BUILDING AIRTIGHTNESS IMPROVEMENTS IN THE FRENCH BUILDING STOCK

Analysis of CEREMA database

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AIRTIGHNESS IN THE EP-REGULATION RT2012

- **French indicator**: $q_{at} = \frac{q_4}{A_{Tbat}} = \frac{Q_{4Pa-Surf}}{A_{Tbat}}$

  \[ q_4 = \text{airflow rate at 4 Pa} \]

  \[ A_{Tbat} = \text{envelope surface area excluding lowest floor} \]

- **Limit values for residential buildings**:
  - Single-family houses: $q_{at} \leq 0.6 \, m^3 \, h^{-1} \, m^{-2}$ ($n_{50}=2.3 \, h^{-1}$)
  - Multi-family buildings: $q_{at} \leq 1.0 \, m^3 \, h^{-1} \, m^{-2}$

- **Default values for non-residential buildings**
  - $q_{at}=1.7$ or $3.0 \, m^3 \, h^{-1} \, m^{-2}$
TESTERS QUALIFICATION

- Mandatory justification:
  - Airtightness measurement performed by a qualified tester
  - Certified Quality Management Approach

- National qualification scheme for testers:
  - reference: ISO 9972 + French standard (FD P50-784)
  - qualifying State-approved training + examination
  - testing experience (minimum 10 tests)
  - yearly follow-up checks including a national database

- September 2020: 896 qualified testers

AIRTIGHTNESS DATABASE FIELDS

- Building general information: owner, location, use, year of the construction, year of the rehabilitation
- Special requirements: label, certification
- Building main characteristics: main material, constructional type, insulation, ventilation system, heating system
- Measurement protocol: tester, date of measurement, measurement device, time of measurement (building state), method
- Measurement input data: envelope area (excluding low floor), floor area, volume
- Measurement results: $C_L$, $n$, $q_{50}$, $n_{50}$, uncertainties
-Leaks: classification of the leaks (46 categories)
FRENCH DATABASE OVERVIEW

Analyses in 2020 → 380 503 tests performed until 2018

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FRENCH DATABASE OVERVIEW

Distribution according to the building use

- Non-residential buildings: 67%
- Multi-family dwellings: 29%
- Single-family houses: 4%

Distribution according to the construction phase

- At commissioning: 91%
- During occupation: 9%
- During construction: 5%
- Before retrofitting: 5%

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**EVOLUTION OF THE TESTS RESULT**

Single-family houses performance

- 53% of tests < 0.4 m³ h⁻¹ m⁻²
- 93% of tests < 0.6 m³ h⁻¹ m⁻²

**EVOLUTION OF THE TESTS RESULT**
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Multi-family dwellings performance

71% of tests < $0.8 \text{ m}^3 \text{ h}^{-1} \text{ m}^2$

83% of tests < $1.0 \text{ m}^3 \text{ h}^{-1} \text{ m}^2$

**DATA FOR RENOVATION**

1560 tests on renovated buildings (EP regulation for renovation)

Initial = before renovation / Chantier = during renovation / Réception = after renovation
DATA REGARDING LEAKS LOCATION

Number of observations for 10 leaks identified on single-family houses with the highest median $q_{a4}$ value (from the sample of 121,478 measurements on houses)


FRENCH DATABASE FOR DUCTWORK AIRTIGHTNESS

- **Regulatory context:**
  - Tests only for class A, B or C in EP-calculation
  - Mandatory tests and minimum class for Effinergie labels

- **Justification:**
  - Airtightness measurement performed by a qualified tester

- **National qualification scheme for testers:**
  - reference: French standard (FD E51-767)
  - qualifying State-approved training + examination
  - testing experience (minimum 10 tests)
  - yearly follow-up checks including a national database

- **December 2020: 123 qualified testers**
FRENCH DATABASE FOR DUCTWORK AIRtightness

Evolution of the number of tests

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Tests</th>
</tr>
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<tbody>
<tr>
<td>2019</td>
<td>133</td>
</tr>
<tr>
<td>2018</td>
<td>740</td>
</tr>
<tr>
<td>2017</td>
<td>612</td>
</tr>
<tr>
<td>2016</td>
<td>419</td>
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<tr>
<td>2015</td>
<td>144</td>
</tr>
<tr>
<td>2014</td>
<td>20</td>
</tr>
<tr>
<td>2013</td>
<td>16</td>
</tr>
</tbody>
</table>

Distribution according to the construction phase

- At commissioning: 20%
- During construction: 14%
- During construction – ductwork installed: 4%
- Other: 62%

Evolution of the number of tests

- Single-family houses
- Multi-family dwellings

Leakier than 2.5*A

<table>
<thead>
<tr>
<th>Year</th>
<th>Single-family houses</th>
<th>Multi-family dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>20</td>
<td>740</td>
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<tr>
<td>2013</td>
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</table>

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FRENCH DATABASE FOR DUCTWORK AIRTIGHTNESS

Objective

- C N = 84
  - >2,5*A
  - 2,5*A
- B N = 215
  - >2,5*A
  - 2,5*A
- A N = 467
  - >2,5*A
  - 2,5*A
- 2,5*A
  N = 298
  - >2,5*A
  - 2,5*A
- Other
  N = 725
  - >2,5*A
  - 2,5*A

Test result

FRENCH DATABASE FOR VENTILATION SYSTEM

- Regulatory context:
  - New regulation for building RE2020: from January 1st, 2021
  - Ventilation: mandatory check and measurement for residential buildings

- Justification:
  - Promevent protocol (similar to EN14134) performed by a qualified tester

- National qualification scheme for testers:
  - Being defined at the moment
  - Similar than envelope and ductwork airtightness
  - Better process to collect data
FRENCH DATABASE FOR VENTILATION SYSTEM

- Private database: by DooApp

https://open-promevent.fr/

THANKS

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