

THE ROLE OF THE AIR INFILTRATION AND VENTILATION CENTRE

M. Liddament and M. Orme
Air Infiltration and Ventilation Centre
University of Warwick Science Park
Sovereign Court, Sir William Lyons Road
Coventry CV4 7EZ
United Kingdom
Tel: +44 1203 692050
Fax: +44 1203 416306
Email: airvent@aivc.org

ABSTRACT

The Air Infiltration and Ventilation Centre was established as a jointly funded International Energy Agency activity in 1979. This paper seeks to describe some of the work of the AIVC and outline its evolving structure which is aimed at strengthening the link between research and application.

1 INTRODUCTION

The Air Infiltration and Ventilation Centre was established as a jointly funded International Energy Agency activity in 1979 and is currently sponsored by 12 countries. Since then it has grown significantly and has developed a strategy that has provided the opportunity for growth while reducing its dependency on financial contributions from government funding agencies. The availability of new technology combined with a strong international market for its products has secured the future of the Centre and has set one example of how complex research material can be disseminated to practitioners for application in industry. This paper seeks to describe some of the work of the AIVC and outline its evolving structure which is aimed at strengthening the link between research and application.

2 THE INTERNATIONAL ENERGY AGENCY

The Air Infiltration and Ventilation Centre operates as an activity of the International Energy Agency (IEA). This agency was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD). Its basic aim is to foster co-operation between the IEA's member countries and other interested countries to increase energy security through energy conservation, the development of alternative energy sources and through energy research development and demonstration (RD&D). This is achieved in part through a programme of collaborative RD&D currently consisting of over 40 Implementing Agreements containing more than 80 active RD&D projects. Participation in any activity is optional and most commonly takes the form of a task shared 'Annex' in which those countries that wish to take part commit an agreed level of effort. Occasionally an Annex may be 'jointly funded' in which case a single institution receives funding from each country to undertake specific tasks. Activities within each Implementing Agreement are co-ordinated through an Executive Committee, comprising representatives nominated by each participating country of the Implementing Agreement.

3 THE AIR INFILTRATION AND VENTILATION CENTRE

The AIVC is a jointly funded activity of the IEA Implementing Agreement: Energy Conservation in Buildings and Community Systems, and is currently supported by 12 countries. It was established in 1979 with 8 participants and since then has steadily grown in

size. The role of the Centre is to provide technical support for the research and development of ventilation technology and to ensure the widest dissemination of information on related energy and air quality issues. It is essentially one of the dissemination centres of the IEA. Other such centres include:

- CADDET - the Centre for the Dissemination of Demonstration End Use Technology,
- ETDE - Energy Technology Data Exchange, and
- HPC - The Heat Pump Centre.

4 ACTIVITIES

Approximately one third of primary energy is consumed in buildings. Of this, it is likely that up to 50% is dissipated through air change (i.e. intentional ventilation losses and losses through building leakage – air infiltration). As the quality of the thermal fabric of buildings improves, air change is set to become the dominant mechanism for building heat (or cooling) loss. Furthermore, substantial investment is made in the ventilation technology of buildings since it is vital for securing a good indoor climate. Air distribution is also widely used for thermal conditioning. It is the strong interaction between the supply of fresh air, its considerable impact on energy use and the need to secure good indoor air quality that makes ventilation so pivotal in building technology. Designing for energy efficient ventilation, however, is made especially difficult by the complexities of air flow behaviour, climatic influences, occupancy patterns and pollution characteristics.

At the time of the AIVC's inauguration, primary concern was over identifying the energy impact of ventilation. Very little was understood about building air leakage (i.e. the infiltration consequences of the many gaps and cracks in the building envelope). Also very little was understood about the magnitude of infiltration rates induced by the pressures acting on such openings due to wind and temperature effects. The early objectives of the Centre, therefore, were to address these issues.

The AIVC fulfils its objectives by providing a range of services and facilities. These include:

Technical

The Centre undertakes its own technical programme that is focused on the analysis and interpretation of international research. Fundamental activities have included:

- **Evaluating the performance of Air Infiltration and Ventilation Computer Models:** This represented one of the first programmes. It involved compiling air change measurement data (tracer gas analyses) from many sources with associated information about the buildings in which measurements had been made and concurrent prevailing wind and indoor/outdoor temperature conditions. Air change measurement data were compared with the predicted results of mathematical models (Liddament and Allen, 1983). A total of eleven models were evaluated and this study provided the first indication of the performance of such models and the quality of data needed for reliable results. This study also demonstrated a promising capability of models provided the user understood the input data and could construct an accurate network of flow openings.
- **Production of Calculation Techniques (Liddament 1986) and Measurement Techniques (Charlesworth 1988) Guides:** An important outcome of the model evaluation study was the identification of a need to produce calculation and measurement techniques guides. These have been widely used as references by practitioners.
- **Development of a Numerical Database:** A further outcome of the Centre's first study was the scarcity of data needed for design and application. The AIVC, therefore, embarked on a comprehensive survey of data covering the typical airtightness characteristic of building components, as well as of entire building structures. These data were compiled into a

database and were also analysed for statistical trends. Using such information it was possible to develop guidelines on selecting appropriate data from the database for design and also to estimate overall building air tightness according to construction technique and level of caulking. The database also contains relevant standards for performance as introduced by various countries and information about evaluating wind pressure according to building height, surrounding terrain, shielding and wind velocity. This database has been published as a printed document (Orme et al 1994, 1998). An extension of this work is the AIVC's Numerical Data Guide, currently under development.

- **A Guide to Energy Efficient Ventilation:** Much of the technical work of the Centre has culminated in the publication of a Guide to Energy Efficient Ventilation (Liddament 1996). Its purpose is primarily to provide an introduction to the topic of ventilation. Numerical equations have been restricted to the last two chapters (on measurements and calculations) while the main emphasis has been placed on understanding the mechanisms and underlying philosophy behind ventilation. Nevertheless, sufficient information and guidelines have been included to enable basic calculations to be undertaken. In fact, various universities including institutions in Alaska, Sweden, the United Kingdom and continental Europe have now adopted this Guide as a course text book.
- **Applicable Models:** to augment existing work, a description of applicable ventilation related models has been compiled (Orme 1999). This is aimed at demonstrating the availability and applicability of models that are readily accessible by downloading from internet sites and other sources.
- **Energy Impact of Ventilation:** A key part of the AIVC programme has been to evaluate the energy impact of air change and to identify the potential for reducing unnecessary losses. Estimates have been made for all AIVC participating countries for both dwellings and non-residential (service and commercial sector) buildings (Orme 1998).

Information and Dissemination

A fundamental task of the AIVC is to ensure the widest possible dissemination of information. In fulfilling this task it publishes many technical reports and co-ordinates and publishes the results of related IEA activities. In addition, the Centre organises regular conferences and specialist workshops. It also publishes 'Air Infiltration Review' a quarterly journal of information, news and short technical items. 'Air Infiltration Review' is currently circulated to organisations and individuals in over 40 countries. In addition, as part of its dissemination activity, the AIVC carries out regular world wide surveys of research into building ventilation and indoor air quality. Other important information based activities include:

AIRBASE

The Centre's bibliographic database, '*AIRBASE*' is the hub of its information service. It contains abstracts of over 12,000 specialist articles related to ventilation and associated topics. *AIRBASE* is regularly updated and may be accessed via the AIVC or obtained as a CD-ROM. Updates are posted on the Web Site of the AIVC. Topics include:

- ventilation research;
- applications;
- indoor air quality;
- energy issues;
- natural ventilation;
- mechanical ventilation;
- ventilation effectiveness;
- heat recovery;

- measurement methods;
- calculation techniques;
- all building types;
- design data.

Key subject areas have also been developed into a series of annotated bibliographies, technical notes and guides.

International Library Service

Subject to copyright restrictions, items referenced in *AIRBASE* are available from the Centre's international library service. This world-wide service handles requests for approximately 4000 items each year.

Bookshop

An advantage of the extensive infrastructure of the Centre has been taken to develop a targeted bookshop. This supplies products to all participating countries and beyond. The bookshop has become a significant source of income and is steadily evolving to meet the needs of users. Essentially it is used to target:

- AIVC Publications;
- AIRBASE;
- Other publications of the International Energy Agency;
- AIVC Services.

It is also being expanded to distribute other items including:

- Third party publications;
- Relevant software;
- Tool kits and other design products generated from related research activities.

World Wide Web Services

The Web has developed as an important marketing tool of the Centre. It attracts a steadily growing number of users from many countries and access currently averages almost 4000 each month. The Web site contains several information products that were formally printed and distributed by post. Furthermore, the out-reach of the Centre has become truly world wide. Newly introduced is a service page that will enable users to access suppliers of services related to ventilation.

5 MEETING THE NEEDS OF THE FUTURE

Considerable developments have occurred during the life-span of the Centre towards understanding the role and impact of air infiltration and ventilation on energy use and indoor air quality. Nevertheless significant problems are still experienced in the ventilation and envelope design of both new and existing buildings. The special needs of large buildings, particularly in relation to air distribution and energy efficient cooling, require particular attention. In part, difficulties arise as a consequence of insufficient transfer of information or inadequately interpreted information from the research sector to practitioners. Often, research design guidance and calculation methods can either be too complex to understand or too superficial to be of value. Either way, use is prevented of the enormous developments made in the research field. It is this gap in the dissemination chain that the Centre now needs to address.

Framework

In developing a future strategy it has been important to understand the reality of the market in which the Centre must evolve. This has helped to establish a framework within which the viability and funding mechanism of the Centre can be established.

The primary 'boundary' conditions that have been incorporated in planning for the future include:

(i) **Information is accessible to all:** The homogeneity of the scientific community means that no constraint can be put on the availability of information.

(ii) **Unique Benefits of Participation:** For the foreseeable future, some level of country funding will be needed. To maintain interest and attract new participants unique benefits for participating countries need to be identified.

(iii) **Funding:** The current country funding and participation mechanism of the AIVC makes it difficult for the Centre to attract new participants. Future funding approaches are aimed at reducing dependency on country contributions by expanding the role of the bookshop and generating other revenue raising methods.

(iv) **Role of the AIVC:** Within this framework, the role of the Centre in relation to other IEA activities, the research community and energy end users should be well defined.

Goals

Taking the above into consideration the following future goals have been established:

- To reduce dependency on country contributions;
- To become the focus for dissemination of ventilation technology;
- To demonstrate the value of the AIVC throughout the world by securing a strong market and product base;
- To extend the product range of reports and data.

Defining the Future Role of the AIVC

The Centre was initially established to provide a support role for researchers. To fulfil this it undertook basic analytical work and operated an information and dissemination service to research organisations in participating countries. Some countries saw a further need to provide information to energy 'end users', since, it was argued, that to achieve energy efficiency, it was necessary to ensure that research information found its way to practitioner level. As a consequence, the role of the Centre was broadened to provide 'applicable' information to a wider range of users. The intention is that this transition should continue to be the role that the Centre adopts. It is accepted that research is best undertaken by the many research institutions and universities throughout the world, while the Centre itself provides a focus or base for dissemination. In other words the AIVC should not only be a source of information but a place where information is disseminated by those who have a scientific and technical understanding of the information. To achieve this, the following strategy has been developed:

- The Centre should, in part, be product oriented.
- AIRBASE, the AIVC bibliographic database should continue to expand. This is a world renowned source of information.
- Emphasis should be given to developing synthesis reports for researchers and practitioners. They should focus on relevant topics and identify the rationale for research and the benefits for practitioners. The topic range should be broadened to cover, for

example, the impact of ventilation and air change on other energy and environmental aspects of building physics.

- The AIVC 'Guide' series should be further developed, again with the practitioner in mind. Guides should explain the relevance of a particular application and how it can be performed.

8 CONCLUSIONS

Over the last 20 years, the AIVC has grown substantially to support the work of ventilation research. It has also developed expertise in disseminating the results of such research and producing products for practitioners and other end-users. As the Centre approaches the new millennium, this work is expected to continue.

To secure a good level of funding, steps have been taken to change the funding structure to make it less dependent on country contributions. Over the next three years, it is expected that income from other sources will reach or exceed 50% of total income.

Examples and scenarios have been presented in an endeavour to demonstrate a benefit to participants combined with the opportunity to disseminate material throughout the world.

Through its recently implemented bookshop, the AIVC has demonstrated the potential for the distribution of information to a wider market than the direct sponsors of the Centre.

9 REFERENCES

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PARTICIPATING COUNTRIES OF THE AIVC

Belgium, Denmark, Finland, France, Germany, Greece, Netherlands, New Zealand, Norway, Sweden, United Kingdom, United States of America