Air Infiltration Review

19TH AIVC CONFERENCE PROGRAMME INSIDE

a quarterly newsletter from the IEA Air Infiltration and Ventilation Centre

International Energy Agency - AIVC

Vol. 19, No 3, June 1998

Dutch Regulation for the Siting of Air Inlets

Reviewed by Martin Liddament

Dutch regulations for ventilation in buildings have been updated to include information about the siting of air inlets in relation to contaminant exhaust locations. This is covered by the Dutch Code of Practice NPR 1088 and the regulation NEN 1087, "Ventilation of Buildings: Determination Methods for New Buildings"

Basic Principles

For fresh air in a living or working area to be of adequate quality, the air entering through an intake must also be of good quality. To achieve this, any local source of pollution must be diluted to a safe level of concentration before reaching the vicinity of an air intake. This regulation provides a simple algorithm for the siting of an air intake, based on calculating the dilution factor from a polluting source and the flow path between the polluting source and the fresh air intake.

Conditions

This approach is applicable to:

1) pollution from fume extraction vents connected to appliances which do not exceed 130 kW. Distinction is made between fumes from gas fired appliances and fumes from appliances using other fuels.
2) indoor air extract vents of capacity less than 1000 dm^3/s

Table 1

Outlet Type	Dilution Factor f
Air renewal	0.01
Fume outlet (gas)	0.01
Fume outlet (other than gas)	0.0015

Acceptable dilution factors, *f*, are given in Table 1

Calculating the Dilution Factor

The dilution factor at an air inlet is based on the source strength of the pollutant and the geometry separating the pollutant source from the air intake. Calculation of the dilution factor is determined from the equation:

$$f = \frac{\sqrt{q_v \text{ or } B}}{C_1 \cdot l + C_2 \cdot \Delta h}$$

[equation 1]

where:

f is the dilution factor

q_v is the extraction rate of inside air in dm^3/s (q_{vtot} or q_{vsom})

In this issue

B is the combustion appliance capacity (B_{tot} or B_{som}) in kW

l is the numerical value, (m), of the length of the connecting line in m between the air inlet, (i.e., an opening intended for the supply of fresh air or the supply of combustion air if this is supplied by a living or working area) and the exhaust outlet, (i.e., for the extraction of inside air or fumes).

Δh is the numerical value of the difference in height (m) between the air intake and the exhaust outlet.

C_1, C_2 are dilution coefficients

The dilution coefficients C_1 and C_2 are determined from the information provided in Table 2 and the 17 configurations given in Table 3 (See page 4). By means of an example, for configuration 1,(Table 3), it can be seen by reference to Table 2 that for :

a ventilation outlet, $C_1 = 325$, $C_2 = 650$,

a fume outlet (gas fired), $C_1 = 163$, $C_2 = 325$

a fume outlet (other fuels), $C_1 = 325$, $C_2 = 1100$

Example: Calculating the Dilution Factor

The dilution factor is calculated for the following example. An outlet of a mechanical ventilation system for four dwellings with a capacity of 168 dm^3/s exits 0.3 m above the roof surface. The distance to the edge of the roof is 2 m.

In the facade bordering on the roof surface there is an inlet opening of the intake for ventilation of a habitable area. The distance from the inlet to the edge of the roof is 0.5 m.

The dilution factor is determined by the following steps:

Step 1
Determine the type of inlet and outlet.
- The inlet is for ventilation of a habitable area.
- The outlet is a ventilation outlet.

Step 2
Determine the type of location.
- The location, as described in this example, agrees with configuration 1 of Table 3.

Step 3
Determine the values of coefficients C_1 and C_2.
- Based on Tables 2 and 3 and the previous example, the coefficient C_1 should be 325 and C_2 should be 650.

Step 4
Determine the length of the connection line, l.
- the distance (*l*) between the inlet and outlet is: 2 m to the edge of the roof + 0.5 m below the edge of the roof = 2.5 m
- the height difference between the inlet and outlet (Δh) is: 0.3 m above the roof + 0.5 m below the edge of the roof = 0.8 m.

Step 5
Calculate the dilution factor to five decimal places from equation 1, i.e.,

$$f \geq \frac{\sqrt{168}}{325 \bullet 2.5 + 650 \bullet 0.8}$$

[equation 2]

According to the formula given in the standard, the calculated dilution factor, *f*, is:

$f = 0.00988$

Step 6
Check that the requirements are fulfilled (Table 1)
- The required dilution factor for air renewal or ventilation is 0.01. Since the dilution factor is less than this number the requirement is fulfullled.

Air
Infiltration
Review

Editor: Janet Blacknell

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

Table 2: Coefficients C_1 and C_2 depending on the position and type of outlet

Type of outlet	Coefficient	Position determined according to Table 5								
		1, 6, 8, 9	2	3, 15	4, 16	5, 7, 10	11, 13	12	14	17
Ventilation outlet	C1	325	163	650	500	163	220	325	325	163
	C2	650	163	325	-163	163	650	110	163	163
Fume outlet (gas-fired)	C1	163	60	163	500	80	110	163	163	110
	C2	325	60	440	-325	80	325	60	80	325
Fume outlet (other fuels	C1	325	220	N/A	N/A	220	N/A	N/A	N/A	N/A
	C2	1100	220	N/A	N/A	650	N/A	N/A	N/A	N/A

Additional Parameters

The following additional parameters play a part in the good functioning of a ventilation system.

Conduits

- The speed of the air in the conduits

In view of noise pollution, it is desirable to limit the speed of the air in the conduits. The air speed must not exceed approx. 3 m/s in the vicinity of the gratings. At a greater distance from the gratings, a higher air speed is permissible. For example 5 m/s.

- Extra equipment such as a motorless exhaust hood, filters, mufflers

This equipment can significantly improve the quality of the system, but in general it restricts capacity.

Compensating measures are usually needed, for example a ventilator with a greater capacity or larger conduits.

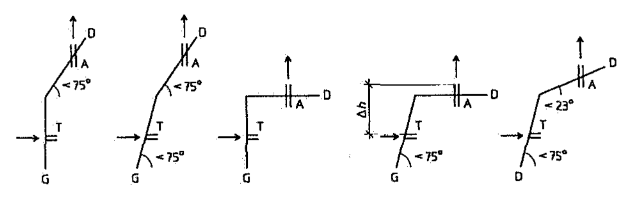
- Air leakage from conduits

It is desirable for conduits to lose no more than 10% of the nominal flow volume through connections and walls during use.

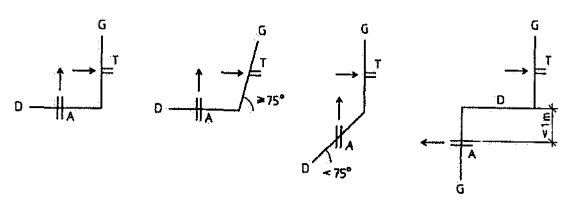
Code of Practice for the Location of Outlets

The code recommends that the outlet for the mechanical extraction facility is located close to the ceiling. The distance between the outlet opening and the ceiling should not exceed 0.3m. If there is an open connection between the habitable area where the cooker is installed (kitchen) and other areas, it is recommended that a vapour barrier of 300 mm is installed on the ceiling, on the separating surface between the habitable area and other areas, to significantly reduce the spread of odour and vapour. If the outlet of the mechanical extractor exits above the roof, it should clear the surface of the roof by at least 0.3 m to ensure its proper functioning. Mechanical extraction facilities for ventilation can be combined with mechanical fume extractors.

Table 3: Configurations



Configuration 1



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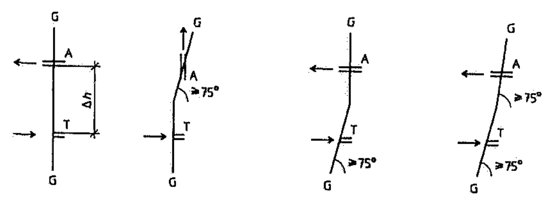
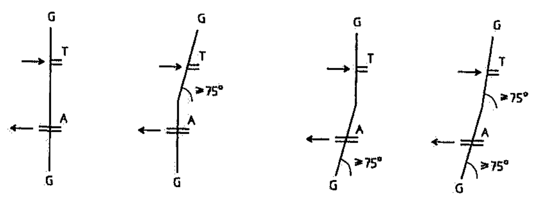
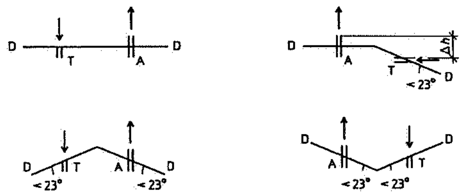


Configuration 3



Configuration 4

Where:G is the facade, D is the roof surface, T is the inlet, A is the outlet, Δh is the vertical distance between the outlet and inlet openings



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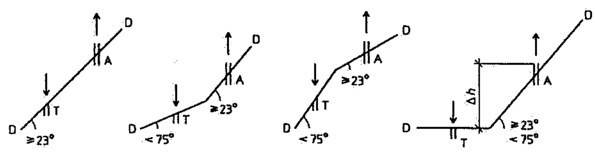

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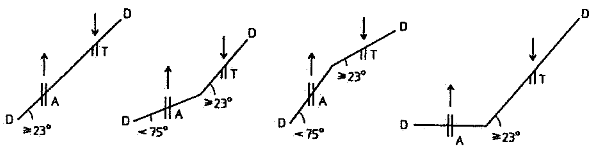

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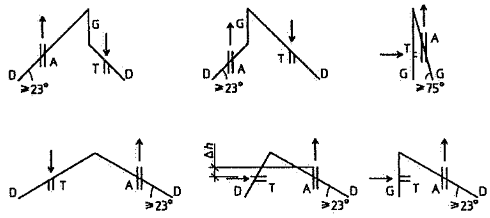

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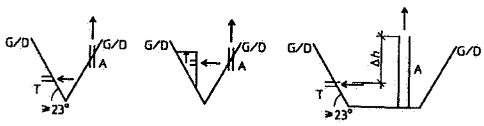

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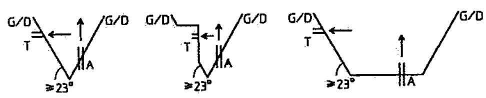

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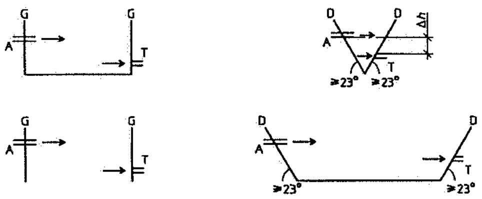

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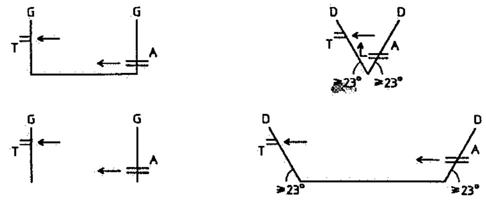

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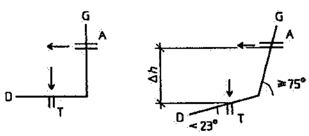

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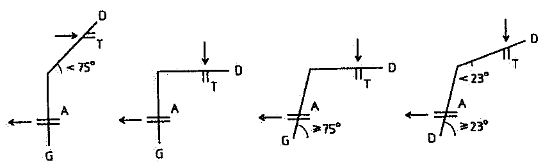

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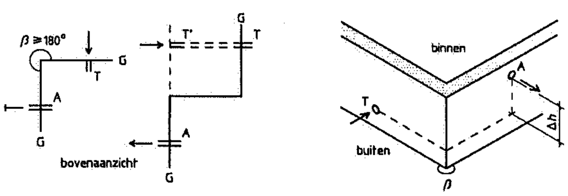
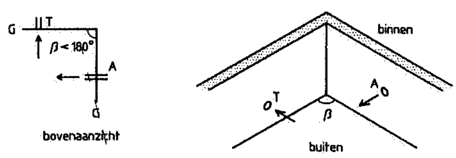


Configuration 15, 16



Configuration 17

Increasing Pressure......

by Mark Limb, AIVC

describes a seminar, "Airtightness in UK Non Domestic Buildings: Current Status and Future Practice" held at the Chartered Institute of Building Services Engineers, London, UK, March 1998

The campaign to increase the airtightness of UK non domestic buildings gained more support at a recent CIBSE seminar. The UK's Chartered Institute of Building Servicse Engineers (CIBSE) is championing the cause for more pressure testing within the UK's non domestic building sector. Delegates from the UK major supermarkets, design and architectural practices were present at the seminar and workshop at which the current status and future developments were discussed.

Representatives from the UK's Building Research Establishment, CIBSE and Building Services Research Information Association (BSRIA) presented papers, centered around the methods used to undertake such a study, the comfort and energy implications of improving building airtightness, and the information gained so far from real pressure test experiments conducted in the UK by both the BRE and BSRIA. Doug Lawson from Building Sciences Ltd, highlighted a catalogue of examples in which existing buildings with air leakage problems had been investigated, and remedial measures undertaken.

Following the presentations, delegates retired to workshop sessions to discuss the issues raised by the formal presentations. The overwhelming conclusion was that airtightness should be covered in any future update of the UK Building Regulations.

Delegates also agreed that when such a requirement is included in the Building Regulations, as they are successively updated, the airtightness requirements should become progressively more stringent.

The use of a common unit to represent the unit of airtightnes was also agreed between representatives from BRE and BSRIA. A "Q value" was suggested, which would provide a common link between the data and would include a correction for local weather conditions.

Delegates felt that there was a need for greater awareness about building airtightness and its implications in terms of both comfort and energy to help educate architects, clients, property developers and design engineers.

To accompany the introduction of airtightness within the Building Regulations, delegates also agreed that an airtightness audit procedure for existing buildings should be developed.

However, the cost of pressure testing in terms of capital expense and time constraints represented the main area of concern. Participants wanted more information about the expected capital and running cost savings, that might be expected from buildings with low infiltration.

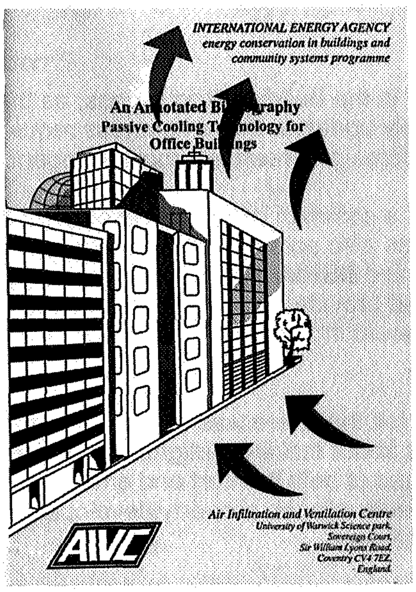
Therefore it appears only a matter of time before airtighness is included in the UK Building Regulations.

Passive Cooling Technology for Office Buildings - An Annotated Bibliography

Mark J. Limb, May 1998

Changes in building style and function have led to a greater dependence on artificial forms of lighting, heating, cooling and ventilation within modern buildings. Recent environmental concerns have however, led to a greater focus on traditional passive methods of solar control and natural lighting and renewed enthusiasm for natural ventilation and passive cooling methods. Designers, architects and engineers have adapted many traditional basic principles to fit in with the modern office environment, both in terms of building practices and materials and in the way in which we work today, often resulting in innovative design solutions.

In this bibliography papers discussing the historical perspective of passive cooling and how it has been adapted for use in modern buildings with much success in hot climates are reviewed along with those discussing the importance of building form, shading, location, construction materials and climate. Good design is essential where passive cooling methods are considered as part of an overall energy efficient building. Environmental design should follow three fundamental steps; prevention of heat gains (protection), modulation of heat gains (modification) and heat dissipation. Protection includes careful landscaping, planning and design of building layout, interior furnishings



and external construction materials, together with solar shading, thermal insulation and a careful control of heat gains. The modification of heat gains, depends upon the heat storage capacity of the building, which if carefully considered and well designed can improve the overall thermal comfort of occupants by removing excessive temperature swings. Heat dissipation deals with the natural removal of internally generated heat, from people and processes within the building, usually via radiative, evaporative, convective or ground cooling. The bibliography contains the following sections:

Introduction

Prevention of Heat Gains (Protection)
- Location, Landscaping, Site Planning and Building Morphology.
- Shading and Other Solar Control Techniques.
  - Pre-Design Tools.
  - Shading Devices.
  - Shading Devices - Automatic Controls.

Modulation of Heat Gains (Modification)
- Thermal Storage.
- Night Cooling.

Heat Dissipation
- Natural Ventilation and Passive Cooling
  - Weather Data Investigations.
- Radiative Cooling.
  - Direct Radiative Cooling Strategies.
  - Indirect Radiative Cooling Strategies.
- Evaporative Cooling.
  - Direct Evaporative Cooling Strategies.
  - Indirect Evaporative Cooling Strategies.
- Earth Cooling.

Conclusions

References

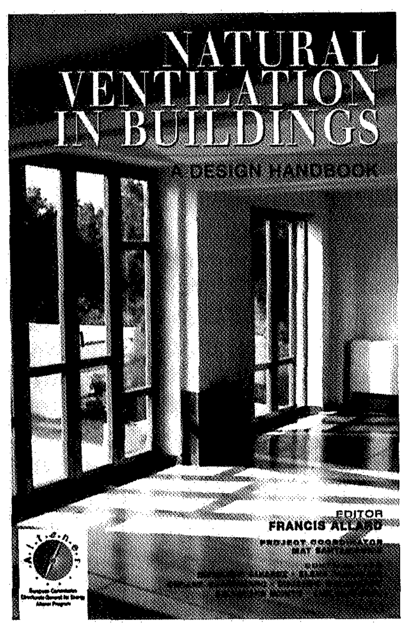
The review concentrates on these passive cooling methods and designs, and discusses a number of different solutions for modern office buildings, examples consider hot dry climates and temperate areas. In all over 110 references are included in this comprehensive bibliography which is now available from the AIVC at £15.00.

New Publication

Natural Ventilation in Buildings: A Design Handbook

edited by Francis Allard, UK, James and James, 1998

This new handbook describes the potential of natural ventilation, its appropriate use, the design and dimensioning methodologies, the need for an integrated design approach, and how to overcome barriers.



The book will provide essential design information for all architects, building engineers and other building design professionals.

The book is written by the AIOLOS projects participants, whose task has been putting into design-tool form the findings from various recent Europe-wide studies on natural ventilation and cooling.

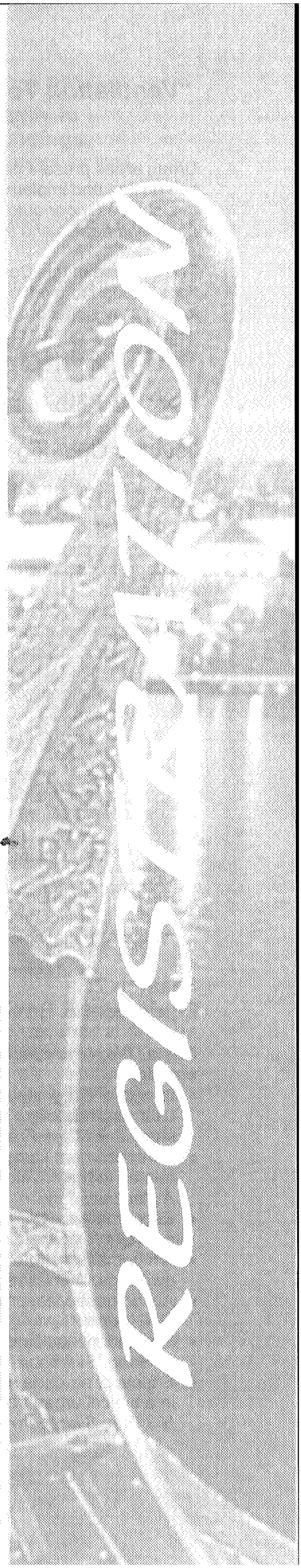
INTERNATIONAL ENERGY AGENCY

AIR INFILTRATION AND VENTILATION CENTRE

19TH AIVC ANNUAL CONFERENCE
28-30 SEPTEMBER 1998

VENTILATION TECHNOLOGIES IN URBAN AREAS

HOLMENKOLLEN PARK
HOTEL RICA
OSLO, NORWAY



"Ventilation Technologies in Urban Areas"

Urban areas present particular problems to ventilation design and implementation. These arise from factors such as: *poor outdoor air quality; excessive noise and heat island effects.*

The purpose of this Conference is to clarify the solutions needed to overcome these difficulties. The following provisional programme includes full oral sessions and poster displays preceded by five minute oral presentations.

Monday, 28th September, 1998

0900hrs Opening Ceremony

Session 1: Modelling & Control Algorithms

- A semi empirical flow model for low velocity air supply in displacement ventilation. *E Skaaret, Norway*
- Development of intelligent algorithms for indoor air quality control through natural ventilation strategies.*G Sutherland, Greece*
- Uncertainty in the prediction of wind pressure coefficients for low-rise buildings in an urban environment. *Sten De Wit, Netherlands*
- Simulation of infiltration heat recovery. *C Buchanan,USA*
- A software approach for economic optimisation of energy use in buildings.*Tor Helge Dokka, Norway*
- Modelling Moisture in Homes.*P. Plathner,UK*
- Modelling supply devices in order to predict improvements in internal air quality. *M W Simons, UK*
- Review of mathematical models and experimental studies of residential passive ventilation systems - A new AIVC technical note *J. Axley, USA*

Session 2: Equipment & Envelope Characteristics

Poster Displays preceded by 5 minute oral presentations

- Impact of airtightness of industrial buildings on air changes: modelling and comparison with a field study.*J-R Millet, France*
- An experiment study on the ventilation control related to the envelope of a new airport terminal. *A Canziani,Italy*
- Experimental determination of the performance of air filters for general ventilation.*P Anglesio, Italy*
- Airtightness performances in new Belgian dwellings. *A Bossaer, Belgium*
- Airtightness Measures in three dwellings in Rome. *G Fasano,Italy*
- Simulation studies on a kitchen ventilation system *W Song, Singapore*
- Effects of air-curtain to the heat and mass transfer in a typical urban transport vehicle. *H J Poh, Singapore*
- A Novel ventilation/Heat recovery heat pump.*S B Riffat, UK*
- Wind-driven ventilation in courtyard and atrium buildings in urban areas. *S Sharples, UK*
- Filtering and humidity measurement in exhaust air of baths and toilets without window. *A Trogisch, Germany*
- External pollution and its influence on indoor air quality - a case study *J Currie,UK*
- Sound attenuator for Fan outlet mounting. *O Solheim, Norway*
- Attenuation of cylindrical silencers in HVAC systems. *A-M Bernard,France*
- Experiences from dwelling ventilation systems with wall exhaust in blocks of flats. *J Palonen, Finland*
- Controlled natural ventilation for commercial and industrial buildings.*B Knoll, Netherlands*
- Ventilation reliability - an evaluation tool for domestic ventilation. *J Kronvall, Sweden*

Tuesday, 29th September, 1998

Session 3: Ventilation Performance & Building Airtightness

- Top-down natural ventilation of multi-storey buildings *G R Hunt, UK*
- Natural ventilation in urban environments. *M. Santamouris, Greece*
- Natural ventilation by thermal buoyancy with several openings and with temperature stratification. *K Terpager Andersen, Denmark*
- Ventilation performances in new Belgian dwellings *A Bossaer, Belgium*
- Comparison of IAQ performances of French ventilation systems in residential buildings. *J-R Millet,France*
- Energy saving advantages of a new approach to dwelling ventilation: regulation of ventilation air flow rates according to the thermal quality of the building. *B Spennato, France*
- Evaluation of thermal performances of residential ventilation systems with heat recovery. *A-M Bernard, France*
- Evaluating the compulsory performance checking of ventilation systems in Sweden. *L-G Mansson, Sweden*
- Airtightness of timber frame buildings not having a plastic film vapour barrier. *E Sikander, Sweden*

Session 4: Ventilation Strategies & Pollutant Transport

Poster Displays preceded by 5 minute oral presentations

- The JOULE-TIPVENT project: Towards improved performances of ventilation systems. *P Wouters,Belgium*
- Natural Ventilation in a semi-basement car park. *S L The, Singapore*
- Natural controlled ventilation: performances and standards. *G Cavanna,Italy*

- Filters for gaseous contaminants: performance measurement and impact on ventilation systems.*M Perino, Italy*
- Model for evaluating building health quality and personal health risk by indoor air contaminants. *Y Takemara, A Moser, Switzerland*
- Improvement of indoor climate and ventilation system in a renovated multistoried residential building in urban area. *J Palonen, Finland*
- Measurement of heat and mass transfer through typical staircases. *A Peppes,Greece*
- Ventilation strategies for thermal performance improvement of an attached sunspace. *C Koinakis, Greece*
- Displacement ventilation in a classroom - Influence of peoples movements and ceiling height. *M Mattsson, Sweden*
- Modelling indoor air pollutant concentrations considering air mixing conditions. *M Kraenzmer, Sweden*
- The principles of a homogeneous tracer pulse technique for measurement of ventilation and air distribution in buildings. *H Stymne, Sweden*
- Salt Bath modelling of the resultant stratified airflows in buildings *S Gage, UK*
- Non Attendance rates among children in Swedish day care centres before, during and after cleaning the indoor air using an electrostatic air cleaning technology. *G Richardson,UK*
- On the time depended efficiency of building ventilation on the indoor air quality in a medium sized urban area in Greece. *N Papmanolis, Greece*
- Assessing natural urban ventilation through an integrated model. *F Marques da Silva, Portugal*
- Spatial variability of pollution induced by traffic in a street canyon. *C Sacre, France*

Conference Gala Dinner

Wednesday, 30th September, 1998

Session 5: NatVent™ - Overcoming Technical Barriers

- NatVent™: its aims and vision, *E Perera*
- Perceived Barriers to Natural Ventilation in Offices. *S Aggerholm, Denmark*
- Overview and synthesis of monitoring activities carried out in the framework of the EC Joule Natvent project.*J Demeester, Belgium*
- A simple interactive design tool for sizing, locating and determining pollution attenuation features of urban air inlets suitable for office buildings. *P Ajiboye, UK*
- Constant airflow through inlets for variable weather conditions. *W De Gids, Netherlands*
- Recovering heat from natural ventilation systems. *J Brunsell, Norway*
- Control of night cooling with natural ventilation. (Sensitivity Analysis of Control Strategies & Vent Openings). *AHC Van Paassen, Netherlands*
- Practical guidelines for integrated natural ventilation design. *J Kronvall, Sweden*

Session 6: Cooling & Indoor Air Quality in Commercial & Public Buildings.

- On the use of ventilation strategies for the retrofitting of office buildings. *E Dascalaki , Greece.*
- Modern passive stack ventilated schools - evaluation of ventilation and moisture conditions. *A Blomsterberg, Sweden*
- A wind tunnel study into the location of natural ventilation air intakes in urban areas. *N E Green, UK*
- Environmental quality and energy consumption in two office buildings in Madrid and Porto. *R Velazquez, Spain*
- Active Envelopes - Essential in Urban Areas? *D Saelens, Belgium*
- Air quality control solutions for Singapore offices. *Y W Wong, Singapore*
- Outline of ventilation standard for acceptable indoor air quality, SHASE Japan. *H Yoshino, Japan*
- Ventilation of public buildings in urban area: a case study, *M Barbat,France*

GENERAL INFORMATION

Conference Venue: The venue for the conference is the distinctive Norwegian "dragon style" Holmenkollen Park Hotel Rica which is attractively situated 350 metres above the city of Oslo and is approximately a 15 minute taxi ride from Fornebu Airport.

Conference Fees: The conference will be held over 3 full days and the overall cost (*inclusive of 3 nights bed/breakfast- Sun/Mon/Tues-at the Holmenkollen Park Hotel Rica, 3 lunches, conference attendance, proceedings and Gala Dinner)* will be **650 pounds sterling** for delegates from AIVC member countries* and **675 pounds sterling** for non-AIVC country delegates. There is also a generous *early payment discount* for registrations received before 31st July, 1998. See next page for registration form

Authors please note: Final papers from both oral and poster presenters should be received at AIVC by **31st July 1998** in order to ensure inclusion in the proceedings which are distributed at the conference. A completed registration form & payment are required from authors prior to acceptance of their paper for publication in the proceedings.

Registration Desk: The conference registration desk will be open on **Sunday 27th September from 1800hrs-1930hrs** for early registration, thereafter from **0830hrs** each day of the conference.

AIVC member countries: Belgium,Denmark,Finland,France,Germany,Greece, Netherlands,New Zealand, Norway, Sweden, UK, USA

19th AIVC Annual Conference
Holmenkollen Park Hotel Rica, Oslo, Norway
REGISTRATION FORM

Delegate Name:..

Organisation..

Address..

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Telephone:..Fax:...e-mail:...

Please complete the appropriate sections below:

	AIVC Rate*£	Non/AIVC Rate £	Total Payable £
1. <u>**FULL CONFERENCE PACKAGE**</u> **from Sunday 27th to Wednesday 30th September, 1998** includes: Bed/breakfast 3 nights (27th,28th,29th) 3 lunches, Gala Dinner (29th), Conference attendance/proceedings, coffee/tea breaks	650	675	[£]
2. <u>**TWO DELEGATES SHARING ACCOMMODATION**</u> (incl. of above package), cost per person: *(please note this section applies to <u>2 delegates</u> sharing, not an accompanying guest)*	500	500	[£]
Please name <u>delegate</u> sharing room:..			
For **EARLY PAYMENT (deadline 31st July 1998)** discount on *above* categories deduct:	*-50*	*-50*	[£]
3. <u>**CONFERENCE ATTENDANCE ONLY**</u> *(i.e. Without accommodation) includes: Conference fees for period 0900hrs Mon.28th to 1700hrs Wed.30th Sept.1998, proceedings, 3 lunch, all applicable coffee/tea breaks.*	330	330	[£]
4. <u>**NON-CONFERENCE GUEST**</u>, sharing double room with delegate booked in Section 1 above. *Includes 3 nights bed/breakfast only*	60	60	[£]
5. <u>**GALA DINNER**</u>: **Cost for Daily Attendees** or **Non-Conference Guests** attending Gala Dinner *(Tuesday, 29th)*	35	35	[£]
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* *i.e. Delegates from AIVC member countries, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Netherlands, New Zealand, Norway, Sweden, UK, USA*

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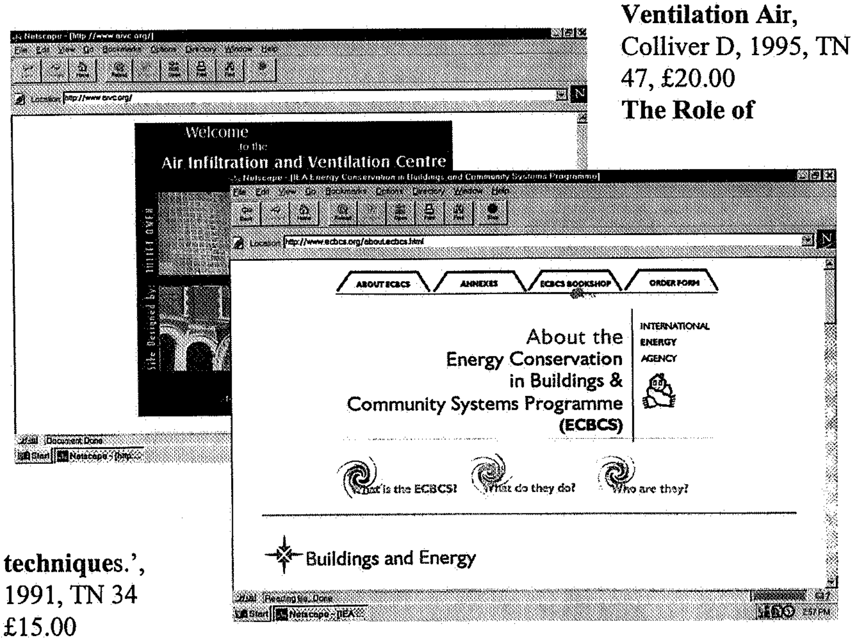

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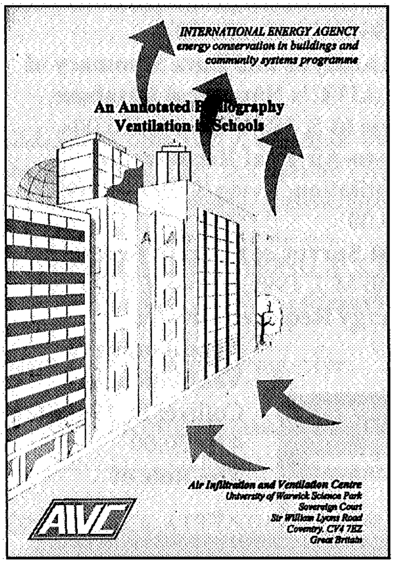

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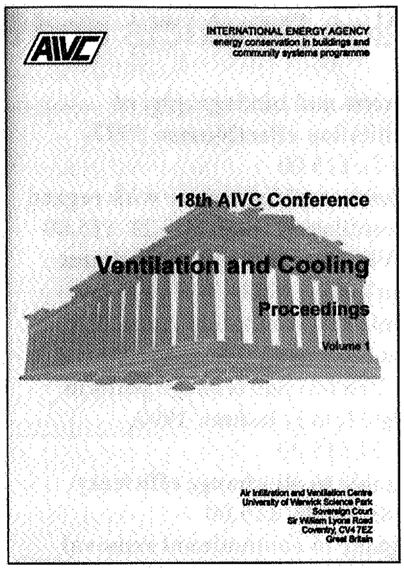

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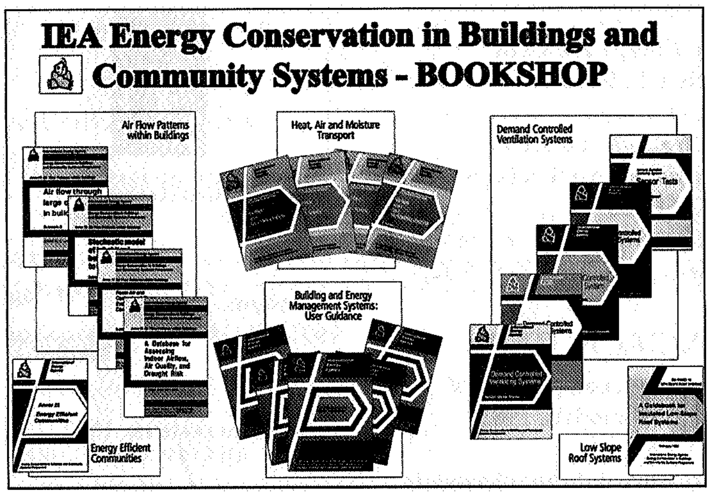

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