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Securing the quality of ventilation systems in residential buildings: status and perspectives
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DETAILED ANALYSIS OF REGULATORY COMPLIANCE CONTROLS OF 1287 DWELLINGS VENTILATION SYSTEMS

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Background

- The new French EP regulation (RT2012) generalizes low energy dwellings
  - Envelope airtightness requirement for single-family dwellings:
    - $Q_{4Pa\_Surf} \leq 0.6\ m^3/h/m^2 \cong n_{50} \leq 2.3\ h^{-1}$
    - Justification : measurement or quality management approach
- Dwellings ventilation is concerned by another 30years-old regulation (1982-1983)
  - A general and continuous airing system
  - Compulsory general layouts of ventilation installation
  - Exhaust airflows in each humid room
    - Depending on the total room number in the dwelling
    - Drive to around 0.5 h^{-1} global ACH in the dwelling
    - Can be reduced in case of DCV systems (e.g. humidity)
      - Additional technical guidelines
  - No compulsory procedure at commissioning

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  - A general and continuous airing system
  - Compulsory general layouts of ventilation installation — 50%
  - Exhaust airflows in each humid room — 43%
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Published statistics of non-compliance (2009) at national level

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What about risks for a generation of performing airtight dwellings to contribute to an unhealthy indoor air ?

Problematic

- Solutions to increase ventilation quality, once systems are installed and in-use ?
- First step : precise analysis of dysfunction types
  - => An accurate picture of on-site ventilation quality

Summary

1. Framework of French regulation compliance controls
2. Overview of the 1287 dwellings analyzed sample
3. Results on the detailed analysis of dysfunctions compilation
4. Why these dysfunctions ? Some tracks of answers

French regulation compliance controls

- Building's owner is legally responsible
- During 3 years, authorities can proceed to a regulatory compulsory check
- Performed by sworn-in & qualified government employees
- Several regulations incl. EP and airing
- The control is based on plans analysis, specifications analysis and calculations, on-site visits
- Financial penalties up to 45k€ (75k€ if repeated)

Controls on airing regulation

- 2 sections :
  - "What can be seen - and - operated observation": control of the ventilation system installation, as well as of the whole ventilation equipment set
  - "Exhaust and supply airflows measurements": check of airflow or pressure difference (DCV) at air vents
- Control reports include original detailed data with precise descriptions of causes
- A potentially important technical database !

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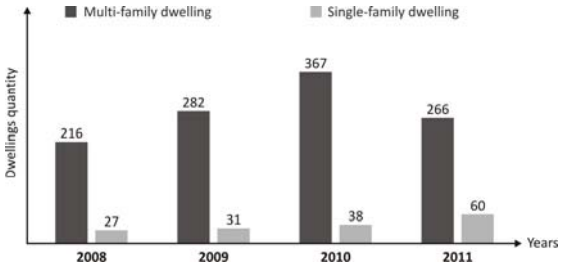
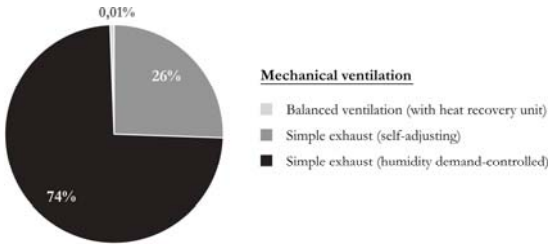
A 1287 dwellings sample

- Several climatic zones
- 88% of multi-family dwellings

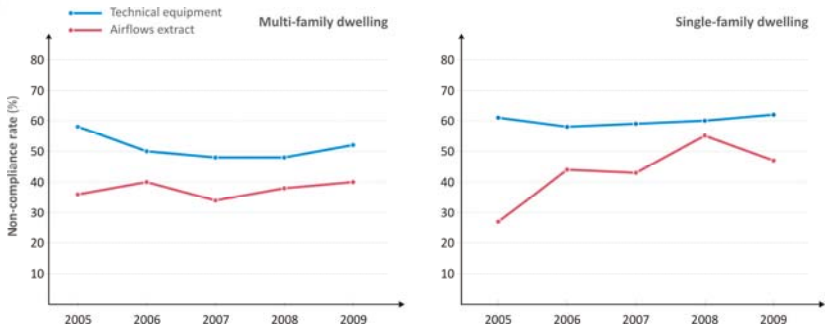


- Ventilation systems repartition = representative of new buildings stock



Global non-compliance rates

- 47% of the total sample (at least one non-compliance remark)
- 68% for single-family dwellings
- 44% for multi-family dwellings.
- These results confirm the national trend



Annual distribution of non-compliance rates, for each type of dwelling, ORTEC, CSTB, 2009

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Classification into 6 representative categories

distributed around 28 dysfunction points

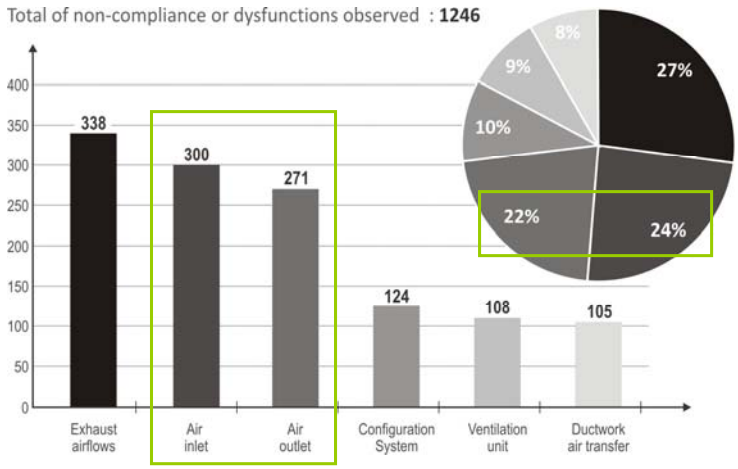
1. Air inlet
2. Air outlet
3. Airflow / pressure (DCV) measurement
4. System configuration
5. Ventilation fan
6. Ducts

Non independent categories regarding their causes

EA	Air inlets
EA1	Absence of air inlets modules
EA2	The Implementation of air inlets does not comply with prescribed rules and regulations
EA3	Presence of inlet air in a humid or service room
EA4	No mortises in window frames or incorrect size
EA5	Air inlet excess in the main rooms
EA6	Obturation of air inlets in one or more rooms
SA	Air outlets
SA1	The air outlets does not comply with regulation requirements
SA2	Control for changing peak flow missing or inaccessible
SA3	Dysfunction of air outlets equipped with presence detectors
SA4	Absence of air outlets in one or more rooms
SA5	Location of air outlets does not comply with regulation and technical requirements
QE	Exhaust airflows
QE1	The pressure measures at the air outlets are not correct
QE2	The exhaust airflows at the air outlets are not correct
SY	System configuration
SY1	The system configuration does not comply with the technical note requirements
SY2	Interversion of air inlet and air outlet
SY3	The system configuration does not comply with the standardized calculations of thermal regulations

Results on dysfunctions

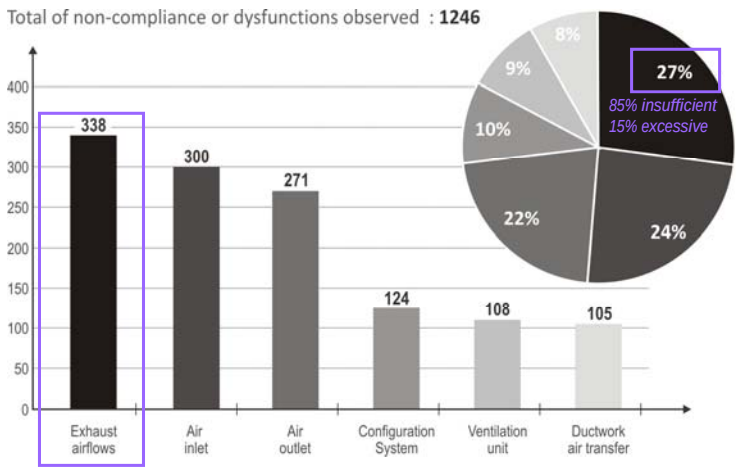
Classified per categories



Lack of module, insufficient module quantity, non-compliance with airflows characteristics

Results on dysfunctions

Classified per categories



Implementation of non-complying air outlet, non-adapted airflows regarding the size of the dwelling, bad quality of ventilation ducts mounting (air leakage and pressure losses)

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Some tracks of answers

- Integrate ventilation into the architectural intial design step
- Lack of attention at the mounting step
  - Actor's dispersion inside multiple technical lots
  - Ventilation rarely defined as a specific lot
  - No one in-charge of the final result
- Lack of continuity between program step, design, mounting, and also material and component suppliers
- Control at commissioning is not systematic, or incomplete
  - Recent guides (CETIAT, 2012) describe precisely these receipt procedures

Conclusion and perspectives

- Adapted industrial solutions available ⇔ very frequent ventilation system dysfunctions
  - That heavily limits the reliability of these installations
- A main issue for low and very low energy buildings
  - Airtight envelopes

⇒ Need of guaranties on in-site ventilation quality
  - the recent Effinergie+ label : ventilation airflows (advisable) + duct leakage measurements (compulsory) at commissioning

⇒ Manage research projects leading to better practices at every stage of the construction
  - The implementation of *quality management approaches ?*

Aknowledgments

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- *The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the Ministry.*