Trends in the Belgian building ventilation market and drivers for change

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ABSTRACT

This paper gives the status on the regulation on ventilation in the different regions of Belgium for residential and non residential buildings. The effect of ventilation, building airtightness and duct airtightness on the energy performance regulation for buildings and its calculation method are specified. The various ways in which this regulation shows to act as a driver for market change, are identified. Due to the increased interest for energy efficiency, the ventilation industry is currently developing and promoting particular systems. However, the energy benefit of such systems can not be evaluated in the standard calculation procedure. Therefore, a framework for the assessment of innovative systems is of first importance.

1. INTRODUCTION

It must be noticed that Belgium is a Federal State composed of three Regions[1] and energy use in buildings and ventilation fall under their responsibility. The Flemish Region has introduced an EPBD related regulation in January 2006. The Region of Brussels-Capital introduces its own Energy Performance of Buildings (EPB) regulation in July 2008. At the time this paper was written, the new regulation of the Walloon Region was approved but not yet published. The regulations are similar. However, in this paper, if the Region is not clearly mentioned, we always refer to the Flemish situation, including for what concerns the E-level described below.

2. NATIONAL TRENDS IN IAQ REQUIREMENTS AND MARKET CHARACTERISTICS

2.1 Requirements on ventilation of dwellings

Historically, ventilation in Belgian buildings became a point of concern only after the first oil crisis and then even primarily because of the interest in reducing the energy consumption for ventilation. It was in that context that Belgium joined in 1983 the Air Infiltration Centre (AIC), which was set up by the International Energy Agency in 1979 with the major objective to improve the building airtightness. As a large number of moisture problems occurred in the first insulated buildings, it appeared clearly that ventilation was more or less forgotten. In 1991, a Belgian standard about ventilation of dwellings was published [1]; this standard was largely inspired by a similar Dutch standard [2].

The application of the standard was made compulsory in 1996 in the Walloon Region (at the same time as a strengthening of the requirements on building insulation). The Flemish Region imposed the application some parts of the standard, as well energy performance requirements in the framework as other requirements, in 2006 (at the same time as

[1] Flemish Region, Walloon Region, Brussels-Capital Region.

of the implementation of the EPBD). The Region of Brussels-Capital imposes similar requirements from July 2008.

It must be noticed that, in Belgium, standards are considered as rules of good practice and, therefore, these requirements or similar performances should be implemented, even if they are not made compulsory by any regulation. However, in practice, this is seldom the case, as clearly shown by the SENVIVV survey [3] of 200 Flemish dwellings built in the early '90s. For instance, no air inlet devices were found in ± 90% of the bedrooms and living rooms and no air outlet devices in ± 60% of the toilets and in 100% of the kitchen[2].

Moreover, a limited study carried out in 2001 in the Walloon Region for the consumers association Test-Achats [4] has shown that even if the standard is compulsory, its application is far from being perfect. Air inlet devices for natural ventilation[3] were too small in ± 50% of the visited "dry rooms"[4], none of the air outlet devices for natural ventilation (if any) was in accordance with the rules in the visited "wet rooms", mechanical supply and exhaust airflows were too small in ± 50% of the visited rooms and air transfer devices were too small in 86% of the visited rooms!

In the framework of the RESHYVENT project, two main reasons were identified for this poor application. The final user[5] is not convinced that a ventilation system is necessary, partly because he receives false information from the market (like "opening the windows two times 15 minutes per day is sufficient") and there is a clear lack of control from the authorities, so the final user knows that he does not take a big risk not complying with the regulation.

[2] Cooker hoods are not considered as part of the basic ventilation system.

[3] In Belgian dwellings, natural ventilation is called system A, mechanical supply is system B, mechanical exhaust is system C, balanced mechanical ventilation is system D.

[4] Dry rooms are bedrooms, living rooms, study room. Wet rooms are kitchens, toilets, bathrooms, service rooms.

[5] In Belgium, most of the one-family dwellings are ordered by their future owners. There is not much "industrialisation" of housing construction as e.g. in The Netherlands where usually a contractor builds a series of tens or hundreds of identical houses. Consequently, the property owners are more implied in the design and construction process of their house.

2.1.1 Has it changed in the last years?

In the Walloon Region, not yet. The correct application of the ventilation requirements is still a problem, as clearly shown by the voluntary action Construire avec l'énergie, which aims to prepare the market to the coming Energy Performance of Buildings (EPB) regulation. Unfortunately, in the Walloon Region, the control has not yet been strongly intensified since the Test-Achats study was carried out.

A clear political message from the SENVIVV survey was that it is not useful to implement a new and more severe regulation without an effective compliance system Therefore, in the Flemish Region, the whole concept of implementation has been changed[6]. With the EPB regulation in 2006 the control possibilities have been strongly reinforced and also ventilation was made compulsory. For instance, an administrative penalty of 4 € per missing m³/h must be paid if the ventilation system is not installed or is too small. Therefore, it is expected that the motivation for a better compliance with the regulation is much higher (no statistics available yet).

A weak point of the legislation might be that there is not a mandatory control of the achieved air flow rates for mechanical ventilation systems. This was considered as a too big step in the legislative process.

2.1.2 Has it improved the actual IAQ in dwellings?

The NBN D 50-001 standard does not give any requirements about the IAQ that must be obtained nor about how the system must be used or controlled.

[6] e.g. declaration of performances after completion of the construction works, a fine system described in the legislation and enforced by civil servants without the need of a judge, the reporter stays responsible for 5 years after the end of the works for the declaration, ...

2.2 Requirements on ventilation of non residential buildings

There is no Belgian standard on ventilation of non residential buildings, except the European ones transposed in Belgian ones e.g. EN 13779 [1]. The regional regulations include requirements on ventilation of non residential buildings. The Walloon requirements date from 1996, but are limited to very briefly described airflow requirements in office buildings and schools. The Flemish requirements date from 2006 and cover all type of non residential buildings; they are based on EN 13779. The Brussels-Capital Region imposes the same requirements from July 2008. The Walloon Region is expected to introduce the similar requirements in September 2008.

As it is the case for dwellings, many existing office buildings do not have ventilation systems and, if available, the air flow rates are often not in line with the requirements. The situation is problematic in schools, due to budget reasons. However, in many new office buildings, the expectations regarding IAQ and thermal comfort are quite high. It is therefore also frequent to have ventilation systems that provide airflows higher than those prescribed by the regulation.

3. NATIONAL TRENDS IN ENERGY REQUIREMENTS AND MARKETS

3.1 Energy requirements

The Energy Performance of a building is expressed by a so-called E-level, which is the ratio between the annual calculated primary energy consumption of the new building and the reference annual primary energy consumption[7]. There are two calculation procedures: one for residential buildings, and one for offices and schools. The following parameters, related to ventilation, may have an impact on the E-level (*: dwellings only):

- selected type of system[3],
- self regulated air inlet devices*,
- ductwork airtightness*,
- correct flow settings*,
- fan energy consumption,
- in case of heat recovery:
    - temperature efficiency,
- balancing of air flow rates
    - automatic flow control

Building airtightness can also have a large impact, as described in § 4.

As can be observed, these parameters not only involve system or product selections, made in the design stage of the construction process, but also parameters that are a result of high quality installation and commissioning work, such as airtight ducts, correct and balanced flows, low fan consumption due to low duct pressure drops. Even more, high quality products only result in good E-levels if they are installed in a (proven) proper way.

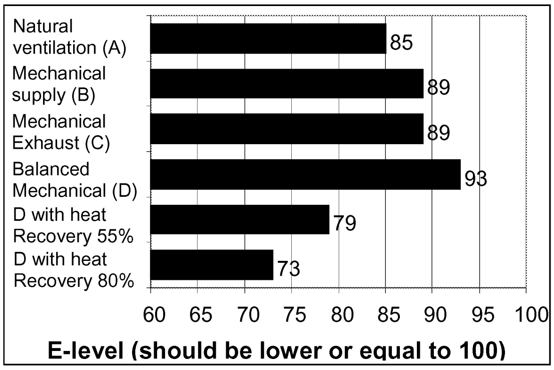

Figure 1. Impact of the ventilation system on the E-level of one particular building

Due to this, the systems that perform the best in terms of E-level [8] are 1) mechanical ventilation systems with heat recovery with a measured efficiency, 2) natural supply and natural exhaust (A), 3) natural supply with fan assisted exhaust (C) or mechanical supply with natural exhaust ventilation systems (B), 4) mechanical ventilation systems without heat recovery (or if the efficiency of the heat recovery is not tested). An example for one particular dwelling is given in Figure 1.

[7] The reference annual primary energy consumption depends on the building volume and heat loss area.

[8] This ranking is only true with the use of the default value for the so-called m-factor that reflects the quality of execution of the system.

3.2 Financial stimuli

In 2008, subsidies are given for the installation of balanced mechanical ventilation with heat recovery in dwellings[9].

3.3 Market impact – residential buildings

At present, there are only energy performance requirements in the Flemish Region. Reliable data about the market share of the different ventilation systems are not yet available.

In the voluntary action Construire avec l'énergie of the Walloon Region (with some ± 700 dwellings participating), the share of the balanced mechanical ventilation systems with heat recovery is strongly increasing, as shown in Figure 2. As the E-level is not yet applicable in the Walloon Region, we can assume that this is partly or even largely due to the regional subsidies.

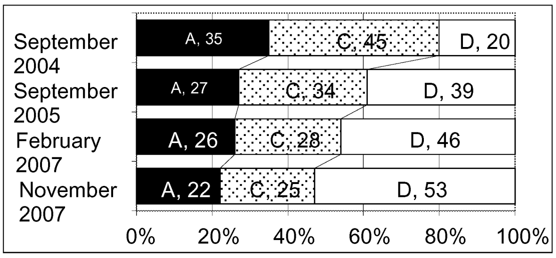

Figure 2. Percentage of each system type total number of project of the voluntary action Construire avec l'énergie

The consequence of this market evolution is that balanced mechanical ventilation systems with heat recovery become the biggest competitor to the other system types. Due to the increased interest for energy efficiency, the ventilation industry is currently developing and promoting demand controlled (humidity, CO2, presence...) natural supply and mechanical exhaust systems. However, the energy benefit of such systems can not be evaluated in the standard calculation procedure of the E-level; therefore, a framework for the assessment of innovative systems is of first importance (see § 5).

[9] Flemish Region: 150 €, Walloon Region: 1500 € limited to 75% of the bill, Brussels-Capital Region: 3000 € limited to 50% of the bill.

4. NATIONAL TRENDS IN AIRTIGHTNESS REQUIREMENTS AND MARKETS

4.1 Building airtightness: situation before EPB regulations

Before the new EPB regulations, building airtightness was not considered in any regulation. There were only recommendations about building airtightness in the NBN D 50-001 standard, but there were no available guidelines on how to reach those targets.

In the SENVIVV survey, airtightness was measured in 50 dwellings (of which 41 were single-family houses and were 9 apartments). Figure 3 shows that only few dwellings (4 out of 50) presented a rather good airtightness ($n_{50} \leq 3$ h^{-1}), and that many of them (10 out of 50) presented a very poor airtightness (≥ 10 h^{-1}). The average n_{50}-value[10] was 7.8 h^{-1}.

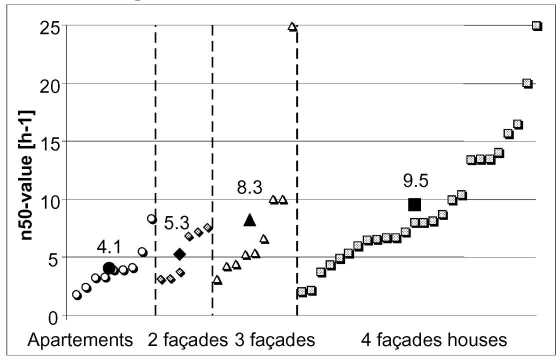

Figure 3. Building airtightness of new dwellings, before the introduction of the EPB regulation (Source: SENVIVV, cited in [6])

4.2 Building airtightness: requirements of the new EPB regulations

Although the EPB regulation does not include specific requirements on building airtightness, it is included in the calculation of the E-level of dwellings and offices/schools, based on a default value. An improved building airtightness, if measured, can therefore result in a substantial improvement of the E-level.

[10] The situation is even worse, as the n50-values were calculated on basis of the volume calculated with the external dimensions, in stead of the volume based on the internal dimensions. This is due to the fact that the study was carried out before the relevant standard was published.

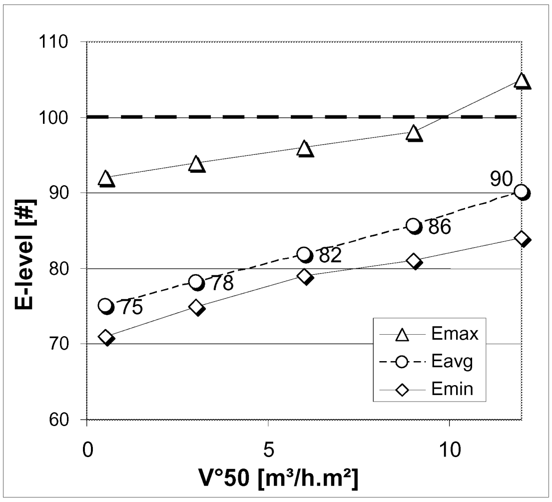

Figure 4. Impact of $\dot{v}_{50}$ on the E-level, calculation for 200 dwellings

The building airtightness is expressed by the $\dot{v}_{50}$ value[11], which is the infiltration rate per unit of heat loss area (based on the external dimensions), at a pressure difference of 50 Pa. Calculations were made for the 200 SENVIVV dwellings to evaluate the impact of the building airtightness on the E-level. The same set of parameters (global insulation level, type of glazing, ventilation system, heating efficiency…) was used to calculate the E-level of each dwelling; only the geometry varied from dwelling to dwelling. The results are shown in Figure 4. E_{min}, E_{avg} and E_{max} are respectively the minimum, average and maximum of the 200 calculated E-levels.

From Figure 4, it can be seen that reducing the infiltration rate $\dot{v}_{50}$ from 12 m³/h.m² (which is the default value if no airtightness measurement is carried out) to 6 m³/h.m² reduces in average the E-level from 90 to 82. A further reduction to 0.5 m³/h.m² would result in an E75. This reduction can be compared to other energy saving measures, as the improvement of the global insulation level K. A similar analysis shows that, in average, improving the airtightness down to a value of $\dot{v}_{50}$ = 3 m³/h.m² is equivalent to reducing the global insulation level from K40 to K27. Similar results may be found for non-residential buildings.

[11] The leakage is usually described by its n_{50} value, which the infiltration rate divided by the building volume, measured with the internal dimensions.

4.2 Building airtightness: market transformation

At present, there is only a limited experience about building airtightness among Belgian building professionals. During the start-up period of the new EPB regulations, it is not expected that testing the building airtightness will be a standard practice. It is likely that airtightness will be tested in a limited number of projects, in order to evaluate the airtightness that can be achieved with "business as usual" and to estimate the required efforts needed to achieve a certain level of airtightness (e.g. improving building details, more care during execution of the work…).

Only if this learning process is successful and if building designers/contractors can be confident about the building airtightness that they can achieve, they will start to rely on a lower $\dot{v}_{50}$ value at design stage.

The situation could be improved if a financial stimulus (like subsidies or tax reduction) would be given by the authorities; this is currently under discussion.

4.3 Duct airtightness: situation before and after EPB regulations

Before the new EPB regulations, there were only recommendations in the specifications "Cahier des charges-type 105" of the federal buildings agency [7] on duct airtightness.
With the establishment of the EPB regulation, the calculation procedure of the E-level for dwellings takes in account ductwork airtightness, based on a default value.

As for building airtightness, the positive influence can only be assessed if the duct airtightness is measured after completion of the installation. The potential impact is different for each ventilation system type and ranges from a very small effect below 1 E-level point for system A up to an E-level reduction of 2 or 3 points for systems C and D.

5. NATIONAL TRENDS IN INNOVATIVE SYSTEMS AND MARKETS

As said in § 3.3, a framework for the assessment of the energy performance of innovative systems [12] is of first importance. Without it, innovation of some products is strongly discouraged, and the market competition between systems becomes unfair.

In the three Regions, a Decree (or Ordinance) has been voted by the Parliament to give the general framework for the EPBD implementation. The three Decrees give the possibility to define the procedure for the assessment of innovative systems to the government. At the time this paper was written, the procedure is only known in the Flemish Region. This procedure foresees that the innovative system must apply for an ATG-E, which is kind of technical approval limited to its energy characteristics and which is delivered by the Belgian Union for Technical Approvals (UBAtc/BUTgb).

6. CONCLUSIONS

Attention for and implementation of ventilation systems is a relatively new phenomena in Belgium (where the three Regions are in charge of regulations related to ventilation).

It is clear that the EPB regulations are a major driver for change. First of all, it makes ventilation compulsory in each type of new buildings and in each Region. Secondly, there is a strict control scheme which probably will motivate most stakeholders to respect the regulation. The market uptake of energy efficient ventilation systems is promoted by fiscal stimuli.

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[12] In the context of energy performance regulations, innovative systems/technologies are defined as: systems/technologies which mostly give a better performance in terms of the energy performance of buildings than the common technologies and whose performance cannot be assessed by the standard EPB calculation methods.

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