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1990 Survey of Current Research into Air Infiltration and Related Air Quality Problems in Buildings

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Air Infiltration and
Ventilation Centre

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Mark Limb

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Preface

International Energy Agency

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the twenty-one IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources and energy research development and demonstration (RD&D). This is achieved in part through a programme of collaborative RD&D consisting of forty-two Implementing Agreements, containing a total of over eighty separate energy RD&D projects. This publication forms one element of this programme.

Energy Conservation in Buildings and Community Systems

The IEA sponsors research and development in a number of areas related to energy. In one of these areas, energy conservation in buildings, the IEA is sponsoring various exercises to predict more accurately the energy use of buildings, including comparison of existing computer programs, building monitoring, comparison of calculation methods, as well as air quality and studies of occupancy. Seventeen countries have elected to participate in this area and have designated contracting parties to the Implementing Agreement covering collaborative research in this area. The designation by governments of a number of private organisations, as well as universities and government laboratories, as contracting parties, has provided a broader range of expertise to tackle the projects in the different technology areas than would have been the case if participation was restricted to governments. The importance of associating industry with government sponsored energy research and development is recognized in the IEA, and every effort is made to encourage this trend.

The Executive Committee

Overall control of the programme is maintained by an Executive Committee, which not only monitors existing projects but identifies new areas where collaborative effort may be beneficial. The Executive Committee ensures that all projects fit into a pre-determined strategy, without unnecessary overlap or duplication but with effective liaison and communication. The Executive Committee has initiated the following projects to date (completed projects are identified by *):

I Load Energy Determination of Buildings *
II Ekistics and Advanced Community Energy Systems *
III Energy Conservation in Residential Buildings *
IV Glasgow Commercial Building Monitoring *
V Air Infiltration and Ventilation Centre
VI Energy Systems and Design of Communities *
VII Local Government Energy Planning *
VIII Inhabitant Behaviour with Regard to Ventilation *
IX Minimum Ventilation Rates *
X Building HVAC Systems Simulation*

XI Energy Auditing *
XII Windows and Fenestration *
XIII Energy Management in Hospitals *
XIV Condensation*
XV Energy Efficiency in Schools
XVI BEMS - 1: Energy Management Procedures
XVII BEMS - 2: Evaluation and Emulation Techniques
XVIII Demand Controlled Ventilating Systems
XIX Low Slope Roof Systems
XX Air Flow Patterns within Buildings
XXI Thermal modelling
XXII Energy Efficient Communities

Annex V Air Infiltration and Ventilation Centre

The IEA Executive Committee (Building and Community Systems) has highlighted areas where the level of knowledge is unsatisfactory and there was unanimous agreement that infiltration was the area about which least was known. An infiltration group was formed drawing experts from most progressive countries, their long term aim to encourage joint international research and increase the world pool of knowledge on infiltration and ventilation. Much valuable but sporadic and uncoordinated research was already taking place and after some initial groundwork the experts group recommended to their executive the formation of an Air Infiltration and Ventilation Centre. This recommendation was accepted and proposals for its establishment were invited internationally.

The aims of the Centre are the standardisation of techniques, the validation of models, the catalogue and transfer of information, and the encouragement of research. It is intended to be a review body for current world research, to ensure full dissemination of this research and based on a knowledge of work already done to give direction and firm basis for future research in the Participating Countries.

The Participants in this task are Belgium, Canada, Denmark, Federal Republic of Germany, Finland, Italy, Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom and the United States of America.

INTRODUCTION

The Air Infiltration and Ventilation Centre's worldwide survey of current research into air infiltration and related topics provides organisations in participating countries with regularly updated information about ongoing research in this field. In particular the major objectives of this survey are to encourage the international cross fertilization of research ideas and to promote cooperation between research organisations in different countries. The results of the first survey were published in October 1980, and contained an analysis of 65 research summaries received from researchers in 14 different countries. The second edition followed in December 1981, with the number of entries almost doubling to 126. In November 1983, the third survey was published . This edition extended its scope to cover research into indoor air quality and the response was again increased, with 187 summaries being received from organisations in 22 countries. In addition to the increased scope of the survey, researchers were also asked to provide an indication of project size in terms of allocation of staff time. The fourth survey followed in December 1986; 219 project summaries from 19 countries were received and analysed.

This, the fifth survey, is based on summaries received from researchers following the distribution of a survey form *(Appendix A)* to organisations thought likely to be involved in air infiltration and indoor air quality research. Essentially similar to the form used in the 1986 survey, additional space was provided in order that more detailed information regarding objectives and project details could be obtained. Additional space was also allowed so that important reports or publications could also be listed. Once again there has been an increase in the number of projects reported; Figure 1 shows the trends over the last ten years in the number of replies received from the first survey of 1980 to the results of the fifth survey in 1990. A total of 233 summaries have been received from organisations in 23 different countries. The origin and distribution of survey replies are shown in Figures 2 and 3 and have been tabulated in Table 1.

The analysis of the survey is provided in two sections. In the first the results are analysed in terms of the various headings on the survey form, i.e., specific objectives, project details, building or component type, parameters with which infiltration and indoor air quality will be related, and allocation of staff time. This information is presented in such a way that the reader may use the analysis to ascertain which research summaries lie within the bounds of any subject area. In order to facilitate this type of analysis, and to enable easy access to the data the research summaries are stored in a database, which can be rapidly searched using the Air Infiltration and Ventilation Centre's free text retrieval system. This facility is also available as a supplementary database, alongside our extensive bibliographic database known as "AIRBASE". Both are available for purchase in a personal computer version; details are given in Appendix D. The task of analysing the research replies was also eased by the allocation of a set of keywords to each summary. These keywords are presented in alphabetical order, in Appendix B.

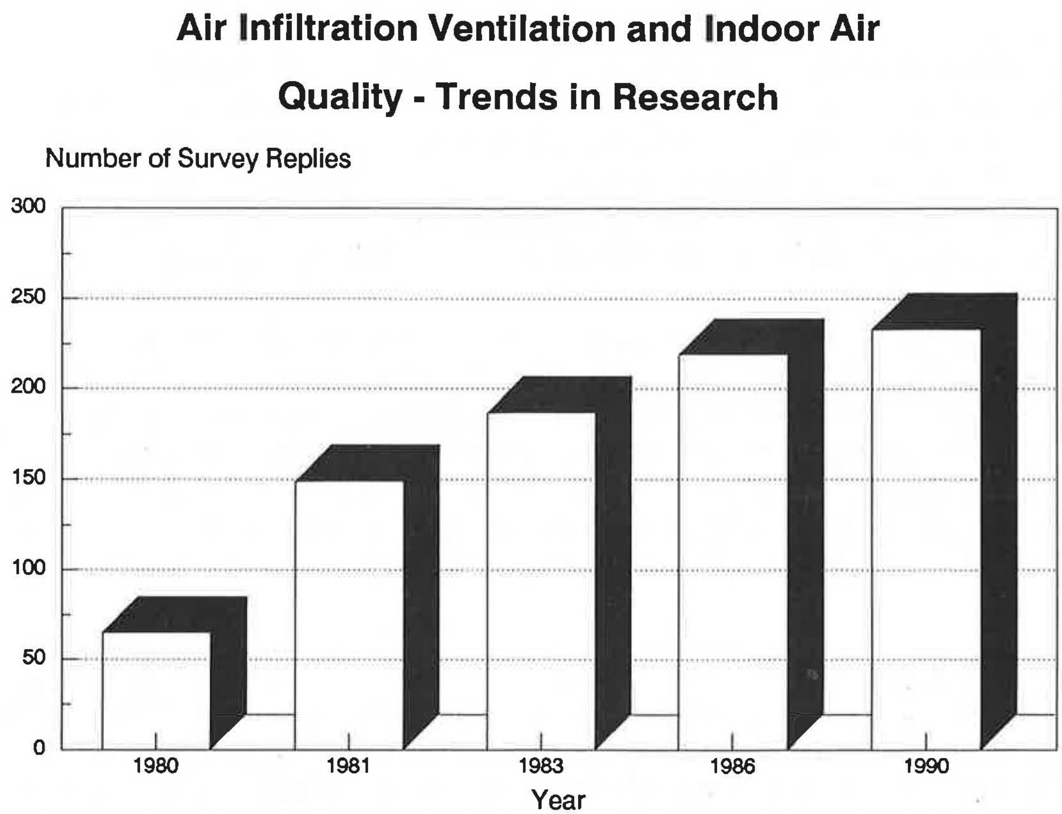

Figure 1

All the research summaries are presented in Section two. They are divided into two sub sections;AIVC Participating and Non-Participating countries. Each project is identified by a reference number comprising a country identification code, *(Table 1)* followed by a number indicating the order in which it appears under the relevant country heading, (Countries are listed in alphabetical order in each sub-section). A list of principal researchers and organisation addresses is contained in Appendix C.

The preparation of this report was only possible as the result of the cooperation of the researchers in forwarding details of their studies. The assistance of all who contributed to this study is acknowledged with gratitude.

Origin and Distribution of Survey Replies

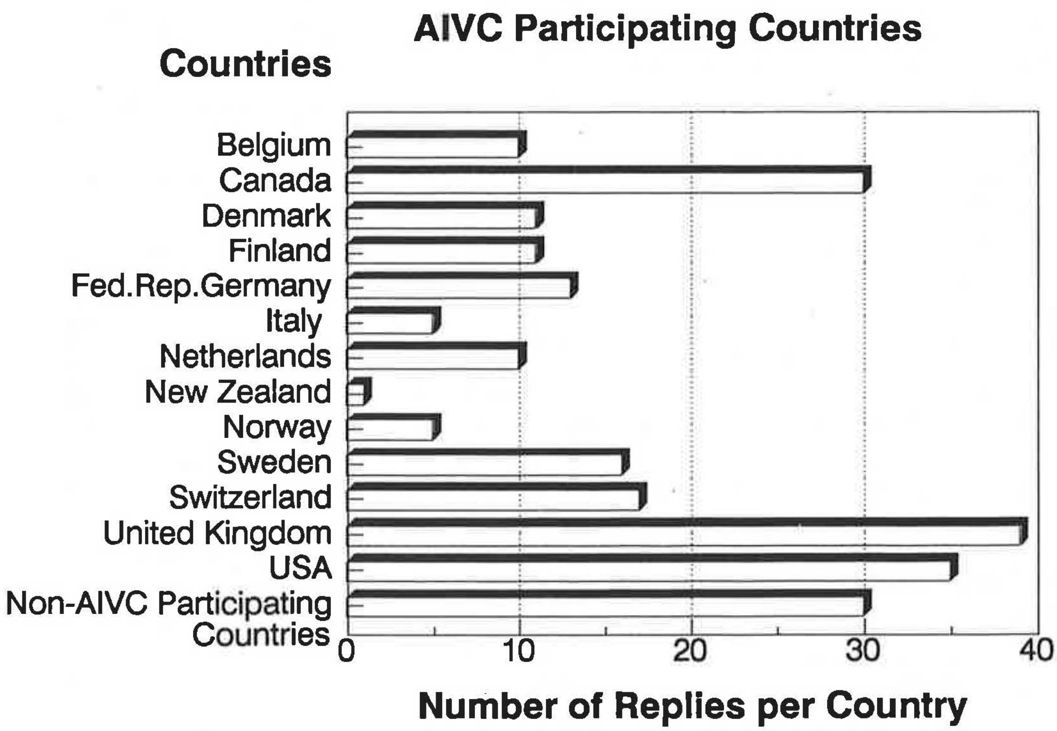

Figure 2

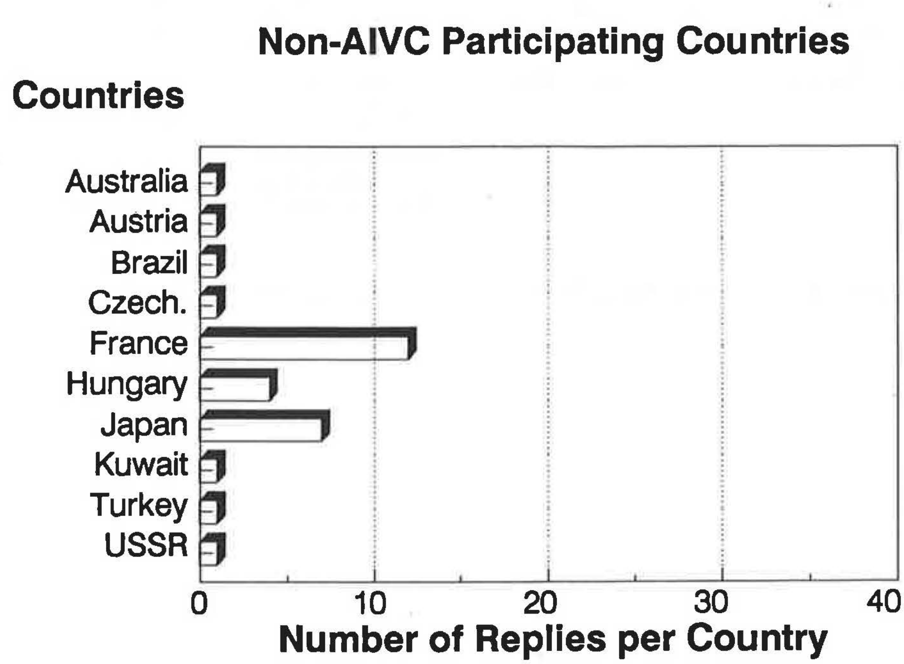

Figure 3

Participating countries	Code	Replies
Belgium	B	10
Canada	CA	30
Denmark	DK	11
Finland	SF	11
Germany	D	13
Italy	I	5
Netherlands	NL	10
New Zealand	NZ	1
Norway	N	5
Sweden	S	16
Switzerland	CH	17
United Kingdom	UK	39
United States of America	USA	35
	Total	**203**
Non participating countries		
Australia	AUS	1
Austria	AU	1
Brazil	BZL	1
Czechoslovakia	CS	1
France	F	12
Hungary	H	4
Japan	J	7
Kuwait	K	1
Turkey	TR	1
USSR	SU	1
	Total	**30**
	Grand Total	**233**

Table 1 - Origin and distribution of survey replies

Section 1
Analysis of Results

SECTION 1 - ANALYSIS OF RESULTS

1.1 Specific objectives

The specific objectives of the research summaries have been divided into 27 categories. The range of subjects are outlined below. In many cases a single project has several different objectives, and therefore may appear under more than one heading. The 27 categories have been divided into 3 principal groups; Group A relates to studies and measurements, Group B to simulations and modelling, and Group C to other aspects.

A) Projects related to studies and measurements

This is the largest group and has been further subdivided into four broad subject areas and 13 specific categories, *(Table 2)*. The replies include those projects currently involved in the study or measurement of air movement and indoor air quality, the major theme being the study and measurement of indoor air and contaminant movement *(83 replies)*. Compared with the previous survey there is increased interest in relation to indoor air quality/occupant comfort and health *(65 replies)*, and studies involving heating, ventilating systems and strategies *(47 replies)*. The final category within this division concerns the projects that are involved in energy conservation and the use of energy *(19 replies)*.

B) Projects related to simulation and modelling of indoor air and contaminant movement

Group B has been further subdivided into 2 broad subject areas and 6 specific categories, *(Table 3)*. Replies cover projects involved with indoor air movement and air quality simulations. Much work is being undertaken to simulate air and contaminant movement within the indoor environment *(31 replies)*. The simulation of infiltration and ventilation, and the investigations of internal and external pressures and air movement around buildings form the second division within this group *(15 replies)*.

Table 2 - Projects related to studies and measurements

Air movement
1) Indoor air movement. *(24 replies)* 2) Indoor air/heat movement. *(9 replies)* 3) Indoor air/heat/moisture movement. *(4 replies)* 4) Air infiltration, ventilation and air change rates within buildings. *(23 replies)* 5) Airtightness/air leakage of buildings. *(22 replies)*
Indoor air quality
6) Indoor air quality/climate. *(41 replies)* 7) Indoor air pollution sources. *(8 replies)* 8) Moisture/mould generation and prevalance in buildings. *(6 replies)* 9) Occupant behaviour/perceptions. *(7 replies)* 10) Thermal comfort. *(3 replies)*
Heating and ventilation systems and strategies
11) Heating and ventilation systems and/or strategies. *(43 replies)* 12) Vented appliances. *(4 replies)*
Energy conservation and use
13) Energy conservation/efficiency/use within buildings. *(19 replies)*

C) Miscellaneous

This sub division contains 8 categories, representing projects related to work in air infiltration, ventilation and indoor air quality, but which do not fall into the above two sections. This section (Table 4) includes market reviews, the formulation of expert systems and databases, model validation and work to improve codes and standards. This miscellaneous section also includes projects monitoring radon, and investigating tracer gas methods, both new and old.

Table 3 - Projects related to simulations and models

Air movement and quality simulations
14) Indoor air movement. *(10 replies)* 15) Indoor air/heat movement. *(10 replies)* 16) Indoor air/heat and contaminant movement. *(8 replies)* 17) Indoor air quality. *(3 replies)*
Air infiltration and ventilation simulations
18) Air infiltration and ventilation in buildings. *(7 replies)* 19) Outside pressure distribution/air movement around buildings. *(5 replies)*

Table 4 - Projects related to all other activities

20) To compare and validate airflow models. *(2 replies)* 21) Relating air movement/ventilation and infiltration to construction practices. *(4 replies)* 22) To investigate new or existing tracer gas methods. *(7 replies)* 23) To monitor radon entry/harmfulness as a pollutant. *(11 replies)* 24) To produce/contribute to new ventilation and indoor air quality guidelines and standards. *(7 replies)* 25) To compile a database of information. *(5 replies)* 26) To develop expert systems. *(2 replies)* 27) To undertake a market review. *(2 replies)*

Table 5 examines in greater detail the categories and divisions discussed above.

Table 5 - Specific Objectives

A) Projects related to studies and measurements

Air movement

1) Indoor air movement *(24 replies)*

B6,B7
CA6,CA9
CH2,CH5
D4,D10,D13
DK1,DK3
F10
I3
NL2
S4
SF9
UK1,UK4,UK11,UK19,UK25
USA2,USA7,USA24

2) Indoor air/heat movement *(9 replies)*

B1
CA20
D1,D12
F5
TR1
UK12,UK30
USA19

3) Indoor air/heat/moisture movement *(4 replies)*

NZ1
UK3,UK5
USA8

4) Air infiltration, ventilation and air change rates within buildings *(23 replies)*

AUS1
CA9,CA11,CA14,CA17,CA26,CA27
D8
DK7,DK8
H4
NL10
S8
SF9,SF10
UK5,UK11,UK13,UK14,UK16,UK38
USA13,USA14,USA15

5) Airtightness/air leakage of buildings *(22 replies)*

B1
CA12,CA21,CA22
CH13,CH14
F8,F11
K1
S6,S10
UK8,UK9,UK15,UK23,UK37
USA4,USA10,USA16,USA20,USA21,USA29

Indoor air quality

6) Indoor air quality/climate *(41 replies)*

B2,B3
CA1,CA6,CA7,CA8,CA9,CA11,CA16,CA19,
CA25,CA26,CA27,CA29
CH15
D2,D5,D11
F6
H4
N1,N2,N3,N4
NL4,NL5,NL7
S1,S12,S13 SF8
UK2,UK10,UK26,UK33,UK36
USA9,USA27,USA28,USA32,USA35

7) Indoor air pollution sources *(8 replies)*

D9,D10
DK5,DK8,DK9
SF1
USA15,USA22

8) Moisture/mould generation and prevalance in buildings *(6 replies)*

CA3,CA13
UK3,UK9
USA3,USA26

9) Occupant behaviour/perceptions *(7 replies)*

CH7
F9
NL10
SF10
UK27
USA14,USA26

10) Thermal comfort *(3 replies)*

BZL1
S11
SF5

Heating and ventilating systems and strategies

11) Heating and ventilation systems and/or strategies *(43 replies)*

AU1
B8
BZL1
CA7,CA13,CA18,CA25,CA30
D6,D7
DK7,DK10
F1,F4,F7
J5
N2
NL6,NL7
S1,S2,S5,S14,S15,S16
SF1,SF2,SF3,SF4
UK6,UK7,UK22,UK29,UK31,UK33,UK35,
UK36,UK38,UK39
USA15,USA20,USA23,USA34

12) Vented appliances *(4 replies)*

F6
I1
NL1
USA27

Energy conservation and use

13) Energy conservation/efficiency/use within buildings *(19 replies)*

CA3,CA4
D5,D11
H4
NL9
S2,S6,S9,S15
SF2
UK5,UK9,UK18,UK27,UK29,UK39
USA11,USA12,USA26

B) Projects related to the simulation and modelling of indoor air and contaminant movement

Air movement and quality simulation

14) Indoor air movement *(10 replies)*

CH8
D13
DK2
J3,J7
NL3
UK1,UK17,UK28
USA31

15) Indoor air/heat movement *(10 replies)*

B4
CH3
D3
F3
SF6
SU1
UK20,UK24
USA6,USA17

16) Indoor air/heat/contaminant movement *(8 replies)*

CH9,CH17
J2
S7
SF7,SF11
NL1,NL9

17) Indoor air quality *(3 replies)*

NL9
USA5,USA32

Air infiltration and ventilation simulations

18) Air infiltration and ventilation in buildings *(7 replies)*

B5
CA17
CH11
NL9
H2
SF6
UK34

19) Outside pressure distribution/air movement around buildings *(5 replies)*

CH16
F2,F12
I2
USA2

C) Miscellaneous

20) To compare/validate airflow models *(2 replies)*

TR1
UK25

21) Relating air movement/ventilation and infiltration to construction practices *(4 replies)*

AU1
CS1
K1
S10

22) To investigate new or existing tracer gas methods *(7 replies)*

CH4
DK8
S4
I5
UK21
USA7,USA30

23) To monitor radon entry/harmfulness as a pollutant *(11 replies)*

B9
CA2,CA10,CA30
CH1
DK11
J1
USA1,USA25,USA26,USA33

24) To produce/contribute to new ventilation and indoor air quality guidelines and standards *(7 replies)*

AU1
CA5
CH10
D6
I4
S14
UK16

25) To compile a database of information *(5 replies)*

CH12
NL8
H1,H3
UK32

26) To develop expert systems *(2 replies)*

J6
UK1

27) To undertake a market review *(2 replies)*

CH6
S14

1.2 Project details

Project details have been divided into the following subjects:

- Measurement analysis. *(Table 6)*
- Analysis of tracer gas tests. *(Table 7)*
- Analysis of indoor climate. *(Table 8)*
- Theoretical analysis. *(Table 9)*
- Building occupancy. *(Table 10)*
- Heating and ventilation systems. *(Table 11)*

As with the specific objectives *(1.1 above)*, often the details of individual projects span several categories.

Details of measurement analysis are summarized in Table 6. Tracer gas studies account for 33% of the replies, while pressurisation and airtightness studies account for a further 20% of the total. Of growing importance are projects related to the measurement of energy consumption (29% of the total). The remaining 16% of replies encompass measurement techniques such as pressure differences, flow visualisation, thermography and wind tunnel models.

Tracer gas investigations are still the most popular type of measurement technique. Table 7 identifies the methods and the tracer gases currently being used. The most common tracer techniques reported are the passive methods, based on passive perfluorocarbon techniques (PFT's) and grab bag sampling. Constant concentration and constant injection are also popular methods. Sulphur hexafluoride (SF_6) is still the most common tracer gas used, but since the last survey in 1986, nitrous oxide (N_2O) shows increasing use.

The increased number of survey replies covering indoor air quality and related work has led to a greater number of pollutants being investigated than in the 1986 survey. Table 8 gives a breakdown of these pollutants.

It is interesting to note that the most measured pollutant is carbon dioxide (CO_2). Pollutants which are being increasingly measured include bacteria and mycoflora, suspended particles and organic compounds. Other pollutants reported at a similar level to the previous survey include combustion products, formaldehyde, moisture, odour and radon. Pollutants not previously covered in recent surveys include polychlorinated biphenyls (PCB's), ozone and noise.

Items relating to theoretical analysis are covered in Table 9; modelling is referred to in 146 replies, a large proportion of these replies concerning airflow models, including multizone and room air movement simulation. Other modelling activities include air quality modelling, occupant behaviour simulation, thermal analysis and the development of scale models. A substantial number of studies in this section include surveys, questionnaires and reviews *(42 replies)*. Other replies include the development of expert systems, databases and the contribution to standards and guidelines.

A large number of replies made reference to either real or simulated occupancy, *(80 replies)*. The greater amount of work concerned studies of occupied buildings *(69 replies)*. The results of building occupancy studies appear in Table 10.

Since 1986 projects involving ventilation and heating systems have increased from 51 to 132 replies; Table 11 identifies the main systems, although studies involving mechanical ventilation systems account for the majority of the work in this area *(76 replies)*. Natural ventilation is also significant, *(49 replies)* and still accounts for a good deal of research work. Demand controlled ventilation (DCV) research has also increased, with carbon dioxide (CO_2) being the most popular pollutant used to govern demand controlled ventilating systems.

1.3 Building type and components

Information relating to this section is outlined in Table 12. The majority of this work is centred on residential type buildings, such as single family dwellings and apartments. Commercial/office and industrial type buildings are also well represented in the survey. The remaining studies cover a variety of other building types, including test chambers, attic spaces, theatres, auditoriums and schools.

Studies on building components include facade openings (for example windows, doors and cracks) and flow through internal components, such as walls, ceilings and floors.

1.4 Parameters to which air infiltration, ventilation and indoor air quality are related

In almost all instances air infiltration data is being related to weather parameters, specifically wind speed and direction, temperature and humidity.

Table 13 details those parameters which are related specifically to air infiltration and ventilation studies. Such parameters as building characteristics and performance are included. These cover building design/type, airtightness and internal airflow paths. Other parameters include heating and ventilation systems, occupant behaviour and energy consumption.

Table 14 details those parameters to which indoor air quality is being related. Parameters include pollutant concentrations and sources in general. A total of eighteen specific pollutants are referred to including carbon oxides, radon, and moisture. Physical variables encompass areas such as indoor air movement, type of building and heating and ventilation systems.

1.5 Allocation of staff time and origin of replies

Information about the staff time allocated to each project was stated in 70% of the survey replies. These results are summarized in Figure 4. As in the 1986 survey, the time being expended on individual projects is in the region of 1 to 3 person years. There are some notable exceptions, with 15 long term projects of between 10 000 - 20 000 hours, and 6 projects over 20 000 person hours. These projects tend to involve research into more than one subject, and include NZ1, D9, and B5. The overall picture again is similar to the 1986 survey with an estimated one million hours of research effort being documented by this survey.

The distribution of replies is given in Table 1 (see above). From this table it can be seen that nearly half the replies received were from three countries i.e., the United Kingdom, the United States of America and Canada. All AIVC participating countries are represented in the survey. Response from the non participating countries was greater than in the 1986 survey, with France and Japan providing the majority of the replies. The number of replies should be looked upon as an overview, since response to the survey is entirely voluntary, and therefore does not necessarily provide a complete picture.

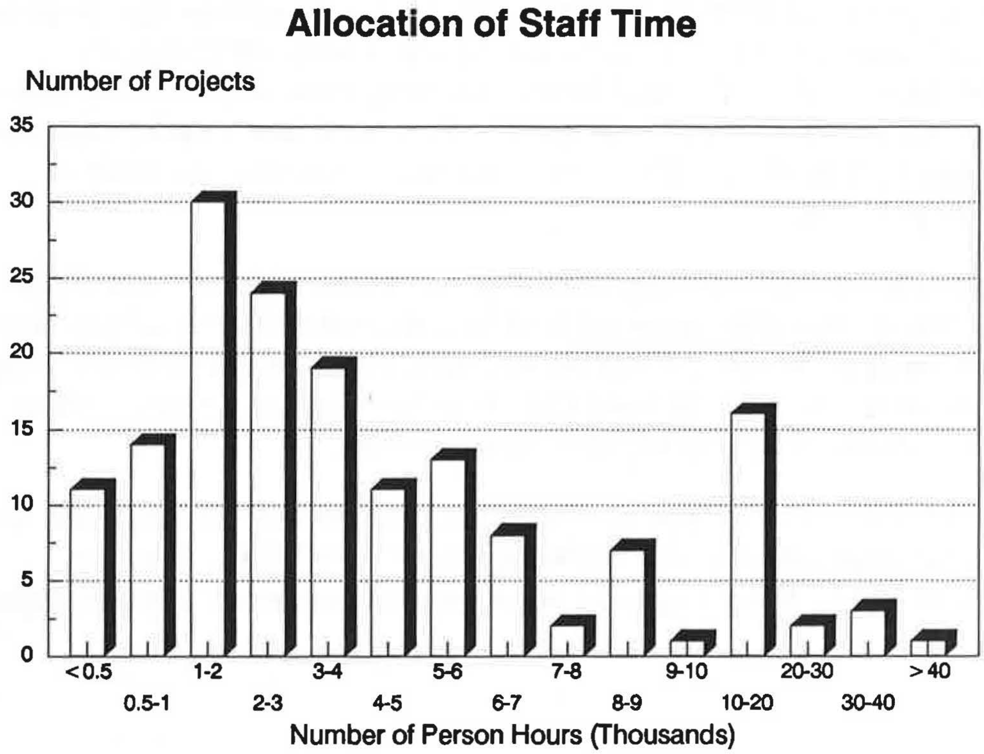

Figure 4

1.6 Concluding remarks

In terms of the total number of replies received and the subjects covered, this survey represents the most comprehensive review of current research yet published by the AIVC. The project summaries from 23 countries essentially cover all aspects of air infiltration and indoor air quality research. It is interesting to note that research into indoor air quality has increased, as too has research into simulating airflow movement.

Research on ventilation and heating systems and strategies, which was deficient in the 1983 survey, has continued to increase into the 1990's as alternative energy sources and a renewed drive towards energy conservation and efficiency have provided a greater impetus to improve the way we use energy.

Simulation work on multizone indoor airflows has continued to increase since the 1986 survey, but so too have airflow models in general, air quality models and models attempting to predict occupant behaviour.

The use of passive tracer gas techniques initially identified in the last survey, has also increased. These passive techniques allow air change rates to be unobtrusively monitored in occupied buildings.

Indoor air quality research has also increased. Of specific interest have been the causes and sources of indoor air pollution, the effect of indoor climate on occupant health and comfort, and the effect of airtightness measures and minimum ventilation rates on indoor air quality. The overall aim of such projects is the development of energy efficient buildings, which also have low levels of indoor air pollution.

An analysis of the research effort being devoted to each project reveals that the reported research studies are generally of fairly short duration, typically between one and three person years. There are exceptions to this, with a total of 15 long term projects having between 6 and 12 person years of effort devoted to them and 6 projects requiring over 12 person years of effort.

It is intended that the survey of current research will be an ongoing venture, as it now appears alongside our bibliographic database "AIRBASE". Thus the database will be continually updated, as projects are completed, and new projects begun.

Table 6 - Measurement Analysis

1) Tracer gas studies *(See also Table 7)*

AUS1
B5,B6,B7,B9
CA1,CA17,CA18,CA30
CH1,CH4,CH14
D8,D13
DK6
F2
I5
J1
H4
NL1,NL6
NZ1
S2,S3,S4,S5,S6,S8,S9,S10
SF7,SF9
UK4,UK11,UK14,UK19,UK21,UK22,UK23,
UK25,UK27,UK33
USA7,USA8,USA10,USA11,USA12,USA13,
USA15,USA24,USA28,USA29,USA30,USA33,
USA34,USA35

2) Pressurisation/depressurisation

B6,B7,B8,B9
CA17 CH13,CH14
D8
F8,F10,F11
J1
NZ1
S2,S3,S5,S6,S9,S10
UK8,UK15,UK22,UK23,UK33,UK37
USA10,USA11,USA12,USA13,USA16,USA20,
USA21,USA29,USA33,USA34

3) Energy consumption/Heat loss

CA2,CA4,CA9,CA11,CA20,CA25,CA26
CH6,CH8,CH11
D11,D12
DK7,DK8,DK10
F1
H2,H4
I1,I4
N4
S2,S3,S6,S9,S15 SF2,SF4,SF5,SF6,SF8,SF11
UK5,UK9,UK18,UK24,UK26,UK27,UK29,
UK32,UK33,UK35
USA3,USA4,USA12,USA11,USA15,USA20,
USA26,USA32

4) Internal/external pressure

CA10,CA12,CA14,CA21,CA22
DK7
F12
H1
SF3,SF4,SF6
TR1
UK19,UK24
USA27

5) Flow visualization

B10
SF11
UK1
USA2

6) Thermography

USA21

7) Wind tunnel models

CA14
CH16
CS1
F2,F12

Table 7 - Analysis of Tracer Gas Studies

A) Techniques

1) Constant concentration

B7
CA17
CH4
S2,S3,S6,S9,S10
UK33
USA24

2) Constant injection

B7
D8
UK19,UK33

3) Decay

CH14
D8
S6
UK14,UK19,UK33
USA10,USA33,USA34

4) Pulse injection

UK19
USA7

5) Passive techniques *(PFT/Grab-bag)*

AUS1
CA1,CA30
CH4
DK6
NZ1
S8,S10
SF9
UK23
USA13,USA24,USA29,USA35

B) Tracer gas

1) Carbon dioxide *(CO_2)*

B6
CA1
USA7

2) Freons

UK11
USA24

3) Nitrous oxide *(N_2O)*

B6,B7
CH1
D8,D13
N2 S2,S3,S4,S5,S6,S9 UK33

4) Perfluoro monomethyl/ dimethyl cyclohexane

USA35

5) R-12

UK14

6) Sulphur hexafluoride *(SF_6)*

US1
CA1,CA17
D8
DK6
UK4,UK23,UK33
USA12,USA24,USA33,USA34

Table 8 - Analysis of Indoor Climate

1) Bacteria/mycoflora/fungi etc

CA6,CA7,CA8,CA13,CA15,CA24,CA26
USA9,USA14

2) Carbon dioxide *(CO_2)*

B6,B8 CA1,CA6,CA15,CA16,CA23,CA24,
CA26, CA27,CA28,CA29
CH6
D5,D11
DK10
F4
J1
N1,N2
NL5
S5,S13,S14,S15,S16
UK36,UK39
USA14

3) Carbon monoxide *(Combustion/CO)*

CA1,CA4,CA6,CA12,CA15,CA16,CA25,
CA26
F6
I1
UK36
USA14,USA15,USA27,USA32

4) Chlorine *(Cl)*

N1

5) Formaldehyde *(HCHO/UFFI)*

CA6,CA9,CA11,CA15,CA26
D10
N1
S13,S15
UK36
USA11,USA14,USA22

6) Landfill gas/soil gas

CA10
UK16

7) Moisture/condensation

B2,B3
CA3,CA4,CA7,CA13,CA21,CA22
D5,D11
F1
NL9
NZ1
H3,H4
S14
UK3,UK9
USA3,USA4,USA8,USA13,USA26

8) Noise

CA1,CA24
UK26,UK36

9) Nitrogen oxides *(NO_x)*

CA6,CA9,CA11,CA26
N1,N2
USA11,USA35

10) Odour

B8
CH17
DK8,DK9
S14
USA13

11) Organic compounds

CA6,CA15,CA16,CA19,CA29
D6
F1
S13,S14,S15,S16
UK2
USA14,USA15

12) Ozone *(O_3)*

CA1,CA3,CA6,CA15
USA14

13) Radon

B9
CA2,CA3,CA9,CA10,CA26,CA30
CH1
DK11
J1
UK16
USA1,USA11,USA15,USA25,USA26

14) Sulphates *(SO_4)*

N1

15) Tobacco smoke

CA16
D5,D7
USA14

16) Suspended particles

CA6,CA15,CA16,CA29
B2,B3
F1
N1,N2
UK10,UK36
USA14,USA15

17) Polychlorinated biphenyls (PCB'S)

D2

Table 9 - Theoretical Analysis

1) Modelling

a) Airflow models *(General)*

B5,B10
BZL1
CA4,CA17,CA19,CA20
CH3,CH5,CH14,CH17
D3
DK1,DK2
F1,F2,F3,F7,F10
I2
H1,H2
J3,J4,J5
N2,N5
NL1
S10
SF4,SF5,SF9
TR1
UK1,UK16,UK17,UK20,UK25,UK28,
UK33,UK35
USA2,USA7,USA12,USA15,USA17,USA23

b) Airflow models *(Multizone)*

B6,B8
CA19
CH2,CH3,CH5,CH8,CH9,CH11,CH12
F3
H2
I2,I4,I5
J7
NL4,NL7
S6
SF7,SF9 UK21,UK23,UK24,UK25,UK30,
UK31,UK33,UK34
USA5,USA7,USA24,USA30

c) Airflow models *(Single zone/rooms)*

CA17
CH8,CH9
NL3
UK23,UK25

d) Air quality/pollution models

CA19
D6
F2
I3,I4
J5
NL7,NL9
S10
USA5,USA32

e) Model vented appliances

F6

f) Model validation

B5
CA20
CH5,CH7
DK4
NL1
TR1
UK11,UK17,UK23,UK25,UK33
USA15

g) Occupant behaviour models

BZL1
CH9,CH7,CH11
D5,D13
DK7,DK9
F3
UK27,UK34
USA15

h) Scale modelling

B10
NL2,NL3
UK1,UK7,UK21
USA2

i) Thermal modelling

B1,B4,B5
BZ1
CS1
DK4
H2
I1
SF5,SF6
SU1
UK7,UK20,UK28,UK30
USA6

2) The development of an expert system

J6
UK1

3) The development/use of a database

CH2,CH11,CH12,CH17
DK2
H1,H2,H3
NL8
UK23,UK32,UK37
USA26

4) To conduct a literature survey/study

CA19
CH12
DK2
F6,F12
H1
J6
NL2,NL3,NL8,NL9
UK11,UK31

5) To conduct a questionnaire

CA3,CA6,CA15,CA16
SF8,SF10
F9
N3
NL5,NL10
S13 SF8
UK36 USA13,USA14,USA25,USA26,USA35

6) To conduct a survey *(General)*

CA21,CA12
F7
K1
UK29,UK31
USA1,USA26

7) To conduct a market review

CH6
D5
S14

8) To contribute towards the preparation of guildlines/standards or reference manuals

AU1
B6
CA5,CA29
CH2,CH4,CH9,CH10,CH17
D4,D6
I4
N4
NL7,NL10
S1,S14
UK16
USA4,USA30

Table 10 - Building Occupancy

1) Occupied

B6,B7,B10
CA1,CA4,CA5,CA6,CA9,CA10,CA11,CA12,CA13,CA15,CA16,CA23,CA24,CA26,CA30
CH1,CH7,CH9,CH11,CH14,CH17
D5,D11,D12,D13
DK4,DK6,DK7,DK9,DK10
F4,F9
H4
I1
J1
N1,N3,N5 NL5,NL7,NL10
S1,S3,S4,S9,S13,S14
SF8,SF10
UK1,UK15,UK27,UK33,UK34,UK35,UK36,UK39
USA11,USA13,USA14,USA15,USA22,USA25,USA26,USA29,USA35

2) Unoccupied

AUS1
CA1,CA4,CA17
CH14
D13
F3
J1
S4,S14
UK7,UK14,UK27,UK33
USA11,USA12

3) Simulated occupancy

BZL1
CH9,CH11
D5,D13
DK7,DK9
F3
UK27,UK34
USA15

Table 11 - Heating and Ventilating Systems

A) Ventilation Systems

1) Mechanical ventilation
CA1,CA2,CA3,CA5,CA7,CA8,CA9,CA11, CA12,CA13,CA17,CA20,CA23,CA25, CA26,CA29
CH6,CH8,CH10,CH13,CH14,CH15
D6,D7,D12,D13
DK5,DK7
F1,F3,F4
H2,H4
I3
N3,N5
NL5,NL6,NL7,NL10
S1,S3,S4,S5,S6,S7,S9,S10,S12,S13,S14,S15
SF2,SF4,SF10
UK10,UK15,UK16,UK18,UK20,UK31,UK33, UK36,UK38,UK39
USA4,USA13,USA14,USA20,USA23,USA27, USA29,USA31,USA33,USA34

2) Natural ventilation
B7
BZL1
CA1,CA2,CA5,CA7,CA8,CA12,CA13,CA17, CA20,CA24,CA30
CH13,CH14
CS1
D1
DK7
F7
H2
I3
J1
N1,N5
S1,S6,S7,S14
SF2,SF4,SF5,SF10
UK5,UK6,UK7,UK9,UK15,UK16,UK18, UK20,UK23,UK31,UK36
USA5,USA15,USA16,USA23,USA31,USA33

3) Demand controlled ventilation
B7
CA23,CA27
D5
DK10
N2
I1
S14,S15,S16
SF3,SF4
UK39

4) Heat recovery systems
CA13
D7
DK7
SF2
UK18,UK33
USA4

5) Variable air volume systems
S14,S15
UK38
USA20

6) Air conditioning systems
AUS1
CA8,CA29
CH10
N4
S8
SU1
UK3,UK36,UK38
USA14,USA15,USA20,USA34

B) Heating Systems

1) Heating Systems *(General)*

AU1 CA4,CA8,CA9,CA12,CA18,CA24,CA25,
CA26,CA29
CH6,CH14
D3,D12
F3,F5
I1,I4
N5
NL10
S1,S2,S3,S5,S6,S9,S11
SF1,SF2,SF4
UK1,UK15,UK22,UK29,UK33,UK37
USA1,USA2,USA11,USA12,USA13,USA26,
USA35

2) Electric Heating Systems

CA1
F3
S2,S5,S6,S9
UK37
USA11,USA12,USA13,USA15,USA29

3) Domestic Hotwater Heating Systems

CA1
S1,S2,S9
UK15,UK27
USA35

4) Oil Fired Heating Systems

S1
UK15

5) Gas Fired Heating Systems

CA25
UK15,UK33
USA11,USA15,USA35

Table 12 - Building/Building Components

A) Buildings

1) Buildings general/all

AU1
CA5
CH11
DK8
H2,H3
I5
J6
NL9
S10,S14
SF6
UK8,UK9,UK20,UK24,UK26,UK31,
UK32,UK33
USA6,USA30,USA31

2) Dwellings *(General)*

B2,B8,B9
CA3,CA4,CA9,CA10,CA11,CA12,CA13,
CA14,CA17,CA18,CA19,CA22,CA26,CA30
CH6,CH8,CH9,CH12,CH13,CH14
CS1
D5,D9
DK4,DK6
F1,F2,F3,F4,F6,F7,F8,F10
H1
I1,I3,I4
J2,J6
K1
NL7,NL8,NL10
NZ1
N1
S2,S3,S5,S6,S7,S9,S12,S14
SF2,SF4,SF7,SF9,SF10
TR1 UK1,UK2,UK4,UK5,UK11,UK13,UK16,
U21,UK22,UK33,UK34,UK35
USA1,USA4,USA8,USA9,USA12,USA15,
USA18,USA21,USA22,USA24,USA25,USA27,
USA32,USA34,USA35

3) Dwelling *(Detached)*

CA2
F10
J1,J3
S6
SF1
USA11,USA13,USA24,USA26,USA27,
USA29,USA33

4) Dwelling *(Semi detached)*

SF10
USA24,USA27

5) Apartments/flats

B6,B7,B8
CH13,CH14
CS1
F7,F9
D5
I1
J1,J3
H4
N1
NL10
S1,S3,S14
SF9,SF10
TR1
UK2,UK22

6) Single-storey buildings

UK6

7) Commercial/office buildings

AUS1
B8
CA1,CA6,CA7,CA16,CA23,CA27,CA28,CA29
CH5,CH6,CH7,CH8,CH9,CH17
CS1
D2,D5,D6,D11,D13
DK4,DK11
F5
K1
N4
NL5
NZ1
S12,S14,S15
SF1,SF5,SF8,SF11
UK1,UK2,UK15,UK20,UK23,UK28,UK35,
UK36,UK38
USA1,USA2,USA9,USA14

8) Public buildings

CA21
NL5
NZ1
UK23

9) Industrial/factory buildings

B10
BZL1
CA14
CH6
F5
D13
NL6
SU1
UK14,UK25,UK29,UK35,UK37

10) Test chambers/test house

B5
CA1,CA17,CA20,CA22
CH7,CH15
D7,D12,D13
DK4,DK5,DK7,DK11
F11
J1
S5,S11
UK1,UK7,UK12,UK13,UK21
USA3,USA7

11) Mobile homes

USA10

12) Agricultural buildings

B10
USA23
UK10

13) Hospitals

CA8
D6
UK18

14) Schools

B8
CH6
N3
S14
UK2,UK27

15) Day nurseries

CA24
S14

16) Retail outlets

UK39

17) Clean rooms

J5
S4,S11

18) Single Rooms

B3,B4
D8
NL3

19) Churches

NZ1
N5

20) Museums

S8

21) Libraries

S13

22) Theatres/auditoriums

N2
NL2,NL4
S14
UK30,UK39

23) Attics/roofs

B6,B10
CA3,CA10
I2
S1,S11
UK3,UK11,UK22
USA8

24) Crawlspaces/basements

B9
CA2,CA10,CA30
I2
J1

B) Building Components

1) Openings *(General)*

B6,B8
CA17
CH2,CH3,CH7
H2
J5
NL3,NL4,NL6
UK9,UK11,UK16,UK21
USA3,USA8,USA16,USA31

2) Windows

B4
CA3,CA4,CA17
CH7,CH17
F9,F10
H1
J1,J3
K1
NL2,NL10
S1,S4,S11
UK6,UK9,UK16,UK18,UK21,UK27,
UK30,UK35
USA2

3) Walls

B5
CA3,CA4,CA10,CA22
CH8,CH17
CS1
D9
J2,J3
S1,S10,S11
UK5,UK6,UK7,UK11,UK12,UK15,UK20,UK22
USA2,USA10

4) Doors

B2
CA20
CH7
F3,F9,F10
J1
UK4,UK9,UK16,UK21,UK27,UK37

5) Floors

B2
CA1,CA10
CH1,CH17
D3,D12
DK3
N5
S1
UK4,UK10,UK11,UK22

6) Cracks

CA10
CH3
F11
SF6
UK15,UK21
USA31

7) Ceilings

CH17
NZ1
S3
USA2

8) Stairwells

UK4

Table 13 - Parameters to which Air Infiltration and /or Ventilation are Related

1) Weather/Climate

a) General

B6
CA21
CH2,CH5,CH7,CH9
CZ1
F3,F7
H3
NL2,NL3
NZ1
S7,S10
TR1
UK9,UK13,UK20,UK27,UK28,UK31,
UK32,UK33,UK34,UK35
USA8,USA29

b) Wind speed

AUS1
CA14,CA17
CH3,CH9,CH16
D8
J3
S6,S10
SF6
UK11,UK14,UK15,UK16,UK21,UK23,UK24
USA10

c) Wind direction

CA14,CA17
CH3,CH9,CH16
D8
J3
S6,S10
SF6
UK21,UK23,UK24

d) Wind pressure

B9
CA22
F11,F12
I2
USA6

e) Temperature difference *(Stack effect)*

AU1
AUS1
B9
CA17
CH3,CH7,CH8
D8
DK4
F5
N3
S3,S5,S6,S8,S10
SF6,SF8
SU1
UK4,UK5,UK6,UK11,UK12,UK14,UK15,UK16,
UK17,UK23,UK24
USA6,USA8,USA10

f) Humidity

AU1
B6
F4
S8
SF8
SU1
UK5,UK6,UK11
USA8

g) Radiant exchange

B4
DK3
S8
UK22

2) Building characteristics/ performance

a) Building general *(eg type/design)*

CA12,CA14
CH2,CH5,CH9,CH12
F2,F10,F11
I1
UK25,UK27,UK30
USA12,USA13

b) Building envelope performance/openings/leakage distribution and airtightness

AU1
B9
CA11,CA12,CA14,CA17,CA22
CH3,CH12,CH13,CA14
F3,F8
NL3
S3,S4,S6,S10
TR1
UK1,UK8,UK15,UK16,UK18,UK23,UK24,
UK27,UK33,UK37
USA7,USA12,USA16,USA20,USA21,USA29

c) Building component performance/purpose provided openings

CA4
CH8
B10
DK1,DK2,DK3
F8
H1
J5
K1
TR1
UK20,UK21,UK34
USA2

d) Building construction type

B1
I1
UK33,UK37

e) Building exposure

CA14,CA17
NL2
UK16,UK24,UK33

f) Internal airflow movement

AUS1
B10
CA25
CH4,CH8,CH11
D1,D4,D10
DK1,DK6
F10,F11
J4,J5
H2
NL1,NL9
NZ1
S3,S5
SF8,SF11
UK13,UK17,UK19,UK24,UK28,UK37
USA4,USA5,USA6,USA17,USA23,USA24

g) Internal air velocities

D10
J5
NL1,NL3
SU1
UK17,UK30
USA2,USA8

h) Turbulent airflows

CA17
CH3
DK2
UK30

i) Internal pressures

D8
F10

j) Draughtproofing

UK16,UK23

3) Ventilation systems

CA11,CA12,CA17
F7
NL6
S5
UK31,UK38
USA4,UK20,UK22

4) Heating systems

CA12
F3
UK1,UK20,UK22

5) Pollutant levels/transport

B6
CH2,CH6,CH8,CH9,CH11
F7
N3
NL9
S8
SF8
UK1,UK13,UK15,UK18
USA2,USA5,USA20

6) Pollution sources

F7
H2
USA13

7) Occupant behaviour

B6
CA17
CH2,CH9
F3,F4
UK1,UK15,UK27,UK33,UK34,UK35
USA13,USA29

8) Development of guidelines and standards

CH10
D4
UK9

9) Energy consumption/usage

CA11
I1
S3
SF8,SF11
UK7,UK15
USA4,USA20,USA34

10) Heat recovery

DK7
USA4

11) Heat transfer

B1
CA20
CH9
H2
NZ1
UK3,UK7,UK12,UK17
USA8,USA12,USA19

12) Moisture transfer

CA4
NZ1
UK3
USA4,USA8,USA13

13) Ventilation/air change rate

AUS1
CH4,CH13
H2
J6,J7
UK12
USA4,USA19,USA24,USA34

14) Ventilation effectiveness/efficiency

CH4
I3
SF9
USA12,USA29

15) Combustion appliances/etc

CA4,CA12
NL1
I1

16) Comfort

CH8

17) Thermal insulation

B1

Table 14 - Parameters to which Indoor Air Quality is Related

1) Weather/Climate

a) General

B5,B8
BZL1
CA1,CA2
CH1
D5,D11
F2
H4
J1
N5
NL5,NL10
UK33,UK35
USA3,USA14,USA15

b) Wind speed

B7
CA3
D6,D13
S2,S9,S11,S15
USA32

c) Wind direction

B7
NL4
S11,S15

d) Wind pressure

B7,B9
BZL1
D13
F3
J2

e) Indoor temperature

B9
CA3,CA6,CA15,CA16,CA18,CA23
D7,D11,D13
F5,F7,F8
H4
J1
N2,N3
S2,S3,S9,S11,S13,S15
USA22

f) Outdoor temperature

CA18
S3
USA32

g) Humidity

CA6,CA13,CA15,CA16,CA18,CA23,CA24
D11,D13
F8
H4
J1
N2
S13,S15,S16
UK36
USA22

h) Solar radiation

D11
F3
S9,S12
UK26

2) Pollutants

a) General indoor air quality

CA6,CA7,CA8,CA15,CA16
CH15
D2
NL5
UK2,UK32
USA14,USA15,USA26

b) Pollution concentrations/sources

B8 BZ1
CA2,CA6,CA19
CH17
D2,D6,D9
DK5,DK8,DK9
F7,F8
N1
NL4
UK26,UK36
USA5,USA18,USA22,USA35

c) Bacteria/mould/fungi

CA24,CA6
USA9

d) Carbon oxides (CO_2/CO)

B7,B8
CA6,CA23,CA24CA27,CA28,CA29
D5,D11
F6
J1
N2 NL5
S14,S15,S16
UK39

e) Combustion emissions

I4
S14
USA15,USA27,USA32

f) Dust concentrations.

B2,B3
CA6
N2,N3

g) Formaldehyde releases

CA6
S13,S15
USA11

h) Moisture

B3
S14
USA3,USA4,USA26

i) Nitrogen oxides

USA11

j) Noise/sound attenuation

B8
CA1
D13
F2,F3

k) Occupant health/comfort

CA15,CA16
CH15,CH17
F10
N4
NL10
USA18,USA26

l) Odour

CH17
DK9
S14

m) Ozone

CA6

n) Particles

CA24,CA29
F1

o) Radon/Radon daughters

B9
CA2,CA3,CA10,CA30
DK11
J1
USA11,USA15,USA33

p) Tobacco smoke.

D5,D7

q) Thermal comfort

BZL1
CA18,CA27,CA29
J2
NL10
S11
UK26,UK29,UK36

r) Tracer gas research

USA28,USA30

s) Vapour production

D5

t) Volatile organic compounds (VOC's)

CA6,CA29
F1
S13,S15,S16
UK2

3 Physical Variables

a) Air movement.

B7,B8
CA2,CA6,CA15,CA18,CA23,CA30
D7
F3,F7,F8
J2
NL4
S3
UK29,UK36
USA4,USA5,USA9

b) Air change rate/ventilation rate

CA3,CA6,CA23
CH1
UK26
USA4,USA18,USA33

c) Building construction/design/tightness

B2,B5,B9
CA1,CA2,CA10,CA26
CH1
F1,F2,F3
D6
I4
J1
NL5,NL7
S1,S2,S3,S9,S15
UK25,UK33
USA11,USA18,USA31,USA32,USA33

d) Energy conservation

CA9,CA26
F8,F9
N4
NL10
S3,S9
UK26
USA4,USA26,USA32

e) Heating systems

CA26
D7
NL4
USA4

f) General ventilation/mechanical ventilation systems

B3,B9
CA2,CA3,CA5,CA7,CA8,CA9,CA13,CA26,
CA28,CA30
F1,F2,F4,F9
D7
I3
NL7
S3
UK10,UK36
USA4

g) Geology

CA10
USA1

h) Occupant behaviour

B2
CA1,CA6,CA9,CA26
CH1
D5,D11
F9
N5
NL5,NL7,NL10
UK33,UK35,UK36
USA25,USA32,USA35

i) Standards/guidelines

S1

Section 2
Survey Replies

BELGIUM

REF B1
TITLE
The influence of natural convection in an insulated cavity on the thermal performance.
CONTACT
Lecompte, J
ADDRESS
Laboratory of Building Physics,
K U Leuven,
Kasteel van Arenberg,
B-3030 Heverlee,
BELGIUM.
TEL +32 16 220931 FAX +32 16 22 09 31
TLX ELEKUL 25971
SPECIFIC OBJECTIVES
Quantifying the deterioration of the thermal performance of cavity filling by bad workmanship.
PROJECT DETAILS
The research was structured around three topics. (i) Developing a calculation model for rotative convection around poorly mounted cavity fill. (ii) Analysing the quality of workmanship in partly cavity fill on site. (iii) Simulating reality in hot-box/cold-box tests; comparing test results with model predictions.
BUILDING TYPE
Cavity walls
PARAMETERS
(Not Stated)
STARTDATE 00:00:1987
ENDATE 00:00:1989 TIME 5 person-years (1 res. FT-5 yrs)
KEYWORDS
Cavities, airflow, stack effect, simulation, natural convection
SELECTED BIBLIOGRAPHY
1 Lecompte J (1989), The influence of natural convection in an insulated cavity on the thermal performance of a wall. ASTM STP 1030.
2 Lecompte J (1988), The influence of natural convection on the hygrothermal quality of insulated cavity constructions. CIB Confer. Healthy Buildings, Stockholm, 1988.

REF B2
Vapour distribution in two single family houses.
CONTACT
Senave, E
ADDRESS
Laboratory of Building Physics,
K U Leuven,
Kasteel van Arenberg,
B-3030 Heverlee,
BELGIUM.
TEL +32 16 220931 FAX +32 16 220931
TLX ELEKUL 25941
SPECIFIC OBJECTIVES
To study the influence of different lay out and door uses on the vapour distribution.
PROJECT DETAILS
The study is part of the Belgium engagement in IEA annex XIV. In two houses of a social estate, the distribution of vapour was analysed. Starting with cooking, a given amount of water in one of the rooms. Relationships were studied between: (i) The vapour pressure peak and the hygroscopic mass in the room. (ii) The velocity of peak buildup and ventilation. (iii) The distribution in vapour pressure reaction and door use on floor lay out.
BUILDING TYPE
Houses (Residences)
PARAMETERS
Door use, Floor lay out, Hygroscopic mass
STARTDATE 00:00:1987
ENDATE 00:00:1990
TIME 6 person-months
KEYWORDS
Openings, moisture, hygroscopic, dwelling, airflow
SELECTED BIBLIOGRAPHY
(None Stated)

REF B3
TITLE
Hygroscopic mass.
CONTACT
Hens, H
ADDRESS
Laboratory of Building Physics,
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BELGIUM.
TEL +32 16 220931 FAX +32 16 29 14 34
TLX ELEKUL 25947
SPECIFIC OBJECTIVES

Studying the influence of an increasing hygroscopic mass and surface on the vapour course.
PROJECT DETAILS
The study is part of the Belgium engagement in IEA annex XIV. In a hot box - cold box apparatus, the course of the vapour pressure during a step of vapour production is analysed as a function of: - Outside air ventilation. - Hygroscopic mass. - Surface condensation on simple glazing and thermal bridges.
BUILDING TYPE
Room
PARAMETERS
Ventilation, hygroscopic mass, condensation.
STARTDATE 00:00:1988
ENDATE 00:00:1990 TIME 6 person-months
KEYWORDS
Moisture, hygroscopic, condensation, ventilation
SELECTED BIBLIOGRAPHY
(None Stated)

REF B4
TITLE
Model calculation and experimental study of the air thermocirculation due to solar radiation.
CONTACT
Gratia, E
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Universite Catholique de Louvain,
Unite Architecture - Batiment VINCI,
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1348 Louvain-la-Neuve,
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TEL +32 010 47 22 23 FAX +32 10 47 21 79
EMAIL deherde@info.ucl.ac.bc
TLX 59037 UCL B
SPECIFIC OBJECTIVES
After the observation of the phenomenon of thermocirculation in an experimental cell, elaboration of a simulation model for any airtight volume.
PROJECT DETAILS
The windows are a considerable source of free energy, caused by the sunspace effect, because of this thermocirculation occurs. This phenomenon allows us to get a better uniformity of the internal temperatures and so to avoid the heating of some rooms, while cooling others. The model calculates for an airtight volume the air movement due to the difference between the wall temperatures. It calculates the temperatures, the speed components in the three directions and the pressures at the nodes of the grid. Two graphics programs allows us to visualize the air movement.
BUILDING TYPE
A room with windows
PARAMETERS
The influence of the sun radiation on the thermocirculation
STARTDATE 00:01:1987
ENDATE 00:10:1998 TIME *(Not Stated)*
KEYWORDS
Natural convection, model, passive solar, air movement, temperature gradient
SELECTED BIBLIOGRAPHY
1 Gratia E (1987), Air movement due to solar radiation measurements and modelisation presented at Confer. of Air Distribution In Ventilated Spaces, Stockholm, Sweden. June 1987.
2 Gratia E & Herde A De (1988), La thermocirculation naturelle de l'air et l'architecture. J. d'etudes Salon de la Physique du batiment. CSIC Belgium, 7-10 Sept. 1988.
3 Gratia E (1988), Simulation numerique et experimentale de la thermocirculation de l'air due a l'ensoleillement. October 1988.

REF B5
TITLE
Passys. (GEC-Project)
CONTACT
Wouters, Peter
ADDRESS
Belgian Building Research Institute,
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SPECIFIC OBJECTIVES
Outdoor thermal performance testing of building components/Model validation and development/Simplified Design tool Development.
PROJECT DETAILS
Set up of high quality test cells with common procedures and common equipment and instrumentation (12 sites)
-Measurement of airtightness
-Common pressurisation equipment

-Development of prototype of PASSYS Tracer Gas Equipment for ACR
Measurement in 4 cells. Modelling of airflow (ESP, VENCON)
BUILDING TYPE
Test cell with wall components
PARAMETERS
Outdoor climate; wind; temperature, humidity, solar radiation, performance of south facing wall components.
STARTDATE 01:07:1986
ENDATE 31:12:1991
TIME 29000 person-hours (global project) (of which 2000 hours on air infiltration)
KEYWORDS
Pressurisation, tracer gas, airflow simulation, airtightness
SELECTED BIBLIOGRAPHY
"The PASSYS Test Cells" Final Report Subgroup Instrumentation Part 1, Ed. BBRI, 1989. Final Report Subgroup Instrumentation Part 2 Ed. BBRI 1989.
Final Report Subgroup Test Methodologies, Ed. TNO/CONPHOEBUS, 1989.
Final Report Subgroup Model Validation and development, Ed. TIL.1989.
Final Report Subgroup Simplified Design Tools, Ed.CSTB, 1989.
The PASSYS Test Cells: A unique European network of high quality outdoor test facilities for thermal buildings research, P.Wouters, L.Vandaele, SECA Paris 7 Dec, 1989
Final Reports on Phase 2 (1990-1991) expected end 1991.

REF B6
TITLE
Air flow patterns in buildings - IEA-ECBCS Annex 20.
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SPECIFIC OBJECTIVES
Study of multizonal airflows.
PROJECT DETAILS
1 Measurements in attic space with N_2O and CO_2 injection of ACR, temperature and contaminant distribution (50 measuring points) and wind, surface pressures for different ventilation strategies (single sided, cross).
2 Use of movable air intake grilles in 9 apartments
3 Multizonal ventilation efficiency in apartment (tracer gas measurement and simulation.
4 Edition of Leakage distribution measurement methods Handbook.
BUILDING TYPE
Apartment building, attic space
PARAMETERS
Weather (wind, pressures, temp) humidity, CO_2 level, use of air intake by occupants.
STARTDATE 00:00:1988
ENDATE 00:00:1991
TIME 5880 person-hours
KEYWORDS
Pressurisation, large openings, inhabitants, occupant, contaminant flow, multizonal, attic, simulation
SELECTED BIBLIOGRAPHY
Only working documents, confidential reports. Final reports expected: Leakage distribution measurement methods, Handbook Ed. BBRI 1990.

REF B7
TITLE
Passive humidity controlled ventilation. (CEC-AERECO-BBRI-TNO-CETIAT)
CONTACT
Wouters, Peter
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SPECIFIC OBJECTIVES
Study of airflows in apartments with natural ventilation system with and without hygro-regulated ventilation devices.
PROJECT DETAILS
9 storey apartment building with natural ventilation ducts in kitchen, bathroom and toilet. Pressurisation measurements. Tracer Gas (N_2O) measurements in 54 rooms (9 apartments with normal ventilation devices on 9 apartments with hygroregulated ventilation devices). by BBRI-MATE system (60 channels) Constant injection technique. Measurement of airflow

rates, temperatures, CO_2 levels, humidity, wind speed direction, wind pressures. Occupied building.
BUILDING TYPE
9 storey apartment building (Residence)
PARAMETERS
Temperature, wind speed and direction, humidity, ventilation system, CO_2 level, wind pressure.
STARTDATE 00:00:1987
ENDATE 30:09:1991 TIME *(Not Stated)*
KEYWORDS
Humidity, natural ventilation, monitoring, carbon dioxide (CO_2), tracer gas, demand controlled ventilation (dcv), airflow
SELECTED BIBLIOGRAPHY
Passive humidity controlled ventilation in existing dwellings, the CEC-AERECO Demonstration Project, Part 1. Presentation of the test sites, ed. E.D.E. 1990.

REF B8
TITLE
Controlled ventilation in dwellings, schools and offices (IRSIA project)
CONTACT
Wouters, Peter
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BELGIUM.
TEL +32 2 653 88 01 FAX +32 2 653 07 29
SPECIFIC OBJECTIVES
Study and elaboration of strategies for controlled ventilation.
PROJECT DETAILS
1 Theoretical studies: multizone airflow simulations (VENCON,ESP) on ventilation efficiency, pollutant dispersal, cooking hood effectiveness, climatic factors, large openings, heat transfer.
2 Measurements in lab. and in situ; pressurisation of dwellings and offices, flow characteristics of ventilation grilles, performance of cooking hoods, efficiency of ventilation duct outlets, cross ventilation, reverse flow, indoor air quality.
BUILDING TYPE
Apartment building, terrace residence.
PARAMETERS
Weather, (wind temp. pressure) CO_2, flow rates, cooking contaminants, acoustic performance.
STARTDATE 01:12:1987
ENDATE 30:11:1991 TIME 13440 person-hours
KEYWORDS
Pressurisation, airflow simulation, ventilation efficiency, contaminant multizone, air outlet, indoor air quality (IAQ)
SELECTED BIBLIOGRAPHY
1 Wouters P (1989), Experiences Belges sur la qualite de la ventilation dans les immeubles, IXth International Congress of the CIB. Paris, 19-23 June 1989.
2 Wouters P (1989), New ventilation concepts with respect to indoor air quality and energy conservation. Invited paper on Second European Conf. on Architecture Paris 5.12.89
3 Wouters P,(1989), K.V.I.V. Studiedag "Gezond bouwen" Antwerp 14.12.89 Belgische ervaringen inzake ventilatiekwalitait in gebouwen
4 Wouters P (1990), WTCB Tijdschrift 1989/2; WTCB Brussels Final Report Phase 1 (87-89) expected March 90.

REF B9
TITLE
Radon entry.
CONTACT
Mets, G De
ADDRESS
Belgian Building Research Institute,
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BELGIUM.
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SPECIFIC OBJECTIVES
The evaluation of remedial actions.
PROJECT DETAILS
(a) Measurements : Pressurisation and tracer gas measurements in 2 tier houses and some existing houses with high radon levels.
(b) Simulation by means of the source-spread module of VENCON to control the effect of remedial actions.
BUILDING TYPE
Low rise buildings
PARAMETERS
Radon levels, leakage distribution, ventilation of crawl space, temperature pressure.
STARTDATE 00:00:1990

ENDATE 00:00:1991
TIME 840 person-hours
KEYWORDS
Radon, ventilation, retrofit, tracer gas, measurements, pressurisation, simulation, leakage
SELECTED BIBLIOGRAPHY
(None Stated)

REF B10
TITLE
Experimental study of air diffusion in a large slot ventilated building.
CONTACT
Fissore, Adelqui
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4000 Liege,
BELGIUM.
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TLX 41397 univg b
SPECIFIC OBJECTIVES
Study of airflow pattern and velocity and temperature field in the occupation zone.
PROJECT DETAILS
An experimental study in reduced scale model for ventilation inside a sheep-fold was made. The ventilating system consisted of two slots in opposite side wall and one in the roof. Omnidirectional prove TSI model 1620 has been used for measurements of mean velocity of the air (temperature was also measured), in one section of the model. Visualisation of airflow has been made by smoke tubes. Some measurements of velocity field are given like a simple semi-empirical model
BUILDING TYPE
Agricultural, industrial
PARAMETERS
Archimedes number, flow rate for every inlet and geometry.
STARTDATE 00:10:1986
ENDATE 00:03:1990
TIME 4500 person-hours
KEYWORDS
Industrial, test room, air movements, air velocity, livestock, slot ventilation
SELECTED BIBLIOGRAPHY
1 Fissore A & Nusgens P (1988), Experimental analysis of air diffusion in large space. Effective Ventilation, 9th AIVC Conference Gent, Belgium, September 1988.
2 Fissore A (1989), Experimental determination of the position of the jets for slot ventilated spaces. Air Flow patterns in ventilated spaces. Liege, Belgium, February 1989.
3 Fissore A & Liebecq G (1990), Experimental study of air jet pathways in large slot ventilated spaces. Submitted to ROOMVENT 90, June 1990 Norway. Final and integral report in Ph.D thesis (expected date: April 1990).

CANADA

REF CA1
TITLE
Indoor air quality in office buildings.
CONTACT
Nguyen, Van Hiep
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IRSST,
505 de Maisonneuve West,
Montreal, Quebec, H3A 3C2.
CANADA.
TEL +1 514 288 1551 FAX +1 514 288 0998
TLX 055-61348
SPECIFIC OBJECTIVES
To better the working environment.
PROJECT DETAILS
1) Buildings ranging from 5 to 21 storeys, steel and concrete construction. 2) Natural and Mechanical ventilation, electrical and hot-water heating 3) Tracer gas (SF6 and CO_2), fresh and total airflows, comfort, chemical and microbiological contaminants, noise, radon. 4) Hot-wire anemometers, sampling tubes, air pumps, filters, electron capture GLC, noise meter, direct reading instuments (CO_2, CO, O_3), psychrometer, comfort meter, radon-activated charcoal. 5) Occupied and unoccupied buildings, and test chambers.
BUILDING TYPE
Office Buildings
PARAMETERS
Weather, performance of building components, real behaviour of occupants, construction, cleaning agents, flooring, noise.
STARTDATE 00:01:1989
ENDATE 00:01:1990
TIME estimated 2000 person-hours

KEYWORDS
Indoor air quality (IAQ), tracer gas, office, ventilation system airflow, mycoflora
SELECTED BIBLIOGRAPHY *(None Stated)*

REF CA2
TITLE
Radon measurements and control technology.
CONTACT
Figley, D A
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Institute for Research in Construction,
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CANADA.
TEL +1 306 975 4200 FAX +1 306 975 5956
TLX 074-2471
SPECIFIC OBJECTIVES
The development of control techniques for radon entry into basements.
PROJECT DETAILS
1 Measurement of air leakage rates of below grade foundation components using a guarded pressure box technique. 2 Investigation of cost effective air sealing measures for below grade components.
BUILDING TYPE
Detached residences low-rise
PARAMETERS
Radon source strength, wind, temperature difference, neutral pressure plane, mechanically induced airflow.
STARTDATE 00:00:1988
ENDATE 00:00:1991
TIME 2000 person-hours
KEYWORDS
Radon, basements, dwellings, airflow
SELECTED BIBLIOGRAPHY
1 Figley D A & Dumont R S (1989), Techniques for measuring the air leakage characteristics of below grade foundation components. Proceedings Air and Waste Management Association 1989 Annual Meeting, California, USA.
2 Dumont R S & Figley D A (1989), Control of Radon in houses. Canadian Building Digest No. 247, Institute for Research in Construction, National Council of Canada, Ottawa, K1A 0R6 Feb.89

REF CA3
TITLE
Field trials to assess the validity of the moisture assessment prescriptive procedure. (MAPP).
CONTACT
Szadkowski, Frank
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Energy Mines and Resources Canada,
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CANADA.
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SPECIFIC OBJECTIVES
To obtain additional evidence on the extent to which application of the MAPP achieved its intended purpose.
PROJECT DETAILS
The project consisted of field trials of MAPP involving observations in approximately 20 houses in each of four regions: Vancouver, Winnipeg, Toronto-Ottawa, and Halifax The MAPP is a procedure for use by the energy retrofit that can be implemented without causing significant house performance problems associated with the condensation of water vapour on interior surfaces or within wall or attic spaces; and/or to predict the nature and extent of remedial or preventative measures required to avoid such problems. The house trials involved: recording mid-winter indoor relative humidities for a maximum period of about two weeks in each of the trial houses; completion of a comprehensive questionnaire on relevant house characteristics, operation and performance; measurements of surface temperatures and observations on selectedwindows; observations of moisture conditions on other interior surfaces and in attics and exterior walls; measurements of house ELA; and application of both the comprehensive MAPP and the MAPP Pass procedure to each house.
BUILDING TYPE
Various single family detached houses
PARAMETERS
Direct relationship between infiltration, moisture sources and indoor relative humidities
STARTDATE 00:09:1988
ENDATE 00:09:1989
TIME *(Not Stated)*
KEYWORDS
Moisture, radon, pressurisation, ventilation system, ventilation rate

SELECTED BIBLIOGRAPHY

1 September 1989, Field Trials to Assess The validity of the Moisture Assessment Prescriptive Procedure.

2 Avoiding moisture problems when retrofitting Canadian houses to conserve energy. ISBN 0-662-16788-0 March 1988.

REF CA4

TITLE

Analysis of the effects of energy retrofit work on equivalent leakage area.

CONTACT

Allerie, Joel

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SPECIFIC OBJECTIVES

Obtain Pre-and-post retrofit values of Equivalent Leakage Area and energy usage for energy retrofit work.

PROJECT DETAILS

The project had the contractor measure the ELA before and after execution of three categories of energy retrofit work: window replacement; siding installation; and insulation upgrading. The contractor also used the HOT-2000 computer program (developed by Energy, Mines and Resources, Canada) to estimate energy usage before and after retrofit work. The contractor obtained 52 complete sets of results; all homes are low-rise residential type with a variety of heating systems , exterior wall systems ,etc. All homes were occupied in the course of the study. This study obtained field test data which was used to produce a case study fact sheet for every set of data as a summary sheet (certain homes were used twice because such homes had a combination of retrofit measures). The resulting information will be sent to 250 retrofit contractors in Canada. Equally, the information could be used for training courses, workshops, seminars,etc. The contractor has produced slides to this effect.

BUILDING TYPE

Residential Low-rise

PARAMETERS

Following work, contractor checked for combustion backdrafting and for moisture.

STARTDATE 00:02:1988

ENDATE 00:09:1989 TIME *(Not Stated)*

KEYWORDS

Leakage area, retrofit, energy, heating system, dwellings

SELECTED BIBLIOGRAPHY

1 Energy Efficient Retrofit - Case Studies. Sept. 1989.

REF CA5

TITLE

Building codes designed for ensuring good indoor air quality.

CONTACT

Ferahian, R H

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Consulting Engineer,
4998 de Maisonneuve,
1416 Westmount, Quebec, H3Z 1N2.
CANADA.
TEL +1 514 484 5492

SPECIFIC OBJECTIVES

(Not Stated)

PROJECT DETAILS

To incorporate in codes and by-laws the most up-to-date research results not only at the design and construction stages of buildings but also for the maintenance of the building systems essential for the health and safety of the occupants to ensure good indoor air quality throughout the useful life of the building. Ongoing representations at the local municipal level (City of Westmount) provincial and federal levels together with appeals to ASHRAE and National Research Council to effect the necessary changes in codes, standards and bylaws. Details in author's papers published in Proceedings of the "Healthy Buildings '88" Conference held in Stockholm in September 1988 and AIVC's 10th annual conference, 1989 held in Espoo, Finland.

BUILDING TYPE *(Not Stated)*

PARAMETERS *(Not Stated)*

STARTDATE 00:00:1981

ENDATE Ongoing till goal reached

TIME *(Not Stated)*

KEYWORDS

Standards, indoor air quality (IAQ), ventilation system

SELECTED BIBLIOGRAPHY

See references in author's paper in proceedings of 10th AIVC Conference, 1989 Espoo, Finland.

REF CA6
TITLE
Indoor air quality and ventilation in office buildings.
CONTACT
Nguyen, Van Hiep & Goyer, Nicole
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CANADA.
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TLX 05561348
SPECIFIC OBJECTIVES *(Not Stated)*
PROJECT DETAILS
The study has a bearing on air quality , comfort parameters and ventilation systems. Before taking measures in places of work, a questionnaire was given to the occupants in order to discover how they perceived the air quality and ventilation. The study made at about ten posts of work in each of three buildings, shows an acceptable air quality, as far as chemical contaminants established standards and criteria. In the chapter on ventilation, four types of problem have been identified :losses of fresh air per person which do not reach the ASHRAE recommendation, levels of humidity varying between 10 and 20 %, draughts creating a source of discomfort, and defects in the composition of ventilation systems. The results of the study have been used by the administrators of the buildings to bring solutions to the problems identified. Recommendations have also been formulated, with a view to further studies.
BUILDING TYPE
3 office buildings
PARAMETERS
Temperature in degrees Celcius, Relative Humidity (%), Air speed, Air Changes per Hour, Questionnaires, Dust, Formaldehyde, Volatile Organic Compounds (VOC), Carbon Dioxide (CO_2),Carbon Monoxide (CO) Ozone (O_3), Nitrogen Oxides (NO), micro-organisms
STARTDATE 00:01:1987
ENDATE 00:11:1989
TIME *(Not Stated)*
KEYWORDS
Questiònnaire, indoor air quality (IAQ), comfort, ventilation systems
SELECTED BIBLIOGRAPHY
3 publications and 16 reports of which the principal ones are:
1 Nguyen V H & Goyer N (1988), Qualite de l'air et ventilation dans trois edifices a bureaux. Sommaire de recherche 53 pages. Montreal IRSST, 1988.
2 Nguyen V H (1988), Resultats d'etude de la qualite de l'air et de la ventilation dans 16 edifices a bureaux. Colloque de l'ASHRAE Montreal October 1988.
3 Nguyen V H (1988),Methode d'investigation de la qualite de l'air. CIB conference :Healthy Buildings '88 Stockholm, Compte rendu, September 1988, pp 359-360.

REF CA7
TITLE
The role of moulds in sick building syndrome.
CONTACT
Smoragiewicz, W & Boutard, A
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CANADA.
TEL +1 514 288-1551 TLX 05561348
SPECIFIC OBJECTIVES
To identify the major toxins in the moulds in ventilation systems.
PROJECT DETAILS
Moulds and their toxins affect the quality of air. These contaminants are not well understood in the conditions which favour their presence in ventilation systems. Samples of mould set aside earlier in the ventilation systems of public establishments will be analysed in the laboratory. The characteristics of the most toxic parts will be determined. The project will identify the principle toxins present in the moulds and the conditions favouring their development. A rapid investigatory test on the terrain will be worked out. The project will permit the development of observation methods for the mould. Also familiarity with the toxins will serve to work out preventive measures for the conception and operation of ventilation systems.
BUILDING TYPE
Office, Ventilation systems, Indoor Air Quality (IAQ), Mycoflora
PARAMETERS
Toxins and moulds
STARTDATE 00:01:1989

ENDATE 00:01:1990
TIME *(Not Stated)*
KEYWORDS
Moisture, mould, ventilation systems
SELECTED BIBLIOGRAPHY
Subventions given by Institut de recherche en sante et en securite du travail du Quebec.

REF CA8
TITLE
Microbiological decontamination of ventilation systems.
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SPECIFIC OBJECTIVES
To determine the efficiency of different methods of decontamination and propose a schedule for preventive maintenance.
PROJECT DETAILS
Systems of ventilation, heating, humidification and climatisation, in fulfilling their premier function which is to distribute hot or cold air throughout buildings, are also an effective means of propagating the contaminants present in ambient air. Evidently there exist several processes of decontamination or cleaning to protect the (substracts) and homes from microbial growth. The objectives of this research are therefore to determine the effectiveness of the different processes of decontamination and to establish a timetable of effective maintenance of ventilation systems. Two establishments, from the hospital section have been chosen as study locations . Once these establishments have achieved the decontamination of the identified places according to our recommendations the decontamination will be re-evaluated, with the help of a protocol of the American Conference of Governmental Industrial Hygienists, three times during the year, at different seasons. One of the results will be the diffusion of information to identify and prevent microbial contamination. In addition, knowledge obtained may be very useful for companies which install and manufacture ventilation systems and for those who clean them.
BUILDING TYPE
2 hospitals ;ventilation systems
PARAMETERS
Micro-organisms
STARTDATE 00:04:1989
ENDATE 00:07:1990 TIME *(Not Stated)*
KEYWORDS
Micro-organisms, hospitals, ventilation systems
SELECTED BIBLIOGRAPHY *(None Stated)*

REF CA9
TITLE
R-2000 Home program: ventilation and air quality monitoring.
CONTACT
Riley, Mark
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Energy, Mines and Resources Canada,
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SPECIFIC OBJECTIVES
To document the ventilation and air quality characteristics of R-2000 energy-efficient homes.
PROJECT DETAILS
Measurement of ventilation system flow rates, infiltration rates, indoor levels of formaldehyde, radon, nitrogen dioxide, temperature and humidity over a five year period in approximately 700 homes across Canada. Analysis of results to determine trends and inter-relationships.
BUILDING TYPE
Residential (occupied)
PARAMETERS
Energy consumption, mechanical ventilation system performance, occupant lifestyles, heating systems
STARTDATE 00:00:1983
ENDATE 00:00:1990 TIME *(Not Stated)*
KEYWORDS
Residential, occupied, air infiltration, indoor air quality (IAQ), radon, formaldehyde, nitrogen dioxide, mechanical ventilation
SELECTED BIBLIOGRAPHY
1 Piersol P & Riley M (1987), Ventilation and air quality monitoring in R-2000 homes. ASHRAE Transactions, Vol.93, Part 2, Paper NT-87-07-1.
2 Riley M (1987), R-2000 Indoor formaldehyde monitoring- 1987 Update. 030-MR, Energy

Mines and Resources Canada, R-2000 Home Program Technical Report, August 1987.
3 Riley M (1987), R-2000 Indoor radon monitoring activities - 1987 Update. 029-MR. Energy Mines and Resources, Canada. R-2000 Home program technical report September 1987.
4 Piersol P & Riley M (1988), Indoor Formaldehyde Levels in Energy-Efficient Homes with Mechanical Ventilation. Effective Ventilation, 9th AIVC Conference, Ghent, Belgium, September 1988.

REF CA10
TITLE
Residential soil gas sampling techniques.
CONTACT
Piersol, Peter
ADDRESS
ORTECH International (for CMHC),
2395 Speakman Drive,
Mississauga, Ontario, L5K 1B3.
CANADA.
TEL +1 416 6022-4111 ext. 545
FAX +1 416 823-1446
SPECIFIC OBJECTIVES
Development of techniques for sampling of soil gas which enters residential basements
PROJECT DETAILS
Sampling techniques which conveniently and accurately determine the quality and entry rate of soil gas which enters residential basements, were constructed and evaluated. Techniques were developed for sampling floor drains, dump pits, and floor and wall cracks. The techniques will be used in a large survey to characterise entry rates and constituents of soil gas.
BUILDING TYPE
Residential - Occupied
PARAMETERS
Soil type, water tables, pressure differentials, envelope leakages, foundation type, radon.
STARTDATE 00:00:1986
ENDATE 00:00:1988 TIME *(Not Stated)*
KEYWORDS
Soil gas, measurement, dwelling, basement, radon, occupied, air leakage
SELECTED BIBLIOGRAPHY
1 Piersol P et. al. (1989), Basement soil gas technique. Development and field sampling. EPA/AWMA Symposium.
2 Anon (1989), Measurement of toxic related air pollutants, Rayleigh, N.C. 1989.

REF CA11
TITLE
Air infiltration, formaldehyde and nitrogen dioxide in new homes.
CONTACT
Piersol, Peter
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ORTECH International (for Yukon Home Buildings),
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CANADA.
TEL +1 416 822-411 ext 545
FAX +1 416 823-1446
SPECIFIC OBJECTIVES
Measurement of air infiltration, formaldehyde and nitrogen dioxide on newly constructed homes.
PROJECT DETAILS
The measurements were made on approximately 75 newly constructed homes in the Yukon, for air infiltration formaldehyde and nitrogen dioxide to determine how the homes of this region were performing regarding indoor air quality.
BUILDING TYPE
Residential - occupied
PARAMETERS
Airtightness, ventilation system operation, energy consumption
STARTDATE 00:01:1989
ENDATE 00:06:1989 TIME *(Not Stated)*
KEYWORDS
Residential, indoor air quality (IAQ), dwelling, air infiltration
SELECTED BIBLIOGRAPHY *(None Stated)*

REF CA12
TITLE
1989 Survey of airtightness of new merchant builder houses.
CONTACT
Riley, Mark
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Ottawa, Ontario, K15 5H3.
CANADA.

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FAX +1 613 996-9791
SPECIFIC OBJECTIVES
To determine the airtightness of houses built using current Canadian regional standard construction practices.
PROJECT DETAILS
Approximately 200 homes in the various regions of Canada were tested for airtightness, neutral pressure location, ventilation systems, fire places, heating systems, indoor air quality, air infiltration and builders' comments on airtightness. The results will be used to determine typical air change rates over a typical heating season.
BUILDING TYPE
Residential - occupied.
PARAMETERS
Airtightness, exhaust systems, fireplaces, heating systems, builders' comments on construction practice
STARTDATE 00:00:1988
ENDATE 00:00:1989 TIME *(Not Stated)*
KEYWORDS
Airtightness, construction practices, air quality, ventilation systems.
SELECTED BIBLIOGRAPHY *(None Stated)*

REF CA13
TITLE
Studies of mould growth potential in heat recovery ventilators.
CONTACT
Riley, Mark
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Ottawa, Ontario. K15 5H3.
CANADA.
TEL +1 613 996-8151 FAX +1 613 996-9791
SPECIFIC OBJECTIVES
To determine the mould growth potential of residential heat recovery ventilators.
PROJECT DETAILS
Under standard laboratory conditions, components taken from four HRV units were studied to determine their potential for mould growth. In addition, swab samples were taken from 74 HRV's installed in houses across Canada. The fungal species found in most HRV units corresponded closely with those commonly found elsewhere in Canadian homes. It was concluded that domestic HRV's are not a source of fungi in indoor air.
BUILDING TYPE
Residential (occupied)
PARAMETERS
Ventilation, system components, maintenance, operation, humidity levels
STARTDATE 00:00:1987
ENDATE 00:00:1989 TIME *(Not Stated)*
KEYWORDS
Mould, heat recovery, residential, dwellings, mycoflora
SELECTED BIBLIOGRAPHY
1 Studies of mould growth in heat recovery ventilators, Energy, Mines and Resources Canada - Technical Report Summary.

REF CA14
TITLE
Wind-induced internal pressures in buildings.
CONTACT
Stathopoulos, T
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Centre for Building Studies,
Concordia University,
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Montreal, H3G 1MB.
CANADA.
TEL +1 514 848-3286 FAX +1 514 848-3198
SPECIFIC OBJECTIVES.
Evaluation of wind-induced internal pressures in buildings for different geometries and permeablities.
PROJECT DETAILS
The project aims at the evaluation of wind-induced internal pressures and the infiltration rates for buildings of different geometries and permeabilities both analytically and experimentally. The experimental work is carried out in the boundary layer wind tunnel of the Centre for Building Studies and will be carried out also in full-scale. The work will target on the deterioration of both mean and fluctuating internal pressures.
BUILDING TYPE
Residential and Industrial
PARAMETERS
Exposure, wind speed and direction, building geometry and permeability.
STARTDATE 00:00:1986
ENDATE 00:00:1992 TIME *(Not Stated)*
KEYWORDS

Internal pressure, wind tunnel, air infiltration, dwelling, industrial

SELECTED BIBLIOGRAPHY

1 Stathopoulos T and Kozutsky (1986), Wind -induced internal pressures in buildings. ASCE J. of Structural Engineering, Feb 1986.

2 Stathopoulos and Luchian H D (1989), Transient wind-induced pressure. ASCE J. Engineering Mechanics. July 1989.

REF CA15

TITLE

Influence of volatile organic compounds and other environmental variables on health status of workers in office buildings.

CONTACT

Broder, I

ADDRESS

University of Toronto,
The GAGE Research Institute,
223 College Street, Toronto, M5T 1R4.
CANADA.
TEL 416-978-5884

SPECIFIC OBJECTIVES

To examine the influence of volatile organic compounds and other environmental variables on the comfort and health of office workers.

PROJECT DETAILS

Indoor air quality (IAQ) and employee comfort and health will be assessed on groups of workers located in the immediate vicinity of either liquid process or dry process photocopiers. The IAQ variables to be measured will include temperature, humidity, carbon monoxide (CO), carbon dioxide (CO_2), particulates, ozone, fungal spores, formaldehyde, volatile organic compounds, air movement and fresh air supply. Employee comfort and health will be assessed using a questionnaire, a symptom diary, nasal epithelial cytology, nasal ciliary activity and a test of mental concentration and short term memory.

BUILDING TYPE

Office buildings

PARAMETERS

(See Project Details)

STARTDATE 01:09:1989
ENDATE 31:08:1991
TIME 7 person-years

KEYWORDS

Volatile organic compounds (VOCs), health, photocopiers, occupants, indoor air quality (IAQ), questionnaire

SELECTED BIBLIOGRAPHY

I Broder, P Corey, P Cole, M Lipo, S Mintz, J R Nethercott. Comparison of health of occupants and characteristics of houses among control homes and homes insulated with urea formaldehyde foam.

1 Methodology. Environmental Research Vol. 45,pp141-155, 1988.

2 Initial health and house variables and exposure-response relationships. Environmental Research Vol 45, pp156-178, 1988. 3 Health and House variables following remedial work. Environmental Research Vol 45, pp179-203, 1988.

REF CA16

TITLE

Environmental and health variables of employees before and after non-smoking programme in office buildings.

CONTACT

Broder, I

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SPECIFIC OBJECTIVES

To examine the influence of environmental tobacco smoke on employee comfort and health, and on IAQ.

PROJECT DETAILS

IAQ and employee comfort and health is being assessed immediately before, and one year following the introduction of a smoking cessation program in 3 modern office buildings. The IAQ variables being measured include temperature, humidity, particulates, CO, CO_2, and volatile organic compounds. Employee comfort and health is being assessed through the use of a questionnaire and a symptom diary maintained over 7 consecutive days while at work and over one weekend. Exposure to tobacco smoke will be determined by measurement of salivary nicotine.

BUILDING TYPE

Office buildings (Commercial)

PARAMETERS
IAQ variables (Temperature, Humidity, Particulates, CO, CO_2, and volatile organics.
STARTDATE 01:03:1989
ENDATE 31:03:1991 TIME 4 person-years
KEYWORDS
Indoor air quality (IAQ), tobacco smoke, health, office
SELECTED BIBLIOGRAPHY
I Broder, et. al. Comparison of health of occupants and characteristics of houses among control homes and homes insulated with Urea Formaldehyde Foam (UFFI).
1 Methodology. Environmental research 45: 141-155,1988.
2 Initial health and house variables and exposure-response relationships. Environmental Research 45: 156-178, 1988.
3 Health and house variables following remedial work. Environmental Research 45: 179-203, 1988.

REF CA17
TITLE
Infiltration measurements and modelling at the alberta home heating research facility.
CONTACT
Wilson, David J
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CANADA.
TEL +1 403-4922200 FAX +1 403-4922200
SPECIFIC OBJECTIVES
To determine the effects of windshelter, leakage distribution, mechanical ventilation, and infiltration.
PROJECT DETAILS
Development of predictive models using continuous measurements of air infiltration in six single zone test-houses using SF6 constant concentration. Automated fan pressurisation/depressurisation to characterise leakage of unoccupied building. Passive vent ducts exhaust and supply fans, window opening using computer controlled actuators. Houses in closely spaced rows on rural exposed site provide large variation in wind shelter. Local meterological towers for wind, temperature and turbulence.
BUILDING TYPE
5 wood frame, 1 brick, single storey (Residences).
PARAMETERS
Wind speed, direction, variability, temperature difference, leakage distribution and vents, shelter, fan ventilation.
STARTDATE 00:00:1980
ENDATE 00:00:1990
TIME 10 to 20 person-years on infiltration
KEYWORDS
Air infiltration, mechanical ventilation, openings, modelling pressurisation, tracer gas
SELECTED BIBLIOGRAPHY
1 Kiel D E & Wilson D J (1989), Combining door swing pumping with density driven flow. ASHRAE Trans. 95 part 2.
2 Wilson D J (1988), Variation of indoor shelter effectiveness caused by air leakage variability of houses in Canada and the USA. U.S. EPA/FEMA Conf. on the effective use of in-place sheltering as a potential option to evacuation during chemical release emergencies". Emmitsburg, Maryland NOV 30-Dec.2, 1988.
3 Kiel D E & Wilson D J (1987), Influence of natural infiltration on total building ventilation dominated by strong fan exhaust. ASHRAE Trans. 93 Part 2.

REF CA18
TITLE
The influence of type of heating systems on in-door environment.
CONTACT
Haghighat Fariborz
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SPECIFIC OBJECTIVES
To study the thermal comfort in a room under different heating systems.
PROJECT DETAILS
The purpose of this research project is to investigate experimentally the relationship between types of heating systems and the thermal environment, and the effects on human comfort. The measurements were carried out in a three storey building. To determine air

temperature distribution in the room, shielded thermocouples are used to measure room air temperature at five levels above the floor, and at nine locations. The mean radiant temperature is measured using a two-sphere radiometer. The velocity of the air at these locations is measured by the automated flow analysis system. The single tracer gas technique is used to measure the air exchange rate. Predicted Mean Vote and Predicted Percentage Dissatisfied were also measured.

BUILDING TYPE

3 storey building

PARAMETERS

Outside and inside temperatures, air velocity, relative humidity.

STARTDATE 00:05:1987

ENDATE 00:05:1991

TIME *(Not Stated)*

KEYWORDS

Thermal comfort, heating systems, indoor climate, tracer gas, air movement

SELECTED BIBLIOGRAPHY

1 Auger M et. al. (1989), Field measurement of thermal behaviour of different heating systems, 12th Canadian Congress of Applied Mechanics, 1989.

2 Haghighat F et. al. (1988), Thermal comfort aspects of different heating systems, Technical Report, Centre for Building Studies. 1988.

REF CA19

TITLE

Development of a model for prediction of air quality in multi-zone buildings.

CONTACT

Haghighat, Fariborz

ADDRESS

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CANADA.
TEL +1 514 848-3192 FAX +1 514 848-3198

SPECIFIC OBJECTIVES

To develop a predictive stochastic model to predict the indoor air aerosols, and chemically reactive pollutant.

PROJECT DETAILS

The work includes computer simulation, as well as field measurement. The study concentrates on modelling of the chemical transformation of aerosols and chemically reactive pollutants. The results of a probabilistic approach of analysing a building's thermal and indoor air quality, have also eliminated any existing doubt about practicality and benefits of pursuing a complex approach of analysis. The detailed steps involved in the study can be listed as: 1) An extensive literature survey on chemical kinetic characteristics of pollutants and their mathematical modelling, 2) The incorporation of kinetic modelling into the existing air quality model, and 3) Field testing.

BUILDING TYPE

A three-storey building

PARAMETERS

Pollutant concentration

STARTDATE 00:05:1989

ENDATE 00:05:1991 TIME *(Not Stated)*

KEYWORDS

Indoor air quality (IAQ), multizone, computer simulation

SELECTED BIBLIOGRAPHY

1 Haghighat F (1988), Air infiltration and indoor air quality models- A Review, The International Journal of Ambient Energy, 1988.

2 Haghighat F et. al. (1989), Field measurement of ventilation effectiveness, 3rd Joint ASCE-ASME Mechanics Conference, 1989.

3 Haghighat F et. al. (1988), A predictive stochastic model for the indoor air quality, Building and Environment, 1988.

4 Haghighat F et. al. (1987), Thermal behaviour of building under random conditions, Applied Mathematical Modelling, 1987.

REF CA20

TITLE

Intra and interzonal heat and mass transfer in buildings.

CONTACT

Haghighat, Fariborz

ADDRESS

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TEL +1 514 848-3192 FAX +1 514 848-3198

SPECIFIC OBJECTIVES

To study the pattern of airflow in a two-zone enclosure and to develop correlations for the airflow rate between zones under natural and forced ventilation.

PROJECT DETAILS

A comprehensive model for the airflow in a two-zone enclosure has been developed using the k-epsilon two equation turbulence model to predict the flows through a large opening between two zones, and to study the effects of the size and the location of the doorway. The results of a study for natural convection and airflow pattern in a partitioned room with turbulent flow indicated that the flow pattern is quite sensitive to the variations of door height and location, while the convective heat transfer rate is only sensible to variation of door height. Further study of the airflow pattern and the contaminant dispersion in ventilated two-zone enclosure showed that the location of the door not only guides the direction of the air movement, but also affects the strength of the air circulation in the downstream zone, while the upstream zone is less affected by the door position. The result from the validation of the model tend to support the trend identified by other workers. Namely the agreement between the computed Nusselt number and that obtained from experimental measurements, is very good.

BUILDING TYPE

Two-zone enclosure.

PARAMETERS

Correlations describing the inter-zone heat and mass convection.

STARTDATE 00:05:1988

ENDATE 00:05:1991 TIME *(Not Stated)*

KEYWORDS

K-epsilon turbulence model, interzonal air movement, ventilation, airflow

SELECTED BIBLIOGRAPHY

1 F Haghighat et. al. (1989), Natural Convection and airflow patterns in a partitioned room with turbulent flow, ASHRAE Trans. Vol.95, Part 2, 1989.

2 F Haghighat et. al. (1990), Three dimensional analysis of airflow patterns and contaminant dispersion in two-zone enclosure, accepted for ASHRAE Winter meeting, 1990.

REF CA21

TITLE

Study of cladding on public buildings.

CONTACT

Quirouette, R L

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CANADA.
TEL +1 613 727-9802 FAX +1 613 727-8165

SPECIFIC OBJECTIVES

(Not Stated)

PROJECT DETAILS

The study of claddings on public buildings is a project involving the investigation, examination, documentation, and analysis of the building envelope performance of various building envelope types (31 buildings) in various geographical locations across Canada. The study focuses on four areas of building envelope concern; structural performance, air and moisture control, rain and melt water penetration and thermal performance. Each of the above areas can be further sub-divided into various sub-categories; corrosion, freeze/thaw action, moisture degradation of materials, loss of heating and/or cooling energy through air leakage and/or poor insulation quality. Study is divided into two parts: The first part deals with a field survey to determine the present condition of all of the buildings involved. The second part involves continuous monitoring of differential air pressures, relative humidities, and temperatures across the building envelope of those buildings in Halifax, Toronto, and Winnepeg over a one year period. This performance data will be related to Canadian environmental weather data.

BUILDING TYPE

Institutional/Government (public) buildings.

PARAMETERS

Performance of building envelope/weather.

STARTDATE 00:05:1989

ENDATE 00:03:1990

TIME 2000 person-hours

KEYWORDS

Public buildings, building envelope, facade, pressure differences

SELECTED BIBLIOGRAPHY *(Not Stated)*

REF CA22

TITLE

Performance of rainscreen walls.

CONTACT

Quirouette, R L

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Morrison Hershfield Ltd.,
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Nepean, Ontario, K2G 1G4.
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TEL +1 613 727-9802 FAX +1 613 727-8165

SPECIFIC OBJECTIVES

(Not Stated)

PROJECT DETAILS

Laboratory study of wood frame rainscreen wall systems under static and dynamic pressure loads and water penetration tests. Six types of residential wall construction were tested in an environmental test chamber, under static and dynamic pressure to obtain the pressure distribution across the walls with varying degrees of airtightnes. The results of these tests are being compared as a design tool for rainscreen walls. Tests are also being conducted on these walls to evaluate the rain water penetration control performance of the walls with varying degrees of airtightnes. The final phase of this study deals with the effect of compartmentalisation on rainscreen wall performance. A half scale test cube designed to have varying airtightness and compartmentalisation, is to be placed in a free air stream with differential air pressures, monitored throughout the wall sections.

BUILDING TYPE

Residential wood frame construction.

PARAMETERS

water penetration control and wind induced air pressure loads on wall components.

STARTDATE 00:11:1988
ENDATE 00:10:1989
TIME 400 person-hours

KEYWORDS

Rainscreen walls, facade, airtightness, pressure distribution, computer simulation

SELECTED BIBLIOGRAPHY *(Not Stated)*

REF CA23

TITLE

Indoor air quality control in office buildings based on CO_2 measurements.

CONTACT

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et en Securite du travail du Quebec,
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TLX 0556 1348

SPECIFIC OBJECTIVES

Evaluate the impact of the use of a CO_2 control System on Indoor Air Quality

PROJECT DETAILS

Following the studies effected by the Institute in office buildings, the inadequacy of fresh air entry has been identified as one of the commonly met causes. This situation is principally due to the actual system of ventilation which admits fresh air in variable quantities according to the external temperatures for reasons of energy economy and not because of occupant density. It is recognised that CO_2 is a good indicator of occupant density and ventilation efficiency. It is therefore proposed to control the admission of fresh air by the measurement of CO_2. The project has as an objective the evaluation of the impact of the utilization of a control system by the CO_2 on the quality of the air. The results will demonstrate the effectiveness of the new system, its effect on the quality of the work environment as well as its impact on the energy balance. This new technology once validated, could be applied in office buildings.

BUILDING TYPE

Office buildings: ventilation system

PARAMETERS

CO_2 Verses Air Changes per Hour, Air Speed, Relative Humidity, Temperature etc.

STARTDATE 00:02:1989
ENDATE 00:06:1990 TIME Cost 97,557

KEYWORDS

Indoor air quality (IAQ), DCV, ventilation strategies, carbon dioxide (CO_2)

SELECTED BIBLIOGRAPHY *(Not Stated)*

REF CA24

TITLE

Indoor air quality in six day nursery in Montreal.

CONTACT

Dionne, Jean-Claude & Soto, Julio

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Department de sante communautaire,
Hopital Saint-Luc,
1058, rue Saint-Denis, Montreal, Quebec.
CANADA.
TEL +1 514 281-4010 FAX +1 514 281-4099

TLX 055-61965

SPECIFIC OBJECTIVES

To identify indoor environment parameters, which when amplified, will facilitate the spreading of infectious disease.

PROJECT DETAILS

A purposive sampling of 6 day nurseries have been selected for the study. Different paramenters (Temperature (^oC); RH (%); CO_2; suspended particulates; Noise; moulds; bacteria) were measured in these natural ventilated buildings. Many other informations were collected (volume; surface; occupation density; methods of cleaning; type of heating system; etc.).

BUILDING TYPE

Day nursery

PARAMETERS

T^oC; RH%; CO_2; suspended particulates; noise; moulds; bacteria

STARTDATE 00:03:1989

ENDATE 00:08:1989 TIME 300 person-hours

KEYWORDS

Indoor air quality (IAQ), mycoflora, day nurseries

SELECTED BIBLIOGRAPHY *(Not Stated)*

REF CA25

TITLE

Integrated heater/ventilator unit (IHVA).

CONTACT

Tremayne, Michael

ADDRESS

Consumers Gas Company Ltd.,
P O Box 650,
Scarborough, Ontario, M1K 5E3.
CANADA.

TEL +1 416 495 5989 FAX +1 416 495 5230

SPECIFIC OBJECTIVES

To determine the performance and reliability of the IHVA under field conditions.

PROJECT DETAILS

The Canadian Gas Research Institute of Toronto, developed a combination furnace/A-A-H-E. This unit uses beds of stone as recuperative heat exchangers. This principle provides for a very high overall efficiency of 86%. The unit burns natural gas and has an output of 40,000 Btu/hr. The ventilation rate is 0.5 ach. By combining the furnace and AAHE, a homeowner can achieve high ventilation levels and very high combustion efficiencies. An equivalent system condensing gas furnace and conventional plate AAHE would have a lower overall system efficiency. Two IHVA units were evaluated in residences in the Toronto area.

BUILDING TYPE

Furnace/Air-Air Heat Exchanger

PARAMETERS

Air flow rates were measured. IAQ measurements were not taken.

STARTDATE 00:11:1987

ENDATE 00:03:1989

TIME 1000 person-hours

KEYWORDS

Ventilation system, combustion, airflow

SELECTED BIBLIOGRAPHY

1 Tremayne M (1989), Final report on the Field Evaluation of the CGRI Integrated Heating/Ventilating Appliance. October 1989, Consumers Gas Co.

REF CA26

TITLE

Flair homes energy demo.

CONTACT

Proskiw, G

ADDRESS

1666 Dublin Avenue,
Winnipeg, Manitoba, R3H 0H1.
CANADA.

TEL + 1 204 633-6363 FAX + 1 204 632.1442

SPECIFIC OBJECTIVES

To document the ventilation and Air Quality characteristics of 24 energy-efficient homes.

PROJECT DETAILS

Measurement of air infiltration, indoor levels of formalydehyde, radon, nitrogen dioxide, CO, CO_2, airborne micro-organisms, temperature and humidity in 20 homes which utilize various building techniques and heating/ventilation systems. Monthly seasonal and annual monitoring.

BUILDING TYPE

Residential

PARAMETERS

Energy consumption, occupant lifestyles, construction techniques, heating/ventilation systems.

STARTDATE 00:00:1985

ENDATE 00:00:1991

TIME *(None Stated)*

KEYWORDS

Residential, dwelling, indoor air quality (IAQ), air leakage, energy consumption

SELECTED BIBLIOGRAPHY

Released:

1 Proskiw G (1988), Incremental costs of energy conservation systems , EMR.

2 Fisher D & Proskiw G (1988), A survey of sound levels in five unoccupied houses. EMR; June, 1988.

3 Proskiw G , Figley D A & Fisher D R (1988), Design, installation and commissioning of the ventilation systems in the Flair Homes Energy Demo/CHBA Flair Mark XIV Project. EMR; June, 1988.

4 Proskiw G (1988), Airtightness performance of twenty detached houses over a two year period. EMR; September, 1988.

5 Proskiw G (1988), Interim Report on indoor air quality monitoring of the Flair Homes Energy Demo/CHBA Flair Mark XIV Project. EMR.

Future: Observed field performance of various building envelope systems

Energy performance of 20 energy efficient houses.

Window Air Leakage

Ventilation System Performance

Airtightness of twenty detached houses over a three year period

Final report on Indoor Air Quality monitoring of the Flair Homes Energy Demo/CHBA Flair Mark XIV Project

All reports are available from Energy, Mines and Resources Canada,

Contact: Program Delivery & Marketing Div, Energy, Mines and Resources Canada, 580 Booth St, Ottawa, Ontario, K1A OE4

REF CA27

TITLE

Investigation of CO_2 concentration as an index of air change rate and air quality in office buildings.

CONTACT

Reardon, J T & Shaw, C Y

ADDRESS

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National Research Council Canada,
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Ottawa, KIA OR6.
CANADA.
TEL +1 613 993 9700 FAX +1 613 953 3733

SPECIFIC OBJECTIVES

To measure CO_2 Concentrations, air change rates, and thermal comfort conditions in several large office buildings to obtain the data required to verify a theoretical relationship between CO_2 Concentration and Air Change rate. To examine the use of CO_2 concentration as a measurable index of indoor air quality. To examine the use of CO_2 concentration as an index for controlling the ventilation rate. To develop a procedure to assess air change rate and indoor air quality in large office buildings based on CO_2 measurements.

PROJECT DETAILS

(See Specific Objectives)

BUILDING TYPE

Office Buildings

PARAMETERS

CO_2, Degree of Thermal Comfort

STARTDATE 01:04:1990

ENDATE 01:10:1991

TIME 5 person-years

KEYWORDS

Indoor air quality (IAQ), ventilation, carbon dioxide (CO_2), measurements, demand control ventilation (DCV), air change rate.

SELECTED BIBLIOGRAPHY

1 Shaw C Y (1988), Indoor Air Quality Assessment in non-industrial buildings. Proc. 5th Canadian Buildings and Construction Congress, Nov 1988, Montreal Quebec, Canada

REF CA28

TITLE

Ventilation effectiveness for typical work stations.

CONTACT

Shaw, C Y & Said, M N

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National Research Council Canada,
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Ottawa, KIA OR6.
CANADA.
TEL +1 613 993 9702 FAX +1 613 953 3733

SPECIFIC OBJECTIVES

To examine the influence of various factors such as locations of supply air registers and return air grilles, and office partitions on the ventilation effectiveness of typical work stations. To develop a procedure for measuring ventilation effectiveness at a work station. It is proposed to

conduct modelling and laboratory experiments on a mock-up work station with various typical ventilation supply and return configurations. Work will be expanded to two work stations.
PROJECT DETAILS
(See Specific Objectives)
BUILDING TYPE
Office Buildings
PARAMETERS
Ventilation Effectiveness, CO_2
STARTDATE 01:04:1990
ENDATE 01:10:1991
TIME 2 person-years
KEYWORDS
Room modelling; ventilation effectiveness, indoor air quality (IAQ), office
SELECTED BIBLIOGRAPHY *(None Stated)*

REF CA29
TITLE
Indoor air quality handbook for plant engineers.
CONTACT
Shaw, C Y
ADDRESS
Insititute for Research in Construction,
National Research Council Canada,
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Ottawa, KIA OR6.
CANADA.
TEL +1 613 993 9702 FAX +1 613 953 3733
SPECIFIC OBJECTIVES
To develop a procedure to assess indoor air quality in office buildings.
PROJECT DETAILS
To develop procedure for: - Assessing the performance of HVAC systems. - Measuring chemicals and biological contaminates. - Recommending remedial measures.
BUILDING TYPE
Office Buildings
PARAMETERS
Carbon dioxide (CO_2), Degree of thermal Comfort, VOC, Particles
STARTDATE 01:04:1990
ENDATE 01:0[illegible]:1991
TIME 6 person-months
KEYWORDS
Indoor air quality (IAQ), ventilation, measurements, handbook, heating system,
SELECTED BIBLIOGRAPHY
1 Shaw C Y (1988), Indoor Air Quality Assessment in non-industrial buildings. Proc. 5th Canadian Buildings and Construction Congress, Nov 1988, Montreal Quebec, Canada
2 Shaw C Y et. al. (1990) Indoor air quality guide for property managers in office buildings. To be presented at the 11th AIVC Confer., Belgirate, Italy, 1990.

REF CA30
TITLE
Testing of indoor radon resolution techniques in central ohio houses.
CONTACT
Scott, A G
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American ATCON/Arthur Scott Associates,
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Mississanga, Ontario, L5L IK2.
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EMAIL compnserve 76266,1115
SPECIFIC OBJECTIVES
Verify performance of sub slab ventilation in basement houses and crawl space ventilation.
PROJECT DETAILS
Experimental systems installed in 20 occupied houses, systems monitored, and modified.
BUILDING TYPE
Crawl space, slab on grade basement
PARAMETERS
Radon, Ventilation and Internal Air Temperatures, Flows in crawl space houses (PFT's).
STARTDATE 00:05:1987
ENDATE 00:05:1990
TIME 6000 person-hours
KEYWORDS
Radon, sub-slab ventilation, basements, dwellings, occupied (residence)
SELECTED BIBLIOGRAPHY
1 Installation and Testing of Indoor Radon Reduction Techniques in 40 Eastern Pennsylvanna Houses. - EPA - 600/8 - 88 - 02 - Jan 1988.
2 Testing of Indoor Radon Reduction techniques in Central Ohio House. Phase 1: (Winter 1987-1988) EPA 600/8-89-071 Phase 2: (Winter 1988-1989) EPA (In Preparation).
3 Follow Up Durability Monitoring in 40 Eastern Pennsylvania Houses. EPA - In Preparation.

DENMARK

REF DK1

TITLE

The airflow from different air terminal devices.

CONTACT

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SPECIFIC OBJECTIVES

To describe the flow from air terminal devices by free jets or wall jets.

PROJECT DETAILS

The flow from different air terminal devices will often take the form of a free jet or a wall jet with the characteristic universal profiles for this type of flow. Experiments are made in a large room, and the coefficient of the jets the turbulence level (Reynold's number dependence) and the penetration depth of the flow are measured: This piece of information is important for the simplified room air distribution models, ref (4) and the description of the jets is useful as boundary values in airflow simulation programs.

BUILDING TYPE

Air terminal devices giving plane, 3-dimensional or radial wall jets.

PARAMETERS

(Not Stated)

STARTDATE 00:00:1985

ENDATE ongoing TIME *(Not Stated)*

KEYWORDS

Air outlets, jets, airflow, turbulence

SELECTED BIBLIOGRAPHY

1 Nielsen P V & Moller A (1985), Measurement of the three-dimensional wall jet from different types of air diffusers. World Congress on Heating, Ventilating and Air-conditioning, Copenhagen, 1985.

2 Nielsen P V & Moller A (1988), Measurement on buoyant jet flows from a ceiling-mounted slot diffuser 3rd Seminar on application of fluid mechanics in environmental protection, Silesian Technical University, 1988.

3 Nielsen P V & Moller A (1987), Measurements on Buoyant Wall Jet Flows in Air-Conditioned Rooms. Room Vent '87, Stockholm, 1987.

4 Nielsen P V (1988), Simplified models for room air distribution. Internal report for IEA Annex 20, University of Aalborg, 1988. ISSN 0902-7513 R8831.

REF DK2

TITLE

Airflow simulation in ventilated rooms.

CONTACT

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DK - 9000 Aalborg.
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SPECIFIC OBJECTIVES.

IEA Annex 20 project in co-operation with a number of countries.

PROJECT DETAILS

IEA Annex 20 Project: Airflow patterns within buildings, Subtask A: Room air and contaminant flow. To carry out a survey of existing programmes, data requirements and test cases. To establish an experimental database on room air and contaminant flow. To make airflow simulation with various programmes. The Contributions of Denmark will especially be full-scale isothermal measurements and numerical study of boundary conditions at supply opening and low-turbulent effect in the room airflow, as well as a general work with airflow simulation programmes.

BUILDING TYPE

(Not Stated)

PARAMETERS

(Not Stated)

STARTDATE 00:00:1988

ENDATE 00:00:1991

TIME 2000 person-hours per year

KEYWORDS

Airflow simulation, numerical method, air distribution, database, contaminant flow

SELECTED BIBLIOGRAPHY

1 Nielsen P V (1988), Simplified models for room air distribution. Internal report for IEA Annex 20, University of Aalborg, 1988, ISSN 0902-7513 R8823.
2 Nielsen P V (1988), Selection of air terminal device. Internal report for IEA Annex 20, University of Aalborg, 1988, ISSN 0902-7513 R8838.
3 Nielsen P V (1988), Numerical prediction of air distribution in rooms- status and potentials. Internal report for IEA Annex 20, University of Aalborg, 1988, ISSN 0902-7513 R8823.
4 Nielsen P V (1989), Representation of boundary conditions at supply openings. Internal report for IEA Annex 20, University of Aalborg, 1989, ISSN 0902-7513 R8902.
5 Nielsen P V (1989), Airflow simulation techniques - progress and trends. 10th AIVC Conference, Espoo, Finland, 1989.

REF DK3
TITLE
Displacement ventilation in rooms.
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SPECIFIC OBJECTIVES.
Measurements on the flow in a room with displacement ventilation.
PROJECT DETAILS
Experiments on the flow in a given room ventilated with different low level mounted and floor mounted diffusers. Experiments on different locations and sizes of the heat load. Measurements of the plume from different types of heat load with different location in the room. Measurements of temperature efficiency and radiant exchange between surfaces in the room.
BUILDING TYPE
Room
PARAMETERS
(Not Stated)
STARTDATE 00:00:1987
ENDATE ongoing TIME *(Not Stated)*
KEYWORDS
Room, displacement ventilation, airflow, air outlet
SELECTED BIBLIOGRAPHY
1 Kofoed P & Nielson P V (1988), Thermal plumes in ventilated rooms - an experimental research work. III Seminar on application of fluid mechanics in environmental protection, Silesian Technical University 1988.
2 Nielsen P V et. al. (1988), Displacement ventilation by different types of diffusers. 9th AIVC Conference, Gent, 1988.
3 Nielsen P V (1988), Displacement ventilation in a room with low-level diffusers. Deutscher Kalte- und Klimatgechnischer Verein, Munich 1988.

REF DK4
TITLE
An algorithm to determine the vertical temperature gradient in heated and ventilated rooms.
CONTACT
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
This project is an experimental examination of the vertical temperature gradient in a laboratory test room. Based on the laboratory measurements a simple model is developed to determine the vertical temperature gradient in a heated room with different kinds of ventilation. The model is assumed to calculate two different air temperatures in the room, the mean temperature in the occupied zone and the mean temperature in the zone above the occupied zone. The model will be implemented in SUNCODE-PC, a thermal analysis program for residential and small commercial buildings. Finally, the improvement of the program is validated, and the simulated results are compared with the laboratory measurements.
BUILDING TYPE
Heavy and light laboratory test room.

PARAMETERS
(Not Stated)
STARTDATE 01:09:1988
ENDATE 31:01:1991 TIME 3500 person-hours
KEYWORDS
Temperature gradient, simulation, dwelling, ventilation
SELECTED BIBLIOGRAPHY
(None Stated)

REF DK5
TITLE
Contaminant distribution in heated and ventilated rooms.
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SPECIFIC OBJECTIVES
To investigate the contaminant distribution in ventilated rooms under different air supply heat load and contaminant source conditions.
PROJECT DETAILS
The investigations are taking place in full-scale test rooms of sizes from 35 m^3 to 250 m^3 with ventilation after both mixing and displacement principle. The contaminant distribution in the room and the ventilation efficiencies are found for several different air terminal devices at supply flow rates varying from 35m^3/h to 1500ms/h under both thermal and isothermal conditions.
BUILDING TYPE
Full-scale test room.
PARAMETERS
(Not Stated)
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)* TIME *(Not Stated)*
KEYWORDSContaminant flow, Ventilation efficiency, Mechanical ventilation, Air outlets, Test room
SELECTED BIBLIOGRAPHY
1 Heiselberg P & Nielsen P V (1987), The contaminant distribution in a ventilated room with different air terminal devices. Room vent '87, Stockholm, Sweden. June 1987.
2 Heiselberg P & Nielsen P V (1988), Flow conditions in a mechanically ventilated room with a convective heat source. Proc. at the 9th AIVC conference on "Effective Ventilation" September 12-15, 1988.

REF DK6
TITLE
Application of perfluorcarbon tracer gas technique for measuring air changes in homes.
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
In order to achieve more knowledge of outdoor air changes in occupied Danish homes, SBI (The Danish Building Research Institute) intends to make measurements in several hundred residential buildings. To do so it is necessary to use a technique which is inexpensive, not time consuming, and yet applicable in almost any house and cause least disturbance to the inhabitants. The Tracer Technology Centre of BNL (Brookhaven National Laboratory) has developed a method which seems to fulfil these demands, using tracer gases of perfluorocarbons in a passive sampling technique. In the pilot study the Indoor Climate Division of SBI will compare this method with other more expensive techniques, making measurements in about 10 different buildings. The objectives of the study are to: 1) gain experience on the variations of the air changes and the internal airflows of occupied homes, 2) to develop procedures for distribution of sources and samplers to the homes, 3) to elaborate instructions to households on how to handle and how to deploy the tubes in the homes, and 4) to gain experience on the practical aspects of the interchanging of equipment and results between BNL and SBI.

BUILDING TYPE
Residential (Occupied)
PARAMETERS
(Not Stated)
STARTDATE 00:05:1986
ENDATE 00:12:1987
TIME 12 person-months
KEYWORDS
Tracer gas, air change rate, perfluorocarbons (PFT), airflow
SELECTED BIBLIOGRAPHY *(None Stated)*

REF DK7
TITLE
Natural ventilation with heat recovery.
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SPECIFIC OBJECTIVES
(Not Stated)
BUILDING TYPE
In buildings with very airtight envelopes, balanced ventilation in mechanical systems with heat recovery (plate type heat exchangers or heat pumps) is very energy efficient and thus preferable. In less airtight buildings balanced ventilation may not be optimal, or mechanical systems may not be wanted for some reasons. So far, the only alternative has been natural ventilation (with or without "help" from fans) without any heat recovery - and extremely dependent on the weather conditions. It is the aim of this project to utilize the stack effect in exhaust air systems (without fans) combined with a certain heat recovery (expected efficiency 20-40%) and fresh air intake that do not cause draft sensation for the occupants. The systems will be examined in the low-energy experimental house at the laboratory.
BUILDING TYPE
Test house (Low Energy)
PARAMETERS
(Not Stated)
STARTDATE 00:02:1989
ENDATE 00:09:1990 TIME *(Not Stated)*
KEYWORDS
Airtightness, natural ventilation, test house, heat recovery, mechanical ventilation, stack effect, low energy
SELECTED BIBLIOGRAPHY *(None Stated)*

REF DK8
TITLE
Determination of OLF values for materials in buildings.
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
The ventilation requirements in buildings are determined by the pollution sources indoors. By using the new unit "olf" the strength of the pollution sources can be quantified. The purpose of the present research project is to measure olf-values for materials used indoors. Architects and building constructors can then use the obtained results and select low-olf materials which will reduce the ventilation requirements, and the energy consumption.
BUILDING TYPE
(Not Stated)
PARAMETERS
Olf
STARTDATE 00:06:1988
ENDATE 00:12:1988 TIME *(Not Stated)*
KEYWORDS
Odour, energy consumption, pollution sources, building materials
SELECTED BIBLIOGRAPHY
1 Fanger P O et. al. (1988), Air pollution sources in offices and assembly halls, quantified by the olf unit. Energy and Buildings, 12 (1988), pp 7-19.
2 Pejtersen J et. al. (1989), Air pollution sources in ventilation systems. Presented at CLIMA 2000, Sarajevo, August 1989.

REF DK9
TITLE
Pilot study of ventilation requirements under transient conditions.

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Fanger, P O
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
Body odour is a major pollutant in many spaces in practice. Whereas other indoor pollutants can often be regulated by use of source control, ventilation is necessary to keep body odour at an acceptable level. Previous studies have identified the ventilation required to satisfy the majority of persons entering an occupied room after being in fresh air for some time. Due to adaptation to body odour, the ventilation required to satisfy the occupants in the same room is much lower. The aim of this pilot study is to investigate the transient conditions often found in practice where people move from one room to another with different odour intensity. The study will be performed in two newly constructed environmental chambers at the Laboratory of Heating and Air Condition. The results of this study will give directions for developing a transient model for ventilation requirements.
BUILDING TYPE
Environmental chambers
PARAMETERS
Body odour
STARTDATE 00:05:1986
ENDATE 00:12:1986
TIME 12 person-months
KEYWORDS
Body odour, pollution sources, test chamber, model
SELECTED BIBLIOGRAPHY *(None Stated)*

REF DK10
TITLE
Demand controlled ventilation, a study of the scientific foundation.
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SPECIFIC OBJECTIVES
(See Project Details)
PROJECT DETAILS
In many buildings, ventilation operates independent of the load from occupancy and activities. From an energy conservation point of view it would be preferable to ventilate these buildings according to their actual need at any given time. In order to use demand-controlled ventilation, it is important to identify pollutants which may serve as indicators of the indoor air-quality. The purpose of this present study is to find suitable indicators that will provide a better characterisation of the air-quality than presently used indicators (e.g. carbon dioxide).
BUILDING TYPE
Occupied
PARAMETERS
Indicators for demand controlled ventilation systems
STARTDATE 00:06:1987
ENDATE 00:12:1989
TIME 12 person-months
KEYWORDS
Demand contolled ventilation (DCV), energy consumption, indoor air quality (IAQ)
SELECTED BIBLIOGRAPHY *(None Stated)*

REF DK11
TITLE
Investigation and development of methods to control the level of radon daughters in indoor air.
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
The objectives of this project, are to study especially those characteristics of airborne radon daughters which have a direct or indirect influence on the radiological effectiveness of

remedial aircleaning techniques, such as filtration and electrostatic deposition. In rooms (laboratory and office rooms) with elevated radon levels a series of particle-removing aircleaning methods are being employed. These methods include the use of mechanical and electro filters, electric field deposition, both with non-ionizing electrodes and with simultaneous ion-production and resulting space charge modifications of the fields. The effects of the methods are evaluated by measurements of radon concentration, concentrations and unattached fractions of individual radon daughters, aerosol concentration and other air-characterizing parameters. Preliminary results indicate that it is possible to lower the potential alpha energy concentration by a factor of 5-10 and the radiological dose with 50% by use of filtration systems as well as ionization devices.
BUILDING TYPE
Laboratories, Office blocks
PARAMETERS
Radon, Mechanical Ventilation System, Aerosols
STARTDATE 00:07:1985
ENDATE 00:12:1989
TIME 24 person-months
KEYWORDS
Radon daughters, air cleaning devices
SELECTED BIBLIOGRAPHY *(None Stated)*

FINLAND

REF SF1
TITLE
Heating systems and indoor air.
CONTACT
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SPECIFIC OBJECTIVES
To study organics and particles in indoor air with relation to heating systems.
PROJECT DETAILS
(None Stated)
BUILDING TYPE
Single family houses, offices
PARAMETERS
(None Stated)
STARTDATE 00:00:1989
ENDATE *(Not Stated)* TIME *(Not Stated)*
KEYWORDS
Heating systems, organics, particles, indoor air quality (IAQ), dwelling
SELECTED BIBLIOGRAPHY *(None Stated)*

REF SF2
TITLE
EBES- Residential building.
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TLX 122972 vttha sf
SPECIFIC OBJECTIVES
The aim is to study whether or not it is posssible to achieve a better indoor climate with low building and maintenance costs, by integrating the building elements and heating and ventilation systems developed in the EBES - project.
PROJECT DETAILS
The operation of the systems selected and of the heating and ventilating equipment are simulated, theoretically and experimentally before the construction phase. The functionality of the contract limits, the success of the installations, the work methods and costs are studied during construction. The functionality of the systems, the indoor climate, the energy consumption, and the function of the building elements as an energy store, are followed in the finished building.
BUILDING TYPE
Residential building
PARAMETERS
Mechanical sound attenuation ventilation system with heat recovery, cold climate
STARTDATE 01:03:1988

ENDATE 31:03:1992
TIME 4000 person-hours
KEYWORDS
Residential, dwelling, heating system, ventilation system, indoor climate, energy consumption, simulation, noise, duct
SELECTED BIBLIOGRAPHY
1 Kohonen P et. al. (1988), EBES-integroitu LVIS - ja rakennejarjestelma (EBES-Integrated HEAVC, piping, electrical and building system), Technical Research Centre of Finland, Reasearch reports 537. Espoo, June 1988.
2 Laine J (1988) Control of Indoor Climate by an integrated HVAC and building system. 13th Cong., Helsinki, June 6-10, 1988. Post-cong. Report. Internal Association for Bridge and Structural Engineering IABSE. Jyvaskyla 1989.

REF SF3
TITLE
Spatiotemporally controlled air distribution system.
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SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
The aim is to develop design principles for a demand controlled air duct system. Special consideration is given to the flow and noise technique of airflows, pre-adjustment and the stability of the airflows and the performance values of the system's basic devices. The functional capacity and the design principles of a spatiotemporally controlled ventilation system are solved with advanced simulation programs, capable of an overall examination of the air ducts. The correctness of the calculation results is studied experimentally and the bases and examination methodology of the pre-adjustability of the airflows are clarified.
BUILDING TYPE
Air ductwork, airflow controllers
PARAMETERS
Airflows, sound levels, pressures, tightness, thermal forces, duct noise "breakout", pre-adjustablity
STARTDATE 01:04:1987
ENDATE 30:10:1989
TIME 2700 person-hours
KEYWORDS
Duct, noise, demand controlled ventilation (DCV), airflow, simulation airtightness
SELECTED BIBLIOGRAPHY
1 Laine J (1989), Ilmakanavistion kokonaisvaltainen mitoitus- ja suunnittelumenetema (Overall method of Air Ductwork). INSKO 3-89 VII. 10-12:01:1989.
2 Laine J (1988), Itsestaan saatyva ilmakanavisto - toteutuu! (Pre-adjusted air ductwork - realized!) LVI-lehti 40(1988)11.
3 Laine J (1989), Ilmakanaviston tiiviydella kayttokustannussaastoja ja aanihaitat hallintaan (Operation Cost Savings and Noise Reduction by the Tightness of ductwork). LVI-lehti 41(1989)6-7.
4 Laine J (1989), Demand controlled Air Ductwork. 10th AIVC Confer. 15-28 Sept. 1989, Espoo, Finland.

REF SF4
TITLE
A ventilation concept for future dwelling-houses.
CONTACT
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SPECIFIC OBJECTIVES
To develop ventilation systems for residences.
PROJECT DETAILS
Ventilation systems, suitable for residential buildings in the future, will be analysed in the study. The systems considered should realize the new target levels of indoor air climate while meeting the real ventilation needs of the people. The effect of other disturbances, (such as changes in weather conditions), on ventilation rates and pressure levels in buildings should be eliminated. In addition, the energy economy of different systems will be considered. The

analyses of different systems will be carried out with computer simulations. The target values for ventilation system components as well as the suitabilty of the present components and the need for product development will be defined. Demand for the internal and external air-tightness of buildings will be presented, and the operation as well as the maintenance costs of different systems will be evaluated.
BUILDING TYPE
Residences
PARAMETERS
CO_2-level
STARTDATE 01:04:1987
ENDATE 31:12:1990
TIME 7000 person-hours
KEYWORDS
Residential, dwelling, demand controlled ventilation (DCV), energy consumption, occupants, simulation
SELECTED BIBLIOGRAPHY
1 Luoma M & Kohonen R (1989), A ventilation Concept for future Dwelling Houses. 9th AIVC Confer. Effective Ventilation Proc. 1989.
2 Final report will be published at the end of 1990 (in Finnish).

REF SF5
TITLE
The influence of thermal indoor climate on working efficiency in an office building.
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SPECIFIC OBJECTIVES
To study with a computer model, how thermal indoor climate influences working efficiency.
PROJECT DETAILS
The thermal indoor climate and its influence on working efficiency in an office building was compared for three ventilation systems: constant airflow, variable airflow and mechanical cooling. The energy analysis model used was a Finnish heat balance model, which gives hourly the indoor air and surface temperatures. The relationship between working efficiency and indoor temperature was estimated using two literature sources, which are based on laboratory measurements. The results show, that the pay-back time for cooling even in Finnish climate will be only about 1 year, when the increase of working efficiency is accounted.
BUILDING TYPE
Office building
PARAMETERS
Indoor air and surface temperatures
STARTDATE 01:09:1987
ENDATE 31:05:1989
TIME 1000 person-hours
KEYWORDS
Thermal comfort, ventilation systems, computer simulation, indoor air quality (IAQ)
SELECTED BIBLIOGRAPHY
1 Haapala T (1989), The simulation of thermal comfort in an office building. Tampere University of Technology. Thermal Eng.Div. Report 65. Tampere 1989, 84p (in Finnish).

REF SF6
TITLE
Coupling of an infiltration and ventilation model to a heat balance model of buildings.
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SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
To a heat balance model of buildings an infiltration and ventilation model will be coupled. The infiltration is calculated for given cracks from the pressure and flow balances. The calculation of ventilation system is based on the properties of vents, ducts, blowers etc.
BUILDING TYPE
All
PARAMETERS
outdoor and indoor temperatures, wind speed and direction
STARTDATE 01:01:1989

ENDATE 31:12:1989
TIME 1000 person-hours
KEYWORDS
Thermal simulation, commercial, industrial, dwelling, infiltration, ventilation system, Ducts
SELECTED BIBLIOGRAPHY *(None Stated)*

REF SF7
TITLE
Calculation of contaminant transport in dwellings.
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SPECIFIC OBJECTIVES
To develop a method for calculating the transport of contaminants in dwellings.
PROJECT DETAILS
A simple method to calculate the airflows between adjacent rooms has been modified and validated using tracer gas experiments in a test house. This calculation method has been combined with the multi-zone method to calculate contaminant transport between adjacent rooms. The whole method has been realised in a computer code MULTIC. The MULTIC code has been validated using tracer gas measurements.
BUILDING TYPE
Residences
PARAMETERS
Room air temperatures, infiltration airflows, concentration histories of contaminants.
STARTDATE 05:05:1986
ENDATE 31:12:1987
TIME 3000 person-hours
KEYWORDS
Contaminants, computer simulation, residencies, dwellings, tracer gas, multizone, indoor air quality (IAQ)
SELECTED BIBLIOGRAPHY
1 Siren K (1986), A computer program to calculate the concentration histories and some air quality related quantities in a multi-chamber system. Helsinki University of Technology, Institute of Energy Engineering Rep. No.18, 1986.
2 Siren K (1988), A procedure for calculating concentration histories in dwellings. Building environment, Vol 23, No.2, pp.103-114, 1988.

REF SF8
TITLE
Technical and health effects of recirculated air.
CONTACT
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SPECIFIC OBJECTIVES
To collect data to choose the right proportion of recirculated air, in various situations.
PROJECT DETAILS
The research was executed by making field measurements in two similar office buildings in southern Finland. The technical effects of using various outdoor air ratios were studied by measurements. The health effects were measured by a questionnaire on health, symptoms and perception of indoor air.
BUILDING TYPE
Commercial (Office Building)
PARAMETERS
Outdoor air ratio, energy consumption, temperature, humidity and airflow of the rooms.
STARTDATE 01:05:1987
ENDATE *(Not Stated)*
TIME 10000 person-hours
KEYWORDS
Commercial, recirculation, health, questionnaire, office, energy consumption, sick building syndrome (SBS)
SELECTED BIBLIOGRAPHY
Paper to Indoor Air 1990 (Toronto) Summary report of the results in national publication series (in Finnish)

REF SF9
TITLE
The measurement of air exchange rate and internal airflows in buildings.
CONTACT
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SPECIFIC OBJECTIVES
The aim of the project is to collect information about the ventilation of Finnish buildings.
PROJECT DETAILS
The project is a sequel to a project, during which a CO_2 and indicator-tube field measurement method was developed. This ongoing research developed the use of the passive perfluorocarbon technique in field measurements of ventilation. The PFT-technique is similar to the BNL/AIMS technique. This study involves the building and testing of the accuracy of the method and the mixing of tracers within zones. Theoretical study on multizone models and long-term ventilation efficiency is also included. Field measurements are made in 350 residences in order to test the method and gain information on ventilation in these homes.
BUILDING TYPE
Residences, flats.
PARAMETERS
(None Stated)
STARTDATE 00:01:1987
ENDATE 00:09:1989
TIME 4.5 person-years
KEYWORDS
Measurement, tracer gas, perfluorocarbons (PFT), dwellings, multizone, ventilation efficiency
SELECTED BIBLIOGRAPHY
1 Sateri J, et. al. (1987), A method for field measurements of ventilation rates with CO_2-indicator tubes. In proceedings of the ROOMVENT-87. Stockholm, Sweden, 1987.
2 Sateri J,& Majanen A (1989), The evaluation of field measurements of ventilation parameters made using the passive perfluorocarbon method. In proceedings of the CLIMA 2000. Sarajevo, Yugoslavia, 1989 (unpublished)
3 Sateri J, et. al. (1989), The performance of the passive perfluorocarbon method. In proceedings of the 10th AIVC Conference, Espoo, Finland, 1989 (unpublished)
4 Sateri J (1989), Ilmanvaihtuvuuden intergroivan kenttamittausmenetelman kehittaminen. TKK, LVI- laboratorio, Espoo, Finland, 1989 (unpublished).

REF SF10
TITLE
The performance of ventilation in residential buildings.
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SPECIFIC OBJECTIVES
The aim of the project is to study the effect of the ventilation on health and comfort in Finnish Residences.
PROJECT DETAILS
Over 300 residential buildings have been selected for the study in which information on the performance of ventilation systems has been collected. Both detached or semi-detached houses and blocks of flats are included in the study. The studied ventilation systems are natural ventilation, mechanical exhaust and balanced ventilation. The measurements have covered the ventilation rates of the whole apartment and the bedroom and indoor climate. A questionnaire on health, comfort and satisfaction has been carried out with the measurements. The results of the measurements and the questionnaire are analysed to find out the correlations between; both the ventilation rate and various ventilation systems; and the symptoms and the satisfaction of the people living in the residences.
BUILDING TYPE
Residences, (flats, apartments, houses)
PARAMETERS
Health, comfort, satisfaction.
STARTDATE 00:03:1986
ENDATE 00:12:1989
TIME 10 person-years
KEYWORDS
Ventilation, indoor climate, health, comfort, dwellings, indoor air quality (IAQ)
SELECTED BIBLIOGRAPHY

1 Ruotsalainen R, & Majenen A (1987), The performance of ventilation in some experimental residential buildings (in Finnish). Univ. of Tech., HVAC-lab. Espoo 1987.
2 Ronnberg R et. al. (1989), The performance of ventilation in residential buildings and its effects on indoor climate, health and comfort (in Finnish) Univ. of Tech., HVAC-lab. Espoo 1989.
3 Ruotsalainen R et. al. (1989), The performance of ventilation in residential buildings. In proceedings of the Clima 2000. Sarajevo 1989 (unpublished).
4 Ruotsalainen R et. al. (1989),: The performance of residential ventilation systems. In proceedings of the 10th AIVC Conference. Espoo 1989 (unpublished).

REF SF11
TITLE
Air flow patterns within buildings. (Finnish participation in IEA Annex 20)
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SPECIFIC OBJECTIVES
To evaluate the performance of room air and contaminant flow simulation techniques.
PROJECT DETAILS
The project is Finnish participation in an international research project "IEA Annex 20, Air Flow Patterns within Buildings, subtask 1 - Room air and contaminant flow". The work has been divided into research items for each 11 participating countries. The final report will be based on reports of individual research items. The results can be used in ventilation design to ensure that fresh air supply and pollutant removal requirements are effectively obtained without undue use of energy resources.
BUILDING TYPE
Office room
PARAMETERS
Air flow rates, cooling/heating
STARTDATE 01:05:1988
ENDATE 30:12:1991
TIME 5000 person-hours
KEYWORDS
Room, airflow, simulation, turbulent flow, contaminant flow, office, commercial, pollution sources
SELECTED BIBLIOGRAPHY *(None Stated)*

FEDERAL REPUBLIC OF GERMANY

REF D1
TITLE
Hotwires for indoor measurement of very low air velocities.
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SPECIFIC OBJECTIVES.
Improvement of hotwires for air velocities m/s towards natural convection and temperature compensation, and their calibration.
PROJECT DETAILS
To analyse heat transfer from a hot wire probe to the air by forced and natural convection, taking into consideration the influence of changing properties such as, density, thermal conductivity and viscosity. To deduce an algorithm based upon the equation of heat transfer to calculate the air velocity at the probe as a function of probe heat loss, temperature-difference between probe and air, air temperature and air pressure. To optimise probe dimensions and temperature difference for the measurement of flow under conditions of natural convection.
BUILDING TYPE
(Not Stated)
PARAMETERS
(Not Stated)
STARTDATE 00:01:1988

ENDATE 00:12:1990
TIME 36 person-months
KEYWORDS
Low air velocity, Anemometer, Airflow, Heat transfer, Convection
SELECTED BIBLIOGRAPHY *(None Stated)*

REF D2
TITLE
PCB - decontamination.
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SPECIFIC OBJECTIVES.
PCB-Decontamination of indoor air and office equipment.
PROJECT DETAILS
PCB leaking out of damaged capacitors of lamp-fittings in light appliances and vaporates in the indoor air or precipitates office equipment by penetrating in their surfaces. The research purpose is: - to find out the noxious limit of indoor air by PCB-contamination for general places to work in office buildings, - to find out the necessities of decontamination at the office equipment to prevent PCB-contamination to human skin.
BUILDING TYPE
Office building
PARAMETERS
PCB-contamination in indoor air,
PCB-contamination in the surface of office equipment.
STARTDATE 00:03:1989
ENDATE 00:12:1990
TIME *(Not Stated)*
KEYWORDS
PCB, indoor air quality (IAQ), offices
SELECTED BIBLIOGRAPHY
1 Pforzheim S (1989), AMEV- Exchange of experience, AMEV-Protokoll 1989.1. 025. Bundesministerium fur Raumordnung, Bauwesen und Stadtebau. Ref B I 3.D-5300 Bonn 2.

REF D3
TITLE
Methods for calculating heat loss in supply air ducts of air heating systems.
CONTACT
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SPECIFIC OBJECTIVES
Development of mathematical systems working on personal computers.
PROJECT DETAILS
Heat-loss in floor-integrated air supply systems is very much influenced by two-dimensional heat conduction in the floor. Analytical and numerical methods to quote stationary heat loss for ducts as well as for other air leading systems in the floor construction have been derived. Different boundary conditions and construction types can be considered. This project refers to another project carried out in a cooperation of eht-Siegmund-GmbH and the University of Essen.
BUILDING TYPE
(Not Stated)
PARAMETERS
Development of design documents
STARTDATE 00:00:1988
ENDATE 00:00:1990
TIME 5000 person-hours
KEYWORDS
Heating systems, heat conduction, mathematical simulation
SELECTED BIBLIOGRAPHY *(None Stated)*

REF D4
TITLE
Experimental research of axisymmetric and plane isothermal free jets.
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SPECIFIC OBJECTIVES

Simplification of jet laws for axisymmetric and plane isothermal free jets and their application to design air outlets.

PROJECT DETAILS

The ventilation of rooms by free jets requires a sufficient air mixing as well as a guarantee of thermal comfort for people living or working there. Some realized air outlets consist of nozzles or slots arranged at various distances. This has an influence depending on the initial velocity on jet behaviour, especially on the velocity profiles and the penetration depth. In the present study the effect of the initial velocity of the original on free jets is investigated for various outlet geometries. In three testing plants measurements of centerline velocity and velocity profiles are taken for various nozzles, slots and also for realized air outlets. The decrease of centerline velocity is affected by the initial velocity and also by the outlet geometry that is characterised by the pressure drop in the outlet. These relations are considered in the Euler number that is integrated in the jet equations. So far it is possible to predict the jet behaviour for similar outlet geometries by measurement of the pressure drop and the velocities.

BUILDING TYPE

(Not Stated)

PARAMETERS

Development and design of documents.
STARTDATE 01:01:1988
ENDATE 01:01:1991
TIME 10 000 person-hours

KEYWORDS

Jets, air outlets, airflow, air velocity

SELECTED BIBLIOGRAPHY

1 Dezter R (1972), Beitrag uber das Verhalten runder Luftfreistrahlen Diss. Universitat Stuttgart.
2 Graff B & Hofmann R (1975), Ligenschaften von turbulenten, runden, dichtbenachbarten Freistrahlen in reihenformiger Anordnung. Klima-Kaltetechnik, Nr. 12/1975.
3 Hanel B & Richter E (1979) Das verhalten von Freistrahlen in verschiedenen Reynolds-Zahlbereich Luft- und Kaltetechnik, Nr.1.
4 Huesmann K (1966), Eigenschaften turbulenter Strahlenbundel, Chemie-Ing - Techn. Nr.3.1966.
5 Namer J & Otugen M V (1988), Velocity measurement in a plane turbulent air jet at moderate Reynold's numbers. Exper. in fluids, Nr. 6 1988.
6 Th. Sefker, (1989), Verallgemeinerte Darstellung des Verhaltens isothermer Freistrahlen Th. Sefker, Diss. Universitat Essen, 1989.

REF D5

TITLE

Demand controlled ventilating systems. (IEA-Annex 18, German contribution)

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SPECIFIC OBJECTIVES

Energy savings with specific control strategy with simultaneous improvement of indoor air quality (IAQ).

PROJECT DETAILS

Evaluation of leading contaminants to control ventilation airflows with respect to occupancy load and tobacco smoke. Evaluation of ventilation strategy to avoid moisture problems in dwellings. Review the State-of-Art sensor market. Set up of sensor test program to check qualification of sensors. Performance test of decentralized and centralized commercial ventilation devices in test houses. Basic experiments concerning distribution of contaminants in rooms. Development of simulation code to calculate energy consumption, verification in field tests.

BUILDING TYPE

Dwellings, apartments.

PARAMETERS

Weather performance sensors, behaviour of occupants (real & simulated) expiration of CO_2, vapour production, tobacco smoke.

STARTDATE 00:11:1987
ENDATE 00:12:1990
TIME 15 000 person-hours
KEYWORDS
Contaminant, demand controlled ventilation (DCV), sensor, strategy
SELECTED BIBLIOGRAPHY
1 Raatschen W & Trepte L (1987), Ventilation requirements and demand controlled ventilation. Proceedings of the 8th AIVC Conference Uberlingen (FRG), September 1987.
2 Raatschen W (1988), Was ist Luftungseffektivitat? Klima kalte Heizung, Heft 5/6/7-08:1988, in german.
3 Raatschen W (1988), Market analysis of sensors for the use in demand controlled ventilating systems. Proc. 9 AIVC Conference Vol.1, Gent (B), Sept. 1988.

REF D6
TITLE
Operation of ventilation systems in the case of polluted outdoor air situations.
CONTACT
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SPECIFIC OBJECTIVES.
Development of guidelines for the design and operation of ventilation systems in the case of smog etc.
PROJECT DETAILS
Estimation and modelling of indoor/outdoor relations of pollutants for the following cases: smog, radioactive emissions and others. Development of recommendations and measures to avoid annoyance or adverse health effects in such cases. Summarising lack of knowledge and proposal of further research and development activities. Development of guidelines (VDI-Richtlinie) in 4 parts (Blatter): part 1 Fundamentals, part 2 Smog situations, part 3 Radioactive Emissions, part 4 Other emissions (e.g. chemicals)
BUILDING TYPE
Hospitals, office buildings.
PARAMETERS
Wind, performance of buildings (tightness etc.), source of pollutants.
STARTDATE 00:07:1987
ENDATE Parts 1-3 00:12:1989
Part 4 00:12:1990
TIME 3000 person-hours
KEYWORDS
Indoor air quality, pollution sources, ventilation, standards, guidelines
SELECTED BIBLIOGRAPHY
1 Trepte L (1987), Operation of ventilation plants in the case of polluted outdoor air situations. Draft version of the guideline VDI 3816 completed, procedure of introduction started, implementation of parts 1-3 est start Dec. 1990. Betrieb von RLT-Anlagen bei belastenden Aussenluft- situationen, DKV-Tagungsbereicht, 14. Jg.(1987), Koln, pp 501-511

REF D7
TITLE
Advanced ventilation systems for dwellings - laboratory tests for thermal comfort and air quality
CONTACT
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SPECIFIC OBJECTIVES
Test of ten different systems with respect to: distribution of air velocity, air temperature, tobacco smoke.
PROJECT DETAILS
Mechanical ventilation systems, partly with heat recovery. Indoor air quality (IAQ) - measurements by implementation of tobacco smoke and measuring the decay of 1 micron size particles.
BUILDING TYPE
The laboratory.
PARAMETERS
Different systems, leak recovery.
STARTDATE 01:01:1988
ENDATE 31:12:1989
TIME 2000 person-hours.

KEYWORDS
Mechanical ventilation systems, tobacco smoke, residences, dwellings, thermal comfort, indoor air quality (IAQ), heat recovery
SELECTED BIBLIOGRAPHY *(None Stated)*

REF D8
TITLE
Development of methods for the measurement of the air change rate in rooms and buildings
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
Construction of a mobile measurement system for tracer gas measurements Measurement methods: - initial injection (decay method) - constant injection tracer gas: N_2O or SF6 gas analyzer principle: infrared absorption Eight independent channels can be used to - sample simultaneously at various locations in a single room or building - subsequent measurements in different rooms of a building without change of measurement setup.
BUILDING TYPE
(Not Stated)
PARAMETERS
Temperature and pressure differences between single rooms and the outside, wind speed and direction
STARTDATE 02:02:1988
ENDATE onging
TIME 4000 person-hours per year
KEYWORDS
Tracer gas, air change rate, pressurisation
SELECTED BIBLIOGRAPHY
1 Heidt F D & Werner H (1986), Microcomputer Aided Measurement of Air Change Rates. Energy and Buildings, Vol.9, No. 4, 1986,pp 313-320.
2 Heidt F D & Werner H (1987), Advantages of Microcomputer Support for Air Change Measurements. In: Air Infiltration Centre (Hrsg.): Proceedings of the 8th AIVC Conference, Sept. 21-24, 1987, Uberlingen, F.R.G., 1987, S 17.1-17.11
3 Heidt F D (1987), Zur Messung des Luftwechsels mit Spurengasmethoden Bauphysik, Bd.9, Nr. 6, 1987, Verlag Ernst und Sohn, Berlin, pp.272-278
4 Heidt F D & Rabenstein R (1988), MULTI-CAT Dokumentation, report Univ. of Siegen, FRG, Nov. 1988.

REF D9
TITLE
Investigation concerning indoor pollutants.
CONTACT
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SPECIFIC OBJECTIVES
Screening of emissions from selected building materials with different methods.
PROJECT DETAILS
The crucial points of investigation up to now, were the following building materials: 1) Acid hardened lacquers for furniture 2) Foamed polymers (PUR, PS) 3) Cork plates 4) Wall coverings. The emissions are characterized by different methods, including: a) static Headspace Gas Chromatography b) dynamic Headspace-Gas Chromatography c) Gas Analysis Method d) 1m3-Chambers e) 40m3-Chamber for particular cases As far as possible the time dependence of the chamber concentrations is established
BUILDING TYPE
Residential and office buildings
PARAMETERS
Emission rates of building material
STARTDATE 01:03:1985
ENDATE 30:06:1990
TIME 12250 person-Hours
KEYWORDS
Indoor pollutants, building materials, pollution sources, measurement
SELECTED BIBLIOGRAPHY

1 Marutzky R (1987), Formaldehyde Injuries in Prefabricated Houses: Causes, Prevention and Reduction. Proceedings of the 4th International Conference on Indoor Air Quality and Climate, Berlin, Vol.2 (1987) S.690-694
2 Marutzky R et. al. (1987), Zur Messung der Formaldehydabgabe von Holzwerkstoffen, Baustoffen und Mobeln mittels einer 1 m3-Kammer-Methode. Holz als Roh - und-Werkstoff 45 (1987) S 339-343.
3 Marutzky R et. al. (1988), Untersuchungen zur Formaldehydabgabe von Fertigparkett und Parkettsiegeln. Holz-und Kundstsoffverarbeitung - HK International 23 (1988), S 86-87.
4 Marutzky R (1987), Zur Herstellung von Mobeln ohne oder mit geringer Formaldehydabgabe. Merkblatt in deutscher, englischer und franzosischer Sprache. WKI-Eigenverlag, Braunschweig 1987.
5 Flentge A et. al. (1989), Vergleichende Messungen der Formaldehydkonzentration in Raumluft mittels konventioneller und einfacher Prufmethoden. Gesundheits-Ingenieur 110 (1989) S.201-205.

REF D10

TITLE

Influence of air velocity in large chamber test upon formaldehyde release of particleboards.

CONTACT

Marutzky, R

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SPECIFIC OBJECTIVES

Air Velocity - Chamber Test - Formaldehyde Release - Particleboards

PROJECT DETAILS

The formaldehyde release of particleboards and other wood based materials is determined in large chambers. Large chamber tests require definite temperature, relative humidity and other test conditions. A precondition for chamber tests is a high air velocity (0.1 m/s). In the project the influence of the air velocity upon the formaldehyde release of particleboards is determined. Depending on thickness, structure and density of the board up to 40 percent of the formaldehyde release in chamber tests is due to the influence of the air velocity.

BUILDING TYPE

(Not Stated)

PARAMETERS

Formaldehyde

STARTDATE 01:01:1988
ENDATE 31:12:1989
TIME 400 person-hours

KEYWORDS

Air velocity, test chamber, formaldehyde, particleboards

SELECTED BIBLIOGRAPHY

Publications in preparation

REF D11

TITLE

Analysis by measurements of the administrative tegut - building extended by means of green-solar-architecture.

CONTACT

Hauser, Gerd

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SPECIFIC OBJECTIVES

Measurements of heating energy consumption, temperature, relative humidity, oxygen and carbon dioxide concentrations daylighting.

PROJECT DETAILS

Measurements carried out at an administration building expanded according to the principles of the Green-Solar-Architecture and characterised by two stacked office pavilions almost entirely surrounded by a double glazed winter garden was object of measurements in the period from September 1986 until May 1988. The measurements concerned the heating energy consumption, the temperature and moisture balance, the oxygen and carbon dioxide concentrations of the inside air as well as the daylighting.

BUILDING TYPE

Administration building (Office Block)

PARAMETERS

Carbon dioxide concentration, relative humidity and temperature of the air, Green house, weather data of Fulda, real behaviour of occupants.
STARTDATE 00:09:1986
ENDATE 00:05:1988
TIME *(Not Stated)*
KEYWORDS
Passive solar, hygric behaviour, energy consumption, temperature distribution
SELECTED BIBLIOGRAPHY
1 Hauser G (1989), Beeinflussung der O_2 - und CO_2 - Konzentrationen durch die Grune Solar-Architektur. HLH 40 (1989) H.1, S. 7-12.
2 Hauser G (1989), Messtechnische Untersuchung eines nach den Prinzipien der Grunen Solar-Architektur erweiterten Verwaltungsgebaudes. Bauphysik 11 (1989), H. 2, S. 77-80, H.3, S.127-134.
3 Hauser G (1989), Energetische Wirkung einer durchstromten Glasfassade. TAB 20 (1989), H. 4, S.329-338.

REF D12
TITLE
Experimental investigation of a combined air heating/floor heating system followed by tests in a pilot project.
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SPECIFIC OBJECTIVES
Researching parameters of airflow and heat transfer in a hollow space below the floor leading warmed supply air.
PROJECT DETAILS
Measurements determining pressure drop as well as temperature loss of supply air within the floor construction have been taken in the laboratories of the University of Essen. Therefore several fields of research, each with an area of 4 m^2 to 10 m^2, were built for different construction types in order to improve economy and comfort of the system. One important aspect is to find out an optimal sectioning between air heating part and floor heating part. Basing on the results of the measurements theoretical equations have been gained. Finally it is planned to compare the experimental and theoretical results with measurements under realistic conditions in special test rooms as well as in an inhabited house.
BUILDING TYPE
Not yet known
PARAMETERS
None, research concerning components of a heating and ventilation system.
STARTDATE 01:09:1987
ENDATE 31:08:1990
TIME 10000 person-hours per year
KEYWORDS
Heating system, floor, energy conservation, heat transfer, ventilation system
SELECTED BIBLIOGRAPHY
1 Radtke W & Thiel D (1986), Zweikomponenten-Luftheizungs-System. BMFT Forschungsbericht, 1986.

REF D13
TITLE
Simulation and measurement of airflow within buildings. (similar air).
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SPECIFIC OBJECTIVES
Simulation and measurement of airflow, air purity in buildings.
PROJECT DETAILS
a) measurements: (i) size 12 x 6 x 4 m construction: wood, glass, plastic material (ii) peltier element, radiator, mechanical ventilation, natural convection. (iii) measurement of temperature, pressure, velocity, humidity, acoustics, N_2O tracer gas (iv) measurement system: data acquisition and control system with PC, PT 100, hot-wire anemometers. (v) occupied and unoccupied buildings.
BUILDING TYPE
Commercial, factory, office

PARAMETERS
(Not Stated)
STARTDATE 01:09:1989
ENDATE 01:09:1992
TIME 10 000 person-hours
KEYWORDS
Simulation, measurement, airflow, indoor air quality (IAQ), convection
SELECTED BIBLIOGRAPHY *(None Stated)*

ITALY

REF I1
TITLE
Air infiltration induced by heating appliances.
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SPECIFIC OBJECTIVES
Analyse energy-related and safety problems of operating combustion appliances within inhabited spaces.
PROJECT DETAILS
Theoretical analysis: 1) A mathematical model was developed which determines the pressure and airflow distribution in a building incorporating a heating appliance within the living space. The model takes into account the wind effects, buoyancy-driven air movement and the thermal and fluid dynamic behaviour of the furnace and the chimney. Future refinements shall include the effects of interior partitions, non uniform envelope permeability, and transients (on-off control of furnace).
2) Experimental validation: Measurements will be made in 2 single family houses.
BUILDING TYPE
Residential single-family/multi-family
PARAMETERS
Heating demand building construction and size type of furnace
STARTDATE 00:05:88
ENDATE 00:07:90
TIME 1500 person-hours
KEYWORDS
Heating appliance, mathematical simulation, airflow distribution, thermal simulation, dwelling, flue, energy
SELECTED BIBLIOGRAPHY
1 Fracastoro G V & Masoero M (1988), Air infiltration induced by heating appliances 9th AIVC conference, GENT 1988 2 Final research report to National Research Council of Italy (expected Summer 1990)

REF I2
TITLE
Wind pressure distribution around buildings.
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SPECIFIC OBJECTIVES
Modelling wind pressure distributions around buildings, using wind tunnel data sets.
PROJECT DETAILS
The research will be carried out by:
1) Comparing output from the C_p-calculation model developed during the COMIS workshop, held at the Lawrence Berkeley Laboratory (LBL) in conjuction with the multizone infiltration specialists, with the results from wind tunnel tests. 2) Adding new routine to the model, such as routines dealing with C_p distribution on roof spaces and in crawl spaces. 3) Performance wind tunnel tests in order to evaluate, by parametrical analysis, the influence on C_p distribution of the following variables: - Terrain roughness - Building height - Building Shape.
BUILDING TYPE
Building Envelope; external surface
PARAMETERS
Surface pressure coefficient
STARTDATE 01:03:1990
ENDATE 30:06:1993
TIME 30 person-months
KEYWORDS
Wind pressure coefficient, model, wind tunnel, multizone

SELECTED BIBLIOGRAPHY
1 Allard F et. al. (1990) Fundamentals of the multizone airflow model COMIS, AIC TN 29, 1990.
2 Grosso M (1990), Wind pressure distribution around buildings: A parametrical model.,Submitted to Energy and Buildings, Feb, 1990.
3 Allard F et. al. (1990), User guide to the multizone airflow model:COMIS. AIC TN 29 1990.

REF I3
TITLE
Natural and mechanical ventilation in residential buildings.
CONTACT
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SPECIFIC OBJECTIVES
Evaluation of contaminant diffusion in rooms.
PROJECT DETAILS
A test facility has been built, made of a divisible 2.50 x 2.50 x 4.0 room, which is mechanically ventilated in different ways. A two components infra-red gas analyser is used to detect internal diffusion between the two parts of the room. The test chamber is equipped with four different grilles for inlet or outlet. The fluodynamic field is detected by means of six hot wire anemometers which can be moved along the room. Diffusion and removal of pollutants will be simulated. An experimental campaign will also be performed in the field in order to establish the infiltration rates using two-zone modellization in residential buildings.
BUILDING TYPE
Residential
PARAMETERS
Ventilation efficiency
STARTDATE 01:11:1989
ENDATE 31:10:1990
TIME 1200 person-hours
KEYWORDS
Residential, ventilation efficiency, test chamber, dwelling, mechanical ventilation system, air movement
SELECTED BIBLIOGRAPHY
1 Fracastoro G V & Lyberg M D (1983), Guiding, principles concerning design of experiments, instrumentation, and measuring techniques. Swedish Council For Building Research D:11:1983
2 Fracastoro G V & Pagani R (1988), Un modello sintetico per il calcolo delle infiltrazioi d'aria. La Termotechica - febbraio 1988.
3 Cali, Fracastoro, Vacchelli (1986), Studio con la tecnica dei gas traccianti delle infiltrazioni d'aria in una camera a ventilazione controllata. in Atti del XLI convegno ATI, Napoli, Setembre 1986.
4 Fracastoro, Masoero (1988), Air infiltration induced by heating appliance, 9th AIVC Conf., Gent (Belgium), 1988.

REF I4
TITLE
Operational safety, energy efficiency and indoor air quality in the use of domestic gas appliances.
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SPECIFIC OBJECTIVES
To define guidelines for optimal installation and operation of gas appliances.
PROJECT DETAILS
Gas appliances for space heating and hot water production are present in the majority of Italian residences. This research, conducted in collaboration with the National Gas Utility "ITALGAS", is aimed at analysing the interaction between such appliances and the building, in terms of safety of operation, energy consumption and pollutant emission in the indoor space. Two instrumented single family houses, recently completed by ITALGAS, will be used to carry out the experimental part of the research. Theoretical analysis will be

performed using a simulation model developed at the Politecnico Di Torino.
BUILDING TYPE
Residential
PARAMETERS
Gas appliance installation and operation; Building airtightness
STARTDATE 00:01:1990
ENDATE 00:12:1991
TIME 3500 person-hours
KEYWORDS
Energy efficiency, indoor air quality (IAQ), guidelines and standards, simulation, heating appliance
SELECTED BIBLIOGRAPHY
1 Fracastoro G & Masoero M (1988), Air Infiltration Induced by heating appliances. Proc. IX AIVC Conf., Gent 1988.

REF I5
TITLE
Anaysis of tracer gas experimental data using parameter estimation techniques.
CONTACT
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SPECIFIC OBJECTIVES
Improvement of data analysis in multi room ventilation / infiltration problems.
PROJECT DETAILS
Tracer gas data will be processed with the following objectives: - The determination of the time-dependent parameters based on arbitary tracer gas emission laws. - Evaluation of the influence of experimental uncertainties, mathematical tools are applied to the set of differential equations describing the mass balance of air and tracer gas in each zone. Such tools were originally developed to solve inverse ill-conditioned problems of heat conduction.
BUILDING TYPE
Multizone systems
PARAMETERS
(Not Stated)
STARTDATE 00:01:1989
ENDATE 00:12:1990
TIME 300 person-hours
KEYWORDS
Tracer gas, multizone, air movement, mathematical simulation
SELECTED BIBLIOGRAPHY
1 Cali M (1990), Final report to the National Research Council of Italy. Research Contract. 87.02154.59.
2 Cali M & Borchiellini R (1990), Proc. 11th AIVC Conf.
3 Cali M & Borchiellini R & Coppa P (1990), Proc. 11th AIVC Conf.

NETHERLANDS

REF NL1
TITLE
Exhaust airflows and hood capture efficiency.
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SPECIFIC OBJECTIVES
To predict airflows and capture efficiencies of exhaust hoods (flanged and unflanged) of different shapes.
PROJECT DETAILS
(i) Measurements of velocities above a table with capture hood. (ii) Measurements of tracer gas concentrations in the exhaust duct to determine the capture efficiencies. (iii) Development of a mathematical model to calculate the velocities and capture efficiency. (iv) Validation of the mathematical model by the measurements.
BUILDING TYPE
Capture hood
PARAMETERS
Flow rate, air movements, air velocity, shape and devices of capture hood.
STARTDATE 01:09:1988

ENDATE 31:12:1991
TIME 2000 person-hours
KEYWORDS
Flue, Air velocity, Mathematical simulation, Tracer gas
SELECTED BIBLIOGRAPHY
1 Stegehuis G W (1989), Local exhaust at the work place. Report No. R 89/032.

REF NL2
TITLE
Analysis of ventilation through one opening only.
CONTACT
Crommelin, R D
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P O Box 217,
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TLX 38071 ZPTNO NL
SPECIFIC OBJECTIVES
To determine the ventilation rate through one opening, by fluctuations due to turbulence.
PROJECT DETAILS
The study will involve a literature study, measurements on site, and of scale models, to study the possibilities and limitations in large halls. The aim of the study is to find the relationship between ventilation rates, meteorological and local wind, local turbulence and temperatures.
BUILDING TYPE
Large Halls
PARAMETERS
Weather (wind), obstacles, e.g. houses, trees, etc.
STARTDATE 01:08:1982
ENDATE 31:12:1991
TIME 1600 person-hours
KEYWORDS
Air infiltration, single opening, turbulence, scale model, window measurement
SELECTED BIBLIOGRAPHY
1 Vrins E (1986), Ventilation through an open window by turbulent air flows. Tech. Univ. of Eindhoven, Thesis Report.
2 Crommelin R D (1983), Natural ventilation of houses and rooms under influence of wind, pressure, turbulence and buoyancy effects. Report No. C 532.

REF NL3
TITLE
Air movement in rooms.
CONTACT
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SPECIFIC OBJECTIVES
To study the effects of outdoor air supply on air movement and indoor-climate.
PROJECT DETAILS
Phase 1; Literature study. Phase 2; Experimental work (scale model). Phase 3; Field measurements/evaluation. Phase 4; Modelling.
BUILDING TYPE
Rooms
PARAMETERS
Climate, air movement, air turbulence, form of openings and flow.
STARTDATE 30:06:1986
ENDATE 30:12:1991
TIME 2000 person-hours
KEYWORDS
Airflow, Room, Indoor Air Quality (IAQ), Openings, Scale model
SELECTED BIBLIOGRAPHY *(None Stated)*

REF NL4
TITLE
Transport of heat and contaminants in large spaces by airflow.
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SPECIFIC OBJECTIVES.
To predict temperatures and contaminant concentrations in large spaces, such as industrial halls.
PROJECT DETAILS

Transport of heat and dispersion of contaminants in large spaces, such as industrial halls is studied by measurements in a large number of points and by calculations. Calculations are performed by a multiple- cell model which divides the space into zones.

BUILDING TYPE

Large halls

PARAMETERS

Heat and contaminant sources, supply and exhaust airflow rates, wind, ventilation openings.

STARTDATE 01:01:1987

ENDATE 01:01:1992

TIME 2000 person-hours.

KEYWORDS

Airflow, Dispersion, Indoor Air Quality (IAQ), Mathematical simulation, Contaminant

SELECTED BIBLIOGRAPHY

1 Burlingh E (1987), Calculations of concentrations and temperatures in the S-hall by a multiple model. Report R 87/217.

2 Vincent J (1988),(ed). Validation of a multiple-cell theoretical model for the prediction of air temperatures and pollution concentrations by measurements in an industrial hall. Conf. paper at Symposium Ventilation '88.

REF NL5

TITLE

Research Into Indoor Climate And Health In Office Buildings.

CONTACT

Zweers, Tunnie & Preller, Liesbeth

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SPECIFIC OBJECTIVES

Finding causes of indoor climate and health problems in buildings.

PROJECT DETAILS

The investigation will cover up to 60 office buildings which are not known as sick, having a minimum number of inhabitants of 50 people and a maximum number of up to 200. Questionnaires will be distributed between the office workers enquiring about work related symptoms of ill health; indoor climate related complaints, about satisfaction etc. The ventilation system will be characterized and measurements will be made of carbon dioxide (CO_2), lighting and some clear climatic variables. Trial investigations have been carried out in two test buildings and procedures, questionnaires and checklists have been corrected after these trials.

BUILDING TYPE

office buildings

PARAMETERS

CO_2 lighting and other climatic variables, prevalence of sick building illnesses

STARTDATE 21:11:1988

ENDATE 00:02:1989 (Report at 31:12:1989)

TIME *(Not Stated)*

KEYWORDS

Sick buildings syndrome (SBS), Offices, Health, Mechanical ventilation system

SELECTED BIBLIOGRAPHY *(None Stated)*

REF NL6

TITLE

Ventilation In Industrial Premises.

CONTACT

Gids, W F De / Knoll, B

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TLX 38071

SPECIFIC OBJECTIVES

To study the effects of local ventilation systems.

PROJECT DETAILS

- Measurements with tracer gases on the efficiences of local exhaust hood systems.
- Studies on local displacement systems.
- Local protection of people by personal fan systems
- Airflow through large openings, disturbing local systems.

BUILDING TYPE

Industrial Buildings

PARAMETERS

Vent systems, Local exhaust, Local displacement, ventilation efficiency

STARTDATE 00:00:1988

ENDATE 00:00:1992

TIME 3500 person-hours

KEYWORDS

Industrial, Mechanical ventilation system, Tracer gas, Displacement ventilation, Flue
SELECTED BIBLIOGRAPHY
(None Stated)

REF NL7
TITLE
Indoor Air Quality In Airtight Houses.
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TLX 38071
SPECIFIC OBJECTIVES
Studying problems of indoor air quality in dwellings, due to high levels of airtightness and inadequate use of the ventilation system.
PROJECT DETAILS
Meaurements and model studies on exposure of pollutants by occupants: Studies on:-
- Advanced ventilation systems.
- Develop strategies.
- Producing proposals for standards and test methods.
- Multizone efficiency.
- Distribution of pollutants.
- Effects of Occupants.

BUILDING TYPE
Residences
PARAMETERS
Building airtightness; Occupant behaviour, ventilation systems
STARTDATE 00:001988
ENDATE 00:00:1992
TIME 2800 person-hours
KEYWORDS
Ventilation systems, Ventilation strategies, Airtightness, Indoor Air Quality (IAQ), Multizone, Dwelling
SELECTED BIBLIOGRAPHY *(None Stated)*

REF NL8
TITLE
Database On Air Leakage And Pressure Coefficients Of Buildings.
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TLX 38071
SPECIFIC OBJECTIVES
To establish a database on air leakage and pressure coefficients.
PROJECT DETAILS
Phase1 : Collecting all the available data on air leakage in the Netherlands. Phase2 : Choice of the database software, structure and set up. Phase3 : Data entrance; first tests. Phase4 : Interaction with AIVC Phase5 : First analysis and reports to Ministry of Housing. Phase6 : Collecting of valuable data set on pressures.
BUILDING TYPE
Residences; non-residential buildings
PARAMETERS
Air leakage; pressure differences
STARTDATE 00:00:1988
ENDATE 00:00:1992
TIME 3500 person-hours
KEYWORDS
Database, Pressure Coefficients, Air leakage, Database, Commercial, Industrial
SELECTED BIBLIOGRAPHY *(None Stated)*

REF NL9
TITLE
Developing Models On Infiltration, Ventilation Heat Transfer, Moisture And Pollutants.
CONTACT
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SPECIFIC OBJECTIVES
To develop models and interaction between models to evaluate ventilation, energy and indoor air quality.
PROJECT DETAILS
Phase 1: Study of separate models. Phase 2: Updating the separate models Phase 3: Formulation of input data Phase 4: Network system developed Phase 5: Tests on interaction

and evaluation Phase 6: Description of the complete system.

BUILDING TYPE

Dwelling, Commercial, Industrial

PARAMETERS

Model, Air movement, Pollution sources, Heat transfer

STARTDATE 30:06:1986

ENDATE 30:12:1992

TIME 4800 person-hours

KEYWORDS

Model, Air quality, Ventilation

SELECTED BIBLIOGRAPHY *(None Stated)*

REF NL10

TITLE

Occupants aspects in the framework of a governmental policy with respect to minimal ventilation behaviour to attribute to the occupants own responsibility.

CONTACT

1) Van Dongan, J E F & 2) Gids, W F De

ADDRESS

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SPECIFIC OBJECTIVES

Which minimal ventilation can be attributed to the responsibilty of the occupants.

PROJECT DETAILS

To support the governmental building policy a study; if performed will study the rate of exposure of occupants to polluting agents at conditions of minimal and reasonable occupant behaviour with respect to the use of ventilation devices in residential buildings. What is considered to be a reasonable minimal use of ventilation devices by the occupants will be measured. Pollutants emitted from building materials will also be monitored. The assessment will be based on case studies and surveys of the actual ventilation behaviour in different houses and apartments with different ventilation provisions.

BUILDING TYPE

Residential houses and apartments

PARAMETERS

Occupants behaviour and experience; subjective health effects, thermal comfort; Energy use; In/Outdoor climate

STARTDATE 00:00:1980

ENDATE ongoing

TIME 1000 person-hours/year

KEYWORDS

Occupant behaviour, Questonnaries, Window, Comfort, Health Heating ventilation systems, Test chamber

SELECTED BIBLIOGRAPHY

1 Van Dongen J E F & Van der Wal J F (1990), Perceived Indoor Air Quality, Comfort and Health In Renovated Dwellings with balanced Mechanical Ventilation Systems. Proc. Indoor Air 90, Toronto, 1990.

2 Van Dongen J E F (1990), The Influence of Different Ventilation Devices on occupant behaviour in dwellings. Proc. 11th AIVC Confer. Italy, 1990

3 Van Dongen J E F et. al. (1989), Health Aspects and Quality of the Indoor Environment. A Pilot Study For a Framework to Assesss a Priority List for Physical Biological and Chemical Agents in the Indoor Air of houses. NIPS-TNO, Leiden, 1989, (In Dutch)

4 Van Dongen J E F & Phaff J C (1989), Ventilation Behaviour and Indoor Air Problems, in Different Types of Newly Built Dwellings. In Environment International , Vol 15, pp95-106. 1989.

5 Van Dongen J E F (1988), Use and Quality of Ventilation Devices in dwellings, In Proc. of Healthy Buildings '88, Vol 3, pp61-66, SCBR, Stockholm, 1988.

6 Van Dongen J E F & Phaff J C (1990), Ventilation Behaviour in Dutch Apartment Dwellings, During Summer. In Proc of Lisbon Conf. on Indoor Air Quality and Ventilation, pp105-116, Selper Ltd, London, 1990.

NEW ZEALAND

REF NZ1
TITLE
Air Infiltration and Ventilation In Buildings.
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SPECIFIC OBJECTIVES
To investigate infiltration airflows that transfer heat and moisture.
PROJECT DETAILS
1) Investigation of airflows from living space of houses into the construction cavities of cathedral ceilings. A passive tracer technique is being used in a group of 6 houses in cold and warm parts of New Zealand. 2) Air tightness tests on office buildings using the air handling system to provide a pressure across the envelope. Tracer gases are being used to measure airflow rates in ventilation system ducts.
BUILDING TYPE
All
PARAMETERS
(Not Stated)
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)*
TIME *(Not Stated)*
KEYWORDS
Tracer gas, Residential, Commercial, Industrial, Public Buildings, Dwelling, Airflow, Ventilation, Infiltration
SELECTED BIBLIOGRAPHY *(None Stated)*

NORWAY

REF N1
TITLE
The Relationship Between Indoor And Outdoor Concentrations Of Pollutants In Norwegian Houses.
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TLX 74854 nilu n
SPECIFIC OBJECTIVES
To study how indoor air concentration of pollutants varies with the outdoor air concentrations. This study constitutes a part of a major study of health effects of exposure in the Grenland area in Norway.
PROJECT DETAILS
The measurements were carried out in 15 buildings, twice in 1988, (once in the Winter and then again in the Summer). The 15 buildings included both houses and apartments, and most of them had natural ventilation. The concentrations of SO_2, NO_2, suspended particulate matter (in two size fractions), Cl, NO_3 and SO_4 were measured simultaneously inside and outside the houses, and formaldehyde was measured inside only. The houses were occupied while the measurements were carried out.
BUILDING TYPE
Residences (houses and apartments)
PARAMETERS
Pollutant concentrations
STARTDATE 00:09:1987
ENDATE 00:09:1990
TIME *(Not Stated)*
KEYWORDS
Residences, Pollutant sources, Dwelling, Indoor Air Quality (IAQ)
SELECTED BIBLIOGRAPHY
1 Braathen O -A (1989), Indoor air pollutant in Norway. Paper delivered at 8th World Clean Air Congress, 11-15 Sept, 1989 den Haag, Netherlands.

REF N2
TITLE
Ventilation By Demand.
CONTACT
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SPECIFIC OBJECTIVES
Achieve good indoor air quality with minimum fresh air supply.
PROJECT DETAILS
An auditorium with displacement ventilation and seats for 300 students has been equipped with a demand controlled ventilation system (DCV). CO_2, temperature and humidity have been used as parameters to control the air flow (0 - 12000 m^3/h). Temperature, humidity and CO_2 concentrations have been measured every 10 minutes at 20 locations inside the room. Aerosols have been measured in the exhausted air flow. Air exchange efficiency has been measured with N_2O. Further investigations will be carried out with 3-d numerical computer program (Fluent. Kameleon).
BUILDING TYPE
Auditorium
PARAMETERS
CO2, Humidity, Temperature and dust
STARTDATE 00:10:1989
ENDATE 00:07:1991
TIME 4000 person-hours
KEYWORDS
Ventilation, Indoor Air Quality (IAQ), Demand controlled ventilation (DCV), Field study, Numerical simulation, Survey
SELECTED BIBLIOGRAPHY
1 Finn Drangsholt (1990), Ventilation by demand.,SINTEF - Report STF15 A90005, 1990, Norway.
2 Finn Drangsholt (1991), Dr.ing. - thesis, NTH-Trondeim, Summer 1991.

REF N3
TITLE
Indoor Air Quality Problems In Schools
CONTACT
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SPECIFIC OBJECTIVES
Indoor air quality problems related to indoor climate symptoms.
PROJECT DETAILS
The project will study: - Indoor air quality in schools. - Temperature, humidity, fresh air flow, dust concentration and air exchange efficiency. - Questionnaire about indoor air quality symptoms.
BUILDING TYPE
School buildings
PARAMETERS
Indoor Air quality problems related to the building and to the ventilation system. Main parameters: Dust and Temperature.
STARTDATE 00:01:1989
ENDATE 00:04:1992
TIME 5000 person-hours
KEYWORDS
Indoor Air Quality (IAQ), Field Study, Survey, School, Occupancy
SELECTED BIBLIOGRAPHY
1 Liv Bente Grande , Dr.ing. - thesis, NTH-Trondeim, expected Spring 1992.

REF N4
TITLE
Consequences Of Upgrading Indoor Air Quality. (OPAL - Project)
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SPECIFIC OBJECTIVES
(See Project Details)
PROJECT DETAILS
Upgrading of the indoor environment will be one of the most important issues of our work as qualified consulting engineers in the 1990's. Reducing indoor contaminates by choosing the proper materials, fixtures and furnishings may be the most important step towards better indoor air quality. Cleaning procedures and frequency are to be considered more carefully. Both daily cleaning and maintance of air conditioning installations, filters, heat exchangers and ductwork have to be kept on a higher level. Upgrading air standards includes considerably more clean outdoor air. Todays building procedures and the use of materials makes it necessary with about 15 cubic meters per square meter per hour in public buildings and most office buildings. One of the

consequences of energy consumption, another is higher investment costs. but the rise in total cost per square meter is marginal because wage-related costs totally dominate.
BUILDING TYPE
Office buildings
PARAMETERS
Indoor air quality, total costs, wage-related costs, health
STARTDATE 00:00:1988
ENDATE 00:00:1990
TIME 600 person-hours
KEYWORDS
Indoor Air Quality (IAQ), Building materials, Mechanical ventilation system
SELECTED BIBLIOGRAPHY
1 A Roedseth (1990), Indoor Air Quality Does Not Ruin The Budget, Indoor Air '90, Toronto, Canada, July 1990.
2 A Roedseth (1990), IAQ in Buildings of the year. 11th AIVC Confer. Belgirate, Northern Italy, 18-21 Sept. 1990.

REF N5
TITLE
Local Heating And Ventilation In Stave Churches.
CONTACT
Sorlie, Rolf
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SPECIFIC OBJECTIVES
To study different heating and ventilation systems to reduce damage on art pieces to changing indoor climate.
PROJECT DETAILS
Part 1: Measurements in laboratory.
Part 2: Measurements in a church.
Study: Natural and Mechanical Ventilation systems. Heating systems: Floor heating, convector, heat foil at/under the seals.
Measurements: Temperature, Relative Humidity, Air Velocity, Length extension of wood materials.
Instrumentation: Menu driven software systems allows the computer to receive, display and log acquired in real time from Schlumberger Isolated Measurement Pods (IMPs). Occupied building in the second part.
BUILDING TYPE
Stave Church
PARAMETERS
Weather, Occupant Behaviour
STARTDATE 00:00:1989
ENDATE 00:00:1991
TIME 1000 person-hours
KEYWORDS
Church, Measurement, Heating and Ventilation systems, Simulation
SELECTED BIBLIOGRAPHY
1 Rolf Sorlie (1989), Lokalklimatisering av stavkirker, del 1: Forstudie. SINTEF-report STF15 F89038 - 1989. (Spot Climatization in Stave Churchs. Preliminary Study).
2 Rolf Sorlie (1990), Lokalklimatisering av stavkirker, del 2: Lokalklimatisering av personer. SINTEF-report, July 1990. (Spot Climatization of occupants).
3 Rolf Sorlie (1990), Lokalklimatisering av stavkirker, del 3: Lokalklimatisering av kunstverk. SINTEF-report STF15 F90022, March, 1990 (Spot Climatization of pieces of art).

SWEDEN

REF S1
TITLE
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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
In a suburban area in Stockholm, 455 apartments have been taken into possession in 1981 to 1982 by about 1200 occupants. Worries have arisen due to blackening of oak parquet flooring, owing to liquid casein putty. The project includes going over the ventilation system, and a technical hygienic examination of

the mechanical ventilation system in 50 random apartments, and an enquiry directed to all occupants in the area. The inquiry focuses on symptoms which are characteristic of sick-building syndrome. The 17 buildings included in the project are concrete buildings with concrete ground, concrete beams, concrete wall structure, rough casted and flat roofs. Mechanical ventilation systems exhaust ventilation; via ventilation ducts in the kitchens, bathrooms and separate toilets, and intake air via ventholes in the window frames. Central heating system, oil, hot water circulating system to apartment radiators each with separate thermostats. Liquid case in based putty is direct on the concrete floor, parquet floor of oak or sheetings of plastic of wall-to-wall carpeting.

BUILDING TYPE

455 apartments

PARAMETERS

Swedish construction standards

STARTDATE 25:01:1988

ENDATE 25:01:1990

TIME *(Not Stated)*

KEYWORDS

Apartments, Sick building syndrome (SBS), Occupancy

SELECTED BIBLIOGRAPHY

Ancker K et. al. (1988), Local Exhaust Ventilation and Exposure to Nitrous Oxide in Ambulances. (19:12:88).

REF S2

TITLE

Making The Use Of Electricity More Efficient In Electrically Heated One-Family Houses - Monitoring And Evaluation.

CONTACT

Blomsterberg, A

ADDRESS

National Testing Institute,
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5-50115 Boras,
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SPECIFIC OBJECTIVES

To evaluate indoor climate and energy performance before and after improvements.

PROJECT DETAILS

Improvements including; making the use of electricity more efficient in six one-family naturally ventilated houses. Purpose provided ventilation system consists of vertical shafts and supply vents, with no fan. Examples of measurements which will be taken are; pressurisation, constant concentration tracer gas (N2O), indoor thermal comfort. The following parameters will be monitored continuously: indoor and outdoor temperatures, the use of electricity (heating, domestic hot water, household) in the occupied building. This is one of four parallel projects. All in all, 30 houses will be retrofitted and monitored.

BUILDING TYPE

One-family house.

PARAMETERS

temperature, wind, airtightness.

STARTDATE 01:01:1988

ENDATE 31:12:1990

TIME approx. 1000 person-hours

KEYWORDS

Infiltration, Ventilation, Retrofit, pressurisation, Tracer gas, Thermal comfort

SELECTED BIBLIOGRAPHY

1 Final report 31-12-1990

REF S3

TITLE

Warm Air Heating In A Block Of Flats

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Blomsterberg, A

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SPECIFIC OBJECTIVES

To evaluate a system for warm air heating in an apartment house.

PROJECT DETAILS

The indoor thermal climate, the air quality and the energy consumption will be monitored and evaluated. The warm air is blown into the individual rooms from inlets located in the partitions up by the ceiling. There is no recirculated air. The supply and exhaust can be varied between 0.7 ach and 1.2 ach. Examples of measurements which will be taken are: pressurisation, constant concentration tracer gas (N_2O), air change efficiency, temperature efficiency, indoor thermal comfort. The following parameters will be monitored continuously: indoor, outdoor, and duct

temperatures, household and heating energy consumption etc. in the occupied building.
BUILDING TYPE
Block of Flats/Apartments
PARAMETERS
Thermal environment, Indoor Air Quality, Energy
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)*
TIME *(Not Stated)*
KEYWORDS
Thermal Comfort, Tracer Gas, Measurement, Indoor Air Quality (IAQ), Airtightness, Energy consumption
SELECTED BIBLIOGRAPHY

1 Blomsterberg A et. al. (1989), Warm air heating in apartment houses - pilot study, National Testing Institute, 21-06-1989
2 Blomsterberg A et. al. (1989), Pre-monitoring diagnostic tests of an apartment house NTI 31-12-1989
3 Blomsterberg A et. al. (1990), Pre-monitoring diagnostic tests of four apartments with warm air heating. NTI, 31-07-1990
4 Blomsterberg A et. al. (1991), Post-monitoring diagnostic tests of four apartments with warm air heating. NTI 31-03-1991
5 Blomsterberg A et. al. (1991), Warm air heating in apartment houses - description and evaluation. NTI, 30-06-1991

REF S4
TITLE
Tracer Gas Techniques For Air Flow Estimations.
CONTACT
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SPECIFIC OBJECTIVES
To study how impulse responses with tracer gas can describe air movements in a room.
PROJECT DETAILS
The aim of the project is to find a method to define how the supply air is distributed in a room, by studying the relationship between tracer gas supply sequences and measured gas concentration. The experiments are taken place in rooms with mechanical ventilation. Tracer gas (N_2O) is supplied in sequences at the inlet air grille, and impulse responses are measured in different places in the room and in the exhaust grille.
BUILDING TYPE
Mechanical ventilation.
PARAMETERS
Unoccupied room without windows or any other affecting parameters
STARTDATE 01:05:1989
ENDATE 30:06:1990
TIME 1600 person-hours
KEYWORDS
Tracer Gas, Mechanical ventilation system, Tracer gas, Airflow simulation
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF S5
TITLE
Ventilation Efficiency In Buildings
CONTACT
Sandberg, M & Stymne, H
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SWEDEN.
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SPECIFIC OBJECTIVES
To establish an efficient way of ventilating a house by a mechanical ventilation system.
PROJECT DETAILS
The test house is modern, and located in the laboratory of the National Swedish Institute of Building Research. The house has a volume of $175m^3$ and a floor area of $70\ m^2$. The mechanical ventilation system is an extract system and combined supply and extract. Electrical panel indicators or warm-air heating. Tracer gas: N_2O, Pollutant CO_2. The pressure is recorded both outside and in each room.
BUILDING TYPE
Test house (floor area = $70m^2$) located in the laboratory of the institute. Equipped with mechanical ventilation.
PARAMETERS

Type of mechanical ventilation system, supply airflow rate location of supply - and extract points. Temperature of supply air.
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)*
TIME *(Not Stated)*
KEYWORDS
Ventilation Efficiency, Mechanical ventilation system, Test chamber, Heating system, Pressurisation, Tracer gas
SELECTED BIBLIOGRAPHY

1 Sandberg M (1989), The multi-chamber theory reconsidered from the viewpoint of air quality studies" Buildings and environment 1989
2 Sandberg M (1989), An indoor test house" Air infiltration review Vol.6 1989:1.
3 Sandberg M & Blomquist C (1985), Exploration of ventilation strategies in domestic housing. Theory and experimental results. 6th AIVC confer.1985.
4 Sandberg M & Blomquist C (1985), A quantitative estimate of the accuracy of tracergas methods for the determination of the ventilation flow rates in buildings. Buildings and environment 1985:5
5 Sandberg M & Stymne H (1989), The constant tracer flow technique. To appear in Building and Environment 1989.

REF S6
TITLE
Ventilation And Airtightness versus Energy Balance And Indoor Climate In Residential Buildings.
CONTACT
Blomsterberg, A
ADDRESS

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SPECIFIC OBJECTIVES
To clarify the influence of ventilation and airtightness on energy and indoor climate. To recommend methods, and evaluate performances.
PROJECT DETAILS
Most of the work is based on previous projects where experimental buildings were performance monitored and evaluated. The buildings were either of wood-frame construction or wood-frame and concrete construction. The ventilation system was natural or mechanical. The mechanical systems were either balanced or extract only ventilation. The heating systems were electric warm air (exhaust air heat pump), electric baseboard or hydronic). The following measurements were taken: constant concentrtion tracer gas (N_2O), tracer gas (N_2O) decay (air change efficiency), fan pressurisation, indoor temperatures, energy consumption, weather etc. A simplified theoretical approach (LBL model) and a multi-zone network approach (MOVECOMP -PC(R) were used.
BUILDING TYPE
Detached one-family house and townhouse (Residence)
PARAMETERS
wind, temperature, airtightness etc.
STARTDATE 01:01:1987
ENDATE 30:06:1990
TIME 2000 (not including the measurements, which were performed during 1982-1986)
KEYWORDS
Airtightness, Ventilation system, Indoor climate, Tracer gas, Pressurisation, Multizone, Simulation, Dwelling
SELECTED BIBLIOGRAPHY

1 Blomsterberg A & Stadler C G (1985), Well-insulated houses with warm air heating - description and evaluation of two houses in Skultorp. National Testing Inst., SP-RAPP 1985: 42 (in Swedish).
2 Blomsterberg A (1986), Warm Air Heating - description and evaluation of a one-family house in Taby, National Testing Inst, SP-RAPP 1986:30 (in Swedish)
3 Blomsterberg A & Ulmas B (1984), Passive solar heating - description and evaluation of a home in Vaxjo, Swedish Council for Building Research, R16;1984.
4 Carlson P O & Blomsterberg A (1989), Light construction 85 - energy and resource efficient one-family houses with a low annual cost Swedish Council for Building Research R41;1989 (in Swedish)
5 Blomsterberg A & Eek H (1989), Applied Passive Solar Heating - Resource efficient construction in Karlstad Swedish Council for Building Research, R24; 1989 (in Swedish).
6 Blomsterberg A (1989), Ventilation and airtightness in Energy, balance analysis, 10th

AIVC Conference, Final paper from Lund Inst of Technology

REF S7
TITLE
Air Infiltration Analysis Based On Probabilistic Methods.
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SPECIFIC OBJECTIVES
An all-embracing aim for research is to formulate models, which describe the distribution and mutual relationship between different climatic parameters or driving forces.
PROJECT DETAILS
The research can be expected to give basic data for a risk analysis and for the estimation of requisite safety factors.
(a) (i) wood
(ii) natural and mechanical ventilation
(iii) pressure measurements (full scale measurements)
(b) probablistic methods, spectral analysis.
BUILDING TYPE
House, Residence
PARAMETERS
Climatic factors
STARTDATE 00:00:1989
ENDATE 00:00:1992
TIME *(Not Stated)*
KEYWORDS
Model, Residence, Dwelling, Infiltration, Ventilation system
SELECTED BIBLIOGRAPHY
1 Gusten J (1989), Wind pressures on low-rise buildings. An air infiltration analysis based on full scale measurements., pub. 1989:2. Div.of Structural Design, Chalmers University of Technology, Gothenburg 1989

REF S8
TITLE
Air Infiltration in Museum Buildings.
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SPECIFIC OBJECTIVES
Passive emission and sampling of a tracer gas is proposed to determine the Air Change Rate.
PROJECT DETAILS
Within the framework of ICOM, different International Committees are working continuously. One of these is the Committee for Architecture and Museum Technology (ICAMT). At the global conference in Buenos Aires in October 1986, ICAMT discussed a Swedish paper "Climate Control in Old Museum Buildings" and recommended further investigations on how to improve museum buildings in order to decrease the damage to collections caused by rapid changes of indoor temperature, humidity, and daylight, as well as that caused by gaseous pollutants. At the ICAMT Technical Meeting in Budapest in October 1988, the Committee discussed another Swedish paper, "Air Infiltration in Museum Buildings". This paper suggested the use of tracer gas techniques to establish the air change performance of museum buildings. The committee supported the idea of a simple passive measurement system for a preliminary classification of museum buildings. Following investigations of possible measurement methods, a technique involving the passive emission and sampling of a tracer gas, developed by Dr Russel Dietz at the Brookhaven National Laboratory, is proposed in this report. The method is simple to perform and most of the work can be undertaken by museum staff. It is intended that the measurements should be taken while the museum is operating under normal conditions, i.e. irrespective of whether the air conditioning is on or off or whether a successful exhibition with many visitors is being staged. The results from the measurements are presented as the air change rate for the museum building. A classification system for museums, based on the air change rate has been devised. This will give museum staff a tool which allows them to assess the infiltration performance of their musuem buildings, exhibition halls or store rooms in

office rooms. Model validations are conducted by comparison of the real and generated data.
BUILDING TYPE
Four offices (Commercial)
PARAMETERS
Ambient temperature, time of day
STARTDATE 00:01:1989
ENDATE 00:12:1989
TIME 12 person-months
KEYWORDS
Simulation, Window, Door, Openings, Airflow, Occupant, Office
SELECTED BIBLIOGRAPHY
1 Fritsch R et. al. (198?), A stochastic model of user behaviour regarding ventilation, proposed to Building and Environment.

REF CH8
TITLE
Numerical Prediction Of Air Flow In Single Rooms.
CONTACT
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SPECIFIC OBJECTIVES
Evaluate and test numerical methods and develop airflow design tool.
PROJECT DETAILS
This work is a subproject of a Swiss national project "energy relevant airflows in buildings", ERL, which is supported by government and industry. ERL is structured in (a) single room, (b) multi-zone airflow and (c) ventilation systems. The subproject reported here belongs to task A. The finite-volume fluid flow simulation code "PHOENICS", which employs the K/EPSILON - turbulence model, is tested against LDA- measurements carried out within ERL. Model improvements were realized with respect to buoyancy, Low-Reynolds-Number, and near-wall effects. Prediction of mixed-convection heat transfer is of particular interest.
BUILDING TYPE
Residential, office, commercial
PARAMETERS
Steady-state, wall temperatures given, desired output, flow field, turbulence, temperatures, comfort, concentrations.
STARTDATE 00:07:1986
ENDATE 00:07:1992
TIME *(Not Stated)*
KEYWORDS
Flow field, Turbulence, Heat transfer, Simulation, Multizone, Energy, Ventilation system, Turbulence
SELECTED BIBLIOGRAPHY
1 Chen Qingyan at al (1990), Prediction of buoyant, turbulent flow by a Low-Reynolds-Number k-epsilon model, Symposium paper, ASHRAE Winter meeting, Atlanta, Feb. 1990. B.

REF CH9
TITLE
IEA Annex 20, Air flow patterns within buildings (international project)
CONTACT
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SPECIFIC OBJECTIVES
To evaluate the performance of single and multi-zone air and contaminant flow simulation techniques.
PROJECT DETAILS
Prediction of airflow patterns within rooms and through buildings by numerical methods will help the engineer to design ventilation systems for high energy efficiency, good thermal comfort, and acceptable indoor air quality. Simulation techniques are evaluated and extended in this project by comparison with measurements and by development and testing of new algorithms and models. Guidelines for simulation, handbooks for measurement techniques, and experimental data will be produced.
BUILDING TYPE

Residential, office, commercial
PARAMETERS
Weather, wind, building components, heat load, occupant behaviour, pollution.
STARTDATE 01:05:1988
ENDATE 01:11:1991
TIME *(Not Stated)*
KEYWORDS
Ventilation, Infiltration, Measurement, Simulation, Airflow, Thermal comfort, Energy, Indoor Air Quality (IAQ)
SELECTED BIBLIOGRAPHY
See AIVC's AIRBASE.

REF CH10
TITLE
Demand And Basic Regulations For Air Conditioning.
CONTACT
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SPECIFIC OBJECTIVES
Swiss Standards SIA 382/1 - 3
PROJECT DETAILS
The project leads to the following three Swiss Standards: SIA 382/1 Luftungstechnische Anlagen "Technische Anforderungen" (Basic regulations for VAC-Systems) SIA 382/2 Kuhlleistungsbedarf von Gebauden" (Cooling load) SIA 382/3 "Bedarfsermittlung fur luftungstechnische Anlagen" (demand of air conditioning).
BUILDING TYPE
(Not Stated)
PARAMETERS
(Not Stated)
STARTDATE 00:00:1987
ENDATE SIA 382/1 + 3:2. 00:00:1989
SIA 382/2: 00:00:1990
TIME 6000 person-hours
KEYWORDS
Standards, Ventilation, Heat transfer
SELECTED BIBLIOGRAPHY
Schweizerischer Ingenieur - und Architekten-Verein Postfach, CH-8039 Zurich (Switzerland) - SIA V 382/1
Luftungstechnische Anlagen - Technische Anforderungen April 1989 - SIA V 382/3 Bedarfsermittlung fur luftungstechnische Anlagen April 1989

REF CH11
TITLE
Computer Model Inter-Zonal Air Flow And Contaminant Transport (Infiltration And Ventilation).
CONTACT
Dorer, Viktor
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SPECIFIC OBJECTIVES
Development of a computer model for multizone infiltration and ventilation simulation.
PROJECT DETAILS
The project is a part of the Swiss research project on "Energy Relevant Air Flow Patterns within Buildings", Subpart B: Multizone Air Flow. This Subpart B concentrates on improving data and techniques for input parameters as meteo data, wind pressure data, occupant behaviour, as well as on the development of new algorithms for large opening airflow description. The results of each of these projects will be included in the computer model as new routines and improved databases. A contribution to the "Comis" project at the LBL has been made in the frame of this project.
BUILDING TYPE
Multizone.
PARAMETERS
(Not Stated)
STARTDATE Phase 1 01:01:87
ENDATE Phase 1 31:12:89
TIME 5,000 person-hours
Phase 2 31:12:91
KEYWORDS
Multizone, Computer simulation, Airflow, Energy, Occupant
SELECTED BIBLIOGRAPHY
In German:

Tagungsunterlagen Status - Seminar Forschungsprogramm ERL (Energierelevante Luftstromungen in Gebauden). 1987, 1988, 1989.

REF CH12

TITLE

Leakage and Leakage Distribution Data-Bank For Swiss Buildings.

CONTACT

Hartmann, Peter & Steinemann, Urs

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SPECIFIC OBJECTIVES

To establish a data bank for leakage data of buildings and all relevant external and internal components; to include as much as possible also leakage distribution information.

PROJECT DETAILS

1 To analyse existing data.
2 To develop a suitable structure of the data bank, in close cooperation to the project leaders of the multizone-calculation program which is under development (V Dorer/P Hartmann, EMPA). This data bank is also coordinated with the work in IEA Annex 20 and in the ongoing period of the AIVC.
3 To define needs and "holes" of data.
4 To collect this data in corresponding subtasks.
5 To finalize the data bank in order to - validate the program(s) and to deliver input data to planners. This project is a follow up project of - a project about leakage in residential buildings (U.Steinemann) - and a project on leakage in wooden buildings (H.R.Preisig/EMPA).

BUILDING TYPE

Whole buildings, different constructions internal and external components.

PARAMETERS

(Not Stated)

STARTDATE Evaluation phase end 00:00:1989
ENDATE 00:00:1991
TIME 1660 person-hours

KEYWORDS

Database, Leakage, Leakage Distribution, Multizone, Airtightness, Dwelling

SELECTED BIBLIOGRAPHY *(None Stated)*

REF CH13

TITLE

Air Tightness Of Building Envelopes Of Wood Buildings (Luftdurchlassigkeit der Gebaudehulle von Holzbauten)

CONTACT

Preisig, H R & Zumoberhaus, M

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SPECIFIC OBJECTIVES

The improvement of building envelopes of wood and wood/brickwork buildings.

PROJECT DETAILS

Development and discussion of different systems for enhancing the air tightness of wood and wood/brickwork constructions: planning requirements, effects on materials and finishing on site. The project includes research on about 30 wood - or wood/brickwork-buildings built between 1988 and 1990, equipped mostly with natural ventilation systems (2 buildings with a mechanical ventilation system). Methods of measurement: pressurisation, IR-thermography; - relation between air exchange under natural circumstances and values of air tightness at 50 Pa (nL50-value).

BUILDING TYPE

One and Two-family houses, special apartments

PARAMETERS

(Not Stated)

STARTDATE 00:00:1988
ENDATE 00:00:1991
TIME 1800 person-hours

KEYWORDS

Airtightness, Pressurisation, Thermography, Residence, Dwelling

SELECTED BIBLIOGRAPHY

1 Zumoberhaus M et. al. (1989), Luftdurchlassigkeit der Gebaudehulle im Holzbau publ. in "Schweizer Ingenieur und Architekt", probably about Autumn 1989.
2 Zumoberhaus M et. al. (In print), Final report of the project, probably Summer 1991.

REF CH14
TITLE
Measurements Of The Airtightness Of Typical Swiss Residential Buildings.
CONTACT
Steinemann, Urs
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FAX +41 (1) 784 53 66
SPECIFIC OBJECTIVES
Overview of real airtightness of Swiss residential building/input parameters for air infiltration models.
PROJECT DETAILS
Measurements in buildings:
(i) Multi-storey residential buildings
(ii) Natural ventilation or extract air systems, central heating system
(iii) Pressurisation and tracer gas measurements.
(iv) Pressurisation test with blower door, tracer gas measurements with decay-method.
(v) Measurements in occupied and unoccupied buildings.
BUILDING TYPE
Multi storey residential buildings
PARAMETERS
(Not Stated)
STARTDATE 00:00:1984
ENDATE Part 1: 00:00:1985 / Part 2: 00:00:1990
TIME 4000 person-hours
KEYWORDS
Airtightness, Pressurisation, Mechanical ventilation, Natural system, Blower door, Dwelling
SELECTED BIBLIOGRAPHY

1 Urs Steinemann & Peter Hartmann (1984), Planungshilfsmittel zur Kontrolle des Luftaustausches in Gebauden Schweizer Ingenieur und Architekt, Heft 33-34.
2 Urs Steinemann (1985), Neff-Projekt Nr.226 - Kurzfassung des Berichtes zu Phase 1 mit Messungen an funf Mehrfamilienhausern, Februar 1985.
3 Urs Steinemann, Peter Hartmann (1986), Angepasste Luftdurchlassigkeit der Gebaudehulle bei Wohnbauten Schweizer Ingenieur - und Architekt, Heft 24, 1986.
4 Urs Steinemann (1986), Air leakage characateristics and new standards for Swiss construction Air Infiltration Review Vol.7, No.3, May 1986.

REF CH15
TITLE
Displacement Ventilation.
CONTACT
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FAX +41 052 23 84 47
TLX 896 060 20
SPECIFIC OBJECTIVES
Temperature gradient, air velocities air quality, comfort investigations.
PROJECT DETAILS
Measurements in a test room in Sulzer Laboratory of dimensions 6.50 x 4.50 x 2.65 m. The ventilation system is Displacement, with Repus diffuser exhaust air fittings, with Internal Loads of 10-55 w/m^2, different heat sources. Winter and Summer conditions were investigated. Additional numerical simulation of the test cases. Different control algorithms were tested.
BUILDING TYPE
Well insulated test room
PARAMETERS
(Not Stated)
STARTDATE 00:01:1989
ENDATE 00:12:1990
TIME 24 person-months
KEYWORDS
Air velocity, Temperature gradient, Numerical simulation, Test room
SELECTED BIBLIOGRAPHY

1 Kegel B & U Schulz (1989), Displacement ventilation for Office Buildings. 10th AIVC Congress Helsinki, 1989.
2 Prochaska V & Kegel B (1990), Control Algorithms for rooms with displacement ventilation Room Vent 90, Oslo.

REF CH16
TITLE
Analysis Of The Influence Of Topography On Climatic Exposure Of Buildings.
CONTACT

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SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
Objectives of the Climatological Data Transfer Project: The main goal of this study is to set up a methodology and a modelling system capable to determine the climatic exposure of buildings situated in a particular location of Switzerland, on the basis of corrected data obtained from the automatic meteorological station network "ANETZ". It has been observed that certain parameters, in particular wind velocity and direction, are perturbed by the proximity of other instruments, the presence of obstacles (trees, buildings), and the complexity of Swiss topography. Consequently, the first phase of the project consisted in visiting each station in the ANETZ network in order to draw up an inventory of potential problems. The second phase aims to establish corrections to the perturbed data mentioned above, while at the same time investigating the representativity of the ANETZ network. The corrections are determined by means of windtunnel tests on topographical models as well as on anemometers or special configurations of obstacles. The last step is to set up a numerical model which would provide the correct data from the network data base.
BUILDING TYPE
(Not Stated)
PARAMETERS
Wind and meteorological data.
STARTDATE 00:03:1987
ENDATE 00:12:1989
TIME 5000 person-hours
KEYWORDS
Climatological Parameters, Weather, Wind tunnel,
SELECTED BIBLIOGRAPHY
1 Hertig J-A, Ehinger J (1988), Analysis of the influence of topography on climatic exposure of buildings. 9th AIVC Conference, Gent.
2 Hertig J-A (1989), Quelques aspects de la simulation et des mesures du vent dans la couche limits atmospherique, Fach Kollokium 89/1, ISM-Zurich, LASEN-EPFL.
3 Hertig J-A, Ehinger J, Berney M, Alexandrou C (1990), Analyse de l'influence de la topographie sur les conditions d'exposition des batiments, Final Report to be published soon.

REF CH17
TITLE
Simplified Model With Database Of Computed Flow Fields.
CONTACT
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SPECIFIC OBJECTIVES
To develop a concept for a design tool to assess indoor airflow, thermal comfort and air quality in offices.
PROJECT DETAILS
A number of typical flow patterns are preculculated by PHOENICS flow code for small offices. Thermal comfort will be determined from air velocity, temperature, and turbulence intensity distributions. Using the new units for indoor air quality - the olf and decipol, indoor air quality can be calculated for the odours from occupants, books, floor, ceiling and walls. The computations also provide the distributions of contaminant concentration. The data base concerns different room sizes, space loads, and air supply locations with a displacement ventilation system. The influence of thermal source locations, air supply parameters such air velocity and temperature, and window size, etc. on airflow patterns are also discussed. The database will be compiled as a handbook with detailed theoretical analyses.
BUILDING TYPE
Office
PARAMETERS
Olf, Decipol, Contaminant concentration, comfort due to indoor air quality (percentage dissatisfied occupants).

STARTDATE 00:06:1989
ENDATE 00:12:1990
TIME 13 person-months
KEYWORDS
Airflow simulation, Thermal comfort, Indoor Air Quality (IAQ), Handbook, Odour, Occupant, Contaminant
SELECTED BIBLIOGRAPHY
1 Chen Q (1988), Indoor Airflow, Air Quality and Energy Consumption of Buildings, Ph.D Thesis (146 pages), Delft University of Technology, Delft, 1988.
2 Chen Q et. al. (1988), Measurements and computations of ventilation efficiency and temperature efficiency in a ventilated room, Energy and Buildings, Vol.12, No.2, pp.85-99, 1988.
3 Chen Q & Kooi J van der (1990), A methodology for indoor airflow computations and energy analysis for a displacement ventilation system, Energy and Buildings (in press) 1990.
4 Chen Q (1990), Construction of a low Reynolds number k-e model, The PHOENICS Journal of Computational Fluid Dynamics and Its Applications (in press), Vol.3, No.1, 1990.
5 Chen Q et. al. (1990), Prediction of natural convection in a room by a low-Reynolds-number k-e model, ASHRAE Transactions (in press), Vol.96, Part 1, 1990.
6 Chen Q (1989), Simplification principle and data base structure: a technical note for simplified model with data base of computed flow field. Paper presented in The Fourth Expert Meeting of International Energy Agency Annex 20 - Air Flow Patterns with Buildings, Lommel, Belgium, 1989.
7 Chen Q (1989), Comfort and energy consumption analysis in buildings with radiant panels, Energy and Buildings (in press), (This paper was presented in the Second CLIMA 2000 World Congress of Heating Ventilating, Refrigerating and Air-Conditioning, Sarajevo, 1989 and was awarded No.1 Best Poster by the Scientific Committee).

UNITED KINGDOM

REF UK1
TITLE
Modelling Of Air Movement Within Buildings
CONTACT
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SPECIFIC OBJECTIVES
To model the physics of airflow, driven by natural ventilation in domestic and industrial buildings.
PROJECT DETAILS
Mathematical and small-scale laboratory modelling (using water tanks) to investigate the physical processes relevant to air movement in buildings. Flow visualisation, predictions of flow patterns, measurements of flow velocities and temperature distributions. Development of an "expert-system" for use by architects and ventilation engineers.
BUILDING TYPE
Domestic, Commercial, "Atria"
PARAMETERS
Weather, performance of building components, effects of the heating systems
STARTDATE 00:00:1985
ENDATE ongoing TIME *(Not Stated)*
KEYWORDS
Ventilation, Airflow simulation, Modelling, Expert-system, Domestic, Industrial, Dwelling
SELECTIVE BIBLIOGRAPHY
1 P F Linden & J E Simpson (1985), Bouyancy driven flow through an open door AIR 6, pp4-5
2 G F Lane-Serff et. al. (1987), Transient flow through doorways produced by temperature differences Proceed. Room Vent 1987 Stockholm

REF UK2
TITLE
Review Of Volatile Organic Pollutants In Indoor Air
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SPECIFIC OBJECTIVES

To write a review of current knowledge concerning the native, incidence and health effects of volatile organic indoor pollutants.

PROJECT DETAILS

(None Stated)

BUILDING TYPE

Residential (House, Apartment), Commercial (Office block), School

PARAMETERS

(None Stated)

STARTDATE 00:10:85
ENDATE 00:11:89 TIME *(Not Stated)*

KEYWORDS

Dwelling, Commercial, School, Volatile organic compounds (VOC's), Air pollutants, Indoor Air Quality (IAQ)

SELECTIVE BIBLIOGRAPHY

1 DeBortoli M et. al. (1984), Environments and quality of life: inter- laboratory comparison of passive samplers for organic vapours with respect to their applicability to indoor air pollution monitoring - A pilot study. Commission of European Communities EUR 9450 (1984)

2 Lebret E, (1985), Air pollution in Dutch Homes. An explanatory study in environmental epidemology Dept of Air Pollution, Dept of Envir Tropical Health Wageningen Agricultural Univer R-138

3 IEA (1987), Energy conservation in buildings and community systems programme ANNEX IX "Minimum Ventilation Rates" Final report of working phases I & II (Nov 87).

REF UK3

TITLE

Airflow And Condensation Within Metal Decks Due To Mechanical Fixing Methods

CONTACT

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SPECIFIC OBJECTIVES

The measurement of air infiltration, condensation and the resultant corrosion effect on metal decks, with and without vapour barriers, in single membrane roofs and decks.

PROJECT DETAILS

Metal decks on air conditioned buildings are fixed with metal screws which pierce the vapour barrier and permit air and water passage along the screw to condense within the roof space. This phenomena is investigated and measured with a view to producing screw fastenings which will inhibit condensation and corrosion.

BUILDING TYPE

Metal deck and Purlins

PARAMETERS

Corrosion rates; Thermal losses due to condensation and saturation
STARTDATE 00:06:88
ENDATE 00:11:89 TIME *(Not Stated)*

KEYWORDS

Moisture, Condensation, Corrosion, Metal Decks, Metal Roofs, Vapour barriers

SELECTIVE BIBLIOGRAPHY

1 Building Research Estab. Digest (1987), Flat roof design: Thermal Insulation. Dec 1987, Digest 324.

2 Building Research Estab. Digest (1972), Condensation Digest 110,1972

3 Sarnafil (US) Inc (1987), Moisture control in single membrane roofs and decks.

REF UK4

TITLE

Flow In Doors And Stairwells

CONTACT

Littler, J, Riffat, S, Walker, J

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SPECIFIC OBJECTIVES

To measure airflows in 2-storey houses.

PROJECT DETAILS

Airflows were measured using two SF6 portable kits developed at the Polytechnic of Central

London, and by an energy monitoring company. Flows were measured in doorways and between floors of a 2-storey house, where the flow path was up and downstairs. Both were maintained at a variety of different temperatures.

BUILDING TYPE

2-storey houses (Residences)

PARAMETERS

Change in temperature

STARTDATE 00:00:1987

ENDATE 00:00:1989 TIME *(Not Stated)*

KEYWORDS

Dwelling, Residences, Tracer gas, Airflow, Openings

SELECTIVE BIBLIOGRAPHY

1 Riffat S B and Eid M (1988), Measurement of airflow between the floors of houses using a portable SF6 system. Energy and Buildings, No 12, 1988, p67-75.

REF UK5

TITLE

Moving And Cooling Air Without Use Of Energy *(Provisional title)*

CONTACT

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SPECIFIC OBJECTIVES

If the surface of the cavity wall is wet, the air, if unsaturated will move down the wall, because evaporation will cool the air. This is only the case if the air can enter at the top, and leave at the bottom. The air will then enter the room, providing ventilation and cooling, without the use of electricity.

PROJECT DETAILS

The wet surfaces within the cavity wall are provided by natural matting easily available in urban Egypt. Observations about the behaviour of the air within the cavity and the associated "theory" do not agree. Observations are complete, but analysis continues.

BUILDING TYPE

Traditional working class houses (Residences) in Cairo and climatically similar places.

PARAMETERS

The air entering the rooms to be ventilated will be cooler and moister than the air outside.

STARTDATE 00:00:1987

ENDATE 00:00:1989

TIME 2 person-years

KEYWORDS

Cavities, Ventilation, Cooling, Energy conservation, Air movement, Dwelling

SELECTIVE BIBLIOGRAPHY

1 PhD Thesis, Sept 1989

REF UK6

TITLE

The Solar Chimney

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SPECIFIC OBJECTIVES

To increase ventilation, when the air outside is cool enough to be used for ventilation, without the use of electricity.

PROJECT DETAILS

In Southern Algeria, as in many other Third World countries windows are kept closed throughout the day, as the air outside is too warm to be used for ventilation. When the outside temperature has dropped to about 30 Degrees Celsius windows are then opened. It is then, that the "solar chimney" is designed to help. It is simply a wall outside the sunward wall (the west wall, at low latitudes), joined at the bottom, to the room which is to be ventilated. The cavity is shuttered at both top and bottom during the day when the sun heats up the walls. To increase the ventilation, both shutters are opened, and the enclosed warm air escapes due to bouyancy. The flow of air continues until the solar warmth in the walls is exhausted. After a day's exposure to the sun, the solar chimney will work for 15 to 20 hours. Thus it can be used for much more than helping ventilation; such as the moving of air (for example, for the drying of agricultral produce) when there is no electricity. Bouchair and Fitzgerald have shown that the system works, and have shown how to develop the idea in a way that is both efficient and cheap, (remembering that it is intended for people living in the Third World).

BUILDING TYPE

Single storey buildings of stone, brick or other high thermal capacity material.

PARAMETERS

The nature of outdoor air itself.

STARTDATE 00:00:1986

ENDATE 00:00:1989 (completed)

TIME 2 to 3 person-years

KEYWORDS

Passive Solar energy, Energy conservation, Ventilation, Cavities, Airflow

SELECTIVE BIBLIOGRAPHY

1 A Bouchair et. al. (1987), Passive solar induced ventilation, 8th Miami Inter. Confer. on alternative energy sources, 1987.

2 A Bouchair, D Fitzgerld (1988), The optimum azimuth for a solar chimney in hot climates, Energy and Buildings, 1988, 12, pp135-40.

3 A Bouchair et. al. (1988), Moving air, using stored solar energy SOLAR '88 Proc 1988, Ann. Meeting, US Solar Energy Soc., CAM Mass. USA.

REF UK7

TITLE

Solar Induced Ventilation In The Algerian And Similar Climates

CONTACT

Bouchair, A

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SPECIFIC OBJECTIVES

To improve the thermal comfort, by promoting night ventilation using a sun-warmed cavity.

PROJECT DETAILS

The project was designed from a model (3 metres long; 2 metres wide and 2 metres high); constructed from various materials such as wood, insulation board and aluminum sheets. An electrically heated cavity provided the natural ventilation, which was measured by a thermistor-anemometer,in an unoccupied room. Observations were made under steady state conditions in a laboratory. The cavity had two heated-panelled walls of almost equal size, one fixed in position on the side of the room, while the other was movable. The end walls were variable in size and constructed from insulating board. A simulated room was constructed from wood. A data logging system was used, and theoretical predictions were made using heat and mass balances throughout the whole system, for both steady state conditions. In the unsteady state, the finite differences approach was used.

BUILDING TYPE

(Not Stated)

PARAMETERS

(Not Stated)

STARTDATE 00:10:1985

ENDATE 00:04:1989 TIME *(Not Stated)*

KEYWORDS

Ventilation, Cavities, Comfort, Hot climates, Passive solar, Unoccupied, Rooms, Scale model

SELECTIVE BIBLIOGRAPHY

1 Bouchair A et. al. (1989), Passive Solar Induced Ventilation. Proc. Miami, Inter. Confer. on alternative Energy Sources (8th 1987; Beach Florida) Alter Energy Sources VIII, ed. by Viziruglu Hemisphere Public Co., New York, (1989).

2 Bouchair A and Fitzgerald (1988), The optimum azimuth for a "solar chimney" in hot climates, Energy and Buildings, 12, pp135-140, 1988

3 Bouchair A et. al. (1988), Moving air using stored solar energy Proc 13th Nat Passive Solar Confer, CAM, Mass, ASES,pp33-38 1988

REF UK8

TITLE

The Development Of A System To Measure The Airtightness Of Buildings With Low Pressure Differences

CONTACT

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SPECIFIC OBJECTIVES
To develop a system for the measurement of airtightness of buildings at low pressure differences and to use the system to measure the airtightness of a number of other buildings.
PROJECT DETAILS
The purpose of the project is to construct an apparatus to measure the airtightness of a building using AC pressurisation (also known as infrasonic), to calibrate the method and apparatus using artifical leaks and other elements connected to a very stiff and airtight chamber, and to use the calibrated method to measure the airtightness of some buildings. Results from laboratory and field trials will be compared with results from fan pressurization.
BUILDING TYPE
All
PARAMETERS
(None Stated)
STARTDATE 01:06:1987
ENDATE 31:08:1991
TIME 8000 person-hours
KEYWORDS
Airtightness, Pressurisation, Infrasonic, Test chamber
SELECTIVE BIBLIOGRAPHY *(None Stated)*

REF UK9
TITLE
Energy Conservation, Natural Ventilation And Weathertightness Characteristics Of Buildings
CONTACT
Provan, T F & Younger, J D
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TEL +44 (041) 887 1241
FAX +44 (041) 887 0812
TLX 778951 PCT LIB
SPECIFIC OBJECTIVES
(See Project Details)
PROJECT DETAILS
Weathertightness of buildings has been an increasingly important aspect of building design with respect to air infiltration, water penetration and wind resistance. In recent years it has become apparent that the application of weathertightness criteria to building design, although achieving a better conservation of energy, has resulted in a reduction in natural ventilation and a greater risk of condensation and dampness. The purpose of these investigations is to measure the differences between weathertightness and natural ventilation criteria, in order to achieve a better balance between energy conservation needs and ventilation requirements.
BUILDING TYPE
All, and all components (windows, doors; openings etc.)
PARAMETERS
Weather (temperature; pressure; velocity); performance standards
STARTDATE 01:06:1984
ENDATE ongoing
TIME *(As appropriate)*
KEYWORDS
Airtightness, Energy conservation, Natural ventilation, Moisture, Infiltration rate, Dwelling, Industrial, Commercial
SELECTIVE BIBLIOGRAPHY

1 Provan T F and Younger J D (1985), Weathertightness of windows, Building Technical File, 10,pp57-58
2 Provan T F and Younger J D (1986), Air Infiltration Characteristics of windows Energy and Buildings, 9(4), pp281-92.
3 Provan T F and Younger J D (1986), Weathertightness and Natural Ventilation Characteristics of windows, Proc. of symposium on Air infiltration and moisture transfer BTECC, Fort Worth, Texas, pp420-432, Dec 1986
4 Provan T F and Younger J D (1988), Airtightness of windows- Energy conservation versus Natural Ventilation Building, Tech File, 22, pp65-69.
5 Downey E and Provan T F (1986), Energy conservation - side effects of reduced ventilation rates and increased ventilation, Building Tech File, 13, pp63-4.

REF UK10
TITLE
Aerial Pollutants And Livestock Welfare
CONTACT
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SPECIFIC OBJECTIVES

To investigate factors that reduce dust concentrations in livestock buildings.

PROJECT DETAILS

The investigation included methods and equipment for cleaning air in livestock buildings, but due to the Government's new market-review of research this has had to be curtailed. The study now includes the factors which contribute to the dust laden atmosphere and ways of reducing the dust level by methods other than separation.

BUILDING TYPE

Intensive livestock buildings, which are mechanically ventilated.

PARAMETERS

Feeding system, flooring type, animal activity, ventilation and husbandry tasks.

STARTDATE 01:04:1988 *(Current phase)*
ENDATE 31:12:1992
TIME 250 person-days / year

KEYWORDS

Livestock, Dust, Indoor Air Quality (IAQ)

SELECTIVE BIBLIOGRAPHY

1 Carpenter G A (1986), Dust in livestock buildings - a review of some aspects. J. Agric.Enging.Res 33,pp227-41.
2 Carpenter G A et. al. (1986), The effects of air filtration on air hygiene and pig performance in early winter accommodation Animal Prod 43, pp505-15.
3 Carpenter G A et. al. (1986), Effect of internal air filtration on the performance of broilers and the aerial concentrations of dust and bacteria, British Poultry Sci 27, pp471-80.

REF UK11

TITLE

Investigate The Effectiveness Of Current Provisions For Ventilation Of Wall, Floor And Roof Cavities Of Housing

CONTACT

Gaze, Andrew

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SPECIFIC OBJECTIVES

To measure the airflows in/through timber framed wall cavities; suspended timber floors and in roof spaces. To obtain more precise basis for the provision and location of ventilation openings.

PROJECT DETAILS

1 Literature survey to collate information on building regulations and good practice for walls, floors and roofs; and to review other research.
2 Carry out mathematical modelling to provide a broad framework for on-site tests; review models after test work is completed
3 Carry out on-site measurement of test houses under a variety of wind and temperature conditions and to determine what airflows and ventilation rates take place; also to assess the effects of changing ventilation provision on ventilation rates; using Freon 12 tracer gas and parallel column portable gas chromatograph (UMIST).

BUILDING TYPE

Timber frame and traditional housing (Residences)

PARAMETERS

Temperatures, humidity, wind speed and direction

STARTDATE 00:10:1986
ENDATE 00:09:1989
TIME 1000 person-hours

KEYWORDS

Cavities, Timber, Attic, Freons, Tracer gas, Survey, Dwellings

SELECTIVE BIBLIOGRAPHY

1 Alderson A and Gaze A (1988), Requirements for ventilation of cavities in buildings, June 88, TRADA Report No BD/88/6.
2 Edwards R E (1989), The measurement of cavity wall ventilation rates, Dept. of Building Enginering, UMIST, P O BOX 88, Sackville Street, Manchester M60 14D Jan 89.
3 Edwards R E (1989), Wall cavity ventilation rate measurements. Peterborough (address as above) April 1989.
4 Edwards R E (1989), Measurements of sub-floor ventilation rates in a low energy test house. (Address as above) Jan 1989.

5 Edwards R E (1988), Ventilation and air movement rates in timber frame cavities - Report work carried out during the 1987-88 heating season. (Address as above) April 1988.
6 Hall R C & Atkins W S (1987), TRADA - Building sub-floor cavity airflows, Eng. Sci, Woodcote Grove, Ashley Road, Epsom, Surrey KT18 5BW, Sept 1987

REF UK12

TITLE

Handling Of Convective And Radiative Exchange In Enclosed Spaces

CONTACT

Davis, M G

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SPECIFIC OBJECTIVES

(None Stated)

PROJECT DETAILS

Heat is transferred within an enclosed space both by convection and radiation; neither dominates the other. Heat flow to the walls by convection is driven by volume-averaged air temperature, (Tav). The radiative exchange is much more complicated, but work under this project has shown that the radiant exchange can be handled as though "driven" by the radiant star temperature, (Trs), a network construct, that radiant energy input can be treated as though input at (Trs), and that (Trs) is a fair approximation to the average observable radiant temperature in the enclosure. Two index temperatures can be derived from (Tav) and (Trs): (i) The rad-air temperature, (Tra); this is a low impedance node and Tra can be said to drive the ventilation loss to outside and merged convective and radiation losses to solid surfaces (ii) The comfort temperature, (Tc); this is a high impedence node and is often taken to be the arithmetic mean of (Trs) and (Tav). This scheme provides a logically rigorous approach to handling room heat exchange.

BUILDING TYPE

(Not Stated)

PARAMETERS

Air and radiant temperatures; ventilation rate and local convective coefficients

STARTDATE *(Not Stated)*

ENDATE ongoing TIME *(Not Stated)*

KEYWORDS

Radiant exchange, Comfort, Temperature, Ventilation rate

SELECTIVE BIBLIOGRAPHY

1 Davis M G (1983), Optimum design of resistive and capacitative elements in modelling a sinusoidally excited building wall, Building and Environment, 18, pp19-37.
2 Davis M G (1987), Room internal heat exchange:a new design method, Build Serv. Eng. Res. Tech 8, pp47-60.
3 Davis M G (1989), design models to handle radiation and convection exchange in a room, ASHRAE Trans, vol 94 Pt 2, pp173-95.
4 Davis M G (1989), Rad-air temperature - the global temperature in an enclosure, Building Services Engineering Research and Technology, to appear in Vol 10, No 2.

REF UK13

TITLE

Ventilation And Purging

CONTACT

Marshall, M R

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UNITED KINGDOM.
TEL +44 (021) 705 7581
FAX +44 (021) 704 5203
TLX 339128

SPECIFIC OBJECTIVES

To understand gas mixing and dispersion and the effect of ventilation on this process.

PROJECT DETAILS

The build up of gas (mainly natural gas, possibly propane) following a release into a variety of enclosures is measured for a range of conditions. A test facility off-site includes a full-scale house, domestic kitchen, 20 m^3 cubic test cell, etc. The information collected provides input into codes of practice which specify the minimum ventilation rates for British Gas plant to reduce the potential hazard of gas releases. The project also studies the purging of pipes in

order to minimise the accumulation of flammable gas-air mixture within.
BUILDING TYPE
Full scale housing, domestic kitchen 20 m^3 test cell, etc
PARAMETERS
Air within enclosures affects gas concentration buildup, flow of air within, and weather.
STARTDATE 00:04:1985
ENDATE 00:04:1992
TIME 25 person-years
KEYWORDS
Natural gas, Vented, Airflow
SELECTIVE BIBLIOGRAPHY
1 Marshall M R (1983), The effect of ventilation on the accumulation and dispersal of hazardous gases. A paper presented at the 4th inter. symposium on loss prevention and safety promotion in the process industries, Harrogate, 12-16th Sept, 1983.

REF UK14
TITLE
Air Infiltration Into Modern, Small Factory Units
CONTACT
Fletcher, B
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Yorkshire, S3 7HQ.
UNITED KINGDOM.
TEL +44 (0741) 304240
FAX +44 (0741) 3034
SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
(i) Sizes 170-700 m^3 usually brick built with block interior. (ii) Unventilated. (iii) Tracer gas decay method (R-12). (iv) Micron infrared gas analyser. (v) Unoccupied. Factory units are in different blocks; infiltration to be related to the weather factor, (ie Wind speed and direction, temperature differences) Follow up work carried out in large exposed workshop.
BUILDING TYPE
Modern factory block, single storey (commercial)
PARAMETERS
Wind speed and direction, temperature difference
STARTDATE 00:00:1988
ENDATE 00:12:1989
TIME *(None Stated)*
KEYWORDS
Factory, Unoccupied, Tracer gas, Air infiltration
SELECTIVE BIBLIOGRAPHY *(None Stated)*

REF UK15
TITLE
Air Leakage Identification, Quantification, And Control On Industrial And Commercial Buildings
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UNITED KINGDOM.
TEL +44 (081)-398-2390
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SPECIFIC OBJECTIVES
On commercial basis provide air leakage control services to customers with comfort or energy problems.
PROJECT DETAILS
All types of buildings handled, with and without mechanical ventilation. Heating by oil, gas, district hot water, etc. Buildings almost always occupied. Leakage usually visually identified with use of a smoke pencil. If necessary a part of a building (eg an exterior wall office) can be depressurised using our blower door to highlight the air leakage. Having identified all rectifiable leakage cracks, gaps and holes in the envelope an equivalent leakage area is calculated using Ashrae and Public Works Canada formulae. Based on windage only an average air leakage is calculated and using degree days a yearly cost of leakage is calculated. A cost to rectify is provided and a simple payback period.
BUILDING TYPE
Mainly offices and commercial
PARAMETERS
Temperature and wind energy usage, Staff Comfort Reduction infill air contaminents
STARTDATE Canada 00:06:1970; UK 00:10:1986
ENDATE Ongoing TIME Ongoing
KEYWORDS
Commercial, Office, Air leakage, Comfort, Depressurisation, Tracer gas, Occupant

behaviour, Energy, Heating System, ventilation system

SELECTIVE BIBLIOGRAPHY

1 Ashrae Handbook of Fundamentals. 2 Ashrae Systems Handbook. 3 Public Works Canada Standards and Guidelines EC 128 1980-04-30.

REF UK16

TITLE

Ventilation In Dwellings

CONTACT

Stephen, R K

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FAX +44 0923-664010
TLX 923220

SPECIFIC OBJECTIVES

To provide information on air movement and air leakage rates and routes in dwellings. To provide design guidance in relation to natural and mechanical ventilation on air movement and the control of pollutants. To contribute to various codes and standards.

PROJECT DETAILS

1 Investigate the effectiveness of ventilation openings using models and field trials, including air leakage and tracer gas measurements. 2 Develop BREVENT model to provide advice on ventilation provisions 3 Develop test procedure for, and carry out measurements of, the flow characteristics of ventilation openings. 4 Investigate various aspects of draughtproofing of doors and windows. 5 Carry out program of field trials and modelling of passive stack ventilation systems in dwellings. 6 Investigate factors affecting entry of radon and landfill gases into buildings and the implications for ventilation design.

BUILDING TYPE

Residences

PARAMETERS

Wind, temperature, draughtproofing, air leakage, location

STARTDATE *(Not Stated)*

ENDATE *(Not Stated)*

TIME *(Not Stated)*

KEYWORDS

Dwelling, Air infiltration, Air leakage, Draughtproofing, Passive stack ventilation, Computer simulation, Radon, Landfill gas

SELECTIVE BIBLIOGRAPHY

Various Publications Consult AIVC - Airbase under Building Research Establishment and Authors: P R Warren, B C Webb, R K Stephen, C E Uglow, L M Parkins, R R Walker, M D A E S Perera

REF UK17

TITLE

Development Of A Computational Fluid Dynamics Program (ARIA), For Air Distribution Design

CONTACT

Awbi, H B

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Mechanical and Industrial Eng. Dept,
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SPECIFIC OBJECTIVES

To develop and validate a three-dimensional CFD program for simulating the airflow inside and outside buildings.

PROJECT DETAILS

The finite volume method is used to solve, by iteration Navier-Stoke's equation, the enthalpy equation, and a concentration equation in a three-dimensional co-ordinate system. The k - epsilon turbulence model is used to describe the Reynolds stress and the turbulent heat fluxes. The output is in the form of velocity vectors in 2-D slices and 3-D view; velocity, temperature, and concentration colour contours etc. Validation has been carried out on some flow problems.

BUILDING TYPE

N/A

PARAMETERS

N/A

STARTDATE 00:01:1985

ENDATE Indefinite

TIME 10000 person-hours (to date)

KEYWORDS

Computer simulation, Fluid dynamics, Airflow simulation, Heat transfer

SELECTIVE BIBLIOGRAPHY

1 H B Awbi & A A Setrak (1986), Numerical solution of ventilation air jet, Proc. 5th Inter. Synpos. on the use of computers for Environmental Engineering Related to Buildings, July 1986, Bath, England.
2 H B Awbi & A A Setrak (1987), Air jet interference due to ceiling mounted obstacles, Proc. Roomvent '87, Stockholm, June 1987.
3 H B Awbi (1989).Application of CFD in room ventilation, J. Build. & Envion. Vol24, pp73-84, 1989
4 H B Awbi & A A Setrak (1989), Numerical solution of wall jet, to be published in the ASHRAE Trans 1989.
5 H B Awdi & A A Setrak (1989). Numerical Solution of Air Jet with Ceiling Mounted Obstacles, to be presented at CLIMA 2000, August 27th, 1989, Yugoslavia.
6 H B Awbi & Neri (1989), Scale effect in room air movement modelling, to be presented at CLIMA 2000.

REF UK18

TITLE

Wansbeck General Hospital - Ashington

CONTACT

Haworth, John / Throp, Bernard

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SPECIFIC OBJECTIVES

300 bed district general hospital - value 21m. To design a low energy hospital to consume 40% of the energy of a "normal" hospital, St Mary's Hospital, Isle of White. The first low energy hospital was designed to consume 50% of normal.

PROJECT DETAILS

a) i) Ventilation is a combination of natural and mechanical. Building envelope is designed for 0.6 air changes per hour infiltration. In winter windows are closed and 1 A/C mechanical ventilation is provided to give 1.5 A/C total. The winter ventilation plant is provided with heat recovery.

ii) When first template is complete on site, it will be pressure tested to determine leakage.

b) A building envelope design incorporating an airtight membrane has been developed. A mock up was constructed and tested to validate the design.

BUILDING TYPE

District General Hospital

PARAMETERS

It is hoped that 0.5 A/C infiltration plus 1.0 A/C mechanical ventilation will provide acceptable indoor air quality without opening windows.

STARTDATE On site 05:06:1989

ENDATE 04:06:1992

TIME *(Not Stated)*

KEYWORDS

Hospital, Low-energy, Ventilation system, Indoor Air Quality (IAQ), Airtightness

SELECTIVE BIBLIOGRAPHY

1 The second low energy hospital study report.

REF UK19

TITLE

Measurements Of Airflow In Ducts Using Tracer Gas Techniques

CONTACT

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UNITED KINGDOM.
TEL +44 0509-262171 ext. 2616
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TLX 347282

SPECIFIC OBJECTIVES

Measurement of airflow in ducts using tracer gas techniques.

PROJECT DETAILS

The work is concerned with the use of different types of tracer gas techniques for measurement airflow in ducts. Measurement of tracer gas concentration, air velocity and pressure distribution at various distances from the duct's wall and inlet were made. Measurements of airflow were made using constant injection, pulse injection, and decay techniques are compared with measurements made using hot-wire anemometers and pitot tubes.

BUILDING TYPE

Ducts

PARAMETERS

Duct:- Airflow rate at different Reynolds numbers.

STARTDATE 00:00:1988
ENDATE 00:00:1990
TIME 100 person-hours
KEYWORDS
Tracer gas, Ducts, Airflow, Pressure tests, Air velocity
SELECTIVE BIBLIOGRAPHY
1 Measurement of turbulent flow in a duct using a tracer gas technique. To be published in BSER & T, Vol 11, No1, 1990.
2 A comparison of tracer gas techniques for measuring air flow in a duct. To be published in J. Inst. of Energy.

REF UK20
TITLE
Modelling Of Three Dimensional Conjugate Convection-Conduction Heat Transfer Processes And Turbulence In Building Spaces
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SPECIFIC OBJECTIVES
Prediction of air movement and thermal cells in mechanically and non-mechanically ventilated spaces.
PROJECT DETAILS
Three-dimensional conjugate convection/conduction model using classical Navier-Stokes equation set with k - epsilon turbulence model and standard logarithmic wall functions. Applicability of simple constant effective viscosity model will be explored in low Reynold's number applications, in relation to the less computer efficient k - e model. Particular interest in thermal influence of adjacent zones on air movement in a central subject zone, and the geometry and positional design of mechanical air terminal devices. Limited model verification intended using existing data sets produced by other workers.
BUILDING TYPE
Any (with an emphasis on commercial)
PARAMETERS
Climate data, performance of building components and (of greater emphasis here) HVAC system.
STARTDATE 00:01:1988
ENDATE 00:09:1991
TIME 5000 person-hours
KEYWORDS
Airflow simulation, Thermal simulation, Commercial, Heating system, Ventilation system, Air outlet
SELECTIVE BIBLIOGRAPHY *(Not Stated)*

REF UK21
TITLE
Development Of A Microprocesser Controlled Tracer Gas System And Measurement Of Ventilation In A Scale-Model
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TLX 347282
SPECIFIC OBJECTIVES
Development of a microprocessor controlled tracer gas system which is capable of collecting a large number of tracer gas samples at short or long intervals.
PROJECT DETAILS
The work is concerned with the development of a tracer gas system which could be used for accurate measurement of airflow through openings, e.g. cracks, windows and doorways. The sampling speed of the system can be adjusted so that a larger number of tracer gas samples can be collected during the transient period of an experiment and smaller number during the dominant period. This technique minimises the error in the term dC/dt (Delta C over Delta t) and hence allows an accurate estimation of airflow rate to be made. Measurement of window ventilation and interzone air movement have been made in a scale model.
BUILDING TYPE
Scale model of a house
PARAMETERS

Wind speeds and direction, and area of the windows
STARTDATE 01:10:1988
ENDATE 01:10:1990
TIME 120 person-hours
KEYWORDS
Tracer gas, Ventilation, Scale model, Multizone, Airflow
SELECTIVE BIBLIOGRAPHY
1 Development of a microprocessor controlled tracer gas system and measurement of ventilation in a scale model - 10th AIVC Conf. Finland, 1989.

REF UK22
TITLE
Newham Hybrid Solar Roofspace Heating System
CONTACT
Tindale, Andrew
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Polytechnic of Central London,
Research Building,
35 Marylebone Road,
London, NW1 5LS.
UNITED KINGDOM.
TEL 01 486 5811
SPECIFIC OBJECTIVES
To demonstrate the effectiveness of solar roofspace technology in the UK
PROJECT DETAILS
Six 35m^2 floor area two storey houses in Plaistow, East London, were retrofitted with solar roofspace heating systems. The houses are inter-war local authority with solid floors and cavity filled walls, double glazed and fully draughtstripped. Ventilation tests played a relatively minor role in the experimentation. Three ventilation assessment techniques were used on the houses, each with a different objective: 1) Pressurisation tests to give relative uniformity of roofspaces and house construction. 2) Tracer gas tests gave absolute values of ventilation in one house and roofspace and 3) Air speed measurements showed solar heated air delivery rates.
BUILDING TYPE
Local authority residential, inter-war, brick
PARAMETERS
State of various vents (automatically and manually operated)
STARTDATE 00:00:1985
ENDATE 00:06:1989
TIME 6300 person-hours (approx)
KEYWORDS
Solar energy, Roof-spaces, Passive solar, Tracer gas, Pressurisation
SELECTIVE BIBLIOGRAPHY
1 A Tindale & J Littler (1988), Passive solar roofspace systems: Performance over one heating season in the UK, PLEA Conference Proceedings, July 1988 Published by Pergamon Press.
2 A Tindale et. al. (1989), Hybrid solar roofspace heating systems Final report to CEC, August 1989.
3 A Tindale, & J Littler (1989), Passive solar roofspace heating systems in the UK, ASES Conference proceedings, Colorado, June 1989.
4 C J Hancock & J Littler (1987), A hybrid solar roofspace system - performance Analysis Conference proceedings 1987, European Conference of Architecture, Published by M S Stephen.

REF UK23
TITLE
Ventilation In Non-Domestic Buildings.
CONTACT
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SPECIFIC OBJECTIVES
To develop, validate and provide methods for measuring ventilation and controlling infiltration in large and complex non-domestic buildings and to identify the factors which determine the magnitude of natural ventilation.
PROJECT DETAILS
a) To measure leakage characteristics of large non-domestic buildings using the multifan pressurising system, BREFAN. b) To measure ventilation rates in large buildings using the BRE simplified infiltration measurement (BRESIM) technique. c) To develop passive techniques, using perfluorocarbons, to measure average infiltration and ventilation rates. d) To measure infiltration rates and air tightness of large, single-celled buildings and compare with prediction procedures. e) To measure

ventilation effectiveness in office buildings. f) To establish surface pressure-coefficient database from wind tunnel measurements and to enhance the user-friendly BREEZE multicell airflow computer program.

BUILDING TYPE

Large non-domestic commercial and public buildings

PARAMETERS

Wind, temperature, draughtproofing, air leakage

STARTDATE *(Not Stated)*

ENDATE *(Not Stated)*

TIME *(Not Stated)*

KEYWORDS

Non-domestic, Air infiltration, Air leakage, Multicell computer simulation, Tracer gas, Passive perfluorocarbon techniques (PFT), Pressurisation

SELECTED BIBLIOGRAPHY

Various publications - Consult AIVC Airbase under: Oglesby O D; Perera M D A E S; Stephen R K; Tull R G; Walker R R; Warren P R

REF UK24

TITLE

Extension Of The ESP Zonal Method To Plant-Side Fluid Flow Simulation

CONTACT

Clark, Joe & Hensen, Jan

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TLX 77472 (unslib g)

SPECIFIC OBJECTIVES

To extend ESP's zonal mass balance technique as applied to building airflow to the plant-side fluid flows.

PROJECT DETAILS

Since the early 1980's the ESP system has been equipped to perform building air flow simulation based on a zonal mass balance technique. This project aims to extend this facility in two related aspects: 1 To improve the speed of convergence of the solution of the non-linear flow equations. 2 To extend the approach by the introduction of additional characteristic equations to represent plant-side flow regimes. The objective is to produce a simultaneous solution of the fluid and thermal processes associated with the building and its plant.

BUILDING TYPE

Any

PARAMETERS

Ambient conditions (temperature wind speed and direction) exposure (pressure coefficients), leakage distribution, fluid properties and mechanical inputs.

STARTDATE 00:00:1989

ENDATE 00:00:1991

TIME 2000 person-hours

KEYWORDS

Energy simulation, Fluid flow, Pressure distribution, Leakage distribution, Multizone

SELECTED BIBLIOGRAPHY

1 Clarke J A & Hensen J L M (1989), An approach to the simulation of heat and fluid flow in buildings, ESRU Technical Report, University of Strathclyde, Glasgow, 1989

REF UK25

TITLE

Infiltration And Air Change Studies In Large Single Cell Buildings

CONTACT

Waters, J R

ADDRESS

Dept. of Civil Engineering and Building,
Coventry Polytechnic, Priory Street,
Coventry, CV1 5FB,
UNITED KINGDOM.
TEL +44 0203 631313
FAX +44 0203 258597
TLX 9312102228 (CPG)

SPECIFIC OBJECTIVES

1 To determine the validity of the multizone model as a tool for measuring and predicting air movement patterns in industrial buildings, and 2. To determine the indices of air change efficiency and ventilation effectiveness which are most suitable for describing air quality in industrial buildings.

PROJECT DETAILS

The theory of the multizone model is being studied in order to determine the best method of extracting interzone flow rates from tracer gas measurements, especially when there are limitations on the number of tracers which can be used. Tracer gas measurements on laboratory models are being carried out to provide (i) data to validate the theoretical work, (ii) comparisons between methods of measuring air change efficiency, and (iii) a test bed facility for measurement techniques. The project includes a program of field measurements in industrial buildings.

BUILDING TYPE

Large single cell/industrial

PARAMETERS

Size of zone, and subdivision of zone.

STARTDATE 00:09:1987

ENDATE 00:09:1992

TIME 12000 person-hours

KEYWORDS

Infiltration, Tracer gas, Scale model, Ventilation effectiveness, ventilation efficiency, Air movement, Air change rates, Industrial

SELECTED BIBLIOGRAPHY

1 Waters J R & Simons M W (1987), The evaluation of contaminant concentrations and airflows in a multizone model of a building. Building and Environment, Vol.22, part 4, 305-315, 1987.

2 Lawrence G V & Waters J R (1987), Measurements of Infiltration and air movement in five large single cell buildings. 8th AIVC Conference, September 1987.

3 Waters J R (1987), Ventilation in Industrial Buildings, Final Report, Coventry Polytechnic, June 1987.

REF UK26

TITLE

Improvement In The Working Environment

CONTACT

Winch, G W

ADDRESS

University of Manchester,
Dept. of Architecture,
Manchester, M13 9PL.
UNITED KINGDOM.
TEL +44 061 275 6934

SPECIFIC OBJECTIVES

Instrumented studies of work spaces to secure improvement in air quality and thermal comfort.

PROJECT DETAILS

Quantiative studies of various work spaces to analyse problems and assess causative factors and remedial measures, e.g. airborne particulates and gaseous contaminants, air temperature and motion, air humidity, surface temperatures, ventilation rates, noise levels, lighting levels, etc.

BUILDING TYPE

All types

PARAMETERS

Ventilation rate, thermal comfort, contaminant levels, energy factors.

STARTDATE 01:01:1974

ENDATE ongoing TIME *(Not Stated)*

KEYWORDS

Health, Environment, Sick Building Syndrome (SBS), Retrofit, Solar radiation, Indoor Air Quality (IAQ), Thermal comfort, Energy conservation

SELECTED BIBLIOGRAPHY

1 Winch G R & Tuxford A F (1985), Environmental surveys for comfort and health. Proc. CIBSE Tech.Conf. Birmingham UK 1985.

2 Winch G R & Tuxford A F (1982), A base study of working conditions in the Pharmaceutical Industry. G.R. Proc. International Environment and Safety Conf. UK 1982

REF UK27

TITLE

Airflow Characteristics Of Buildings.

CONTACT

Croome, D J & Yusof, M Z M

ADDRESS

University of Reading,
Dept of Construction Management,
Whiteknights,
P O Box 219, Reading RG6 2BU,
UNITED KINGDOM.
TEL +44 0734 875123
FAX +44 0734 313856
TLX 847813

SPECIFIC OBJECTIVES

In order to plan buildings the interaction between energy and environmental parameters needs to be understood. This includes the effect of occupants. The airflow characteristic is defined by the entrance, corridor, door and window interaction. Between all shut and all open, there are a range of conditions that can occur which effect comfort and energy. This research programme is aiming to carry out field trials in several different types of building and:
(i) Explore the interaction between ventilation with occupancy patterns and internal buildings

form. (ii) Test various modelling techniques and develop one method which can be incorporated into a design method. (iii) Compare measurements of air change rate and air movement with prediction. (iv) Assess the thermal comfort in the selected spaces based on ISO 7730 but also derive a freshness component. (v) Study the relationship between weather patterns and indoor air patterns.

PROJECT DETAILS

a) Measurement in building: (i) brick type construction; (ii) naturally ventilated, and hot water radiators, (iii) tracer gas measurements, temperature, air velocity and comfort level measurements, (iv) instrumentations: thermistors for temperature, constant temperature anenometer for room air velocity, thermal comfort meter and indoor environmental analyser. Infra-red gas analyser for ventilation measurement. Data Logging system, (v) type of occupancy: occupied and unoccupied. b) Theoretical/model calculations using existing methods/model, such as the BRE and LBL models.

BUILDING TYPE

Schools

PARAMETERS

a) weather (temperature, window humidity, solar radiational, b) windows and doors,
c) occupancy patterns (real and simulated)
d) building orientation

STARTDATE 00:03:1989
ENDATE 00:09:1993
TIME *(Not Stated)*

KEYWORDS

Natural ventilation, Airflow, Occupant behaviour, Thermal comfort Energy conservation, Air change rates

SELECTED BIBLIOGRAPHY.

1) Yusof M Z M & Croome D J (1990), Building Planning and Ventilation: Effects of Natural Ventilation via Windows and Doors linked by Corridor/Passageway, (to be presented at Roomvent 90 International Conference in Oslo, 13-15 June 1990)

REF UK28

TITLE

Patterns Of Air Movement In Spaces.

CONTACT

Croome, D J

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FAX +44 0734 313856
TLX 847813

SPECIFIC OBJECTIVES

To define mean velocity, turbulence, standard deviation and periodicity for airflow in rooms due to fans, windows and natural convection sources.

PROJECT DETAILS

This work will be extended to cover auditoria. A revised air movement design procedure will be evolved.

BUILDING TYPE

Theatres, cellular places

PARAMETERS

Airflow

STARTDATE 00:00:1985
ENDATE 00:00:1989
TIME 9600 person-hours

KEYWORDS

Theatre, Airflow, Natural convection, Window, Air movement

SELECTED BIBLIOGRAPHY *(None Stated)*

REF UK29

TITLE

Design And Performance Of Radiant Heating Systems In Factories.

CONTACT

Croome, D J

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UNITED KINGDOM.
TEL +44 0734 875123 TLX 847813

SPECIFIC OBJECTIVES

In conjunction with Grayhill-Blackheat a survey of 20 factories will be made to compare energy and comfort performance. Air movement will be one aspect of this.

PROJECT DETAILS

(Not Stated)

BUILDING TYPE

Factories

PARAMETERS

Energy, Comfort and Air movement
STARTDATE 00:00:1986
ENDATE 00:00:1990
TIME 19200 person-hours
KEYWORDS
Factory, Energy consumption, Air movement, Thermal comfort
SELECTED BIBLIOGRAPHY *(None Stated)*

REF UK30
TITLE
Airflow Modelling Using Computational Fluid Dynamics.
CONTACT
Whittle, Geoff E
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Arup Research and Development,
13, Fitzroy Street, London, W1P 6BQ.
UNITED KINGDOM.
TEL +44 071 636 1531 ext. 3437
FAX +44 071 436 7109
TLX 295341 OVARPT G
SPECIFIC OBJECTIVES
To develop computational fluid dynamics (CFD) methods for airflow modelling in buildings.
PROJECT DETAILS
An in house CFD code (AIRFLO) is under development to predict air movement, temperature distribution and ventilation effectiveness in buildings. The code is a finite volume, Navier Stokes solver which uses a pressure coupled formation. Applications include most types of non-domestic buildings, including offices, large spaces such as atria and process environments. Areas of specific modelling interest include turbulence, improving convergence rate for (High Rayleigh number), buoyant flows, transient simulation for inherently non-steady flows, interaction with (dynamic) thermal model and improving useability.
BUILDING TYPE
Non-domestic buildings
PARAMETERS
Building geometry, fabric, system, weather
STARTDATE 00:04:1988
ENDATE Ongoing (Reviewed annually)
TIME 1600 person-hours / year
KEYWORDS
Air movement, Temperature distribution, Fluid Dynamics, Airflow
SELECTED BIBLIOGRAPHY
1 Whittle G E et. al. (in preparation) Comutation of conduction, convection and radiation in the perimeter zone of an office space.

REF UK31
TITLE
The Development Of A Methodology For The Categorisation Of Ventilation Systems.
CONTACT
Limb, Mark
ADDRESS
Air Infiltration And Ventilation Centre,
University of Warwick Science Park,
Barclays Venture Centre,
Sir William Lyons Road,
Coventry, CV4 7EZ,
UNITED KINGDOM.
TEL +44 0203 692050
FAX +44 0203 416306
SPECIFIC OBJECTIVES
The aim is to examine the ventilation systems typically used in different regions of the world, and try to relate their characteristics, to the ventilation design criteria, building type and climate of that region.
PROJECT DETAILS
The project falls naturally into 4 sections:
1 - Ventilation Design Criteria. This section will review national codes and standards, with the aim of identifying present environmental criteria used for the design of ventilation systems.
2 - Regional Climate. This section will identify a climatic classification system, which will allow the characterisation of climatically similar areas in a manner appropriate to building design.
3 - Construction Methods. This section will highlight the construction methods currently employed in various climatically similar areas.
4 - Ventilation Systems. The final section will be the most substantial and constitute the greater part of the work. Firstly methods of providing ventilation will be surveyed, and systems will be classified by the methods air is introduced, circulated and extracted from the building. A survey will be circulated in order to obtain the information for this section. A preliminary classification of systems will be adopted initally, and changed in the light of replies. Secondly parameters will be sought which will provide an adequate description of the systems, such as parameters that can be used to establish

ERRATA

AIVC's Survey of Current Research Into Air Infiltration and Ventilation, 1990.

PAGE	CODE	CORRECTION
49	CA4	TEL +1 514 288 0998
50	CA6	TEL +1 416 822 4111 ext 545
52	CA11	TEL +1 514 848 3186
59	CA14	Organisation - UNIES Ltd.
64	DK6	Contact - Bergsoe N. C.
70	SF8	TEL +358 0 451 3592
79	I1	FAX +39 11 556 7499
85	NL10	Contact - 1) Van Dongen
89	S2	TEL +46 33165505
98	CH3	Contact - Maas Koos van der
106	UK1	Contact - Linden P. F.
113	UK14	TEL +44 0742 304242/FAX +44 0742 3034
115	UK19	TEL +44 0509 263171
119	UK26	Contact - Winch G. R
119	UK27	TEL +44 0734 318197
120	UK29	TEL +44 0734 318197
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134	USA16	Address - University of Kentucky
134	USA17	Address - University of Tennessee
135	USA18	TEL +1 404 894 3825
135	USA19	Contact - Pedersen C.O.
136	USA21	Address - University of Kentucky
146	F4	TEL +33 1 64 68 82 82
157	K1	Contact - Daoud, Osama E.K.

correlations with building type, climate classification and regional characteristics. Thirdly, the comparisons which provide the strongest correlations will be used to prepare a general ventilation classification system which can be used by designers to identify the most favourable strategy for a specific design problem.

BUILDING TYPE

All

PARAMETERS

Ventilation systems, Ventilation design criteria, Climatic parameters Construction methods.

STARTDATE 00:10:1989

ENDATE 00:06:1992

TIME 2800 person-hours

KEYWORDS

Ventilation systems, Ventilation strategies, Survey, Climatic parameters

SELECTED BIBLIOGRAPHY

1 Elmroth A & Levin P (1983), Air infiltration control in housing - A guide to international practice. Pub IEA\AIVC Swedish council for building Science.

2 Colthorpe K (1990), A review of building airtightness and ventilation standards. Pub. IEA\AIVC publication (In print)

REF UK32

TITLE

Air Infiltration And Ventilation Centre's Numerical Database.

CONTACT

Piggins, James

ADDRESS

Air Infiltration and Ventilation Centre,
University of Warwick Science Park,
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Coventry, CV4 7EZ,
UNITED KINGDOM.
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FAX +44 (0203) 416306
TLX 312401

SPECIFIC OBJECTIVES

To produce a numerical database of air infiltration and ventilation related information.

PROJECT DETAILS

This project will produce a numerical database of core data from as many available sources as possible, and present them in an easily accessible form for use by researchers and specialist consultants. The whole database will be available on disc and selected portions in printed form. The subject areas covered will be: Basic climatic data, International standards, Wind pressure coefficients and associated algorithms, Building and component leakages, Air change rates, Interzonal air flow, Ventilation effectiveness, Airflow patterns, Pollutant transport, Occupant effects, Ventilation heat loss and Cost effectiveness data.

BUILDING TYPE

All

PARAMETERS

All

STARTDATE 00:06:1989

ENDATE 00:04:1992

TIME 1350 person-hours

KEYWORDS

Database, Ventilation, Infiltration, Climatic parameters, Weather

SELECTED BIBLIOGRAPHY

1) Liddament M W (1989), Numerical Database for the AIVC, Air Infiltration Review, Vol 10 No 4 Sept 1989, p12-13.

2) Piggins J (1990), AIVC Numerical Database - The Objectives and Expected Contents. Air Infiltration Review, Vol 11, No 2, March 1990, p5-6

REF UK33

TITLE

Ventilation and Heat Recovery.

CONTACT

Lilly, J P

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British Gas Plc.
Watson House, Peterborough Road,
London, SW6 3HN.
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TEL +44 071 736 1212 ext. 3043
FAX +44 071 731 1648
TLX 919082

SPECIFIC OBJECTIVES

1. To develop theoretical and experimental methods for determining ventilation and indoor air quality.
2. To develop practical domestic heating and ventilating systems for the improvement of the indoor environment for temperate maritime climates.

PROJECT DETAILS

1(a) Refinement of British Gas multi-cell ventilation model with intercell flows validated

with wind tunnel data and measurement in unoccupied dwellings. (b) Continued refinement of constant concentration, emission and decay ventilation measurement techniques in all building types (SF6, N_2O). (c) Use of pressurisation tests in all building types.
2 Development of combined heating and mechanical ventilation/heat recovery systems for traditional and low energy dwellings.
BUILDING TYPE
Objective: 1 All buildings Objective: 2 Domestic and low energy buildings.
PARAMETERS
Weather conditions, occupant behaviour building construction, leakage area, exposure, tracer gas measurements, mathematical models.
STARTDATE 01:04:1989
ENDATE 31:03:1991
TIME 25000 person-hours
KEYWORDS
Residential, Multi-zone, Tracer gas, Heating Systems, Ventilating Systems, Pressurisation.
SELECTED BIBLIOGRAPHY

1 Etheridge D W & Sandberg M (1984), A Simple Parametric Study of Ventilation, Build. & Environ., Vol 19, pp163-173, 1984.
2 Etheridge D W (1984), Air Leakage Characteristics of Houses - a New Approach. BSERT&T, Jan, 1984.
3 Application of the Constant Concentration Technique for Ventilation Measurement in Large Buildings. SERC Workshop, BSER&T, August 1985.
4 Freeman J & Lilly J P (1984), The Measurement of Large Buildings. SERC Workshop, SEGAS Report CLR/47/84.
5 Lilly J P & Gale R (1985), The Reduction of Infiltration in an Industrial Laboratory, Proc 6th AIC Conference, Netherlands, 1985.
6 Etheridge D W; Jones P T & O'Sullivan P E (1985), Ventilation of Factories. Proc. 6th AIC Conference, Netherlands, 1985.

REF UK34
TITLE
A Model For Robust Prediction Of Infiltration And Ventilation.
CONTACT

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UWCC, PO Box 25,
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FAX +44 0222 874192

SPECIFIC OBJECTIVES
To develop and explore utility of, a multicell infiltration model with inbuilt Monte-Carlo methods.
PROJECT DETAILS
A multicell infiltration model is enhanced to include Monte-Carlo methods in its procedures, so that input parameters (Such as crack areas, pressure coefficients, wind direction) can be statistically perturbed. The resulting model should provide both a more robust estimate of infiltration and pathways than a single parameter run, and a measure of uncertainty in the result.
BUILDING TYPE
Domestic (Residence)
PARAMETERS
Component leakage, Weather conditions, Occupant behaviour
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)*
TIME *(Not Stated) (Personal Research)*
KEYWORDS
Infiltration, Airflow simulation, Multizone, Dwelling, Air leakage
SELECTED BIBLIOGRAPHY

1 Etheridge D W & Alexander D K (1980), The British Gas Multi-cell model for calculating ventilation. ASHRAE Trans. Vol 86, Pt 2, 1980.

REF UK35
TITLE
Energy Performance Assesssments.
CONTACT

Alexander, D K
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TEL +44 0222 874000 ext. 5959
FAX +44 0222 874192

SPECIFIC OBJECTIVES
To evaluate the performance of passive solar buildings in the United kingdom.
PROJECT DETAILS
Up to 16 buildings with passive solar features will be assessed using a multi-displinary

methodolgy. Performance terms of Energy, Amenity and cost will be evaluated. As part of this programme, some measurements of ventilation parameters, i.e., leakage, infiltration, air quality, window opening etc, will be undertaken in many of the buildings as the design/intent dictates.

BUILDING TYPE

Domestic; non domestic

PARAMETERS

Computer performance, occupant behaviour, meteorological conditions

STARTDATE 00:00:1985

ENDATE 00:00:1991

TIME *(Not Stated)*

KEYWORDS

Measurement, Passive solar, Infiltration, Indoor Air Quality (IAQ), Occupant behaviour

SELECTED BIBLIOGRAPHY

1 O'Sullivan et. al. (1988), Energy performance Assesssments. A guide to procedures: Vol I - Houses, Vol II - Non-Domestic. Harwell ETSU, 1988.

2 O'Sullivan, Alexander, Vaughan (1988), Technical Report: Looe School. Harwell ETSU, 1988.

3 O'Sullivan et. al. (1989), Multi-dimensional performance evaluations of climatically responsive buildings. Proc. XIth Inter. Congress CIB89, Paris, 1989.

REF UK36

TITLE

Environmental Comparison Between Air Conditioned And Non Air Conditioned Buildings.

CONTACT

Potter, I N

ADDRESS

B.S.R.I.A,
Old Bracknell Lane West,
Bracknell, Berkshire, RG12 4AH.
UNITED KINGDOM.
TEL 0344 426511
FAX 0344 487575

SPECIFIC OBJECTIVES

Determine symptom prevalence between the two groups of buildings.

PROJECT DETAILS

The difference in the environmental conditions in air-conditioned, mechanically ventilated, and naturally ventilated buildings is being examined. This involves using a thermal comfort meter, luminance contrast meter, 1/3 octave band noise level meter, CO_2 analyser, respirable particle mass monitor, and ion concentration analyser. Room air movement surveys and humidity measurements are also made. Occupants clothing and activity levels will be assessed. In addition particle size counts between 0.3 - 10 microns, formaldehyde levels, carbon monoxide concentrations and degree of light flicker will be investigated where considered appropriate. A doctor administered questionnaire will be used to characterize each building and used to examine any relationship between symptoms and the environmental parameters measured.

BUILDING TYPE

Offices

PARAMETERS

(See Project Details)

STARTDATE 00:04:1989

ENDATE 00:04:1992

TIME 2500 person-hours

KEYWORDS

Indoor Air Quality (IAQ), Office, Measurements, Questionnaire

SELECTED BIBLIOGRAPHY *(None Stated)*

REF UK37

TITLE

Ventilation Heat Loss In Factories And Warehouses.

CONTACT

Potter, I N

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BSRIA,
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UNITED KINGDOM.
TEL 0344 426511 FAX 0344 487575

SPECIFIC OBJECTIVES

Measure the air leakage characteristics of factory and warehouse buildings using a mobile pressurisation test facility.

PROJECT DETAILS

Growing evidence and recent BSRIA studies show that in factory and warehouse type buildings the actual leakage rates are significantly higher than necessary. This project provides a purpose assembled mobile measurement platform which can be reversed up to a door without intrusion to the electrical system of the building to provide the necessary

air tightness of the building by measuring its pressure/flow characteristics. During this project at least twelve units of different construction types will be tested, establishing a reference database for relatively large open cell structures. In addition it will identify the more inefficient construction types and provide data for more accurate sizing of heating and/or de-humidification plant.
BUILDING TYPE
Factories and Warehouses
PARAMETERS *(Not Stated)*
STARTDATE 00:04:1989
ENDATE 00:12:1990
TIME 1000 person-hours
KEYWORDS
Air leakage, Pressurisation, Heat loss
SELECTED BIBLIOGRAPHY *(None Stated)*

REF UK38
TITLE
Fresh Air Controllers.
CONTACT
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UNITED KINGDOM.
TEL +44 0344 426511
FAX +44 0344 487575
SPECIFIC OBJECTIVES
Design criteria for the control of minimum fresh air requirements, particularly in VAV mechanical ventilation systems.
PROJECT DETAILS
A number of fresh air/recirculated arrangements will be investigated under laboratory conditions to examine their ability to control the fresh air requirements, namely constant volume, and single and dual duct variable air volume (VAV) systems. Each system will be constructed following current design procedures. The control characteristics of damper actuators to various controllers and the effect of senser location and duct layout will be investigated. The adequacy of fresh air supply over a full turndown range of airflow rates, given the response of the damper actuators to the controller to be addressed. The experience gained from this investigation will be used to provide recommendations for commissioning these systems, with respect to maintaining fresh air requirements.
BUILDING TYPE
Offices and Commercial buildings
PARAMETERS *(Not Stated)*
STARTDATE 00:09:1989
ENDATE 00:12:1990
TIME 500 person-hours
KEYWORDS
Controllers, Fresh air, VAV, Mechanical ventilation system, Guidelines
SELECTED BIBLIOGRAPHY *(None Stated)*

REF UK39
TITLE
Performance Of CO_2 Controlled Mechanical Ventilation Systems.
CONTACT
Booth, W B
ADDRESS
BSRIA,
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Bracknell, Berkshire, RG12 4AH.
UNITED KINGDOM.
TEL 0344 426511
FAX 0344 487575
SPECIFIC OBJECTIVES
Review the use of CO_2 controlled mechanical ventilation systems, and assess the possible energy savings.
PROJECT DETAILS
Many types of buildings, eg theatres, retail store and entertainment establishments experience highly variable occupancy levels. The greater the fresh air supplied to a building may be significantly greater than required during reduced building useage. As occupants raise the level of CO_2 by respiration, the fresh air supplied could be controlled as a function of occupancy density. Previous studies have highlighted the potential energy savings of such systems, and they have now become more widespread. This project will extend previous studies to include the reliablity of such systems and identify those building types which may need modification of their systems and/or unsuitable for this type of control regime.
BUILDING TYPE
Buildings with variable occupancy
PARAMETERS
CO_2
STARTDATE 00:04:1989

ENDATE 00:04:1990
TIME 500 person-hours
KEYWORDS
Carbon dioxide (CO_2), Controls, Occupancy levels, Demand Controlled Ventilation (DCV)
SELECTED BIBLIOGRAPHY *(None Stated)*

UNITED STATES OF AMERICA

REF USA1
TITLE
The Relationship of High Residential Radon Readings With Geological Faults
CONTACT
Lane, Fletcher
ADDRESS
Home Conserv,
40 Wilson Blvd,
Eagleville, PA, 19403
USA.
TEL +1 215-296-8737
SPECIFIC OBJECTIVES
To determine if surface faults can be used to predict a high probability of high radon readings.
PROJECT DETAILS
All types of residential and commercial structures less than 3 stories, may be tested, using a 3-month testing device and an Alpha-Track etch unit. The type of heating and ventilation system will also be noted, as well as the time of year of the test; since Winter is believed to produce the highest levels of Radon (due to heating system De-pressurisation). The water supply system (public, private) will also be noted, as private wells may offer an additional entry point.
BUILDING TYPE
Residential and Commercial (less than 3 stories)
PARAMETERS
The distances of high readings (4pCi/L) taken from PA Geological Survey - ie via Indentified surface faults.
STARTDATE 00:02:1989
ENDATE 00:00:1992
TIME 450 person-hours
KEYWORDS
Radon, Geology, Residential, Commercial
SELECTED BIBLIOGRAPHY
1 Sachs H M et. al. (1982), Regional geology and radon variability in buildings, Environ Int., Vol 8, pp97-103.

REF USA2
TITLE
Measurement Of Ventilation In A Scale Model Enclosure
CONTACT
Kuehn, Thomas H & Ramsey, James W
ADDRESS
University of Minnesota,
Dept. of Mechanical Engineering,
111 Church Street SE,
Minneapolis, MN. 55455-0111,
USA.
TEL +1 612-625-4520
FAX +1 612-625-6069
SPECIFIC OBJECTIVES
To measure air velocity magnitude and direction, turbulence intensity, local temperature and local tracer gas concentrations.
PROJECT DETAILS
A scale model of a commercial office area is being constructed to perform measurements with various ceiling diffusers and return grilles and office furnishing configurations. The chamber will contain temperature controlled walls for buoyant measurements and access for flow visualisation. Data will be obtained using a computer controlled robotic data acquisition system. The chamber can be used to simulate heating or cooling situations with local hot or cold spots to simulate windows or unit heaters, The data will be used to check existing computer simulation codes for the prediction of indoor velocity and contaminant gas concentration as a function of configuration, air supply rate and buoyancy.
BUILDING TYPE
(Not Stated)
PARAMETERS
(Not Stated)
STARTDATE 00:01:1989
ENDATE 00:12:1991
TIME 5000 person-hours
KEYWORDS
Measurement, Scale model, Test chamber, Turbulence
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA3
TITLE
Measurements Of Moisture Permeability And Equilibrium Moisture Content Of Common Building Materials In The United States
CONTACT
Kuehn, Thomas H & Ramsey, James W
ADDRESS
University of Minnesota,
Dept of Mechanical Engineering,
111 Church Street SE,
Minneapolis, MN 55455-0111,
USA.
TEL +1 612-625-4520
FAX +1 612-625-6069
SPECIFIC OBJECTIVES
To measure moisture permeability and equilibrium moisture content of common building materials in the US.
PROJECT DETAILS
A new moisture permeability chamber has been designed and constructed to obtain moisture permeability measurements under both isothermal and non isothermal conditions. Each side of the test specimen maintained at a set humidity level. Initial tests are being performed for isothermal conditions with gypsum board. Later tests will be conducted under temperature and moisture concentration gradients. An equilibrum moisture apparatus is also being constructed to measure the equilibrium moisture content of typical building materials and to serve as a pre-conditioning chamber for the permeability tests.
BUILDING TYPE
Interior construction materials
PARAMETERS
Moisture adsorption-desorption, transient moisture storage in building materials.
STARTDATE 00:01:1987
ENDATE 00:12:1990
TIME 3000 person-hours
KEYWORDS
Adsorption, Moisture, Indoor climate
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA4
TITLE
Complete Airtight Housing Manual
CONTACT
Stum, Karl R
ADDRESS
Enviro-Sun,
1643 North 645 West,
Orem, Utah 84057,
USA.
TEL +1 (801)224-1274
FAX +1 (801) 226-1196
SPECIFIC OBJECTIVES
To publish a manual for designing and building airtightened houses.
PROJECT DETAILS
The manual will cover all aspects of designing and building airtightened houses, including theory and practical applications (illustrated) of moisture and air movement, indoor air quality, theory, control and codes, methods of venting, heat recovery methods, simplified air change and related calculations, and complete economic analyses.
BUILDING TYPE
Residential
PARAMETERS
Instruct designers and builders on superior methods to control air leakage and indoor air quality, including background theory.
STARTDATE 00:00:1986
ENDATE 00:12:1989
TIME 600 person-hours
KEYWORDS
Air Infiltration, Indoor Air Quality (IAQ), Airtightness, Mechanical ventilation, Air change rate
SELECTED BIBLIOGRAPHY
1 Stum K R (1987), Modified Airtight Drywall Methods.
2 Stum K R (1987), Ventilation Assessment Calculations for Designers and Builders.
3 Stum K R (1988), Predicting the Contributing Effects of Occupants on the Total Air Change in Houses.
4 Stum K R (1988), Economic Analyses of House Airtightening.

REF USA5
TITLE
The Development Of CONTAMps88 and CONTAMps89: A Professional Series Of Programs For Indoor Air Quality Analyses.
CONTACT
Axley, J
ADDRESS
Building Technology Program,
Department of Architecture,

Massachusetts Institute of Technology,
3-437, 77 Massachusetts Avenue,
Cambridge, MA 02139,
USA.
TEL +1 (617) 258-7352

SPECIFIC OBJECTIVES

The objective of the project is the development of a professional series of indoor air quality analysis programs, directed towards the day-to-day needs of the professional communities involved in building design, construction, and operation (eg, building engineers, architects, hygienists, health officials, and operators). These programs will be based, from a theoretical point of view, on the mathematical and numerical procedures contained in the NIST(NBS) IAQ Model, developed at NIST over the past three years and, from a user's point of view, upon the development of a graphical user's interface that stresses the diagrammatic representation of a given building airflow system.

PROJECT DETAILS

The project will involve the completion of the first member of the Professional Series, CONTAMps88, a contaminant dispersal analysis program whose development was initiated at NIST with the encouragement of the Environmental Protection Agency, followed by the development of the second member of the Professional Series, CONTAMps89. The primary objective in the development of CONTAMps88 is the development of a workable graphic users' interface based on conventional airflow system diagrammatic conventions. This program is, therefore,being developed using the advanced program development systems for graphic users' interfaces available only on Macintosh microsystems. CONTAMps88 will then be exported to the IBM PC microsystems, so that the results of this work can realise the widest distribution, and some additional capabilities added to develop the second member of the series, CONTAMps89. Both programs will be developed utilizing advanced data structures and numerical procedures that will provide the computational framework needed for the integration of building network airflow analysis, with contaminant dispersal analysis in future generations of the series.

BUILDING TYPE

Applies to whole buildings with flow systems or arbitrary complexity and is, therefore, not limited to a specific building type.

PARAMETERS

These programs relate the spatial and temporal variation of contaminant concentration to airflow into, out of, and within building systems, contaminant generation characteristics, and the kinetic characteristics of other (nonflow) mass transport processes that may affect the dispersal of contaminants in whole-building airflow systems of arbitrary complexity.

STARTDATE 01:04:1989
ENDATE 01:04:1990
TIME 2000 person-hours

KEYWORDS

Indoor Air Quality (IAQ) simulation,
Contaminant distribution

SELECTED BIBLIOGRAPHY

1 Axley J (1987), The NBS Multi-Zone IAQ Model, Proceedings of the Pacific Northwest International Section of the APCA 1987.
2 Axley J (1988), Integrating microscopic and Macroscopic Models of Air Movement and Contamination Dispersal in Buildings, Proceedings of NSF/ASHRAE Symposium: Building Systems: Room Air and Air Contaminant Distribution 1988
3 Axley J (1988), Multi-Zone Contaminant Dispersal Analysis Using An Element Assembly Approach, Proceedings of the 9th AIVC Conference: Effective Ventilation Vol2: 157-182, 1988
4 Axley, J & Grot R (1989), The Coupled Airflow and Thermal Analysis Problem in Building Airflow System Simulation, ASHRAE Symposium on Calculation of Interzonal Heat and Mass Transport in Buildings V95,Pt2:1989
5 Axley J (1986), Building Energy Simulation Using Assemblages of Discrete Thermal Elements, 11th National Passive Solar Conference Proceedings 1986
6 Axley J (1987), Indoor Air Quality Modelling Phase II, Report NBSIR 87-3661 USDOC,NBS, Gaithersburg, MD1987
7 Axley J (1988), DTAM1: A Discrete Thermal Anaysis Method for Building Energy Simulation: Part I Linear Thermal Systems with DTAM1 Users Manual NISTIR 88-3868 USDOC,NIST,Gaithersburg,MD 1988
8 Axley J (1988), Progress Toward a General Analytical Method For Predicting Indoor Air

Pollution in Buildings : Indoor Air Quality Modeling Phase III Report NBSIR 88-3814 USDOC,NBS, Gaithersburg,MD 1988
9 Axley J (1989) Multi-Zone Dispersal Analysis by Element Assembly, Building and Environment Vol24, No2:pp 113-130,1989
10 Grot R & Axley J (1987), The development of a Model for the Prediction of Indoor Air Quality in Buildings, Proceedings of the 8th AIVC Conference: Ventilation Technology Research and Application 1987.

REF USA6
TITLE
The Development Of DTFAM: A Program For The Analysis Of The Coupled Airflow And Thermal Problem In Whole-Building Simulation
CONTACT
Axley, J W (1) and Grot, R (2)
ADDRESS
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Dept of Architecture,
Massachusetts Institute of Technology,
2A313, Building 226,
National Institute of Standards and Technology,
Gaithersberg, MD, 20899, USA.
2. Indoor Air Quality and Ventilation Group,
National Institute of Standards and Technology
13-437,77 Massachusetts Avenue,
Cambridge, MA 02139, USA.
TEL 1. +1 (617) 258-7352
2. +1 (301) 975-6430
SPECIFIC OBJECTIVES
The objective of the project is the development of a theoretical and computational implementation of an approach to solve the coupled airflow and thermal problem in whole building systems.
PROJECT DETAILS
This project will integrate discrete methods of building thermal analysis and building airflow analysis developed earlier at NIST and implemented in the programs AIRMOV, AIRNET, and DTAM1 to develop an approach to the coupled airflow and thermal analysis problem in building simulation. The theoretical framework has been set and a first implementation of this theory has been completed in the program DTFAM (Discrete Thermal and Flow Analysis Method) First numerical investigations using this program will be initiated presently.
BUILDING TYPE
Applies to whole buildings with flow and thermal systems or arbitrary complexity and is, therefore, not limited to specific building type
PARAMETERS
DTFAM and the underlying theory relate the spatial and temporal variation of system temperatures, pressures, and discrete flow rates to thermal and airflow driving forces and the physical parameters that are chosen to characterize the thermal and airflow characteristics of whole-building systems
STARTDATE 00:10:1988
ENDATE 00:04:1990
TIME *(Not Stated)*
KEYWORDS
Airflow simulation
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA7
TITLE Determination Of Interzonal Air distribution Using A Single Tracer Gas
CONTACT
Crawford, R
ADDRESS
1206 W Green Street,
Urbana, IL 61801,
USA.
TEL +1 (217) 333-4108
FAX +1 (217) 244-6534
SPECIFIC OBJECTIVES
Determine volumetric airflow rates and effective zone volumes in buildings using pulsed tracer gas concentration data.
PROJECT DETAILS
State-space control theory and system identification techniques are being developed for this application. A laboratory test facility with three well-mixed zones ($15m^3$, $15m^3$, and $30m^3$) and controlled interzonal airflow rates (05 to 50 l/s) has been built to validate the developed procedure using CO_2 as a tracer gas. A computer-based data acquisition and control system is used to control and measure the CO_2 pulse injections, interzonal airflow rates, and CO_2 zone concentrations
BUILDING TYPE
Controlled laboratory test facility
PARAMETERS
Tracer gas concentrations

STARTDATE 00:01:1988
ENDATE ongoing TIME (unknown)
KEYWORDS
Tracer gas, Interzonal air movement
SELECTED BIBLIOGRAPHY
1 P J O'Neill & R R Crawford, (1989), Multizone Flow Analysis and Zone Selection Using A New Pulsed Tracer Gas Technique, accepted for presentation, 10th AIVC Conference, Espoo, Finland, Sept25-28,1989.

REF USA8
TITLE
Attic Ventilation Project
CONTACT
Rose, William B
ADDRESS
Small Homes Council,
University of Illinois,
1E St Mary's Road,
Champaign, IL 61820,
USA.
TEL +1 (217)-333-1801
FAX +1 (217)-244-2204
SPECIFIC OBJECTIVES
To measure residential attic performance - heat, moisture, air movement.
PROJECT DETAILS
Eight residential attic assemblies are constructed above controlled spaces. Each study bag measures 8 inches x 20 inches. Three variables are studied: attic volume (flat ceiling/vaulted ceiling); attic connection to outdoor air (coupled/uncoupled); attic connection to indoor air at 70F 50%RH (coupled, uncoupled). Measured values in each bay are: wood moisture content, surface temperature, air temperature, air humidity, moisture flux (between sheathing surface and attic air), air velocity through openings, heat flux, weather. Air flow measurements will be compared to tracer gas results to verify actual air flow rates.
BUILDING TYPE
Residential attic
PARAMETERS
(Non Stated)
STARTDATE 01:01:1989
ENDATE 31:12:1990 TIME *(Not Stated)*
KEYWORDS
Residential, Dwelling, Attic, Tracer gas
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA9
TITLE
Surface Sampling Techniques For Building Microflora In Indoor Environmental Quality Investigations
CONTACT
Cooper, Clifford A
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Chem-Safe Inc,
P O Box 546,
Pullman, WA 99163,
USA.
TEL +1 509/334-0922
FAX +1 509/334-1552
SPECIFIC OBJECTIVES
Use samples of building supply air surfaces to measure microflora (bacteria and fungi) and relate to airborne peak concentrations
PROJECT DETAILS
The sampling of building surfaces which are in continuous contact with building supply air, can indicate the recent history as well as the present conditions in a building's microenvironment. When incorporated into a general building IAQ investigation, surface sampling can provide information on the role of microflora in reported health complaints, and may find application in isolating the source of these organisms.
BUILDING TYPE
Commercial and residential
PARAMETERS
Semi-quantitative "severity index" based upon colony count per square inch, air velocity, and additional dispersion model parameters
STARTDATE 00:00:1988
ENDATE 00:12:1989 TIME *(Not Stated)*
KEYWORDS
Residential, Commercial, Microflora, Indoor Air Quality (IAQ)
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA10
TITLE
Reduction Of Air Infiltration Rates In HUD-Codes Manufactured Homes Due To Air Infiltration Barriers.
CONTACT
Tuluca, Adrian
ADDRESS
Steven Winter Associates Inc,
50 Washington St,

Norwalk CT, 06854,
USA.
TEL +1 203/852-0110
FAX +1 203/852-0741

SPECIFIC OBJECTIVES

Quantify the reduction in leakage area due to AIB's for single-wide and double-wide "mobile" homes.

PROJECT DETAILS

In the first phase of the project, existing measurements, obtained with a decay tracer gas technique, measurements of gas decay, wind speed, indoor and outdoor temperatures for 708 hours in Winter, Spring and Summer were used to estimate the equivalent leakage areas of two single-wide HUD-code manufactured homes: one caulked, and one with AIB. In the second phase of the project, blower door tests will be undertaken on both single-wide and double-wide homes. An attempt will be made to characterise the reduction in leakage areas as a function of envelope surface area, wall surface area, or some other physical characteristic of these homes.

BUILDING TYPE

"Mobile" homes, factory-produced

PARAMETERS

Wind speed, indoor air temperature, outdoor air temperature

STARTDATE 00:00:1988
ENDATE 00:00:1991
TIME 1800 person-hours

KEYWORDS

Leakage area, Mobile-homes, Tracer gas, pressurisation, Blower doors

SELECTED BIBLIOGRAPHY

1 Tuluca A N, Sherman M H, & Krarti M, (1990)(No Title Stated)

REF USA11

TITLE

A Comparison Of Two Weatherization Techniques - "NU Seal-Up" vs "The Air Sealing Specialist"

CONTACT

Johnson, Russell K

ADDRESS

Marketing Services Dept.,
P O Box 270, Hartford,
Connecticut, 06141,
USA.
TEL +1 (203) 665-4664
FAX +1 (203) 721-2919

SPECIFIC OBJECTIVES

(None Stated)

PROJECT DETAILS

A 1) Variety of single-family homes
2) Homes used gas or electric heating systems
3) TESTS: Pressurisation, radon, NO_2, formaldehyde- before and after weatherizing
4) Blower doors; charcoal radon sample (3-day)
5) All buildings occupied
B Field test and measurement only; no modelling

BUILDING TYPE

Single-family detached Residences

PARAMETERS

Each other

STARTDATE 00:10:1986
ENDATE 00:06:87(testing), 00:03:89(reporting)
TIME 2000 hours(testing), 300 hours (reporting)

KEYWORDS

Weatherisation, Retrofit, Residences, Indoor Air Quality (IAQ)

SELECTED BIBLIOGRAPHY *(Non Stated)*

REF USA12

TITLE

Short Term Test Method For Predicting The Thermal Performance Of Buildings

CONTACT

Saunders, D H

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NAHB National Research Center,
400 Prince Georges Blvd,
Upper Marlboro,
MD, 20772,
USA.
TEL +1 301-249-4000
FAX +1 301-249-3096

SPECIFIC OBJECTIVES

To refine an existing method for predicting the performance of energy retrofits.

PROJECT DETAILS

Short-term test method (primarily one night) for predicting thermal performance based on measured parameters, (a) Building description (areas, volumes, etc); electric coheating, blower door, SF_6 tracer gas, heating system efficiency and cooldown tests; data acquisition controller with temperature sensors and measured electric power; tests primarily performed in unoccupied homes. (b) One-zone thermal network; predicted thermal performance based on measured parameters ie temperatures, energy,

leakiness and overall heating system efficiency; validated by comparison to long-term monitored data, computer simulation, and uncertainty analysis.
BUILDING TYPE
House (Residential)
PARAMETERS
Performance of the building envelope and heating system
STARTDATE 00:09:1988
ENDATE 00:07:1990
TIME 4000 person-hours
KEYWORDS
Building performance, Heating systems, Measurement, Energy, Retrofit, Tracer gas, Simulation, Dwelling
SELECTED BIBLIOGRAPHY
1 Duffy J J & D H Saunders (1987), Low cost methods for evaluation of the space conditioning efficiency of buildings, University of Lowell report to NAHB National Research Center.
2 Duffy J J, D H Saunders, & J W Spears, (1987), Low cost methods for evaluation of the space conditioning efficiency of buildings.

REF USA13
TITLE
Northwest Residential Infiltration Survey (NORIS)
CONTACT
Parker, Graham B
ADDRESS
Battelle Pacific Northwest Laboratories,
Battelle Blvd,
Richland, WA, 99352,
USA.
TEL +1 (509) 375-3805
FAX +1 (509) 375-3614
SPECIFIC OBJECTIVES
Measure the infiltration and ventilation characteristics of new (post 1980), electric-heat single family detached homes in the Bonneville Power administration service area.
PROJECT DETAILS
NORIS was conducted in two cycles Cycle I was carried out during the 1987/88 heating season; cycle II was carried out during the 1988/89 heating season. The homes studied in cycle I were a statistically representative sample of occupied single-family detached homes, without "special" mechanical ventilation, constructed after January 1st, 1980 in the region (Oregon, Washington, Idaho and 17 countries west of the Continental Divide in Montana). Cycle II homes were occupied homes with non-heat recovery ventilation systems which met the April 1987 Super Good Cents (SGC) energy efficient construction specifications developed for the region. Five (5) ventilation systems were available in the SGC homes: 1) integrated spot and whole house system; 2) ducted central exhaust systems; 3) discrete spot and whole house system 4) whole house system integrated with a central forced air heating and cooling system; and 5) discrete spot and whole house system with distributed exhaust and central supply. Two techniques were employed to measure ventilation and infiltration: blower door leakage test combined with the Sherman-Grimsrud infiltration model and the time-averaged perfluorocarbon tracer technique (PFT). The PFT technique was used in up to a 3-zone configuration in a home for a minimum of a one week exposure period during the heating seasons. In addition, occupant characteristics and structure characteristics data as well as heating system and ventilation system characteristics and operation data were acquired. Occupant activities records were also kept during the time period of the PFT testing. A total of 140 homes were tested in cycle I and 189 homes in cycle II NOTE: The project was a cooperative effort between Batelle, Bonneville, Washington State Energy Office, Idaho, Dept. of Water Resources, Oregon Dept of Energy, Montana Dept of Natural Resources and Ecotope Inc.
BUILDING TYPE
Single family detached electrically-heated residences
PARAMETERS
PFT air exchange compared to blower door air exchange rate. Air exchange rate compared to: 1) architecture, 2) heating system type, 3) use of wood as fuel, 4) occupant perceptions of odour and moisture and drafts, 5) presence of moisture, 6) occupant activities.
STARTDATE 00:07:1987
ENDATE 00:07:1989
TIME 12000 person-hours
KEYWORDS
Residences, Tracer Gas, Blower doors, Pressurisation

SELECTED BIBLIOGRAPHY
1 Palmiter L & I Brown (1989), Northwest residential infiltration survey sample selection and bias assessment Ecotope, Inc, Seattle, Washington June 28, 1989.
2 Palmiter L & I Brown (1989), Northwest residential infiltration survey analysis and results Ecotope, Inc, Seattle, Washington June 23, 1989.
3 Heller J, Baylon, D, & L Palmiter (1989), Northwest residential infiltration survey cycle 2 study design and sample selection Ecotope Inc, Seattle, Washington June 9, 1989.
4 Parker G B, M McSorley, & J Harris (1989), The Northwest residential infiltration survey: A field study of ventilation in new homes in the Pacific Northwest, BN-SA-2633 Proceedings from the "ASTM symposium on air change rate and air tightness in buildings", Atlanta, Georgia April, 1989.
5 Hadley, D L (1989), Results of a pre-field measurement program fan pressurisation comparative test BN-SA-2645 Proceedings of the "ASTM symposium on air change rate and air tightness in buildings", Atlanta Georgia April, 1989.
6 Parker, G B & D L Hadley (1988), Northwest residential infiltration survey (NORIS) technical reference field manual, PNWD-1197-3 Battelle Pacific Northwest Laboratories, Richland, Washington, July, 1988.
7 Parker, G B, D L Hadley & P A Morrow (1988), Northwest residential infiltration survey (NORIS) recruitment plan, PNWD-1197-2 Battelle Pacific Northwest Laboratories, Richland, Washington, April 1988.
8 Parker, G B & D L Hadley (1988), Northwest Residential Infiltration Survey (NORIS), Project Protocol PNWD-1197-1 Battelle Pacific Northwest Laboratories, Richland, Washington, April 1988

REF USA14
TITLE
Indoor Air Quality In The Work Environment.
CONTACT
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GEOMET Technologies Inc,
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Germantown, Maryland 20874,
USA.
TEL +1 (301) 428-9898
FAX +1 (301) 428-9482
SPECIFIC OBJECTIVES
To quantitatively assess effects of ventilation rates on IAQ and related parameters, and to evaluate occupant perceptions of IAQ and comfort.
PROJECT DETAILS
18-storey (100,000 sqft) office building will be monitored at 25 randomly selected locations in the building during the summer and the winter. HVAC system will be operated at 2 different damper settings (20 cfm/person, 35 cfm/person). Measurement parameters include CO_2, CO, O_3, RSP, T, RH, Air velocities, Bioaerosols, VOC's, Formaldehyde Nicotine, and Air Exchange. Occupant survey questionnaire will also be administered
BUILDING TYPE
Commercial Office
PARAMETERS
Indoor Air Quality (IAQ), HVAC, Weather
STARTDATE 00:07:1989
ENDATE 00:04:1990
TIME 2000 person-hours
KEYWORDS
Office, Ventilation effectiveness, Indoor Air Quality (IAQ), Energy, Comfort, Mechanical ventilation, Dwelling
SELECTED BIBLIOGRAPHY
Monitoring and occupant survey plan (GEOMET Report No IE-2109).

REF USA15
TITLE
Experimental Testing In GEOMET Research Houses.
CONTACT
Nagda, Niren L
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20251 Century Boulevard,
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FAX +1 (301) 428-9482
SPECIFIC OBJECTIVES
Controlled testing of residential space-conditioning systems, indoor pollutant sources, and natural infiltration.
PROJECT DETAILS
Two contemporary homes of wood-frame split foyer construction (1100 sq ft living space) built

side by side to identical specifications in 1982. Measurement parameters include indoor comfort parameters (air temperature, mean radiant temperature, relative humidity, air velocity);, natural infiltration and interzonal airflows (using automated tracer gas methods) energy consumption, indoor air quality (combustion products, particulates, organics, radon), and outdoor environment (temperature, humidity, winds, barometric pressure, solar radiation, precipitation). Experiments and controlled testing conducted in the research houses includes (1) effects of energy conservation strategies on indoor air quality and natural infiltration, (2) performance testing of gas and electric appliances, (3) pollutant transport indoors, and (4) performance testing of indoor pollutant control strategies. Project-specific data bases are incorporated into evaluation and development models. Work is conducted for a variety of Government and private sector clients.

BUILDING TYPE

Residential houses

PARAMETERS

Weather, Comfort, Real/simulated Occupancy, Indoor Air Quality (IAQ)

STARTDATE 00:00:1982

ENDATE ongoing TIME *(Not Stated)*

KEYWORDS

Residential, Indoor Air Quality (IAQ), Energy conservation, Infiltration, Tracer gas

SELECTED BIBLIOGRAPHY

1 Nagda N L, Koontz M D, Rector H E (1985), Energy use, infiltration, and indoor air quality in tight, well-insulated residences. EPRI Report No EA/EM-4117; June 1985.

2 Nagda N L (1988), Air infiltration and interzonal airflow measurements in research houses, EPRI Report No EM-5968; December 1988 Performance evaluation of heating plants in contemporary research houses, GEOMET Report No IE-1911; June 1988.

3 Koontz M D et. al. (1988), Preliminary Experiments in a research house to investigate contaminant migration, in indoor air. EPA Report No EPA 56015-88-004 June 1988.

REF USA16

TITLE

Evaluation Of Techniques For The Measurement Of Air Leakage Of Building Components

CONTACT

Colliver, Donald G

ADDRESS

129, Agricultural Engineering Building,
Agricultural Engineering Dept,
Lexington, KY 40546-0075,
USA.

TEL +1 606-257-5658

SPECIFIC OBJECTIVES

(None Stated)

PROJECT DETAILS

Compile the available data on the leakage areas of building component and testing technique. Assess the adequacy of the component effective leakage area concept and develop equivalent geometric parameters. Evaluate methods of testing component air leakage. Establish a uniform system of reporting air leakage.

BUILDING TYPE

(Not Stated)

PARAMETERS

(Not Stated)

STARTDATE 01:12:1987

ENDATE 31:03:1990

TIME 42 person-months

KEYWORDS

Infiltration, Air leakage, Building components

SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA17

TITLE Calculation Of Room Air Motion

CONTACT

Baker, A J

ADDRESS

404 Andy Holt Tower,
Knoxville, TN 37996-0140,
USA.

TEL +1 615-974-7674

SPECIFIC OBJECTIVES

(Not Stated)

PROJECT DETAILS

To develop an accurate and efficient computer program for the prediction of laminar and turbulent room air circulation patterns, by numericaly simulating the unsteady momentum, energy and continuity equations. Also to verify the developed program by prediction of several 2-dimensional flow and thermal convection geometries, and compare results to available experimental data. Derive the corresponding 3-dimensional theory and develop and execute

the plan of action to implement the 3-dimensional computer program.
BUILDING TYPE
(Not Stated)
PARAMETERS
(Not Stated)
STARTDATE 01:04:1988
ENDATE 31:03:1990
TIME 30 person-months
KEYWORDS
Air distribution, Airflow simulation
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA18
TITLE
Indoor Air Quality Evaluation Of Three Office Buildings (Two Of Conventional Construction Designs, And One Of Special Designs To Reduce Indoor Air Contaminants)
CONTACT
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Georgia Tech. Research Corporation,
Centennial Research Building,
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TEL +1 404-84-3825
FAX +1 404-894-3120
TLX 542507 GTRCOCAATL
SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
To evaluate the indoor air quality of three office buildings in relation to the construction techniques, ventilation rate, indoor pollutant concentration, and human health and comfort
BUILDING TYPE
(Not Stated)
PARAMETERS
(Not Stated)
STARTDATE 01:12:1986
ENDATE *(Not Stated)* TIME *(Not Stated)*
KEYWORDS
Indoor Air Quality (IAQ), Commercial, Office
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA19
TITLE
Assessment And Modification Of Standard Hourly Methods For Predicting The Performance Of Ventilative Cooling
CONTACT
Pederson, C O
ADDRESS
University of Illinois at Urbana-Champaign,
144 Mechanical Engineering Building,
1206 W Green Street,
Urbana, IL 61801,
USA.
TEL +1 217-333-2072
SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
Controlled experiments were conducted to quantify the heat transfer characteristics of a ventilated room. The experiments and subsequent analysis:
1 determined the limits of applicability of a current detailed calculation procedure, and
2 provided modifications as necessary to this procedure to extend its range of usefulness under the high rates of ventilation.
BUILDING TYPE
(None Stated)
PARAMETERS
(None Stated)
STARTDATE 01:09:1987
ENDATE 31:12:1989
TIME 38 person-months
KEYWORDS
Ventilation rate, Energy, Rooms
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA20
TITLE
Control Of Outside Air And Building Pressurisation In VAV Systems
CONTACT
Howell, R H & Sauer, H J
ADDRESS
University of Missouri-Rolla,
211 Parker Hall,
Rolla, MO 65401,
USA.
TEL +1 314-341-4638
SPECIFIC OBJECTIVES
(None Stated)
PROJECT DETAILS
Develop a methodology, preferably adaptable to manual calculation and to personal computer calculations, by which to compare operating cost, ventilation air quantity and building pressurisation resulting from various means of outside air and return air/relief air control in

variable air volume air conditioning systems, and to evaluate and compare typical representative systems.
BUILDING TYPE
(None Stated)
PARAMETERS
(None Stated)
STARTDATE 01:09:1988
ENDATE 31:08:1990
TIME 16 person-months
KEYWORDS
VAV, Pressurisation, Ventilation system, Indoor Air Quality (IAQ)
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA21
TITLE
A Round-Robin Test Of Fan Pressurization Devices
CONTACT
Murphy, William E
ADDRESS
129 Agricultural Engineering Building,
Agricultural Engineering Dept,
Lexington, KY 40546-0075,
USA.
TEL 606-257-2666
SPECIFIC OBJECTIVES
(Not Stated)
PROJECT DETAILS
To evaluate the accuracy, precision and repeatability of different blower doors on the market, as well as to determine the effect of the operator on the precision of the readings. Four blower doors will be used to test 4 houses by 3 operators with three replications each. The contractor will compile all data and perform an analysis as outlined in ASTM E691-79 to determine precision and percent deviations between the different doors, operators, and tests. In addition thermographic scans of each house will be performed as a qualitative measure of where the air leakage occurs. The doors will also be tested on a standard test chamber to quantify absolute errors.
BUILDING TYPE
(None Stated)
PARAMETERS
(None Stated)
STARTDATE 01:01:1989
ENDATE 13:10:1989
TIME 80 person-months
KEYWORDS
Pressurisation, Blower doors, Air leakage
SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA22
TITLE
Reassessment Of Formaldehyde In Homes Insulated With UFFI
CONTACT
Toal, Brian
ADDRESS
Connecticut Health Dept,
150 Washington Street,
Hartford, CT 06106,
USA.
TEL +1 203-566-8167
SPECIFIC OBJECTIVES
Document decreased formaldehyde levels in homes with ageing UFFI.
PROJECT DETAILS
30 occupied homes with ageing UFFI were measured with chromatropic acid for formaldehyde in two different rooms.
BUILDING TYPE
Residential (Houses)
PARAMETERS
Humidity and temperature
STARTDATE 00:06:1987
ENDATE 00:12:1987
TIME 900 person-hours
KEYWORDS
Formaldehyde (UFFI), Residential dwelling, Occupied
SELECTED BIBLIOGRAPHY
1 Brian F Joal, & David R Beacon (1989), Reassessment of formaldehyde exposures in homes insulated with UFFI, Leah Weintrub. Applied Industrial Hygiene, June 1989, Vol 4, No 6 pp147-153.

REF USA23
TITLE
Computer Modelling Of Air Movement In Slot-Ventilated Enclosures
CONTACT
Albright, Louis D
ADDRESS
Cornell University,
206 Riley-Robb Hall,
Ithaca, NY 14853,
USA.
TEL +1 607-255-2483

FAX +1 607-255-1836
EMAIL KF5J@cornella (bitnet)
TLX 6713054

SPECIFIC OBJECTIVES

Develop analysis method to use as a tool for designing ventilation systems in slot-ventilated agricultural buildings.

PROJECT DETAILS

The k-epsilon model of turbulence transport is being used. Effects of obstructions within a ventilated space, nonisothermal ventilation jets, and boundary conditions are being investigated to develop a workable computer model that predicts airflows that compare well with experimental data.

BUILDING TYPE

Slot-ventilated animal housing barns and greenhouses

PARAMETERS

k-epsilon

STARTDATE 00:00:1983
ENDATE 00:00:1992 TIME *(Not Stated)*

KEYWORDS

k-epsilon turbulence model, Slot-ventilation, Recirculation, Airflow, Jets.

SELECTED BIBLIOGRAPHY *(None Stated)*

REF USA24

TITLE

Measurements Of Airflow In Buildings

CONTACT

Harrje, David T

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FAX +1 609 258 6260 or 6744
EMAIL Bitnet DTHarrje @PUCC

SPECIFIC OBJECTIVES

Measurements of airflows in buildings CCTG System Conversion to a two Tracer Gas System.

PROJECT DETAILS

To measure interzonal flows more than a single gas is preferred. The constant concentration approach to multizone airflow measurements has used methods of tracer gas depletion to individual zones as a method of measuring interone flows Bohac-Harrje in the 8th AIVC conference. The quicker method is to use multiple tracers. During the next few months we will be making measurements using SF_6 and one of the freon gases in a two gas CCTG systems to better document internal airflows. Software will follow the developments of the Collet-Egedorf system at the Teknologisk Institut in Denmark.

BUILDING TYPE

Single or Multifamily buildings (Residences)

PARAMETERS

Stated in measured airflow and air changes per hour (ach)

STARTDATE 15:04:1989
ENDATE 00:02:1990
TIME 750 person-hours

KEYWORDS

Tracer gas, Airflow measurement, Interzonal air movement, Dwelling, Air change rate

SELECTED BIBLIOGRAPHY

1 Harrje D T & Gadsby K J (1989), Airflow Measurement Techniques Applied to Radon Mitigation Problems, 10th AIVC Conference Proceedings 1989.

2 Harrje D T et. al. (1989), Tracer Gas Measurement Systems Compared in Multifamily and Commercial Buildings, Proceedings of the ASTM Symposium on Air Infiltration Measurements, Atlanta, GA, 1989, ASTM, Philadelphia, PA.

REF USA25

TITLE

How Does Perception Of Risk Influence The Public In Testing And If Needed Mitigating Their Homes For Radon.

CONTACT

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SPECIFIC OBJECTIVES

To try to examine the awareness of the public about Radon problems/matters.

PROJECT DETAILS

A recent analysis of employees' homes has raised a number of questions. Some are: 1) Low response to radon testing - why? (lack of information, misinformation from media). 2) Why has no one tested more than one season as recommended? 3) Does the public understand that a screening does not correlate with annual radon exposure? 4) What is the difference between charcoal screening test and a track etch device. 5) Does the public perceive radon mitigation as easy or costly? Issues will be addressed by a questionnaire.

BUILDING TYPE

Residences (Homes)

PARAMETERS

The Report will try to identify factors that affect public decision to test or not test their homes

STARTDATE 01:06:1989

ENDATE 00:09:1990 TIME *(Not Stated)*

KEYWORDS

Radon, Occupant behaviour, Questionnaire, Dwelling

SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA26

TITLE

Household Energy Study.

CONTACT

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SPECIFIC OBJECTIVES

1) To obtain data on Iowa homes.
2) To characterize energy use.
3) Determine the extent of moisture problems.
4) To determine the extent of radon problems.
5) To determine homeowner attitudes.

PROJECT DETAILS

A random survey of 334 Iowa homes was conducted during March and April 1988. A large database has been developed on energy efficiency, age of home, heating systems, moisture problems, radon levels and attitudes toward energy, air quality and health. Homes that were tighter (as shown by energy use) had a greater number of moisture problems. Approximately one-half of the homes failed the radon screening test.

BUILDING TYPE

Detached single-family residence

PARAMETERS

Energy-efficiency, moisture

STARTDATE 00:00:1987

ENDATE 00:00:1988

TIME 200 person-hours

KEYWORDS

Radon, Database, Energy, Indoor Air Quality (IAQ), Dwelling, Survey Occupant behaviour

SELECTED BIBLIOGRAPHY

To be determined.

1 Greiner T H et. al. (1988), Household Energy Study: Report to Iowa Dept of Natural Resources, Iowa State University Extension Report, May 1988.
2 Presteman & Dean R (1989), Household Energy Study, Iowa State University - 1988. Prepared for the 3rd Annual Iowa Quality Housing Conference March 31st, 1989, Ames, Iowa.

REF USA27

TITLE

A study Of Residential Combustion Venting Failures.

CONTACT

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SPECIFIC OBJECTIVES

1) Instrument homes with venting failure.
2) Monitor Air Quality.
3) Monitor pressure differences.

PROJECT DETAILS

Three homes with water heater combustion venting failures were studied. Findings were that
1) Thermocouples can be used at dilution gap to monitor venting performance.
2) Carbon monoxide (CO) can reach dangerous concentrations in low - volume mechanical rooms.
3) Neither carbon monoxide (CO) nor carbon dioxide (CO_2) concentrations give accurate indications of flue gas spillage in large rooms.
4) Spillage temperatures may not be consistent around the hood.
5) Faulty vent design and/or maintenance can result in venting failure.

BUILDING TYPE

Single family or duplex (Residence)

PARAMETERS
Vent failure
STARTDATE 00:00:1987
ENDATE 00:00:1989
TIME 2000 person-hours
KEYWORDS
Combustion, Indoor Air Quality (IAQ), Pressure differences, Dwelling Vented, Carbon monoxide (CO)
SELECTED BIBLIOGRAPHY
1 Shouse & Shawn (1988), A study of Residential Combustion Venting Failures. Unpublished Master's thesis. Iowa State University Ames, USA Dec. 1988

REF USA28
TITLE
Ventilation Monitor
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SPECIFIC OBJECTIVES
The development of an instrument to be used in indoor air quality analysis.
PROJECT DETAILS
Working with the most key people in the USA, to come up with the specifications needed for the analysis commonly performed.
BUILDING TYPE
Whichever is required
PARAMETERS
The use of tracer gas to determine different parameters influencing indoor air quality
STARTDATE 00:01:1989
ENDATE Ongoing TIME N/A
KEYWORDS
Tracer gas, Survey, Indoor Air Quality (IAQ)
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF USA29
TITLE
Northwest Residential Infiltration Study
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SPECIFIC OBJECTIVES
To measure the ventilation rate and air tightness of typical Northwest Homes.
PROJECT DETAILS
The project consisted of Fan Pressurisation and passive perfluorocarbon tracer gas tests on a random sample of 140 homes, (built to current construction standards) and 50 homes built to energy efficient standards in the Pacific Northwest region of the United States. The standard construction sample is largely light wood frame constructed single family detached buildings with electric heat. The energy efficient buildings are a similar set of homes, with greater levels of insulation tighter construction standards and mechanical ventilation systems. Homes were measured during the winter heating season for a two week period.
BUILDING TYPE
Single family detached (Residence)
PARAMETERS
Equivalent leakage area, Effective ventilation rates, Weather, decurant behaviour.
STARTDATE 00:00:1987
ENDATE 00:00:1990
TIME 6000 person-hours
KEYWORDS
Tracer gas, Passive Perfluorocarbon Techniques (PFT), Blower door, Infiltration, Airtightness, Mechanical ventilation system, Dwelling Pressurisation
SELECTED BIBLIOGRAPHY
1 Northwest Residential Infiltration Survey (1989,) Analysis and results. August 15, 1989. Ecotope, Inc. Seattle, WA.
2 Northwest Residential Infiltration Survey (1988), Study design and sample, June 16, 1988, Ecotope, Inc. Seattle, WA.
3 Noris Protocol - Cycle II Field Reference Manual (1989), Feb 21, 1989, Ecotope, Inc. Seattle, WA.
4 Northwest Residential Infiltration Survey Cycle II (1989), Study Design and sample selection, June 9, 1989, Ecotope, Inc. Seattle, WA.

5 Northwest Residential Infiltration Survey (1989), Description and summary of results; to be published with proceedings of ASHRAE/BTECC/ CIBSE thermal performance of the exterior envelopes of building IV Conference, Orlando, Florida, Dec,1989.

REF USA30
TITLE
Ventilation Research: Tracer Gas Measurement Techniques
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SPECIFIC OBJECTIVES
Use and develop tracer gas techniques to improve the understanding of ventilation process.
PROJECT DETAILS
3 phase: 1) Development of a multiple tracer measurement technique for the estimation of multizone ventilation. 2) Development of analysis tools for use in reducing tracer gas data 3) development of standards and guidelines related to ventilation measurement.
BUILDING TYPE
Dwellings to medium sized buildings (Residence, Office, Factory)
PARAMETERS
Tracer Gas Measurement Techniques
STARTDATE *(Not Stated)*
ENDATE *(Not Stated)*
TIME 1 full time equivalent
KEYWORDS
Tracer gas, Ventilation, Commercial, Dwellings
SELECTED BIBLIOGRAPHY
1 M H Sherman et. al. (1989), Description of a System for Measuring Interzonal Air Flows using Multiple Tracer Gases. To be published in the Proc. of the Inter. Center heat Mass Transfer Confer. Sept 1989, Yugoslavia. LBL Report LBL-26538.
2 M H Sherman, (1989), On Estimation of Multizone Ventilation Rates from Tracer Gas Measurements. Building and Environment (1989) LBL. Report LBL-25772.
3 M H Sherman, & D J Dickerhoff (1990) A Multigas Tracer System for Multizone Air Flow Measurements. To be published in the Proc. of the Thermal Performance of the Exterior Envelopes in Buildings Conference IV. LBL. Report LBL-26087.
4 M H Sherman (1989), Error Analysis of Air Flow Measurements Using Tracer Gas Measurements. Building and Environment (1989) LBL Report LBL-25415.
5 M H Sherman(1990), Analysis of Errors Associated with Passive Ventilation Measurement Techniques. Submitted to Building and Environment. LBL.Report LBL-23088.
6 M H Sherman & D J Wilson (1986), Relating Actual and Effective Ventilation in Determining Indoor Air Quality. Building and Environment, 21(3/4), pp.135-144, 1986. LBL Report No.20424, September, 1986.

REF USA31
TITLE
Development Of A Multizonal Infiltration And Ventilation Model
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SPECIFIC OBJECTIVES
Model development
PROJECT DETAILS
COMIS not only takes crack flow into account but also covers flow through large openings, single-sided ventilation, cross ventilation and HVAC-systems. The model contains a large number of modules which are peripheral to a steering program. COMIS can also be used as a basis for future expansion in order to increase the ability to simulate buildings. Special emphasis has been given to the input routines so that the final program should not only be user-tolerant but user-friendly. It is being developed in such a way that it can be used

either as a stand-alone infiltration model or as an infiltration module of a building simulation program. The input procedure is therefore being developed in such a way that either the COMIS input modules can be used or only the input/output interface. This makes it possible for the user to connect the program with other software (e.g., CAD-systems).
BUILDING TYPE
(Not Stated)
PARAMETERS
Air flow through cracks, Ventilation systems
STARTDATE 00:10:1988
ENDATE 00:09:1993 TIME *(Not Stated)*
KEYWORDS
Mathematical simulation, Ventilation, Airflow simulation, Multizone, Crack, Air leakage
SELECTED BIBLIOGRAPHY
1 H E Feustel (1989), Mathematical Modelling of Infiltration and Ventilation, Proc., 10th AIVC Confer. Progress and Trends in Air Infiltration and Ventilation Research, Espoo, Finland, September 1989, LBL.Report, LBL-27995.
2 H E Feustel, et. al. ,(1989), The COMIS Infiltration Model, Proc. 10th AIVC Conference, Progress and Trends in Air Infiltration and Ventilation Research, Espoo, Finland, September, 1989, LBL. Report, LBL-27996
3 COMIS Newsletters
4 COMIS Fundamentals and COMIS User Guide (will be published as AIVC Publications).

REF USA32
TITLE
Indoor Air Pollution Exposure Assessments.
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SPECIFIC OBJECTIVES
To assess, via measurements and modelling, indoor air pollution concentrations and the factors that affect these concentrations.
PROJECT DETAILS
The factors that affect indoor air pollution concentrations, based on experimental research, can be mathematically combined to predict indoor air pollution levels. Initial research has concentrated on indoor concentrations of combustion-generated pollutants because of the existence of source usage information and models. Future work will address the sensitivity of the model to various input factors and will expand the model to include other important indoor pollutants.
BUILDING TYPE
Residences
PARAMETERS
Volume, specific leakage area, appliance usage rates, appliance emmission rates, outside temperature and wind speed, misc. energy parameters.
STARTDATE 00:00:1986
ENDATE Ongoing
TIME *(Not Stated)*
KEYWORDS
Mathematical simulation, Indoor air Quality (IAQ), Combustion, Occupant behaviour, Dwelling, Energy
SELECTED BIBLIOGRAPHY
1 Traynor G W et. al. (1988), The effects of infiltration and insulation on the source strengths and indoor air pollution from combustion space heating appliances, JAPCA 38: 1011-1015, 1988.
2 Traynor G W et. al. (1989), Macromodel for assessing residential concentrations of combustion-generated pollutants: Model Development and Preliminary Predictions for CO, NO_2 and Respirable Suspended Particles,. LBL-25211, Lawrence Berkeley Laboratory, Berkeley, CA 94720, 1989.

REF USA33
TITLE
Radon Pressure Differential
CONTACT
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Florida Solar Energy Center,
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TEL +1 407 783 0300 ext. 115
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SPECIFIC OBJECTIVES

To assess pressure differences which exist in Florida homes as a result of natural and mechanical forces.

PROJECT DETAILS

Approximately four-hour tests in 70 homes. Air Changes per Hour 50 is determined by blower door. ACH 50 is measured again with all supply and return registers sealed by paper and tape. Pressure differences are measured from the main body of the house to outdoors, subslab (subfloor) and various rooms when AH (air handler) is turned on, when interior doors are closed , when exhaust fans (dryer, etc) are operating and when everything is off. Approximately five hour tracer gas (decay) tests (SF6) in 50 of the 70 homes. 1.33 hrs x 4 tests, with AH off, Ah on, exhaust fans on, and Ahon/doors closed.

BUILDING TYPE

Single family homes; 0-5 years old

PARAMETERS

Air Changes / Hour on ; ACH off; Return leak fraction, CFM

STARTDATE 00:08:1989

ENDATE 00:09:1990

TIME 6000 person-hours

KEYWORDS

Radon, Blower doors, PFT, Tracer gas, Pressurisation, Sub-slab ventilation, Air Change rate

SELECTED BIBLIOGRAPHY

1 Tyson J et. al. (1990), Draft technical report, radon pressure measurement project., April 1990. Florida Solar Energy Center, Cape Canaveral, Florida.

2 Cummings J, Tooley J & Moyer N (1990), Support documentation for recommended code changes. April 1990. Florida Solar Energy Center, Cape Canaveral, Florida.

REF USA34

TITLE

Duct Leak Project.

CONTACT

Cummings, Jim

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SPECIFIC OBJECTIVES

To assess duct leakage in Florida Homes.

PROJECT DETAILS

Tests will be carried out on 150 Florida homes to determine the quantity of duct leakage. The methodology behind this is: tracer gas (decay method - SF6) with AH (Air handler) on and with AH off. RLF (Return Leaks Fraction) determined by decreasing the SF6 concentration from return to supply register. Blower door tests done on 100 of the 150 homes. methodology: 20-60 Pa depressurisation. ACH 50 obtained. Blower door tests repeated with all registers sealed by paper and tape. ACH 50 in duct systems determined by subtraction. Duct repairs done on 50 homes. ACH on , ACH off, ACH 50 measured again. cooling energy use measured before and after repairs with constant setpoint.

BUILDING TYPE

Single family homes and manufactured

PARAMETERS

ACH on, ACH off, RLF, ACH 50, cooling kWh, CFM.

STARTDATE 00:04:1989

ENDATE 00:11:1990

TIME 8000 person-hours

KEYWORDS

Air leakage, Duct, Tracer gas, Blower door, Pressurisation, depressurisation, Energy, Mechanical ventilation

SELECTED BIBLIOGRAPHY

1 Cummings J & James B (1988), Central air conditioner impact upon infiltration rates in Florida homes. Proc. 13th Nat. Passive Solar Confer., May 1988, Boston.

2 Cummings J et. al. (1989), Infiltration rates and pressure differences in Florida homes caused by closed interior doors, when the central air handler is on. 14th Nat. Passive Solar Confer. Proc. , American Solar Energy Society Confer., Denver, CO, June 1989.

3 Cummings et. al. (1989), Infiltration and pressure differences induced by forced systems in Florida residences.,Preprint from symposium at the ASHRAE Summer 1989 meeting in Vancouver.Scheduled to be pub. ASHRAE Trans. 1989, V. 95, Pt 2.

4 Cummings J & James B (1989), Tracer gas as a practical field diagnostic tool for assessing duct system leaks., Proc. of the Symposium on

Improving building Systems in hot and humid climates. Oct. 3-4, 1989, Dallas, Texas.
5 Cummings et. al. (1990), Impacts of duct leakage on infiltration rates, space conditioning, energy use and peak electrical demand in Florida homes. Draft, prepared for ACEEE 1990 Summer study.

REF USA35
TITLE
Indoor Air Quality Study In Greater Boston.
CONTACT
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SPECIFIC OBJECTIVES
To reveal relationships among indoor NO_2 concentration, air infiltration rate and house characteristics.
PROJECT DETAILS
Subject houses were selected to represent the total population of the Boston Standard Metropolitan Statistical Area (SMSA). A 2-stage sampling scheme incorporating stratification by range fuel was used for sampling and logistical efficiency. A total of 973 housing units were identified with 581 agreeing to participate in the monitoring and 501 were actually monitored in the Winter of 1985. The house characteristics questionnaire consisted of five categories;
1) Setting and home type.
2) Heating system and fuel.
3) Cooking and water heating fuel.
4) Ventilation
5) Participants.
Two types of tracer gases, perfluoro monomethyl cyclohexane (PMCH) and perfluoro dimethyl cyclohexane (PDCH), were used for the air infiltration rate measurements. These gases were released in the house through permeation tube capsules whose emission rates were gravimetrically measured prior to the study. Tracer gases were passively sampled by activated charcoal (Ambersorb 347) in capillary absorption tubes (CAT) placed in the kitchen, living room and bedrooms. After exposing CAT's to indoor air for two weeks, the amount of the adsorbed tracer gas was analyzed with a GC/ECD. NO_2 concentrations were measured several indoor microenvironments with a passive sampler (Palmes Tube).
BUILDING TYPE
Residential house
PARAMETERS
To find these parameters is one of the objectives of this study.
STARTDATE 00:00:1984
ENDATE ongoing TIME *(Not Stated)*
KEYWORDS
Indoor Air Quality (IAQ), Gas appliances, Combustion, Tracer gas, Air infiltration, Dwelling, Questionnaire, Heating system
SELECTED BIBLIOGRAPHY
1 Yanagisawa Y et. al. (1989), Measurement of air exchange rate of residential houses. Proc. of the 82nd Annual Meeting of Air poll. Control Assoc., 89-82.2, 1989.
2 Yanagisawa Y et. al. (1990), Relationships among indoor NO_2, air exchange rate and house characteristics of residential houses in Boston.Proc. 5th inter. Confer. on Indoor Air Quality and Climate, July 29 - August 3, 1990.
3 Yanagisawa Y (1990), Placement of tracer gas sources and samplers to measure infiltration rate. (Submitted to Indoor Air).

AIVC NON PARTICIPATING COUNTRIES

AUSTRALIA

REF AUS1
TITLE
Ventilation Of Buildings.
CONTACT
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SPECIFIC OBJECTIVES
To measure infiltration, ventilation and air conditioning parameters in office buildings.
PROJECT DETAILS
Sulfur Hexafluoride (SF6) tracer gas with gas chromatagraphy/electron capture detection. (possibly at some later date may use other tracer gases for multiple tracer studies). Planned to locate GC, in the building being investigated, for on-line measurements, combined with grab-bag sampling for subsequent analysis e.g. after hours. The principal interest is in the adequacy of air quality rather than infiltration /energy consumption concerns (air intake/distribution effectiveness). Maybe of possible interest, efficiency of exhaust systems too.
BUILDING TYPE
office buildings mainly, but any unoccupied building.
PARAMETERS
Outdoor air intake into AC system; AC parameters relevant to air distribution; temperature and wind data.
STARTDATE 00:07:1989
ENDATE est 00:06:1990 TIME *(Not Stated)*
KEYWORDS
Tracer gas, Sulphur Hexafluoride (SF_6), Unoccupied, Office, Ventilation Air distribution
SELECTED BIBLIOGRAPHY
1 Biggs K L et. al. (1987), Air infiltration rates in some Australian houses. Austr. Inst. of Building papers, vol 2, pp49-61.
2 Biggs K L et. al. (1986), The tightness of houses in: Air permeability of some Australian houses. Build. and Envir. vol 2, pp89-96.
3 Biggs K L & Bennie I D (1988), Ventilation studies of some Australian Houses. Austr.Refig. air condit. and heat. vol 42, pp15-21, Jan 88.

AUSTRIA

REF AU1
TITLE
Critical Climatological Data In Design Of Building Envelope And Heating System.
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SPECIFIC OBJECTIVES
Which combination of outdoor temperature and wind velocity has to be applied in the design of the building envelope and the heating system, with data from Austrian meteorological stations.
PROJECT DETAILS
Preparatory theoretical work for new Austrian Standards.
BUILDING TYPE
Various.
PARAMETERS
Outdoor temperature, wind velocity, air humidity, indoor temperature, humidity, Building environmental parameters.
STARTDATE 00:00:1988
ENDATE 00:00:1990
TIME 500 person-hours
KEYWORDS
Meteorological, Heating system, Building envelope, Standards
SELECTED BIBLIOGRAPHY *(None Stated)*

BRAZIL

REF BZL1
TITLE
Mathematical Modelling Of Naturally Ventilated Buildings.
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SPECIFIC OBJECTIVES
To assess the impact of natural ventilation systems on the occupants' thermal comfort.
PROJECT DETAILS
To develop a model which takes into account most of the relevant parameters affecting air

ventilation, (such as wind speed and direction, shape of the atmospheric boundary layer, temperature difference, thermal stratification etc.), and to also calculate the wind pressure coefficients internally. To couple this program to a building thermal simulation program in order to assess the impact of the ventilation system on the occupants' thermal comfort.

BUILDING TYPE

Industrial (factory)

PARAMETERS

Weather - performance of building;
Components - source of pollution

STARTDATE 00:01:1988
ENDATE 00:01:1990
TIME 3000 person-hours

KEYWORDS

Natural ventilation, Thermal simulation, Thermal comfort, Mathematical simulation

SELECTED BIBLIOGRAPHY

1 Melo C (1985), Improved convective heat transfer and air infiltration models for building thermal simulation. Ph.D. Thesis, Cranfield Inst. of Technol. Bedford. UK.
2 Melo C (1986), Convection and infiltration modelling for the built environment. Proc. 10th CIB Congress, Washington, USA. 29-26th Sept, 1986. pp848-57.
3 Melo C (1987), Flow - An algorithm for calculating air infiltration into buildings. ICBEM '87, Lausanne, Switzerland, 28/09 -2/10/1987, pp5-12.
4 Melo C (1987), Influence of an improved air infiltration model on the NBSLO program performance. ICBEM'87, Lausanne, Switzerland, 28/09-2/10/1987, pp106-12.
5 Melo C (1987), Development and validation of a model for air infiltration rates into buildings. IX Brazilian Congress of Mecn. Engineers, Florianopolis-Sc, Brazil, 7-11 Dec. 1987, pp427-30.

CZECHOSLOVAKIA

REF CS1

TITLE

Influence Of Architectural Features On Ventilation Losses.

CONTACT

Cernik, P

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SPECIFIC OBJECTIVES

Investigation of mullions and balconies effect on the ventilation losses from a multi-storey building.

PROJECT DETAILS

On the basis of wind tunnel measurements the project will investigate the influence of vertical mullions with various dimensions and spacing, and various types of balconies onto the wall wind loading of a multi-storey building. Pressure coefficients obtained from the tests will be used for the calculation of air exchange rates and associated heat losses from naturally ventilated rooms with wall equipped by mullions or balconies. The air exchange rates will be calculated for two types of buildings: storey type and shaft type buildings. The results will be presented in a non-dimensional form which relates the heat loss due to natural ventilation for a room with smooth walls to heat loss with certain roughness.

BUILDING TYPE

Commercial And Residential multi-storey

PARAMETERS

Weather (temperature, wind)

STARTDATE 00:01:1989
ENDATE 00:12:1989
TIME 800 person-hours

KEYWORDS

Facade, Balconies, Scale model, Wind tunnel, Pressure Coefficients

SELECTED BIBLIOGRAPHY

1 Cernik P & Wiren B (1989), Influence of architectural features on pressure distribution and ventilation losses. The National Swedish Institute for Building Research, December 1989.
2 Cernik P (1990), Effect of wall roughness on the pressure distribution. Journal of Wind Eng., January 1990.

FRANCE

REF F1

TITLE
Ventilation Efficiency.
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SPECIFIC OBJECTIVES
Comparing the performance of the different ventilation systems.
PROJECT DETAILS
Assessment of the efficiency of each ventilation system with regard to energy consumption and air quality. This assessment shall be carried out with the assistance of a computer code including different items such as condensation, CO_2, concentration, etc.
BUILDING TYPE
House, building
PARAMETERS
Ventilation system components, building components
STARTDATE 00:06:1986
ENDATE 00:06:1990
TIME 1000 person-hours
KEYWORDS
Indoor Air Quality (IAQ), Computer simulation, Ventilation system, Dwelling
SELECTED BIBLIOGRAPHY
1 Bienfait D & Lalba F (1988), Performances energetiques et qualite de l'aeration des logements. Batiment Energie Mars-Avril 1988.
2 Bienfait D (1988), Compared efficiency of ventilation techniques with regard to heat losses and air quality, CIB W17, Champs sur Marne, October 27-28 1988.
3 Bienfait D (1989), Appreciation de l'efficacite des systemes de ventilation. Seminaire AFME, Sophia-Antipolis, septembre 1989.

REF F2
TITLE
Wind Turbulence.
CONTACT
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SPECIFIC OBJECTIVES
This project is aimed at assessing the effects of wind fluctuation on the ventilation of dwellings.
PROJECT DETAILS
Calculation of airflow rate using a computer code which takes into account air compressibility as well as the instantaneous pressure values of the wind measured in a wind tunnel. Calculation of pollutant concentration using the same code. Comparing the calculation results with airflow measurements undertaken on an experimental house near Nantes. The measurements shall be carried out using tracer gas.
BUILDING TYPE
House, Building (Residence)
PARAMETERS
Wind, Pollution sources
STARTDATE 00:09:1987
ENDATE 00:09:1990
TIME 2000 person-hours
KEYWORDS
Wind pressure, Dwelling, Pollution sources
SELECTED BIBLIOGRAPHY
1 Riberon J et. al. (1989), La turbulence du vent. Barnaud seminaire Ventilation et Renouvellement d'air - AFME, Sophia-Antipolis, 19-20 September 1989.
2 Mounajed R (1989), Fascicule de documentation du code de calcul SIREN. September 1989

REF F3
TITLE
Heat And Mass Transfer In Multizone Buildings.
CONTACT
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TLX 970 194 F
SPECIFIC OBJECTIVES

Modelling of Interzonal Heat and Mass Transfer (Specific topic: Great Apertures)

PROJECT DETAILS

(a) (i) Real scale experimental test cell. Construction type: Multilayer manufactured components (ii) Mechanical ventilation system (variable - turnable - airflow) Heating system: electric convectors (iii) Air velocities in the doorway (9 probes on a moveable cane) Air temperature, surface temperature Air flows at outlet and inlet of the mechanical ventilation system. (iv) Air velocities: omnidirectional probe and themistor for measuring temperatures coupled with a Multichannel Flow Analyser (DANTREC 54R10x54N10) Air Flows: Flowmeters installed in a convagent-divergent device (CETIAT 5 to 400 m3/h) Air Temperatures: PT 100 sensors (=/-1 ^{0}C) (v) Unoccupied building. (b) Calculations of pressures taking into account the stratification profiles of temperatures in each zone. Calculations of the local and global discharge coefficients. Simplified model to compute average values of airflow patterns.

BUILDING TYPE

House (Residence)

PARAMETERS

(a) Temperature, Wind, Sun (Solar) (b) Internal doors (c) Simulated behaviour of occupants (d) - (e) Influence of heating system

STARTDATE 00:06:1986

ENDATE 00:12:1990

TIME 8000 person-hours over 4.5 years

KEYWORDS

Mixed convection, Stratified temperatures, Mechanical ventilation system, Heating system, Airflow, Simulation

SELECTED BIBLIOGRAPHY

1 Some publications Internal heat transfers and heating needs of buildings R Pelletret/International Congress on B.E.M. Lausanne/Switzerland/09.28.- 10.02 1987 A new model to compute airflow patterns R Pelletret & H Khodr/Building simulation '89 Vancouver/Canada/06.23,24 1989

2 Reports: CSTB/ECTS/86-408 CSTB/DPE/87-500 CSTB/DPE/87-478 CSTB/DPE/88-630

3 PhD: Internal heat and mass transfer in buildings A Lamrani/March 1987 Mixed convection in large openings H Khodr/expected in September 1990

REF F4

TITLE

Technology Of Mechanical Ventilation Systems.

CONTACT

Riberon, J

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TLX 694.282 F

SPECIFIC OBJECTIVES

To study the operating of mechanical ventilation systems (both standard and humidity controlled)

PROJECT DETAILS

Field investigation of the different types of humidity-controlled ventilation systems: ageing and fouling of ventilation components, behaviour of occupants; evaluation of the efficiency of the above-mentioned system. Studying the pathology of mechanical exhaust systems within single-family dwellings: measurements of air leakage and pressure losses from ducts, designation of components undertaken in laboratories, field measurements of exhaust flow rate.

BUILDING TYPE

Air inlet, Exhaust vent

PARAMETERS

Real behaviour of occupants, Air humidity

STARTDATE 00:06:1986

ENDATE 00:06:1990

TIME 2000 person-hours

KEYWORDS

Mechanical ventilation system, Demand controlled ventilation system (DCV), Occupant behaviour, Ventilation strategy

SELECTED BIBLIOGRAPHY

1 Bienfait D & Lalba F (1987), Advanced ventilation systems in France. IBCEM'87, Lausanne 28 septembre - 2 octobre 1987.

2 Riberon J (1988), Les installations de VMC en maison individuelle. CSTB - GEC - 88-4456-Champs sur Marne, 5 aout 1988.

3 Riberon J (1989), Etude du vieillissement des hygrostats RANCO. CSTB - GEC-89-4702, Champs sur Marne, 23 fevrier 1989.

4 Anon (1989) Pathologie des installations de ventilation mecanique et systemes

hygroreglables. Sophia Antipolis, Septembre 1989.

REF F5
TITLE
Aerothermal Engineering With Regard To Indoor Rooms.
CONTACT
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SPECIFIC OBJECTIVES
Better knowledge of stratification phenomena within premises.
PROJECT DETAILS
Research on models designed for the prediction of temperature fields within premises. Suitability for use in large premises. Measurements of the stratification generated by different types of heating systems. Design of destratification device.
BUILDING TYPE
Commercial, factory, office
PARAMETERS
performance of the shell components, Air temperature
STARTDATE 00:10:1988
ENDATE 00:10:1991
TIME 3000 person-hours
KEYWORDS
Temperature gradient, Measurement, Modelling, Thermal, Factory, Office Building components
SELECTED BIBLIOGRAPHY
1 E Hutter & J Riberon (1989), Study of thermoconvective phenomena inside rooms. Experimentations and modelling. CIB W 67 Sophia Antipolis, April 17-18 1989.
2 Mesure des temperatures dans des locaux de grand volume CSTB GEC no.4826-Fr. Socquet, July 1989.

REF F6
TITLE
Carbon Monoxide In Dwellings.
CONTACT
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SPECIFIC OBJECTIVES
Investigation of carbon monoxide production and how to reduce it.
PROJECT DETAILS
Carbon monoxide in dwellings may be produced either by unvented (cookers..) or vented (gas heaters..) appliances. Work programme: Bibliography: statistics on casualties. - Investigation in actual houses. - Modelling of vented appliance, flue shaft and wind effect in order to investigate especially in transient conditions, the production of pollutant and the possibility of reverse flow.
BUILDING TYPE
Residences (dwelling)
PARAMETERS
CO (Carbon monoxide)
STARTDATE 00:00:1989
ENDATE 00:00:1993
TIME 2500 person-hours
KEYWORDS
Carbon Monoxide (CO), Vented, Unvented, Dwellings
SELECTED BIBLIOGRAPHY
1 Bienfait D (1989), Le monoxyde de carbone dans l'air interieur. Sophia-Antipolis, 19 et 20 septembre 1989.

REF F7
TITLE
Natural Ventilation.
CONTACT
Riberon, J
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TLX 694 282 F
SPECIFIC OBJECTIVES

This project is aimed at improving the design and dimensioning of natural ventilation systems.

PROJECT DETAILS

The development of computer codes intended to predict the flow rates, both in single-family and multi-family dwellings; calculation of air transfers between rooms of the same building. Experimental survey intended for field measurements: typology of natural ventilation systems: measuring of the pressure and heat losses in vertical shafts.

BUILDING TYPE

House, apartment, Residence

PARAMETERS

Temperature, wind, pollution sources

STARTDATE 00:06:1986

ENDATE 00:06:1900

TIME 3000 person-hours

KEYWORDS

Modelling, Natural ventilation system, Interzonal airflow

SELECTED BIBLIOGRAPHY

1 Riberon J & Mounajed R (1988), Dimensionnement des installations de ventilation naturelle en maison individuelle. CSTB 88-4457, Juillet 1988.

2 Riberon J & Mounajed R (1989), La ventilation naturelle. Seminaire ventilation et renouvellement d'air AFME Sophia-Antipolis, 19-20 septembre 1989

3 Mounajed R (1989), La modelisation des transferts d'air dans les batiments - Application de l'etude de la ventilation. These de doctorat ENPC, Paris? 5 octobre 1989

4 Mounajed R (1989), Fascicule de documentation du code de calcul GAINE. septembre 1989.

REF F8

TITLE

Development Of A Simple Device For The Measurement Of Dwelling Airtightness.

CONTACT

Riberon, J

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SPECIFIC OBJECTIVES

This project is aimed at designing and implementing a specific device suitable for field measurement.

PROJECT DETAILS

Depressurisation of the dwelling shall be undertaken using either the existing ventilation system or a specific apparatus. Definition of the methods suitable for each specific dwelling (either house or apartment). Definition of the characteristics of the prototype. Realization of the prototype, as well as testing on different types of dwellings.

BUILDING TYPE

House, building, Residence

PARAMETERS

Performance of the shell components

STARTDATE 00:04:1989

ENDATE 00:04:1991

TIME 800 person-hours

KEYWORDS

Air leakage, Measurement, Airtightness, Blower doors, Depressurise Dwelling

SELECTED BIBLIOGRAPHY

1 Riberon J (1989), Guide methodologique pour la mesure de la permeabilite a l'air des enveloppes de batiments CSTB - GEC 89-4222 - Champs sur Marne, juin 1989.

REF F9

TITLE

Occupants' Behaviour With Regard To Window Opening.

CONTACT

Fleury, B

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TLX 370511 F

SPECIFIC OBJECTIVES

To identify the variables that influence occupants' behaviour, and the impact of a ventilation system.

PROJECT DETAILS

A sociological survey on a sample of 60 apartments will be conducted. Micro switches are to be placed on every window of 30 of the

apartments. These micro swtiches register the number, and the cumulative time of opening, over a period of time (15 to 30 days). This will be followed by a statistical analysis of the data and a comparasion of the two approaches.
BUILDING TYPE
Residence, apartment, Windows, doors
PARAMETERS
Window opening (number and time), Ventilation system, Energy consumption
STARTDATE 00:01:1989
ENDATE 00:06:1990
TIME 1000 person-hours
KEYWORDS
Window, Occupant behaviour, Ventilation systems, Energy consumption
SELECTED BIBLIOGRAPHY *(Not Stated)*

REF F10
TITLE
Air Movement Within A Three Bedroom House.
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TLX 370511 F
SPECIFIC OBJECTIVES
The identification and the role permeability, on airflow patterns within buildings.
PROJECT DETAILS
- Pressurisation tests, with pressure control of every zone.
- The role of every room.
- To identify the flow behaviour both internally and externally.
BUILDING TYPE
Residence, Partitions, air inlets, windows and doors
PARAMETERS
Flow rate, Pressure difference, Building and Component quality
STARTDATE 00:04:1989
ENDATE 00:12:1990
TIME 2000 person-hours
KEYWORDS
Air movement, Pressure difference, Pressurisation
SELECTED BIBLIOGRAPHY
1 Fleury B & Gadilhe A (1989), Experimental study of airflow patterns in a three bedroom house. 10th AIVC Confer. Espoo, Finland, 1989.
2 Gadilhe A & Fleury B (1989), Potentials et limites des modeles en pression. AFME, Sofia Antipolis, September, 1989.

REF F11
TITLE
Air Flow Through Building Cracks
CONTACT
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SPECIFIC OBJECTIVES
Hydrodynamic behaviour of cracks and slots in the low change in pressure range.
PROJECT DETAILS
Identification of the flow behaviour of air (both its velocities and pressure changes) for various building components with a perfect control of Pressure changes from (0 delta P2 Pa). In a purpose-built design apparatus. Influence of the geometry of the crack, visualisation of the flow will be by smoke generation.
BUILDING TYPE
Air inlet, cracks
PARAMETERS
Flow rate, pressure difference, geometry
STARTDATE 00:01:1989
ENDATE 00:06:1990
TIME 400 person-hours
KEYWORDS
Cracks, Flow visualisation, Pressure differences, Pressurisation, Airflow
SELECTED BIBLIOGRAPHY
1 Gadilhe A & Fleury B (1989), Air flow through cracks: A bibliography review. CLIMA 2000, Sarajevo, September 1989.

REF F12
TITLE
Pressure Coefficients
CONTACT

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SPECIFIC OBJECTIVES
A comparison of the pressure coefficients by three approaches: numerical, wind tunnel and on site.
PROJECT DETAILS
Numerical determination of the pressure coefficients with a k-e model for two buildings. Feasability study comparison with wind tunnel on site experiments and a literature study.
BUILDING TYPE
Building facade
PARAMETERS
Pressure coefficient
STARTDATE 00:06:1987
ENDATE 00:06:1990
TIME 2500 person-hours
KEYWORDS
Wind pressure coefficients, Numerical simulation, Facade
SELECTED BIBLIOGRAPHY
1 Gadilhe A & Fleury B (1989), Wind pressure coefficients: A comparison between phoenics and wind tunnel results. 3rd Inter. Phoenics User Confer. Dubrovnick, August 1989.
2 Fleury B & Gadilhe A (1987), Determination des coefficients de pression en facade des batiments. Journees Ventilation, November, 1987.

HUNGARY

REF H1
TITLE
Development Of An Air Leakage Database For Filtration And Ventilation Calculations.
CONTACT
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FAX +36-1-166-3766/G3/
SPECIFIC OBJECTIVES.
Database of air leakage of building components. Measurement of air leakage. Survey and evaluation of literature data.
PROJECT DETAILS
The project targets the first stage of the development of an air leakage database for calculating the filtration and ventilation of buildings, that can be used in connection with filtration computer models. Series of pressure tests will be carried out in typical Hungarian buildings. Leakage is intended to be determined either for the unit length of well defined leaks/around windows and doors or at structural joints/or for the unit area or structural components. Results from several measurements of the same structure and same installation conditions will be statistically analysed.
BUILDING TYPE
Traditional masonry buildings and RC panel structures
PARAMETERS
Pressure difference over the structural components
STARTDATE 01:07:1989
ENDATE 31:03:1990
TIME 5500 person-hours
KEYWORDS
Pressure tests, Database, Air leakage, Dwellings
SELECTED BIBLIOGRAPHY
Future publications:
1 Air leakage database. Research report/ with English abstract
2 User's manual for the LEAKBANK software/ English version is not yet decided
3 Some papers on the model in Hungarian and perhaps foreign technical periodicals/ later in English.

REF H2
TITLE
Development Of A Multizone Computer Model Of Filtration And Ventilation.
CONTACT
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SPECIFIC OBJECTIVES.

Multi-cell computer model of filtration and ventilation of buildings linkage to special databases, user friendly version.

PROJECT DETAILS

The project targets the development of a multicell computer model of filtration and ventilation of buildings, that can be used in the design and analysis of airflows in buildings. The program is intended to be a design tool. Model Features: network of nodes/ external, rooms, ductwork nodes/ connected by a number of flow paths. Flow paths type; large openings, cracks, porous structures, different air inlets, outlets, vents, fans, ducts, HVAC systems. Solving algorithm: "regula falsi" method. Planned capacity: no direct restriction on number of nodes, neither on number of flow paths between connected nodes. Separate treatment of duct systems and HVAC provided. Program Features: Source code in pascal, program designed for IBM AT and compatible machines, no graphics in the "minimum requirement" version, connection between input, calculation and output module and external databases through standardized data files in text format. The minimal requirement version includes the present state of available knowledge in Hungary. Objectives of the planned further development: improvement of modules, extension of databases, inclusion of single sided ventilation, interface to CAD systems, linkage to building thermal models.

BUILDING TYPE

Any type of multicell structure

PARAMETERS

Air change rate, heat demand, indoor migration of pollutants and smoke.

STARTDATE 01:11:1988
ENDATE 30:11:1989
TIME 4000 person-hours

KEYWORDS

Computer simulation, Multi-zone, Air change rate, Mechanical ventilation Natural

SELECTED BIBLIOGRAPHY

Future Publications:
1 Reference guide/ English version is not yet decided
2 User's manual/ English version is not yet decided
3 Some papers on the model in Hungarian and perhaps foreign technical periodicals / later in English

REF H3

TITLE

A Limited Meteorological Database For The Analysis Of Thermal Behaviour And Ventilation Of Buildings

CONTACT

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SPECIFIC OBJECTIVES.

A metoerological database and handling program related to buildings.

PROJECT DETAILS

The project targets the first stage of the compilation of a meteorological database of Budapest for calculating the thermal performance, external thermal and moisture loads, filtration and ventilation of buildings. The database is designed to be used in connection with filtration computer models too. In its full version the database will be extended, and it will be based on analyzed data from 5-10 representative regions of Hungary. Data from many years of observation will be compressed into a "test reference year" file(s), including solar data, wind data, air temperature and humidity.

BUILDING TYPE

(Not Stated)

PARAMETERS

(Not Stated)

STARTDATE 01:07:1989
ENDATE 30:11:1989
TIME 1500 person-hours

KEYWORDS

Meteorological, Database, building envelope

SELECTED BIBLIOGRAPHY

Future Publication:
1 Test reference year. Budapest. Research report/ with English abstract.
2 User's manual for the METBANK software/ English version is not yet decided.
3 Some papers on the model in Hungarian and perhaps foreign technical periodicals/ later in English

REF H4
TITLE
Energy Saving And/Or Hygienic Requirements - Real Or Illusory Conflicts?
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SPECIFIC OBJECTIVES
To establish that even with the appropriate ventilation, energy consumption does not depend on ACH.
PROJECT DETAILS
The necessary conditions for moulding to occur is capillary condensation in the surface finishing. At a given moisture development the higher is the ACH, the lower is the acceptable surface temperature and vice versa. The products of air mass flows and indoor-outdoor temperature differences are the same. This concept has been proved by laboratory experiments, the condition of capillar-condensation has been determined for cca 50 building materials and surface finishing. Diagrams have been elaborated showing the necessary ACH, the surface temperature, the moisture production in the room, the indoor temperature and the weather parameters. The results have been checked by the Hungarian Building Science Institute (K.Balazs) in occupied blocks of flats (prefabricated concrete panels, mechanical exhaust, district heating between 1988 and June 1989, using tracer gas, temperature, RH and wind registration.
BUILDING TYPE
(Not Stated)
PARAMETERS
(See Project Details)
STARTDATE 00:00:1988
ENDATE 00:06:1989
TIME *(Not Stated)*
KEYWORDS
Energy consumption, Air change rate, Ventilation
SELECTED BIBLIOGRAPHY *(None Stated)*

JAPAN

REF J1
TITLE
Indoor Radon Pollution In Residential Buildings.
CONTACT
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SPECIFIC OBJECTIVES
To study the mechanisms of the indoor build-up of radon, and to establish counter measures.
PROJECT DETAILS
(i) Several experimental houses (unoccupied) and more than ten houses with occupants. Most of the houses have about 100 - 200 m^3 of floor area and are constructed with timber frames or concrete blocks. (ii) Most houses do not have forced ventilation systems. (iii) Tracer gas was the main measurement technique, but in one experimental house a depressurisation method was used. (iv) The tracer gases were analysed by an infrared analyser or ECD gas chromatograph. Pressure differences were detected by a diaphragm detector.
BUILDING TYPE
Detached or apartment houses (Residences)
PARAMETERS
Indoor and outdoor temperature and humidities, Most windows and doors were closed, Real, Radon, CO_2
STARTDATE 00:04:1986
ENDATE 00:03:1991 TIME *(Not Stated)*
KEYWORDS
Radon, Crawl space, Ventilation, Depressurisation, Tracer gas, Apartment, Natural ventilation

SELECTED BIBLIOGRAPHY
1 Ikeda K et. al. (1989), Experimental Studies on the indoor Radon and Radon daughter concentration build-up in Japanese houses. Proc. 4th Inter. Conf. on IAQ '89. August 1989.
2 Ikeda K et. al., Experimental Studies on the effects of crawl space ventilation on the IAQ of residential buildings.ASHRAE Trans. (Now in reviewing process)

REF J2
TITLE
Development Of Numerical Prediction Method For Indoor Thermal And Aerial Environment.
CONTACT
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SPECIFIC OBJECTIVES
Distribution and fluctuation of indoor thermal and aerial environment would be totally predicted.
PROJECT DETAILS
This prediction method will include the variables as follows: 1 Air velocity and pressure 2 Air temperature 3 Surface temperature of surrounding walls 4 Radiation interchanges 5 Heat transfer through wall 6 Thermal comfort indices like Predicted Mean Vote (PMV) or Subjective Environmental Temperature (SET) 7 Concentration of gas
BUILDING TYPE
Residence
PARAMETERS
Room air distribution
STARTDATE 00:00:1985
ENDATE 00:00:1992
TIME 10 person-years
KEYWORDS
Numerical simulation, Thermal comfort, Heat transfer, Dwelling
SELECTED BIBLIOGRAPHY
1 Kaizuka M & Iwamoto S (1989), Numerical Predictions of Thermal Environment, in a Heated Room, J. of the Soc. of Heating, Air-Conditioning and Sanitary Engineers of Japan, Vol.63,No.2,1989,pp.29-37.
2 Iwamoto S & Kaizuka M (1989), A Numerical Prediction of Periodic Thermal Environment in a Heated Room considering Radiation Interaction. Trans. of the Soc. of Heating, Air-Conditioning and Sanitary Engineers of Japan, No. 39,Feb.1989, pp 113-120.
3 Kaizuka M & Iwamoto S (1987), A numerical Calculation on the Distribution of Surface Temperature and Thermal Comfort Index Caused by Radiation Interaction in a Heated Room, Trans. SHASE, No.33 ,Feb, 1987 pp.103-113.

REF J3
TITLE
Numerical Simulation For Indoor Airflow Induced By Cross-Ventilation.
CONTACT
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FAX +81-92-592-0211
SPECIFIC OBJECTIVES
Indoor airflow distribution by cross-ventilation for effective natural cooling.
PROJECT DETAILS
This project consists of four steps: Step 1: Numerical simulation for the indoor airflow distribution in a room. Constant velocity is given on the inlet opening boundary as forced ventilation. The turbulence models used here are two-equation models and large eddy-simulation. Step 2: Simultaneous numerical simulation for the airflow around the house and for the indoor airflow. The numerical simulation is carried out on the single grid system, including indoor space, which is fixed around the model house. Step 3: Design of new boundary condition for the inlet boundary. When numerical simulation area is limited to the indoor space the boundary condition, which expresses the natural wind blowing into the room, is needed for the inlet opening. Step 4: Estimate of the numerical simulation results. The calculations results are compared with the results of the model experiments to examine the accuracy of numerical simulation. The thermal

comfort in a room with cross-ventilation is examined by thermal comfort index, SET or PMV.

BUILDING TYPE

Single unit residential house and apartment house.

PARAMETERS

Natural wind condition: wind speed and wind direction. Building condition (window shape, size and position in wall), layout of rooms and partitions.

STARTDATE 01:09:1987

ENDATE 30:06:1990

TIME 6000 person-hours

KEYWORDS

Cross-ventilation, Numerical simulation, Airflow

SELECTED BIBLIOGRAPHY

1 Yoshimizu H et. al. (1988), Measurement of indoor airflow distribution in time of cross ventilation using a model enclosure (Japanese),

2 Summaries of technical papers of annual meeting, Architectural Institute of Japan, Oct. 1988.

3 Tsutsumi J et. al. (1988), Numerical simulation of indoor turbulent airflows caused by cross ventilation and its model experiments,

4 Katayama T et. al. (1988), 9th AIVC Conference Effective Ventilation Proc. Vol 2, Sep.88 Numerical Simulation of indoor turbulent airflow caused by cross ventilation, Part1 and Part2 (Japanese),

5 Summaries of technical papers of annual meeting, Architectural Istitute of Japan, Oct. 1989

6 Tsutsumi J et. al. (1990), (Planning to submit a paper, title is not yet decided) 5th International Conference on Indoor Air Quality and Climate, July 1990.

REF J4

TITLE

3-Dimensional Numerical Simulation Of Turbulent Air Flow In And Around Buildings Based On The K-Epsilon Model With Generalized Curvilinear Coordinates.

CONTACT

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SPECIFIC OBJECTIVES

We analyse the air distribution in and around a building by the finite difference method based on generalized curvilinear coordinates.

PROJECT DETAILS

The air distribution in and around a building with a complicated configuration is well simulated by the finite difference method based on generalized curvilinear coordinates. This project follows preceeding ordinary Cartesian coordinates. Numerical simulations of room airflow by the present method using the k-epsilon method based on curvilinear coordinates are conducted. Its validity and feasibility for application to engineering problems are confirmed by comparing simulation results with the experimental results.

BUILDING TYPE

(Not Stated)

PARAMETERS

(Not Stated)

STARTDATE 00:10:1986

ENDATE 00:03:1989

TIME 5000 person-hours

KEYWORDS

Numerical simulation, Airflow

SELECTED BIBLIOGRAPHY

1 Kato S & Murakami S (1988), New ventilation efficiency scales based on spatial distribution of contaminant concentration aided by numerical simulation. ASHRAE Trans., Vol 94, Pt 2, pp 309-330.

2 Kato S et. al. (1988), Model experiment on indoor climate and space air distribution in a large-scale room. International Symposium on Scale Modeling, July 18-22, Tokyo.

3 Murakami S et. al. (1987), Three-dimensional numerical simulation of turbulent airflow in a ventilated room by means of a two-equation model. ASHRAE Trans., Vol 93, Pt 2, pp 621-642.

4 Murakami S et. al. (1988), Numerical and experimental study on turbulent diffusion fields in conventional flow type clean room. ASHRAE Trans., Vol 94, Pt 2, pp 469-493.

5 Murakami S et. al. (1988), Numerical simulation of room airflow with generalized curvilinear coordinates 1-2. Journal of Architecture, Planning and Environmental

Engineering (Trans. of AIJ), No.386 (April) NO.391 (September).
6 Nomura T et. al. (1980), Correspondence of the three-dimensional numerical analysis of turbulence flow. Trans. of the Architectural Institute of Japan, No.298 (December).

REF J5

TITLE

Numerical Study On Diffusion Field As Affected By Arrangement Of Supply And Exhaust Openings In Conventional Flow Type Clean Rooms.

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SPECIFIC OBJECTIVES

We analyse room air distribution and contaminant diffusion affected by the arrangement of supply outlets and exhaust inlets.

PROJECT DETAILS

Room air distribution is greatly affected by the arrangement of supply outlets and, possibly, exhaust inlets. The influence of those arrangements on the flow fields is studied here by numerical simulation based on the k-epsilon two-equation turbulence model. Room airflows in several types of conventional-flow-type clean rooms are analysed from this point of view. The flow fields in such rooms as analysed here, are well modelled as serial combinations of "flow units", each of which is composed of one supply jet and the rising streams around it. When the number of supply outjets is decreased the flow units corresponding to the eliminated supply outlets vanish and the remaining flow units expand. A change in arrangement or in the number of exhaust inlets hardly affects the entire flow field; however, such changes often have a large influence on the contaminant diffusion field.

BUILDING TYPE

Clean room

PARAMETERS

Representative velocity for non-dimensionalization defined by inflow jet velocity, representative length for non-dimensionalization defined by width of supply outlets.

STARTDATE 00:03:1985
ENDATE 00:03:1990
TIME 10000 person-hours

KEYWORDS

Clean room, Numerical simulation, Clean rooms, Indoor climate

SELECTED BIBLIOGRAPHY

1 Kato S & Murakami S (1988a), New ventilation efficiency scales based on spatial distribution of contaminant concentration aided by numerical simulation. ASHRAE Trans., Vol 94, Pt 2, pp 309-330.
2 Kato S et. al. (1988b), Study on diagnostic system for simulation of turbulent flow in room (Part 17). Investigation on each type wall boundary of k-e-2 equation model (No.1). Trans. of annual meeting of SHASEJ, pp 573-576.
3 Nagano S et. al. (1988), Study on diagnostic system for simulation of turbulent flow in room (Part 18). Investigation on each type wall boundary of k-e-2-equation model (No.2). Trans. of annual meeting of SHASEJ, pp 577-580.
4 Murakami S et. al. (1987), Three-dimensional numerical simulation of turbulent airflow in a ventilated room by means of a two-equation model. ASHRAE Trans., Vol 93, Pt 2, pp 621-642.
5 Murakami S et. al. (1988), Numerical and experimental study on turbulent diffusion fields in conventional flow type clean room. ASHRAE Trans., Vol 94, Pt 2, pp469-493.

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TITLE

Development Of A Prototype Of Expert System On The Ventilation In Houses.

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SPECIFIC OBJECTIVES
To make a prototype enabling a lot of qualitative and quantitative knowledge to become available for designers, engineers and researchers.
PROJECT DETAILS
1 Survey of ongoing project relating to the expert system on ventilation. 2 Development of a program to calculate multi-zone ventilation. 3 Check of the conditions for making the expert system. 4 Making the date structure which describes the building appropriate to the ventilation calculation. 5 Making a prototype with a developing tool of expert system.
BUILDING TYPE
Ventilation system
PARAMETERS
Ventilation rate
STARTDATE 00:10:1988
ENDATE 00:10:1991
TIME 2000 person-hours
KEYWORDS
Expert system, Ventilation,multizone, Ventilation system
SELECTED BIBLIOGRAPHY
1 Y Utsmi & H Matsumoto (1989), An expert system for the design of ventilation. Pt 1 Background and Introductory studies. Ann. Meeting of Archit. Instit. of Japan 1989, 10 (in Japanese)
2 H Matsumoto & Y Utsumi (1989), An Expert System for the design of ventilation. Pt 2 Prototype results. Ann. Meeting of Arch. Instit.of Japan 1989, 10, (in Japanese).

REF J7
TITLE
Sensitivity Analysis Of Multizone Ventilation Calculation.
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SPECIFIC OBJECTIVES
To specify the effect of the parameters relating to mutizone ventilation.
PROJECT DETAILS
1 To choose the multizone ventilation calculation program. 2 To set the parameters appropriate to representing each characteristic. 3 To evaluate the effects of the parameters and to make practical recommendation for designers and engineers.
BUILDING TYPE
Multizone buildings
PARAMETERS
Ventilation rate
STARTDATE 00:10:1989
ENDATE 00:10:1992
TIME 1500 person-hours
KEYWORDS
Multizone, Ventilation, Computer simulation
SELECTED BIBLIOGRAPHY
1 Yoshino H et. al. (1989), Measurement of airtightness, Air Infiltration and Indoor Air Quality in ten Detached houses in Sendai, Japan. ASTM Symposium, Air Change Rate and Air Tightness in Buildings. 1989.4.

KUWAIT

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TITLE
Field Survey And Performance Assessment Of Aluminium Windows In Kuwait.
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SPECIFIC OBJECTIVES
Evaluate current window construction practices in Kuwait, identifying causes of poor performance and the effect of window type, age, source, and cost.
PROJECT DETAILS
A visual inspection method was developed to assess the causes of air infiltration and rough operation in aluminium windows. A list of all defects found in aluminium windows and their frequency in a sample of 154 installed windows was provided. Field air infiltration test was

performed on the sample units and the air infiltration rate was compared with visual assessment results. The effects of type of building, cost, age and type of window, dimensions, source, sealing condition, operation ease, source and number of defects on the air infiltration were determined. The 154 windows were installed into buildings of variable age from new to more than 10 years old.

BUILDING TYPE

Residential, commercial and office buildings were included.

PARAMETERS

Window (age, type, source, cost, operation classification, sealing condition visible defects, sources of defects, dimensions).

STARTDATE 00:04:1988

ENDATE 00:06:1989

TIME Researcher (1950 person-hours), Assit (1950 person-hours)

KEYWORDS

Air infiltration rate, Window performance, Dwelling, Window

SELECTED BIBLIOGRAPHY

1 Daoud O et. al. (1989), Field survey and performance assessment of aluminium windows in Kuwait, Technical Report No.5, ASD-12, KISR 3072, Kuwait Institute for Scientific Research, Kuwait, June 1989

2 Daoud O et. al. (1990), Assessment methodology of defects in aluminium windows.(Under preparation for publication in Building and Environment, England, Pergamon Press).

3 Daoud O et. al. (1990), Defects in aluminium windows and their impact on dust and air infiltration, (Under preparation for publication in Building and Environment).

4 Daoud O et. al. (1990), Field Assessment of aluminium windows in Kuwait, (under preparation for publication in Energy and Buildings, U.S.A.)

TURKEY

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TITLE

Comparison Of Different Infiltration Models On Residential Buildings In Turkey.

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SPECIFIC OBJECTIVES

To study the effect of infiltration rates on the heating load; and to improve an engineering model for accurate calculation of infiltration loads in Turkish type of buildings.

PROJECT DETAILS

The main aim of the project was to investigate the accuracy of existing methods which are already used in Turkey. The research was carried out using analytical methods. A few typical Turkish apartment houses were selected for application. Different methods were applied to determine infiltration rates under different environmental condtions. Results were then compared and discussed. Only the inside pressure variations were due to wind and stack effect, they were measured with vacuum gauges. A computer simulation was developed in order to calculate and compare the infiltration rates with different methods.

BUILDING TYPE

5 floor apartment type residential buildings

PARAMETERS

Performance of building components; weather conditions

STARTDATE 01:10:1988

ENDATE 01:09:1989

TIME 200 person-hours

KEYWORDS

Residential, Dwelling, Computer simulation, Infiltration, Pressure

SELECTED BIBLIOGRAPHY *(Not Stated)*

USSR

REF SU1

TITLE

A Mathematical Simulation Of Thermal Conditions In Buildings.

CONTACT

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Moscow, 103754,
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SPECIFIC OBJECTIVES

A mathematical simulation of air conditions in industrial buildings.

PROJECT DETAILS

Obtained the formula for determining air infiltration passing through the enclosing structure on its characteristic part. This formula considers: the distribution pattern of the indoor air temperature over the height of the room; the function of aerodynamic factors of the building; and the humidity of the outdoor and indoor air. The formula is an integral on the area of the surface of the enclosing structure or its characteristic part.

BUILDING TYPE

Large industrial buildings.

PARAMETERS

The period of heating: T (out) = -26C; v = 3-6m/s; RH = 60%. The period of cooling: T (out) = +30C; v = 6m/s.

STARTDATE 01:09:1985

ENDATE *(Not Stated)* TIME *(Not Stated)*

KEYWORDS

Mathematical Simulation, Industrial, Heating system, Building envelope

SELECTED BIBLIOGRAPHY

1 Tabunschikov Y et. al. (1986), Thermal performance of the building envelope. Stroizdat, Moscow, 1986.

2 Tabunschikov Y & Yuriev I (1988), Mathematical model and computation algorithm to control microclimate by air conditioning systems. Izvestiy Vuzow. Stwitelstvo i arthetectura. Novosibirsc, N1, 1988.

Appendix A
Survey Form

Air Infiltration and Ventilation Centre

Survey of Current Research into Air Infiltration Ventilation and Indoor Air Quality

For Office use only	
$$T #REF	Title of project ______________________________
	______________________________
$$N CONTACT $$T	Principal researcher ______________________________
$$N ADDRESS	Organisation ______________________________
	Address ______________________________
	______________________________
	Telephone ______________ Fax ______________
	Electronic mail no. ______________ Telex ______________
#infodate	Date survey form complete ______________________________
$$N DESCRIP	**Description of project** Specific objectives ______________________________
	______________________________
$$P <	Project details ______________________________

For office use only	
$$P < $$P <	Building and/or component type_____ Parameters with which infiltration and indoor air quality will be related_____
# startdate	Date project began_____
# endate	Expected termination date_____
# time	Estimated number of man hours_____
$$N KEYWORDS	
$$N BIBLIOG	Important reports and publications, both past and future (titles, authors, publishers, dates of publication)_____
$$A	Please return completed form to: The Air Infiltration and Ventilation Centre, Warwick University Science Park, Barclays Venture Centre, Sir William Lyons Road, Coventry, Great Britain.

Appendix B
Keywords

APPENDIX B

KEYWORDS

A

Adsorption
Aerosols
Air change rate
Air distribution
Air infiltration
Air inlet
Air leakage
Air movement
Air outlet
Air velocity
Airflow
Airflow measurement
Airflow simulation
Airtightness
Anemometer
Apartments
Attic

B

Balconies
Blower doors
(See Pressurisation)
Body odour
Building components
Building envelope
Building materials
Building performance

C

Calculation
Carbon dioxide
Carbon monoxide
Cavities
Church
Clean room
Climatic chamber
Climatic parameters
(See also Weather)
Combustion
Comfort
Commercial
Computer simulation
Condensation
(See also moisture)
Constant concentration
Contaminant flow
Contaminant
Convection
Cooling
Corrosion
Crack
Crawl space
Cross-ventilation

D

Database
Day nurseries
Decay
Demand controlled ventilation systems (DCV)
Dispersion
Displacement ventilation
Domestic
Draughtproofing
Duct
Dust
Dwelling

E

Energy
Energy conservation
Energy consumption
Energy efficiency
Envelope
Expert system

F

Facade
Factory
Field study *(See also Survey)*
Floor
Flow field
Flow visualisation
Flue
Fluid dynamics
Fluid flow
Formaldehyde
Freons
Fresh air

G

Gas appliances
(See Combustion)
Geology *(See also Soil gas)*
Guidelines

H

Handbook
Health
Heat balance model
Heat conduction
Heat loss
Heat recovery
Heat transfer
Heating appliance
Heating systems
Hospital
Hot climates
Humidity
Hygric behaviour
Hygroscopic

U

V

W

Appendix C
Index of Principal Researchers

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Appendix D

AIVC's Survey of Research&Airbase Databases on Archivist Software

Survey 90 & AIRBASE for your Personal Computer

The AIVC's 1990 Survey of Research and AIRBASE, the AIVC's bibliographic database are now available as a PC version. These databases use Archivist software, from Oxford University Press, and are available from the Air Infiltration and Ventilation Centre, complete with software, for £115. Hardware requirements include at least 7.5 Mb of hard disk space, DOS 3.1 or above and an INTEL 8086 processor or above. Archivist should therefore operate on almost any of the common IBM clones. It also operates efficiently on portable PC's, thus making it extremely mobile.

Features include "free text" searching on the entire database text or the searching of selected fields.

The software is "menu" driven and is exceptionally straightforward to use. Starting with a single search term, e.g. infiltration, the computer develops a retrieved list of all entries containing this term. The search may then be systematically narrowed or widened by using the appropriate function key and entering a new term. Searching is very rapid and normally takes only a few seconds. At any stage, entries may be displayed on the screen, printed out, or stored in an output file for later use. Full instructions with sample searches are provided with the Survey 90 and AIRBASE documentation.

Updating AIRBASE & Survey 90

AIRBASE and Survey 90 are updated regularly. Software updates may be purchased as needed at £20 for each update.

Obtaining AIRBASE & Survey 90

The databases are available directly from the Air Infiltration and Ventilation Centre to participating countries only. They may be ordered by completing the form below and returning it to the AIVC. AIRBASE & Survey 90 come complete with documentation and Archivist software.

AIRBASE & SURVEY 90 ON ARCHIVIST ORDER FORM

Please provide __________ copies of AIRBASE/SURVEY 90 at £115.00 Sterling each, inclusive of VAT.

[ ] 5 - 1/4" 1.2 Mb [ ] 5 - 1/4" 360 Kb (only as a last resort) [ ] 3 - 1/2" 720 Kb

Backed up using [ ] DOS 3.1 [ ] DOS 3.2 [ ] DOS 3.3 [ ] DOS 3.4

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The Air Infiltration and Ventilation Centre provides technical support to those engaged in the study and prediction of air leakage and the consequential losses of energy in buildings. The aim is to promote the understanding of the complex air infiltration processes and to advance the effective application of energy saving measures in both the design of new buildings and the improvement of existing building stock.

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