Quality and compliance of ventilation systems: ongoing developments, lessons learnt, future challenges

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Manager INIVE EEIG

International Network for Information on Ventilation and Energy Performance
... and you expect a good quality

You expect a reliable label
You expect a reliable label

... and you expect a good quality
... and you expect a good quality
You expect the presence of a ventilation system

... and you expect good performances (air flow, acoustics, IAQ, energy, ...
Poor design and execution

• Energy performances critical
• IAQ problematic
• Acoustics
• Maintenance
• …
QUALICHeCK project had 2 objectives...

• To set up a series of actions which should result in more attention and practical initiatives for actual compliance with the claimed energy performance for new and renovated buildings
  i.e. ‘Boundary conditions which force people to do what they declare’;

• To set up a series of actions, which should result in more attention and practical initiatives for achieving a better quality of the works.
  i.e. ‘Boundary conditions which stimulate and allow the building sector to deliver good quality of the works’.
QUALICHeCK products and outcomes

1. About the status on the ground...
2. About interesting approaches...
3. About guidance for improvements
4 focus areas in QUALICHeCK

- Transmission characteristics
- Ventilation and airtightness
- Sustainable summer comfort techniques
- Renewables in multi-energy systems
Example from FRANCE:
Quality of ventilation systems in 1.287 new dwellings

44% of multi-family dwellings don’t comply
68% of single-family dwellings don’t comply
Example from SWEDEN: Airtightness of air distribution systems
QUALICHeCK products and outcomes

- 2 booklets
- 3 global reports
- 2 source books
- 9 country reports
- 54 fact sheets
- 6 newsletters
- 16 webinars
- 4 conferences
- 4 focused technology workshops
- 9 national roadshows
- 3 special issues of REHVA Journal
- ...

www.qualicheck-platform.eu
Source book on quality of the works

Aim:

To give guidance towards better frameworks for quality of the works
What is a factsheet?
Short document on a specific topic
<table>
<thead>
<tr>
<th>ASPECTS</th>
<th>TECHNOLOGIES</th>
<th>Transmission Characteristics</th>
<th>Ventilation and Airtightness</th>
<th>Sustainable Summer Comfort Technologies</th>
<th>Renewables in Multi-Energy Systems</th>
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<tbody>
<tr>
<td>Status on the Ground</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Compliant and Easily</td>
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<td>Accessible EPC Input</td>
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<td>Data</td>
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<td>Quality of the Works</td>
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<td>X</td>
<td>X</td>
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<td>Compliance Frameworks</td>
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Since 2006, there has been a significant reward in the French energy regulations for good airtightness, which has been combined with a minimum requirement for residential buildings in the 2012 version of the regulation. Airtightness test results show that the average building airtightness performance has improved by nearly 50% in single- and multi-family buildings since 2006 and now stabilises below the minimum requirements around $q_{50} = 2.8 \text{ m}^3/\text{h per m}^2$ of envelope area, excluding lowest floor (or about $n_{50} = 1.8 \text{ h}^{-1}$).
<table>
<thead>
<tr>
<th></th>
<th>Minimum requirement</th>
<th>Possible values in case of Quality Management (QM) approach (multiples of 0.1 m³/h/m²)</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family buildings</td>
<td>0.6 (3.2)</td>
<td>0.3-0.6 (1.6-3.2)</td>
<td></td>
</tr>
<tr>
<td>Multi-family buildings</td>
<td>1.0 (5.4)</td>
<td>0.3-1.0 (1.6-5.4)</td>
<td></td>
</tr>
<tr>
<td>Non-residential buildings</td>
<td></td>
<td>0.3-1.7 (1.6-9.2) or 0.3-3.0 (1.6-16.2) depending on building type (QM no longer applicable as of July 2015)</td>
<td>1.7 (9.2) or 3.0 (16.2) depending on building type</td>
</tr>
</tbody>
</table>

Table 1: Airtightness levels in the 2012 French regulation in m³/h per m² of envelope surface area at 4 Pa. Approximate corresponding values at 50 Pa are shown in parenthesis.

**OPTION 1:** systematic test by certified tester  
**OPTION 2:** Quality management approach (see other factsheet)
Figure 1: Specific building air leakage rate at 4 Pa performance depending on the construction year of measured buildings.
BUILDING REGULATIONS CAN FOSTER QUALITY MANAGEMENT: THE FRENCH EXAMPLE ON BUILDING AIRTIGHTNESS

The French regulation includes an alternative route to systematic building airtightness testing to justify for a given airtightness level. This route was developed to push professionals to revisit their methods for implementing building airtightness solutions and to include specific quality requirements. At the end of 2014, 81 such quality management approaches have been approved representing a production of about 15,500 buildings per year.
Figure 1: Possible values of maximum air permeability guaranteed by the applicant in single-family dwellings and multi-family buildings.
<table>
<thead>
<tr>
<th>Type of buildings</th>
<th>Production</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family dwellings</td>
<td>Nprod ≤ 500</td>
<td>Ntests = 5 + 10% Nprod</td>
</tr>
<tr>
<td></td>
<td>Nprod &gt; 500</td>
<td>Ntests = 55 + 5% (Nprod - 500)</td>
</tr>
<tr>
<td>Other buildings</td>
<td>Nprod ≤ 50</td>
<td>Ntests = 30% Nprod</td>
</tr>
<tr>
<td></td>
<td>Nprod &gt; 50</td>
<td>Ntests = 15 + 15% (Nprod - 50)</td>
</tr>
</tbody>
</table>

Table 2: Minimum sample size for the QM approach in the 2012 French regulation
Figure 1: Distribution of builders applying the approach according to their yearly production
Figure 5: Distribution of measured airtightness of houses with and without implementation of a certified QM approach.
<table>
<thead>
<tr>
<th>Level of complexity</th>
<th>Potential for replication</th>
</tr>
</thead>
<tbody>
<tr>
<td>(dark orange = simplest)</td>
<td>(dark orange = best)</td>
</tr>
</tbody>
</table>

**Prerequisite:**
Substantial reward for good airtightness in EP calculation

**Hints**
- Stress the benefits of QM approaches to secure airtightness level and comply with the regulation among stakeholders
- Discuss options with stakeholders
- Progressively increase QM requirements
- Ensure fair evaluation of the applications
- Conduct in situ controls
- Carefully estimate the minimum size of the sample to be measured

**Pitfalls**
- Resources for examining applications
- Proof of application of standard drawings is not sufficient, some measurements must be done

*Table 5: Overall hints and pitfalls to avoid when developing such an approach*
<table>
<thead>
<tr>
<th>Technology</th>
<th>Aspect</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation and air tightness</td>
<td>Compliant and easily accessible EPC input data</td>
<td>France</td>
</tr>
</tbody>
</table>

**FRENCH VOLUNTARY SCHEME FOR HARMONISED PUBLICATION OF VENTILATION PRODUCT DATA**

A voluntary scheme defining the data to be announced in the product documentation has been launched in 2012 by Uniclima, the French association of ventilation product manufacturers. It ensures that product characteristics are provided under a harmonised form (same physical quantity, unit and assessment method), and facilitates access to relevant input data for the energy performance calculation of a building. The scheme contributes to enhancing the compliance of published data.
Voluntary Scheme and Database for Compliant and Easily Accessible EPC Product Input Data in Belgium

The “EPB product database” in Belgium is an effective scheme to improve the compliance and easy access to product characteristics used as input data for the Energy Performance Certificate (EPC) calculation. The acceptance of this scheme by the market has been successful for many years. The present factsheet explains this Belgian scheme and tries to identify the reasons for its success and the prerequisites for the implementation of similar schemes in other countries.
REGULATORY COMPLIANCE CHECKS OF RESIDENTIAL VENTILATION SYSTEMS IN FRANCE

Regulatory compliance checks on samples of residential ventilation systems are operational in France. The analysis of their results shows a significant rate of non-compliance with the ventilation regulation (rate on the order of 50%).
Total number of non-compliant items or defects observed: 1246

Figure 1: Number of non-compliance or defects per category in a sample of 1287 dwellings, see Jobert and collaborators (2012, 2013)
Figure 2: Origin of defects observed in residential ventilation systems in France (Sycodes, 2012)
BELGIAN/FLEMISH EVALUATION SCHEME FOR VENTILATION SYSTEMS

Since many years, several monitoring studies have shown that the quality and compliance of installed ventilation systems can be low. The recently developed Evaluation scheme in Belgium tries to tackle this problem, thanks to the mandatory Ventilation Performance Report of all new ventilation installations, to be delivered by a Ventilation Reporter recognised by a Third-Party control organisation. This factsheet describes the approach of this scheme, including the penalty scheme and the role of the actors involved.
Figure 1: Principles of the evaluation scheme for ventilation in Belgium
Quality frameworks in Flemish Region (Belgium)

- **Insulation of existing cavity walls**
  - Operational since July 2012
  - About 90,000 buildings done since then

- **Internal insulation of external walls**
  - Only by “competent” contractors

- **External insulation**
  - In preparation

- **Building airtightness**
  - For new buildings since January 2015
  - If not done in quality framework: use of default value

- **Residential ventilation**
  - For building permits after January 1 2016
  - If not done in quality framework: air flow rate = 0 m³/h

**DRIVER: SUBSIDIES**

**DRIVER: ENERGY LEGISLATION**
Practical information on airtightness and ventilation quality frameworks

• Quality framework for **building airtightness:**
  • About 3 years of experience

• Quality framework for **residential ventilation:**
  • For new buildings with building permit after January 2016
  • In practice limited number of dossiers
Quality framework for airtightness testing

Context:

• **NOT** mandatory

• BUT if done outside quality framework: use of default value
  • 12 m\(^3\)/h.m\(^2\) of building envelope

• In practice: will become standard practice with increasing requirements on energy efficiency
  → See next slide
All buildings of new buildings tested in quality framework.
Who can do a test?

• No requirement of independence
  • Contractor can test his own building

• Proof of competence:
  • Theoretical exam
  • Practical exam
Control by third party organisation

• Desktop checks
  • **10 %** of submitted reports are checked

• In situ checks
  • **10 %** of tests are checked on-site
    • Or during the test itself
      • Appropriate equipment? Preparation of building? Testing and reporting
    • Or after test (based on SMS message)
      • Is there a reliable reporting?
SMS procedure

• **SMS 1:** If airtightness tester believes a test is possible:
  • SMS 1: dossier number + estimated time of finishing test

• **SMS 2:** If test is finalised:
  • SMS 2: measured result

• BCCA actions in case on-site check are the requirements:
  • Within 5 minutes: an SMS indicating that an inspector will come on site
  • Within 20 minutes: inspector must be on-site
Desktop checks – BCCA statistics for 2017

• About 6,200 buildings tested
• How many checks: **10,1% of reports** (631 checks)
• At least one check for each testing company: 152 companies were checked (**100%**)
In situ checks – BCCA statistics for 2017

• Checks: 10,2% of reports (634 inspections)
  • 66% after sending of SMS
  • Also during weekend

• Duration of inspection?
  • Average duration of inspection: 21,5 minutes
  • Average waiting time for inspection to arrive: 2,8 min

→ Since 10% of tests are checked: average time ‘loss’: about 2.5 minutes
In situ checks – statistics 2017 – 634 inspections

What did they declare in the SMS message?
In situ checks – statistics 2017

Distribution of results (m³/h.m² at 50 Pa)
In situ checks – statistics 2017

Location of airtightness testing
In situ checks – statistics 2017

Location of in situ checks
Characteristics Flemish VENTILATION quality framework

• Mandatory scheme in context of requirements for new buildings

• Major elements:
  • “Competent” person(s) must execute a number of activities
    • Ventilation pre-design concept
      • Major objective: inform the building owner
    • Ventilation performance report
      • Declaration of performances of ventilation system
  • Desktop checks – 10%
  • In situ tests – 10%
### Competence: Online exams

<table>
<thead>
<tr>
<th>Role</th>
<th># of persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinator</td>
<td>686</td>
</tr>
<tr>
<td>Designer</td>
<td>800</td>
</tr>
<tr>
<td>Rapporteur supply openings</td>
<td>737</td>
</tr>
<tr>
<td>Rapporteur transfer openings</td>
<td>999</td>
</tr>
<tr>
<td>Rapporteur exhaust openings</td>
<td>648</td>
</tr>
<tr>
<td>Rapporteur mechanical ventilation</td>
<td>784</td>
</tr>
</tbody>
</table>

### Competence: Practical tests

Rapporteur mechanical ventilation: about 350 persons
Conclusions

• Is it not evident to assume that:
  • everybody is following the regulations
  • Everybody reports correctly

• There are various interesting approaches for achieving better compliance