

Energy building codes and IAQ concerns: status, opportunities and threats

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1. INTRODUCTION

The aim of this paper is to have a general discussion of the status regarding energy building codes in relation to IAQ concerns. First, there is a brief discussion of the trends in energy regulations and in IAQ concerns. Then the objectives and outcome of a recent workshop on trends in national building ventilation markets and drivers for change are given. This is followed by a brief overview of some areas where there might be major opportunities but at the same time threats. Finally, information about 2 information platforms is given as well as some overall conclusions.

2. TRENDS IN ENRGY POLICIES AND REGULATIONS

The combined effect of the increased evidence of environmental concerns related to climate change, the raising awareness that non-renewable energy resources become more and more scarce and the strong increase of the energy prices result in an increasing number of countries with more and more stringent energy performance regulations.

In Europe, the EPBD (Energy Performance of Buildings Directive) obliges all 27 Member States to implement energy performance regulations. In order to minimize the risk that energy efficiency measures will deteriorate the

indoor climate, the EPBD draws in article 4 specific attention to the indoor climate:

“Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings are set, based on the methodology referred to in Article 3. When setting requirements, Member States may differentiate between new and existing buildings and different categories of buildings. These requirements shall take account of general indoor climate conditions, in order to avoid possible negative effects such as inadequate ventilation, as well as local conditions and the designated function and the age of the building. These requirements shall be reviewed at regular intervals which should not be longer than five years and, if necessary, updated in order to reflect technical progress in the building sector.“

The EPBD give the Member States a large freedom regarding the calculation methods. With respect to the calculation methods, the requirements are very brief and given in the text of the annex:

“The methodology of calculation of energy performances of buildings shall include at least the following aspects:

- a. thermal characteristics of the building (shell and internal partitions, etc.). These characteristics may also include air-tightness;*
- b. heating installation and hot water supply, including their insulation characteristics;*
- c. air-conditioning installation;*
- d. ventilation;*
- e. built-in lighting installation (mainly the non-residential sector);*

- f. *position and orientation of buildings, including outdoor climate;*
- g. *passive solar systems and solar protection;*
- h. *natural ventilation;*
- i. *indoor climatic conditions, including the designed indoor climate.”*

The requirements in the EPBD reflect also the awareness that a correct operation of technical installations is not evident. Therefore, there are requirements (articles 8 and 9) to have regular inspections of boilers and air conditioning systems. However, there is at present no requirement to inspect ventilation systems if there is no cooling involved.

3. TRENDS IN IAQ CONCERNS

In the past, indoor air quality concerns were almost exclusively reflected by focusing on the minimum air flow rate requirements. At present, there is increased and well documented knowledge that other aspects are also very important for achieving a good indoor air quality, e.g.:

- Control of pollution sources (outdoor air of good quality, limiting the emission from building materials, limiting the emission from ventilation systems, appropriate maintenance procedures, ...)
- Air flow patterns within the space (e.g. displacement ventilation);
- Correct execution of the works and during the lifetime of a building (Importance of commissioning)
- Minimising complaints (draught, noise, ...) due ventilation systems in order to avoid a wrong operation of the systems.

As stated in article 4 of the EPBD (see §**Error! Reference source not found.**), a regular update of the building regulations is required in order to reflect the technical progress in the building sector.

4. WORKSHOP ON “TRENDS IN NATIONAL BUILDING VENTILATION MARKETS AND DRIVERS FOR CHANGE”

The workshop “Trends in National Building Ventilation Markets and drivers for change” was held in Ghent on March 18-19 2008. It was an initiative of AIVC (www.aivc.org) , organised by INIVE EEIG (www.inive.org) , in collaboration with REHVA (www.rehva.eu) and with the European SAVE ASIEPI (www.asiepi.eu) and SAVE BUILDING ADVENT (www.buildingadvent.com) projects and supported by the EPBD Buildings Platform (www.buildingsplatform.eu) .

The workshop was focusing on the following kind of questions:

- Which evolutions in the type of requirements and the type of buildings are covered by the regulation? Are there requirements in terms of ventilation for achieving good indoor air quality, in terms of controls, in terms of stimulating the reduction of the energy consumption, regarding building and/or ductwork airtightness, night time ventilation for passive cooling, thermal/acoustical comfort linked to ventilation? Are there specific requirements regarding buildings with or without major renovation and about ventilation systems for low energy buildings (passive)?
- What are experiences with compliances? What about the quality of the ventilation systems on their real life? Are they well installed and do they receive adequate maintenance? Is the information and training of installers and maintenance companies OK?
- What are the major trends in the type of systems used? For instance, what about eco-design of ventilation components?
- Is there a framework for the assessing the energy performance of innovative ventilation systems in the context of energy performance regulations?

In total, there were presentations for some 15 countries as well as synthesis presentations. All reports will be published by the AIVC.

At the end of August 2008, the following reports were published as VIPs (Ventilation Information Papers - www.aivc.org) :

- VIP 17 – Trends in the building ventilation market in **England** and drivers for change
- VIP 18 – Trends in the **Belgian** building ventilation market and drivers for change
- VIP 19 – Trends in the **French** building ventilation market and drivers for change
- VIP 20 – Trends in drivers in the **Finnish** ventilation and AC market
- VIP 21 – Trends in the **Norwegian** building ventilation market and drivers for change
- VIP 22 – Trends in the **US** building ventilation market and drivers for change
- VIP 23 – Trends in the **Brazilian** building ventilation market and drivers for change
- VIP 24 – Trends in the **Polish** building ventilation market and drivers for change
- VIP 25 – Trends in the **Japanese** building ventilation market and drivers for change
- VIP 26 – Trends in the **Korean** building ventilation market and drivers for change

Reports for other countries will be published in the near future as well as the various synthesis reports.

From the various presentations and related discussions, the following conclusions can be drawn :

1. As illustrated by the different information papers (VIPs), there is a tremendous difference in the national building ventilation markets and their regulations.
2. These differences cannot only be explained by objective factors as climate differences and differences in building style. Moreover, the observed differences are much larger than e.g. the differences between various countries with respect to thermal requirements for buildings.
3. The available knowledge regarding indoor air quality control is very well reflected in certain regulations (e.g. source control and displacement ventilation in the Finnish context) whereas nearly not present in other regulations, even for similar climatic conditions.
4. With respect to energy efficiency, some countries have regulations which give strong stimuli for energy efficient ventilation (heat recovery, fan energy, demand controlled ventilation, ...) whereas other countries have much more simplified approaches.
5. With respect to the stimulation of the market uptake of innovative ventilation systems, several countries (e.g. France and the Netherlands) have a well developed approach, whereas other countries have not yet a clear policy.

5. OPPORTUNITIES AND THREATS

Emphasis on energy efficiency

On the **short term** and because of the overall growing interest in energy efficiency of buildings in combination with the very high energy prices, there is a potential risk that the attention for a good indoor air quality will become secondary in relation to the energy



saving targets. Especially in cases with limited attention for compliance checks, there is a risk of indoor air quality complaints.

On the **medium term** (horizon 2020), it is realistic to expect a substantial strengthening of the requirements for new buildings and increased attention for the energy efficiency of existing buildings. This is illustrated by the targets set by e.g. the European Commission and various countries, which are in the order of 20...30 % savings to be achieved.

On the **long term** (horizon 2050), the targets are even much stronger and values in the range of 60...80 % savings compared with present energy use are common. It is clear that such energy savings cannot be reached without a substantial reduction in the energy use for conditioning the ventilation air.

The most logical approach for meeting these short, medium and long term targets is to set up strategies combining source control, minimizing air infiltration (good building airtightness), implementation of demand controlled ventilation and energy efficient conditioning (heat recovery, ...) and transport of the ventilation air, whereby explicit attention will be given to compliance checks after construction and during operation.

- If so, this represents tremendous opportunities for the ventilation and material sector (source control, airtight constructions, high quality ventilation systems, ...) whereby there is an enormous market for innovative technologies and systems.
- If not, there is a very big risk that too much emphasis will be given to energy saving without guaranteeing the required indoor climate conditions. This may result in severe indoor air quality problems.

Building airtightness

Uncontrolled airing due to envelope leakages can result in a substantial increase in the energy consumption. Therefore, improving the building airtightness is often an interesting possibility for achieving energy savings and, moreover, it is a must in case of very low energy buildings. At

present, extreme levels of building airtightness become more and more common. The most striking example is the airtightness requirement for Passive Houses ($n_{50} \leq 0.6 \text{ h}^{-1}$). Such levels of airtightness require the availability of a well designed and operating ventilation system and this during the whole lifetime of the building. If not, major indoor climate problems may be found. Airtightness is, together with good insulation and a well designed, operated and maintained ventilation system the indivisible base towards low energy concepts.

More information on the issue of building airtightness can be found in Information Paper 72 of the Buildings Platform (www.buildingsplatform.eu).

Design, realisation and operation

Design and material choice:

A good design and material choice is essential to come to the required performances. In practice and in particular in the dwelling sector, many systems are not well designed or use materials for which it is not evident to meet the target. Such situation is only possible if there is limited or no attention for compliance checks (see §0).

Realisation:

A good ventilation design is the first step. However, even well designed systems are in practice not performing well if poorly installed. As it is the case for the design process, such situation can in principle only occur if there is limited or no attention for compliance checks (see §0).

Operation:

A ventilation system is not assumed to work only correctly during its first year of operation but during the whole lifetime of the system. This requires that there is a regular inspection of the ventilation system. At present, only few countries (e.g. Sweden) have a mandatory regular check of ventilation systems.

Market uptake of innovative systems

It is not evident to cover all kind of technologies in building regulations. In most cases, technologies which are not covered by building regulations will face difficulties for a wide market uptake. Various reasons are possible, e.g. these innovative systems are not allowed in the framework of the regulations because not in line with the requirements, the systems don't receive an energy benefit, ...). In order to stimulate innovative solutions, several countries have a framework called the "principle of equivalence". Such framework allows to assess these systems by the use of alternative procedures. In e.g. France and the Netherlands, innovative ventilations systems can be assessed in such way. As a result, humidity controlled ventilation systems represent a substantial part of the French ventilation market.

More information on the issue of innovative systems can be found in Information Paper 63 of the Buildings Platform (www.buildingsplatform.eu).

Compliance

It is not evident to assume that building regulations are correctly implemented in practice. This is the case for all aspects of regulations but the risk of non-compliance for ventilation requirements is probably higher than for energy requirements and surely much higher than aspects involving fire security and stability. Whether there is good compliance or not depends on various elements, e.g. the attitude of citizens with respect to regulations, the way the building sector is organised, the compliance checks by government, ...

In case of poor compliance levels, it is clear that high quality systems and execution processes will face more problems for a wide market uptake.

6. SPECIFIC INFORMATION PLATFORMS



EPBD Buildings Platform

The EPBD Buildings Platform is a European Commission initiative in the framework of the Intelligent Energy - Europe (2003-2006) programme, which provides information services for practitioners and consultants, experts in energy agencies, interest groups and national policy makers in the European Member States for helping the implementation of the European Energy Performance of Buildings Directive (EPBD). The EPBD Buildings Platform is managed by INIVE EEIG: www.inive.org, on behalf of Transport and Energy DG.

The services provided by the EPBD Buildings Platform include a website, a monthly newsletter (available in 10 languages), about 100 different information papers, a publications database with more than 700 EPBD related publications, database on standards, software tools and events and a helpdesk. All information is accessible through www.buildingsplatform.eu.



AIVC – The IEA information centre on ventilation related aspects of buildings

The Air Infiltration and Ventilation Centre is operated under Annex V of the Energy Conservation in Buildings and Community Systems implementing agreement of the International Energy Agency. The primary objective of the AIVC is to provide a high quality international technical and information forum covering the areas of ventilation and air infiltration in the built environment with respect to efficient energy use, good indoor air quality and thermal comfort. The main drivers for this

work will be the national and international concerns in the areas of sustainable development, responses to climate change impact and healthy buildings.

The services provided by AIVC include:

The AIVC Website as a reference portal for ventilation related issues. At present, there are some 20.000 visitors per month.

The publications database AIRBASE, containing nearly 20.000 abstracts and some 3.000 articles in pdf format. There are some xx.000 documents downloaded each month.

The quarterly newsletter AIR (Air Information Review) with information on the most relevant developments regarding ventilation, indoor climate and energy in buildings. Typically, 3000 copies of printed of each issue.

Publication of Ventilation Information Papers (VIPs)

Publication of technical notes, focused on activities within and outside the AIVC.

An annual conference

7. CONCLUSIONS

There are multiple reasons to pursue a drastic reduction of the energy consumption of buildings. This is reflected in increased number of regulations regarding the energy efficiency of buildings whereby energy efficient ventilation is stimulated.

On the medium (2020) and long (2050) term, it is realistic to expect a very substantial strengthening of the energy performance targets for new and existing buildings and, indirectly, of energy efficiency requirements for ventilation systems.

There is growing evidence that the indoor air quality conditions in many buildings are critical. An increased number of countries have regulations regarding minimum ventilation requirements but the requirements vary widely.

The appropriate transposition of the existing scientific knowledge regarding indoor climate and ventilation as well as ways for achieving

energy efficient ventilation into standards and regulations is in many countries far from optimal.

In addition, the effective achievement in daily practice of the specifications in standards and/or regulations is often not the case.

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