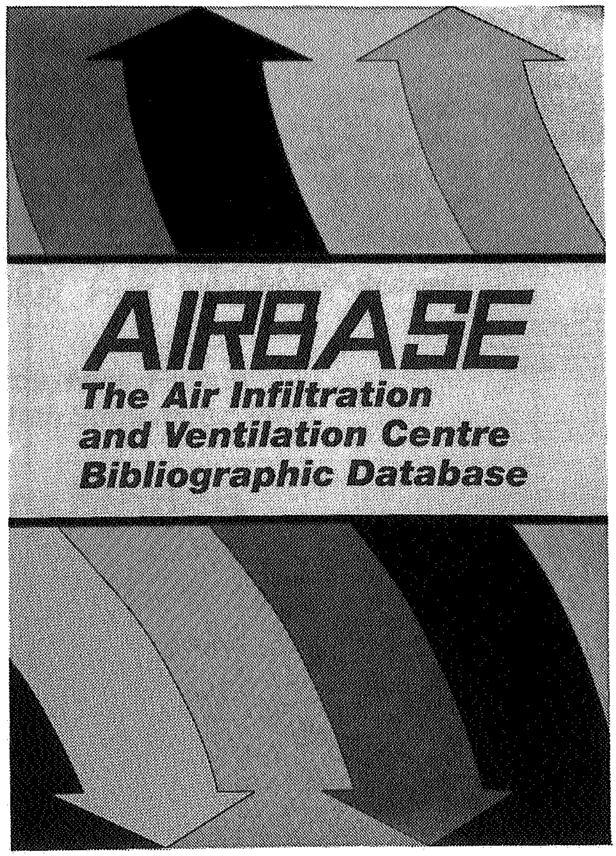
Proposed Work Programme

To fulfill these objectives, the following work programme is proposed:

Information

(i) AIRBASE

It is proposed that the Centre's information service should continue in the same format as presently structured but that emphasis should be given to the wider availability and use of AIRBASE. On current projection, it is estimated that AIRBASE will more than double in size to between 8000 and 10000 articles by the end of the 1995 operating period.



Leaflet for AIVC's AIRBASE for personal computer

(ii) Survey of Current Research

This Survey has recently been incorporated into an AIRBASE file which may be interrogated using IDEALIST software. The results of this survey have been widely used and it is updated as new projects are identified. The scope of the survey will continue to be directed at ventilation issues as they influence energy and air quality.

(iii) Ventilation Related Standards Database

A new database is proposed following the AIRBASE format. This will focus on Standards, Codes and Regulations related to ventilation and associated topics. It will therefore form an extension to existing Standards compilation activities of the AIVC but will be much easier to distribute, interrogate and update.

(iv) International Library Service

The above databases will be used in support of the AIVC's existing international library service. This service continues to be very popular and forms the backbone of the AIVC's information service.

Contacting the AIVC

For Literature Requests, Airbase Searches and other Technical Enquiries, please write, phone or fax as follows:-

Tel: 44 203 692050

Fax: 44 203 416306

Air Infiltration and Ventilation Centre,
University of Warwick Science Park,
Barclays Venture Centre,
Sir William Lyons Road,
Coventry CV4 7EZ,
Great Britain

(v) Recent Additions to AIRBASE
This publication is published quarterly and contains a complete record of all information being entered into AIRBASE. It is proposed that this publication should continue and include additions to the new current research and standards databases.

Literature Request Form

Library
Air Infiltration and Ventilation Centre
University of Warwick Science Park
Barclays Venture Centre
Sir William Lyons Road, Coventry
CV4 7EZ Great Britain

Telephone: (0203) 692050
Fax: (0203) 416306

#NO	AUTHOR AND TITLE

Airbase Search Request Form

Subject of search (Please be as specific as possible)__________

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

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Recent Additions to AIRBASE, No 55, March 1992

Literature Request Form

Technical Analysis

It is intended that the thrust of the AIVC's technical work programme should be directed at a full assessment of the energy implications of ventilation, the role of ventilation, as a control of indoor air quality, and minimum energy ventilation strategies. In addition, it is proposed that the existing ongoing analysis of the performance of numerical models, the development of the AIVC Numerical Database and the Centre's interaction with related air flow annexes should continue. Thus the following activities are proposed:

(i) Analysis of the Energy Implications of Ventilation
It is intended that a study should be undertaken, in the form of a technical review, to determine the energy implications of current air change rates in existing buildings and to project the potential reductions in energy consumption that are achievable.

(ii) The Role of Ventilation in Controlling IAQ
There are currently many uncertainties and much misunderstanding concerning the role of ventilation in relation to the control or maintenance of good indoor air quality. Since the rate of ventilation in buildings has a substantial energy effect, it is essential that the role of ventilation in relation to indoor air quality is properly understood. It is therefore intended to make a technical review of existing information and measurement data in order to assess the role of ventilation and, if necessary, to identify possible areas of future research needs that could be undertaken as task shared IEA research.

(iii) The Development of a Guide to Ventilation
It is proposed that the outcome of tasks (i) and (ii) above should be used in the preparation of a Guide to Ventilation. The target audience should be designers, policy makers, environmentalists and other end users who are able to promote the widespread use of this information. The intention of the guide is to encapsulate the knowledge obtained by the AIVC and by related IEA air flow annexes in a way which may be readily understood by these target groups.

This publication will include sections on:

the need for ventilation; air quality implications; energy implications; climatic factors; strategies; building requirements (airtightness, internal structure); standards; examples; building type (commercial,dwellings); goals - what is achievable.

(iv) Model Evaluation and Numerical Database Development.
In support of the above activities, it is proposed that the Centre's ongoing activities in relation to model evaluation and numerical database development should continue. Both these tasks are necessary, because substantial data from current IEA activities are becoming available. Only by documenting this work will it be possible to develop and verify the predictive models and design tools of the future.

Dissemination

The Centre's dissemination role is vital in ensuring that its knowledge base is utilised. Therefore, its conference and workshop programme, its interaction with other annexes, its publicity programmes and its technical newsletter and publications activities will continue.

Strategic Programming

An important part of the current workplan has been to develop a strategy for identifying future areas of energy related ventilation research. This has resulted in the preparation of a strategy plan which outlines future needs and shows how current IEA and other activities mesh to provide a coherent approach. An objective of the forthcoming period is to continue this strategic analysis and to ensure that ventilation is incorporated within an overall strategy for building energy use.

Further details on the work and activities of the AIVC may be obtained directly from the Centre.

International Energy Agency ,
Air Infiltration and Ventilation Centre

13th Annual AIVC Conference

Ventilation for Energy Efficiency and Optimum Indoor Air Quality

Hôtel Plaza Concorde, Nice, France
Tuesday 15th to Friday 18th September, 1992

Preliminary Notice

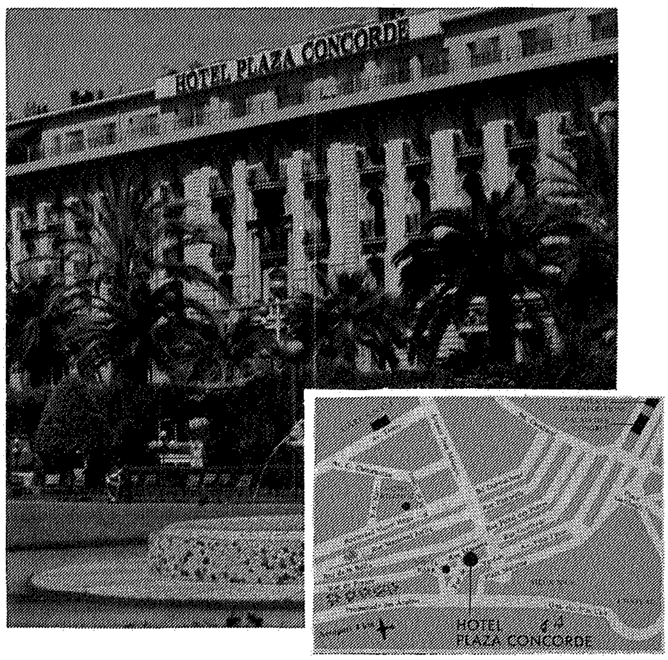
Ventilation is needed in order to meet the metabolic needs of occupants and to dilute and disperse internally generated pollution.

As contaminant sources and concentrations in buildings increase, ventilation is called upon to play a growing role in controlling the indoor environment. This imposes an additional energy load as well as increased capital and operational costs. In turn, extra energy demand feeds back to global concerns over the environmental risk of excess energy use.

The purpose of this conference is to identify the energy impact of ventilation and to assess the practical limit of ventilation as an air quality control mechanism. It is also intended that the conference should look to future developments and future research needs.

Topics cover:

- The energy impact of ventilation (including national and international assessments).
- The role of ventilation in optimising indoor air quality
- Ventilation requirements and standards.
- Ventilation control in hot climates.
- Ventilation control in cold climates.
- Influence of internal heat loads on ventilation needs.
- Designing for heat recovery (including cost implications, examples of energy recovery and payback potential).
- Improved air quality through ventilation efficiency.



- Developments in ventilation strategies.
- Ventilation case studies illustrating improved indoor environment combined with energy efficiency.
- Guidelines for the future - future research needs.

The conference fee will include full board accommodation on the conference dates.

Attention Conference Delegates

I am considering attending the AIVC 13th Conference in France, September 1992. Please send me full details when available.

Name..

Address ....

....

The Carbon Dioxide Reduction Programme of the Federal Republic of Germany

High Requirements for Technical Building Equipment

Günther Mertz, Operating Agent of the Fachinstitut Gebäude-Klima, the German representation of the AIVC.

Introduction

With this resolution, passed on November 7th, 1990, Germany's Federal Government aims high: as a step towards the protection of the global atmosphere, an extensive national CO_2-reduction programme is supposed to cut back the carbon dioxide emissions in Germany by 25% by the year 2005. These values are based on the 1987 figures so that 25% are the equivalent of 300 million tons of CO_2. The following industries are directly concerned: agriculture and forestry, traffic, new technologies and building and construction. As for the latter, an even higher percentage is to be achieved.

Carbon Dioxide Reduction in the Building and Construction Industry

In 1987 - the basic year of the programme in case - carbon dioxide emission resulting from heating systems in housing eas roughly 140 tons. Hot-water supply caused an additional 20 tons. These figures show that heating and hot water supply for residential buildings cause 30% (5% respectively) of the total CO_2 emission load (716 t) originating from the consumption of fossile energy sources. The reasons for this relatively high percentage are chiefly the average heating load requirements of residential buildings being higher than 200 kWh/m^{2}a. Peak values of 350 kWh/m^{2}a are not unusual.

Given the environmental problems as well as the energy problems known so far or still to become apparent, this fact is definitely unjustifiable and therefore requires efficient and immediate measures.

The implementation of the "heat transfer barrier act", an energy conservation code, was no doubt a good and important decision as regards single family dwellings which were built in accordance with this new resolution produce heating load requirements between 130 and 180 kWh/m^{2}a only. Thanks to this considerable improvement it seems feasible to limit additional CO_2 emission from those residential buildings which are to be built before the end of 2005 to 50% at around 10 million tons CO_2. It is much more difficult, however, to achieve similar results with older buildings. In this area, a potential diminution by 60 up to 65 per cent can only be realized through comprehensive measures aiming at the efficient use of energy as well as at the substitution of energy sources.

The heating load requirements of so-called Niedrigenergiehauser ("low-energy houses") are again much lower: single and two family dwellings of that type require only between 50 and 90 kWh/m^{2}a, apartment buildings even less. The typical features of such buildings are clearly improved heat transfer barriers on the one hand and highly heat insulated windows on the other hand. The constant diminution of heat transmission losses comes along with important hygienic problems yet: these airtight windows can function properly only if they are kept closed during the heating season. Since this is hardly practicable, it is indispensable to equip the building with a ventilation system in combination with heat recovery in order to prevent high ventilation heat losses.

Qualified calculations showed that CO_2 emissions from such highly thermal insulated buildings, which are equipped with that kind of ventilation system, have decreased by 1 to 2 tons per year. In this context further positive effects can be achieved through small heat pumps. These are capable of substituting fossil fuel sources in room air-conditioning systems by means of heat recovery.

Attention Conference Delegates

AIVC 13th Annual Conference

Pre-registration

Return to:

Air Infiltration and Ventilation Centre
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Coventry CV4 7EZ
Great Britain

Carbon Dioxide Reduction and Investment Costs

The Federal Building Ministry starts from the assumption that two thirds of all existing residential buildings dispose of - at least partly - considerable energy saving potentials. With the help of intensified measures to save energy, CO_2, emissions from housing could be reduced by approximately 50 million tons per year by 2005.

By substituting oil by gas and replacing the heat generator, CO_2 emission could be reduced by an extra load of 10 to 15 million tons per year.

According to estimations of several Federal Ministries, this saving potential is confronted with investments ranking between 250,000 to 350,000 million Marks (US$250 to 350 billion) though. Suppose out of this volume of investment 90,000 million Marks can be covered by the saving of energy costs, 160,000 to 210,000 million Marks will still be remaining, i.e. roughly 11,000 to 15,000 million Marks per year. The specific investment cost to carry through the reduction programme is estimated to be between three and four Marks/kg CO_2. This means that the houseowner has to be offered considerable incentives to make him invest in the renovation of his heating system.

Here, it must be made clear that the amount to be raised is a one-off investment whereas the CO_2 reduction effect will occur every year.

But not only financing represents a problem on the way to realization of the CO_2 reduction programme. A basic question is whether or not the building and construction industry as well as technical building equipment companies are capable at all of satisfying the immense demand potential resulting from the programme. This branch of industry is already booming as an acute shortage in housing led to the promotion of corresponding aid programmes. At the same time this branch of industry faces a significant shortage of construction workers, so that at the short term an increase in construction capacity seems out of the question.

International Aspects

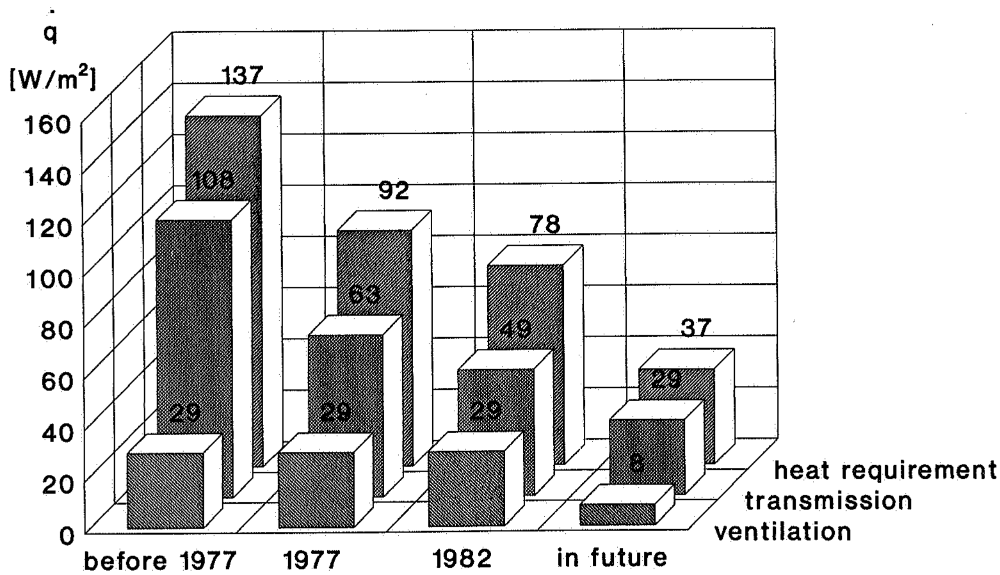
In view of the current and future environmental dangers resulting from the greenhouse effect, any effort to reduce CO_2 emissions must be supported. The concentration on national programmes seems to be little promising nonetheless. Even if the CO_2 reduction programme of the Federal Government turns out successfully in 2005, the 25% reduction of CO_2 emission in Germany represents a worldwide diminution of 1.25% only. And if - as is supposed - CO_2 contributes only 50% to the greenhouse effect, this figure is reduced even more to 0.675%.

The sole possible and obvious consequence of these numbers is that only joint international efforts can combat the greenhouse effect efficiently - sooner or later all nations will be concerned.

On January 16th, the German press reported that the Federal Government was allegedly considering a withdrawal, the reason mainly being the problem coming up with traffic. According to a survey conducted by the Swiss PROGNOS Institute, individual mobility would be drastically restricted in case the required measures were put into practice.

Before this article had to go to press, the Federal Government had not released any comment.

However, as far as the building industry is concerned, no revision of the reduction programme is currently at stake.



Heat requirement of residential buildings in Germany

A Comparison in Measurement of Local and Room Mean Age of Air

N O Breum National Institute of Occupational Health, Denmark

Introduction and Objectives

Concepts of age distribution theory provide useful tools for quantification of flow patterns of air and contaminants in rooms. Three populations of fluid elements of interest may be defined[1]: 1) the total internal population of all elements within the room, 2) the local internal population of all elements within a small volume centered at an arbitrary point within the room, and 3) the population of all elements leaving the room. The age distribution of a population may be determined experimentally by labelling the air or the contaminant using a stimulus- response tracer-gas technique. The stimulus is a tracer signal input and the response is the measured tracer-gas concentration. In a linear process any type of signal may be used in a signal-response technique. However, the most common signals in flow studies are:

A. decay ("step-down"),

B. continuous injection at a constant rate ("step-up"),

C. pulse injection.

The equations used for estimating local mean age of air or room mean age of air are given in Table 1.

The purpose of this paper was to compare the results obtained by the three methods and also to determine the repeatability of the measurements. The comparison included local mean age of air as well as room mean age of air. Tests were also carried out to determine the influence of sampling rate on the reliability of the three methods.

	Tracer injection strategy		
	Step-up	Pulse	Decay
Local mean age of air	$\int_0^\infty (1 - \frac{C_e(t)}{C_e(\infty)})\,dt$	$\frac{\int_0^\infty t \times C_e(t)\,dt}{\int_0^\infty C_e(t)\,dt}$	$\int_0^\infty \frac{C_e(t)\,dt}{C_e(0)}\,dt$
Room mean age of air	$\frac{\int_0^\infty t \times (1 - \frac{C_e(t)}{C_e(\infty)})\,dt}{\int_0^\infty (1 - \frac{C_e(t)}{C_e(\infty)})\,dt}$	$\frac{\int_0^\infty t^2 \times C_e(t)\,dt}{2 \times \int_0^\infty t \times C_e(t)\,dt}$	$\frac{\int_0^\infty t \times C_e(t)\,dt}{\int_0^\infty C_e(t)\,dt}$

Table 1. Equations for estimating mean age of air*

* Concentration at the exhaust is denoted C_e . A steady-state concentration is denoted $C(\infty)$. In a decay-test the concentration at t = O is denoted C(O).

Materials and Methods

Experiments were performed in a laboratory using a mock-up of an office room. Its dimensions (given in m) were 5.2 x 3.7 x 2.3 (LxWxH). In all tests air was supplied at a rate of Q_s through an inlet at floor level. outlet at ceiling Air was exhausted at a rate of Q_e through an outlet at ceiling level. The ventilation process was kept balanced ($Q_e = Q_s$) at an air exchange rate of 3.5 h^{-1} . In all tests an extra fan inside the room was used to accelerate mixing of the chamber air. Using SF_6 as a tracer concentration data were obtained at sampling rates of 9, 36, 72, and 144 s and injection strategy Nos.A, B, and C in a 4x3 factorial design experiment with 3 replications. The obtained data served as input in estimating local mean age of air and room mean age of air, respectively.

For step-up tests a mixture of SF_6 in air was injected into the fresh air supply from a storage bag and its flow rate was maintained at a constant flow rate of 50 cm^3 min^{-1} by means of a gas-tight pump with an estimated control accuracy of ± 3%. The tracer was injected in the supply duct at a distance from an inlet of more than 80 times the duct diameter. When it enters the room the tracer may be considered homogenously mixed with the the supply air[2]. The injection time was more than 4 times the time constant of the test chamber. For pulse tests neat SF_6 was injected into the fresh air supply by means of a gas-tight syringe. The injection time was a few seconds. For decay tests tracer gas was injected into the room and brought to a uniform concentration by means of the internal fan. Tracer gas concentrations were obtained using a rapid response multipoint measuring system[3] (see Fig.1).

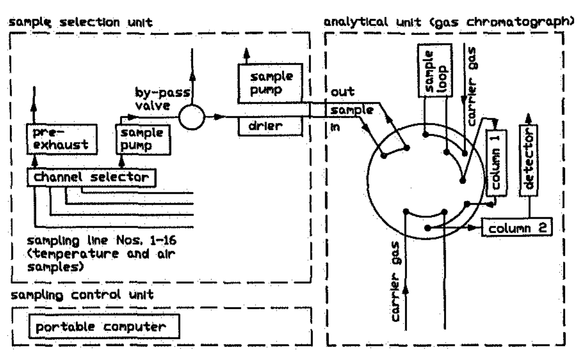


Figure 1: Schematic diagram of the tracer-gas measuring unit (the gas chromatograph is shown in the load mode)

Results

Table 2 is a complete summary of the data obtained. Each result is the average of three tests, and the standard deviation is also given. A two-way analysis of variance at a 1% level of statistical significance did not support a hypothesis of an effect of the two factors on the estimated mean age of air. The two factors were the injection strategy and the sampling rate.

		Tracer injection strategy		
	Sampling rate	Step-up	Pulse	Decay
Local mean age	9 sec.	17.5±0.6	16.3±0.5	16.9±0.8
	36 sec.	17.8±0.4	16.5±0.5	17.2±0.8
	72 sec.	16.9±0.3	16.6±0.4	17.3±0.6
	144 sec.	18.1±0.9	17.8±0.9	17.3±0.4
Room mean age	9 sec.	17.6±0.3	16.3±0.3	17.5±0.9
	36 sec.	17.7±0.3	16.3±0.4	17.3±1.4
	72 sec.	16.7±0.5	16.9±1.1	17.5±0.4
	144 sec.	18.1±0.8	17.2±1.0	17.2±0.4

Table 2. Estimated mean age (min.) of air

Discussion

No influence of the four sampling rates was observed on the estimated mean age of air. A Nordtest report[4] on measuring the local mean age of air recommended a sampling interval of less than 180 sec. For a multi-channel measuring system the sampling rate should be kept low, so as to allow for many sampling lines needed for a detailed spatial characterisation of flow patterns of air.

A comparison of the three injection strategies has been made in previous studies. In a field study it was observed that mean ages of air estimated by the decay technique was elevated (1-23%) compared to results of the step-up approach[5]. The pulse technique estimated the lowest mean ages. However, the time period of the pulse injection was not very short compared to the time constant of the ventilation process. Findings of the present study were consistent with a previous test chamber study[6]. However, the present data were inconsistent with a recent chamber study[7] where it was concluded that the step-up method was the least reliable of the three methods. Reasons for the inconsistency remain unknown. However, in the present study it was observed that the step-up method is sensitive to back-ground concentrations of tracer gas. For field studies of air flow patterns in large rooms the step-up method or the pulse method is recommended to escape the initial complete mixing condition of the decay-method.

Conclusion

The three common tracer injection strategies all proved reliable in a test chamber under complete mixing conditions. For field studies of air flow patterns in large rooms the step-up method or the pulse method is recommended to escape the initial complete mixing condition of the decay method.

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NBS I - The Nordic Building Research Cooperation Group

The Development of the PFT-Method in the Nordic Countries

Jorma O Sateri, Published by Swedish Council for Building Research, Stockholm 1991

NBS-I is the working group of the Nordic Building Research Cooperation Group dealing with research on different aspects of indoor climate. The activities include characterisation of air quality, the causes of building related illnesses and measures to eliminate them. The sub-group responsible for this document has the task of developing simplified methods of measuring ventilation rates in occupied buildings.

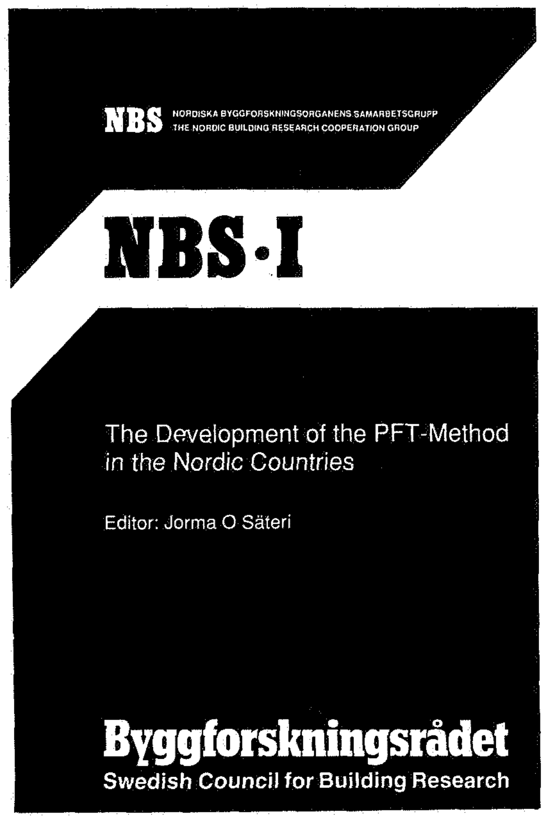
The passive perfluorocarbon tracer method (PFT-method) was developed by Brookhaven National Laboratory in the beginning of the 1980s. The research in Denmark, Finland and Sweden started in 1984-1986. This report describes the state of the art of the PFT-research and development in the three countries.

From the beginning Swedish researchers have developed a new version of the analysis system, based on commercially available components. The laboratories in Denmark and Finland have purchased their analysis equipment as well as the tracer sources and samplers from the USA. Several hundred field measurements have already been carried out in Denmark and Finland. The technique is now also applicable in Sweden for field measurements.

The principle of integrating techniques for ventilation measurements (e.g. the PFT technique) is to release the tracer gas at a constant rate into the air. Assuming a constant flow of fresh air, an equilibrium concentration of the tracer in the air is reached after a while. This concentration can then be measured using an integrating sampling technique, which gives the average concentration during the measurement period. The fresh air flow can be calculated as the tracer release rate and the equilibrium concentration are known.

The analysis and calibration techniques are discussed in Chapter 3 of this report. The performances of all the analysis systems used in the three countries are described.

Chapter 4 discussed the errors associated with integrating ventilation measurements. The temporal and spatial variation of air flows decreases the accuracy of the method. The spatial variation can be minimized by the proper placement of tracer sources and samplers. The position of the internal doors is the most crucial factor causing spatial variation. The temporal variation yields an error if the results are used in energy use calculations. However, if the contaminant exposures are calculated, no errors are made. A framework for dealing with temporal variation is presented.



The field surveys carried out in Denmark and Finland are described in Chapter 5. In Denmark 123 residences have been measured, in Finland 291. On average the residences studied had a ventilation rate quite close to the value recommended by the National Building Codes. There were, however, rather high variations between residences. Mechanical ventilation systems had slightly better average values than natural ventilation systems.

Chapter 6 describes the field measurement instructions used in Denmark and Finland. In both countries only small modifications have been made to the instructions given by Brookhaven National Laboratory.

Chapter 7 describes the needs for the future development of the method.

Building Technology and Air Flow Control in Housing

By Per Levin

Publisher: Swedish Council for Building Research, Document D16:1991

Available from: Svensk Byggtjänst, S-171 88 Solna, Sweden, approx. price SEK 83 or from AIVC Library Services item #5378

The objective of this thesis is to examine the importance of building technology on air leakage for mainly new Swedish multi-family buildings. Air leakage in buildings can be divided into external air leakage through the building envelope and internal air leakage which occurs within a building. The different consequences of these two types of air leakage are examined in the thesis.

Basic equations for different air flow paths have been reviewed and compared with measurement results. Fan pressurization test results should be used with great care outside the measured pressure range as air flow characteristics, for some types of air leakage paths, were found to vary with pressure difference.

Important air leakage paths in buildings are described. Many examples of building construction details and recommended solutions for airtightness are discussed. Careful planning and control at the building site is important for achieving airtight buildings. The choice of building system and assembly details must be selected for simplicity of on-site construction. The number of penetrations should be minimized.

Air change rates measured in three apartments were found to be constant and close to the fan-controlled air flows. The airtightness in these building envelopes were between 0.8 and 1.0 ach/h at 50 Pa, and that seems to be sufficient in terms of controlling the overall air change rates.

Internal air leakage between apartments measured by fan pressurization has been found to account for between 12 and 50 per cent of the total air leakage.

High pressure differences are easily obtained in new Swedish apartment buildings. When applying forces kitchen extract ventilation, measured pressure differences between the inside and outside of buildings were found to be between about 0 to 100 Pa. As a result of this, internal air leakages up to 12 m^3h between apartments were found. Depending on conditions in adjacent apartments, these air flows may cause occupational odour and pollutant problems. Ventilation systems and means of forcing the kitchen air flow that do not cause big pressure differences should be favoured.

Document D16:1991

Building Technology and Air Flow Control in Housing

Per Levin

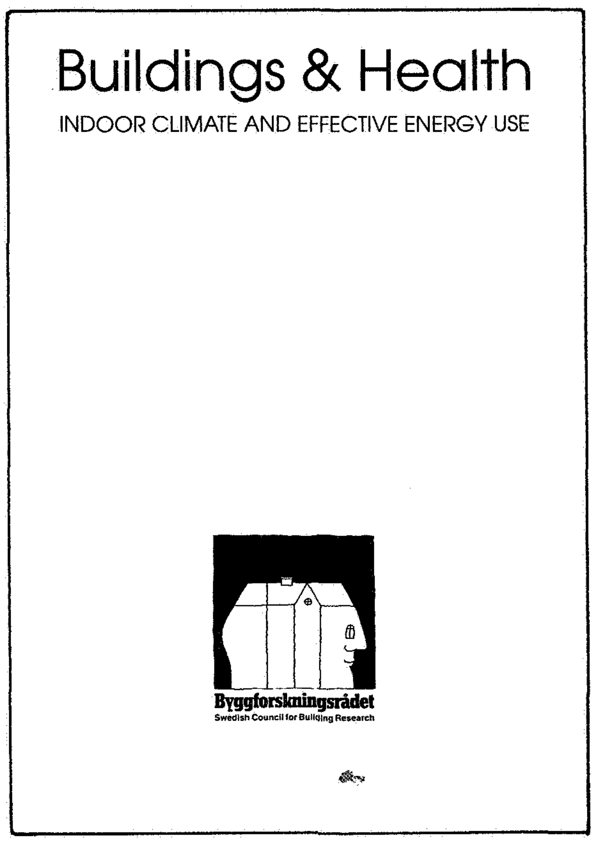
Byggforskningsrådet
Swedish Council for Building Research

Buildings and Health
Indoor Climate and Effective Energy Use

By Bertil G Johnson, Johnny Kronvall, Thomas Lindvall, Allan Wallin and Hanne Weiss Lindencrona

Publisher: Swedish Council for Building Research

Available from: AB Svensk Byggtjanst, S-171 88 Solna, Sweden, approx price SEK 100, or on loan from AIVC library services, item #5421



The indoor climate in our dwellings, offices, schools and other premises is of decisive importance for the health and wellbeing of their occupants. Health and comfort problems associated with the indoor climate have, however, come to constitute a major problem in recent years. A conclusion is that the hygienic and climatic requirements frequently are neglected, and that they must reassume a central position in the building and building management process.

Greater demands must be made on the quality of materials, on responsibility and competence in the building process and on the overall strategy for energy conservation in conjunction with both new construction and modernization.

Present-day knowledge of health problems associated with the indoor climate and an overview of the possibilities of solving these problems are presented in this knowledge survey.

What You Should Know About Combustion Appliances and Indoor Air Pollution

Leaflet prepared by US Consumer Product Safety Commission, US Environmental Protection Agency, and the American Lung Association, 1991

Available from: US Consumer Product Safety Commission, Washington DC 20207, USA, or from AIVC Library Services, #5447

This is a brief but useful booklet aimed at the householder, which discusses in simple terms the types of pollutants that may be produced by combustion appliances, describes how they might affect health, and suggests ways the householder could reduce his exposure to them. It also explains that proper appliance selection, installation, operation, inspection and maintenance are very important in reducing exposure to combustion pollutants.

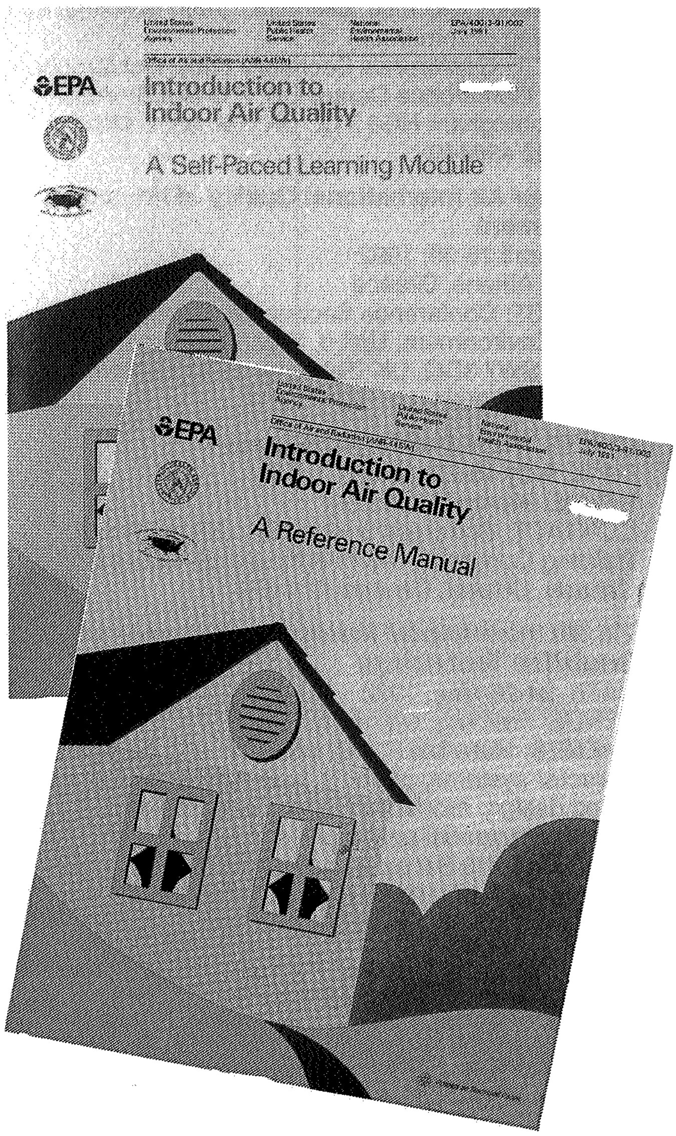
Introduction to Indoor Air Quality: A Self-Paced Learning Module and Reference Manual

By Dr Ingrid Ritchie

Publisher: USA Environmental Protection Agency, US Public Health Service, and the US National Environmental Health Association

July 1991

Available from: The National Environmental Health Association, 720 South Colorado Boulevard, South Tower, Suite 970, Denver, CO 80222, USA. Tel: 303 756 9090, or on loan from AIVC Library Services, #5426/#5427



The two documents have different, but complementary objectives:

Introduction to Indoor Air Quality: A Self-Paced Learning Module is designed to provide a first level understanding of basic IAQ principles. It contains nine lessons organized into three parts; 1) understanding indoor air quality, 2) measuring and evaluating problems, and 3) developing a programmatic response. Each lesson begins with lesson objectives and ends with review questions. Occasional reference is made to the accompanying reference manual where individual subjects may be explained in more detail. The self-learning module, however, is a free standing document. A final examination is contained at the end of the module.

Introduction to Indoor Air Quality: A Reference Manual is a companion document to the learning module. It is designed to provide additional detailed information on selected subjects and thus acts as a source of continuing education to the user of the learning module. It also provides reference data and useful tools (e.g., sample questionnaires, forms, and checklists) for practical applications and problem solving. It is organized in eight sections which track the first eight lessons of the learning module.

Both documents cover principles that are applicable to any indoor environment. However, text covering practical applications and problem solving focuses primarily on residences. Guidance directed toward public and commercial buildings is being independently developed by the Indoor Air Division of the Environmental Protection Agency.

The general goal of these documents is to provide state and local government personnel with a firm foundation in the fundamentals of indoor air quality to assist them in developing and implementing a programmatic response to IAQ problems within their jurisdictions. The documents are also valuable introductions to the subject area for researchers and others individuals with an interest in the subject.

Forthcoming Conferences

Green Buildings - Design, Construction, Services
DATE: March 25, 26, 27, 1992
VENUE: University of Nottingham, UK
THEMES: Four sessions as follows: environmental context for buildings; the making of green buildings; human needs and their fulfilment; green buildings as an ongoing commitment.
CONTACT: Conference Secretary (GB), Construction Industry Conference Centre Ltd, P O Box 2, West PDO, Nottingham NG8 2TZ, UK Tel: 0602 436439 Fax: 0602 436440

IAI Indoor Air International Quality of the Indoor Environment
DATE: April 28-30, 1992
VENUE: Athens, Greece
CONTACT: Conference Secreteriat, Quality of the Indoor Environment, Unit 6, 2, Old Brompton Road, London SW7 3DQ, UK Tel: +44 71 823 9401 Fax: +44 81 780 9894

CIB '92 World Building Congress
DATE: May 18-22, 1992
VENUE: Montreal, Canada
CONTACT: Congress Secretariat, CIB '92 World Building Congress, National Research Council Canada, Ottawa, Canada K1A 0R6

TI5 5th International Meeting on Transparent Insulation Technology
DATE: 24-26 May, 1992
VENUE: Freiburg, Germany
THEMES: Materials R & D; windows and daylighting; collector systems; projects; wall systems; computer aided design; monitored results of completed projects; potential applications.
CONTACT: TI5 Secretariat, The Franklin Company Consultants Ltd, 192 Franklin Road, Birmingham B30 2HE, UK Tel: +44 21 459 4826 Fax: +44 21 459 8206

ESM 92 European Simulation Multiconference
DATE: June 1-3, 1992
VENUE: York, UK
THEMES: Simulation methodology and practice; simulation in aerospace; simulation in society; simulation of electronic circuits and systems; industrial simulation and simulators; simulation in energy systems.
CONTACT: The Society for Computer Simulation International, European Simulation Office, c/o Philippe Géril, University of Ghent, Coupure Links 653, B-9000 Ghent, Belgium Tel/Fax: 0032 91 234 941

ISRACVE International Symposium on Room Air Convection and Ventilation Effectiveness

DATE: July 22-24, 1992
VENUE: University of Tokyo, Japan
CONTACT: Professor S Murakami, Chairman of ISRACVE, Institute of Industrial Science, University of Tokyo, 7-22-1, Roppongi, Minato-ku, Tokyo, 106 Japan Tel: +81 3 3402 6231 ext 2575 Fax: +81 3 3746 1449

CWE '92 First International Symposium on Computational Wind Engineering
DATE: August 21-23, 1992
VENUE: University of Tokyo, Japan
CONTACT: Professor S Murakami, Chairman of CWE '92, Institute of Industrial Science, University of Tokyo, 7-22-1, Roppongi, Minato-ku, Tokyo, 106 Japan. Tel: +81 3 3401 7439 Fax: +81 3 3746 1449

CIB W67 Workshop Energy Efficiency and Ventilation
DATE: September 1992
VENUE: UMIST, Manchester, Great Britain
CONTACT: Prof. K M Letherman, Department of Building Engineering, UMIST, Manchester M60 1QD, Great Britain Tel: +44 61 200 4242 Fax: +44 61 200 4252

Roomvent '92 Air Distribution in Rooms Third International Conference
DATE: September 2-4, 1992
VENUE: Aalborg, Denmark
CONTACT: Roomvent '92, Danish Association of HVAC Engineers, Orholmvej 40B, DK-2800 Lyngby, Denmark Tel: +45 42 87 76 11 Fax: +45 42 87 76 77

AIVC 13th Conference Ventilation for Energy Efficiency and Optimum Indoor Air Quality
DATE: September 14-18, 1992
VENUE: Hôtel Plaza Concorde, Nice, France
CONTACT: AIVC, University of Warwick Science Park, Barclays Venture Centre, Sir William Lyons Road, Coventry CV4 7EZ, Great Britain Tel: +44 (0) 203 692050 Fax: +44 (0) 203 416306

Energy Economy 1992 European exhibition and conference on energy efficiency and environment
DATE: September 15-17, 1992
VENUE: Maastricht, Netherlands
CONTACT: RAI Gebouw bv, Europaplein, NL-1078, GZ Amsterdam, Netherlands Tel: +31 (0) 20 5491212 Fax: +31 (0) 20 6464469

Indoor Air Quality, Ventilation and Energy Conservation in Buildings. 5th Jacques Cartier Conference
DATE: October 7-9, 1992
VENUE: Queen Elizabeth Hotel, Montreal, Canada
CONTACT: Fariborz Haghighat, Centre for Building Studies, Concordia University, Montreal, Quebec, Canada H3G 1M8 Tel: (514) 848 3192 Fax: (514) 848 7965

ASHRAE IAQ '92 Environments for People - Symposium
DATE: October 18-21, 1992
VENUE: San Francisco, California, USA
CONTACT: Manager of Technical Services, ASHRAE, 1791 Tullie Circle NE, Atlanta, GA 30329-2306, USA Tel: 404/636-8400 Fax: 404/321-5478

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