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European **Natvent** Project Completed

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The European **NatVent**™ project, 'Overcoming Technical Barriers to Low Energy Natural Ventilation in Office Type Buildings in Moderate and Cold Climates', is now completed. Of particular interest was the targeting of building and countries where summer overheating from solar and internal gain can be significantly reduced by low-energy design and good natural ventilation. In addition, natural ventilation solutions to buildings located in urban areas where external air pollution and noise levels are usually regarded as being high were addressed.

Background

Concerns over the adverse environmental impact of high-energy usage required for mechanical ventilation and air-conditioning have been growing over recent years. As a result, the design of energy efficient buildings employing natural ventilation has been encouraged. Such buildings can provide year-round comfort. Furthermore, it is estimated that even a modest 10% take up of these strategies could save about six million tonnes of oil equivalent and 25 million tonnes of avoided CO_2 emissions every year within the EU.

Objectives of **NatVent™**

The overall strategic aim of **NatVent**™ was to reduce primary energy consumption (and consequently CO_2 emissions) through efficient natural ventilation strategies in office type buildings but without compromising indoor air quality and comfort. To achieve this main aim, the project had two specific objectives:

- To identify and overcome technical barriers which restrict the implementation of natural ventilation and low-energy cooling in countries with moderate and cold climates.

- To provide practical solutions and guidance and thus encourage the wider uptake of natural ventilation technologies.

An additional priority was to develop natural ventilation solutions to buildings in urban areas where external air pollution and noise levels can be regarded as being high. The project was aimed at both new-designs and major refurbishments.

The **NatVent™** Consortium

This consisted of:

- Building Research Establishment (BRE) from the United Kingdom as the overall Co-ordinator of the project.

- Belgian Building Research Institute (BBRI)

- Danish Building Research Institute (SBI)

- Dutch Building Institute (TNO) .

- AB Jacobson and Widmark (J&W) from Sweden

- Technical University of Delft (TUD) from The Netherlands

- Willan Building Group (WILLAN) from the UK .

- Norwegian Building Research Institute (NBI)

- Sulzer Infra Laboratory (SULZER) from Switzerland

The vision of the Consortium was for **NatVent**™ to play a catalytic role in promoting natural ventilation strategies and technologies.

Key Technical Activities

The objectives were addressed by carrying out the key technical activities as shown in Figure 1.

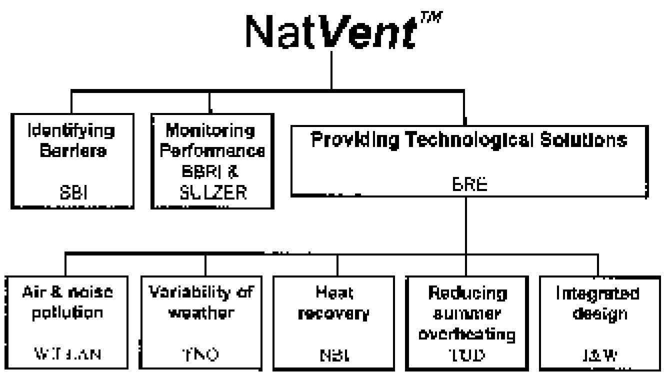

*Figure 1: Overview of activities for the **NatVent**™ project.*

Activity 1: Identification of technical barriers to natural ventilation

This activity was led by the Danish Building Research Institute (SBI). Barriers were identified by carrying out structured interviews based on questionnaires among leading designers, architects, consultants, building owners and developers in each of the participating countries. In total 105 interviews were carried out.

The survey identified that, with varying degrees, there is a significant lack of knowledge and experience on specially designed natural ventilation strategies in office buildings compared with that on mechanical ventilation. In addition, there is a lack of source material on natural ventilation knowledge in standards, guidelines and building studies throughout Europe. There was also a universal requirement for new design tools on natural ventilation including calculation rules as well as computer programs, which are numerically advanced but still simple to use by the non-specialist. This work is reported fully by Aggerholm, 1998.

The following five specific issues were perceived as major technical barriers to widespread use of natural ventilation:

- Air and noise pollution in urban areas and city centres

- Variability of weather around buildings and the dependence of natural ventilation on these variable driving forces

- Recovering heat from natural ventilation systems (an issue of concern to countries with very cold winters)

- Combating summer overheating

- Integrating and maintaining natural ventilation systems

Activity 2: Monitoring the performance of buildings.

The Belgian Building Research Institute (BBRI) and Sulzer Infra Laboratory (SULZER) coordinated this activity. Its aim was to establish pragmatic innovative design strategies by monitoring the **performance** of existing low-energy buildings and providing case studies of current best practice. It was also recognised that ultimately, it is important to demonstrate the viability of natural ventilation in both **performance** and competitiveness if it is to succeed in the market place. To this end, cost effective and pragmatic measuring procedures and protocols were developed and used to evaluate the **performance** of existing buildings. Nineteen buildings within the seven EU countries were monitored in detail during the winter and summer periods (Ducarme, 1996). Figure 2 shows that the buildings cover a wide spectrum of shape and size yet they all use low-energy ventilation technology.

During monitoring, parameters such as room temperatures, humidity, carbon dioxide levels and ventilation rates were measured. In one building that was located in a highly polluted area, levels of pollutants such as carbon monoxide and traffic noise were also monitored

Possible shortcomings and advantages from the ventilation strategies used during the summer and winter monitoring periods, and recommendations for achieving overall successful natural ventilation were identified.

Further details of this activity are presented by Demeester (1998)

Activity 3: Providing solutions to technical issues.

This third activity co-ordinated by BRE, was aimed at developing 'smart' **naturally** ventilated technology systems and components. This was undertaken through the following five key tasks:

(i) Low-energy air supply components for use in buildings in urban locations.

This task was led by Willan Building Services. Its aim was to develop components and strategies for natural ventilation in non-domestic buildings located in urban areas.

As part of this work, existing systems have been evaluated and current standards, **performance** and specifications compiled. An outcome has been the development of a spreadsheet and Visual Basic design tool to determine air inlet size according to the ventilation requirements of a building. A low pressure drop inlet which is capable of damping noise levels and filtering particles has also been developed. Further details of this activity are described by Ajiboye (1998).

(ii) Controlled airflow inlets to account for variability in weather.

This area was led by the Dutch Building Research Institute (TNO) with the aim of identifying and specifying conditions under which newly-developed natural passive controlled air flow inlets can provide acceptable indoor air quality for occupants' health and comfort in offices. An important aspect is to provide an optimum quantity of fresh air for occupants in a manner that is generally independent of short-term external weather fluctuations. The key component of this device is that it provides uniform flow within the normal natural driving force range down to as low as 1 Pa.

To demonstrate viability, an interactive user-friendly software program was developed. This gives visual indication of ventilation, air quality and thermal parameters for many ventilation and weather configurations. Further details are published by De Gids (1998).

(iii) Natural ventilation with heat recovery.

The Norwegian Building Research Institute (NBI) led this task. Its aim was to develop natural ventilation systems with heat recovery. This is needed because in very cold climates, preheating of the ventilation air is preferable to eliminate discomfort.

This particular study focused on determining the distribution of available natural driving pressure at key locations within each participating country. An advanced low-energy fan assisted natural ventilation system with heat recovery has been developed. The fan is extremely energy efficient and consumes approximately 0.25W for each l/s of air flowing through the system. Further details are presented by Brunsell et al (1998).

(iv) Low-energy cooling

The Dutch Technical University of Delft (TUD) led this task to develop low-energy cooling strategies. An important aspect of natural ventilation design is to prevent the need for refrigerative cooling. In much of Northern Europe, excessive external temperature and humidity rarely present a problem. Instead, buildings tend to overheat as a consequence of high internal heat loads and solar gains. Hardware and control algorithms have been developed to minimise these problems.

The control strategy for night cooling has focused on:

- predictive control;

- cooling day control;

- set-point control;

- slab temperature control;

- degree-hours control.

Further details of this activity, its findings and products are found in van Paassen and Leim (1998).

(v) Integration of 'smart' systems for optimum year-round ***performance****.*

This area was led by AB Jacobson and Widmark. A simple but reliable design tool, integrating all the elements of **NatVent**™, was developed so that an optimum solution for any building could be found. Key features in the design tool included the following:

- driving forces (wind and temperature);

- air flow through components;

- solar radiation; and

- a thermal model.

These components have been incorporated into a Visual Basic model with a simple user interface. Behind this is an extensive numerical database and pre-selected default data. Further details are described by Kronvall et al (1998).

Products from the Project

The following is a summary of the products that are available from the project:

Reports

- Individual country reports on Technical Barriers

- European report on Technical Barriers

- Building case studies reports

- **NatVent**™ Guidebook

Design tools

- Spreadsheet based tool for the determination of inlet size and location

- An interactive user-friendly algorithm which gives visual indication of ventilation, air quality and thermal parameters

- Integrated Visual Basic design tool

Components

- Inlet which is acoustically treated and deals with particle attenuation

- Controlled air flow inlet to compensate for the variations in external climate

- Low pressure heat recovery system

- Night cooling devices and controls

The NatVent™ CD

- A CD has been produced containing sample software, a complete guide to **NatVent**™ solutions, full case study information and other reports and products arising from this activity.

For information about the CD Rom, please contact the project coordinator, Dr Earle Perera at the UK Building Research Establishment Ltd, BRE, Garston, Watford WD2 7JR, Tel: +44 1923 664486, Fax: +44 1923 664796, email pererae@bre.co.uk (BRE is on the Internet at: www.bre.co.uk).

Conclusions

NatVent™ has been successful in identifying the technical barriers that exist amongst building professionals. It has established innovative design strategies by monitoring existing low -energy buildings throughout Europe and thus provided case studies of current practice with recommendations.

References

Aggerholm, S, 'Perceived Barriers to Natural Ventilation in Offices', Proceedings of the 19th AIVC Conference, Oslo, Norway, (1998)

Ajiboye, P, 'A simple interactive design tool for sizing, locating and determining pollution attenuation features of urban air inlets suitable for office buildings', Proceedings of the 19th AIVC Conference. Oslo, Norway, (1998)

Brunsell, J, 'Recovering heat from natural ventilation systems', Proceedings of the 19th AIVC Conference, Oslo, Norway, (1998)

Cook, J and McEvoy, M, '**Naturally** ventilated buildings: Simple concepts for large buildings', Solar Today, pp 23-25, (March/April 1996)

Demeester, J, 'Overview and synthesis of monitoring activities carried out in the framework of the EC Joule **NatVent**™ project', Proceedings of the 19th AIVC Conference, Oslo, Norway, (1998)

De Gids, W, 'Constant airflow through inlets for variable weather conditions', Proceedings of the 19th AIVC Conference Oslo Norway, (1998)

Ducarme, D, 'Overview of investigated buildings', BBRI, Belgium, (1996) Ellis R, A survey for Richard Ellis by the Harris Centre, British Office Market, (1994)

Kukadia, V, '**NatVent**™: Its aims and vision', Conference proceedings, June 1998, BRE, UK, (1998)

Van Paassen, D, 'Control of night cooling with natural ventilation. (Sensitivity Analysis of Control Strategies & Vent Openings)', Proceedings of the 19th AIVC Conference, Oslo, Norway, (1998)

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*Figure 2: Some of the **NatVent**™ monitored buildings*

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