QUALITY AND COMPLIANCE ON BUILDING VENTILATION AND AIRTIGHTNESS IN THE DUTCH CONTEXT

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EVOLUTION IN EPC

1980

2000

2020

- Bldng envelope & components
- Bldng heating needs
- Energy use for heating and cooling
- Overall building energy performance
- Energy producing built environment
NOW: OVERALL ENERGY PERFORMANCE OF BUILDINGS (EPB)

Overall Energy balance (energy use, own production)

Ways to express EP (numbers, indicators, ratings)

Overall Energy balance

Requires an integrated and modular set of calculation procedures

SYSTEMATIC APPROACH: THINK PYRAMID

Boundary conditions

Component input data

Building energy needs and system energy losses

Collect all energy elements

Boundaries, classification

EP aggregation

EP expression

Common terms, definitions, and symbols
WHY DO WE NEED A SYSTEMIC APPROACH

Product performance ≠ Performance in building

EXAMPLE: HEAT RECOVERY UNIT (VENTILATION)

High performance product: 95% efficiency
Applied in building:
› Duct heat losses?
› Frost protection?
› Windows opened?
› By pass (summer)?
› Balanced flow?

[Diagram of heat recovery unit with flow arrows]
EP REQUIREMENTS IN THE NETHERLANDS BOOSTS INNOVATION

Research and innovation:
• New EPB technologies

(Inter-)national policies:
• Regularly tightened minimum EP requirements
• (Financial) incentives
• Awareness campaigns

EPB Standards:
• Regularly updated with new technologies

High performance lighting (offices)
Heat pumps
High performance glazing
Heat recovery & Demand controlled ventilation
Heat recovery showers
Solar hot water systems
PV systems
Future: ??!!

Energy Performance Requirements, NL
Transparent long term national policy

Served as one of the examples for the European Directive
PRINCIPLE OF EQUIVALENCE FOR INNOVATIVE VENTILATION SYSTEMS

In the past:
- Each consultancy company uses its own simulation models
- No interaction between the consultants about the approach
- No common methodology how to conduct a study

As a result, there was discussion of the outcome.

MANUFACTURERS AND CONSULTANCY COMPANIES JOINT FORCES

- Dutch Association of Air Handling Equipment Manufacturers (VLA)
- Research institutes / consultancy companies:
  - Nieman
  - Peutz
  - TNO

Each report is reviewed by one of the other bureau’s.

- Purpose is to calculate correction factors of the ventilation flow (NEN 8088) to be used in the Energy performance calculation (NEN 7120).
METHODOLOGY

- Semi-probabilistic approach
- 7 dwelling types (row houses, apartments)
- Different occupant types
- Different airtightness
- Different wind exposure

- Common simulation tool (COMIS) is used for a final check by another bureau
- Requirements
  - Exposure to carbon dioxide (CO2)
    - LKI < 30 kppmh
  - LKI = \( \sum \left( \frac{C_{\text{exposure}} - 1200}{1000} \right) \times \text{time}_{\text{exposure}} \) [kppmh]

REPORTS ARE PUBLISHED ON THE “VLA” WEBSITE

- In the near future this must be the database of Bureau CRG: Bureau of control and registration of declaration of equivalence (www.dcrg.nl)
HOW DO VENTILATION SYSTEMS PERFORM IN PRACTICE? MONICAIR

› Monicair project: MONItoring & Control of Air quality in Individual Rooms

Field studies aimed at:
› Performance measurements of indoor air quality and energy performance of different ventilation systems.
› Energy performance of dwellings in relation to comfort level and user patterns.

› Purpose of the study
› Improve ventilation systems
› Improve calculation methods, standards, and building regulations.

MONICAIR CONSORTIUM

Fabrikanten

Adviesbureaus

Onderzoeksinstitutena
FACTS AND FIGURES

› 62 dwellings (row houses, 2 floors, pitched roof)
› 9 ventilation systems (+ natural ventilation, system A)
› Correct installed
› 1 year of measurements
› Measurements > 100 million data points
› Field test including users

MEASURED DATA

› IAQ (indoor air quality): CO2-level
› Temperature (air temperature)
› Humidity
› Presence (PIR)
› Energy use
  › Condensing boiler and ventilation-unit
› Weather station
MAIN CONCLUSIONS

- Large differences between systems which comply to regulations
- Large differences between dwellings
- Occupants almost don’t control their ventilation systems. Manual controlled ventilation systems are most of the time in low speed. 53% of the occupant is positive and 5% is negative towards the ventilation systems.
- Sleeping rooms are critical
- Bigger correlation between ventilation flow and indoor air quality when a mechanical component is in the occupant space
- Large differences in energy performance
CONCLUSIONS

- CO2 levels are too high even with systems which are build according to regulations.

- Improvement is needed:
  - Regulations
  - Standards
  - Systems
  - Awareness

CALCULATION OF AIRTIGHTNESS

Three different methodologies can be used to determine the airtightness value to be used in the energy performance calculation:

1. Calculate a fixed value according to NEN 8088 based on building year, building type
2. Use blower door measurements of similar buildings in the past, quality control is important to meet this value
3. Calculation bases on SBR reference details, if this outperforms the fixed value according to NEN 8088 a blower door measurement is necessary.

Compliance and quality control will be part of the new system.
QUALITY CONTROL: DUTCH BUILT TRANSPARANT (BOUWTRANSPARANT)

- Check of the Energy performance calculation
- Near Infrared pictures
- Blower door and smoke tests
- Ventilation Flow
- Indicative noise measurement
- Tools for assessment of construction mistakes Estimation Energy losses

**CAUSES OF LEAKAGES AVOIDABLE, MOSTLY IN THE SAME SPOTS**

<table>
<thead>
<tr>
<th>Cause of leakage:</th>
<th>number of times in project</th>
<th>total number of times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chimney</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Window</td>
<td>9</td>
<td>32</td>
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<tr>
<td>Window frame</td>
<td>9</td>
<td>29</td>
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<tr>
<td>Door</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Roof-facade</td>
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<tr>
<td>Ventilation grill</td>
<td>5</td>
<td>18</td>
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<tr>
<td>Hatch crawl space</td>
<td>3</td>
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<tr>
<td>Door frame</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
MOST COMMON SPOTS: CHIMNEY AND ROOF OUTLETS

AIR LEAKAGES AT WINDOWS AND WINDOW FRAMES
CLEAR NEED TOWARDS QUALITY CONTROL

› Higher infiltration can not only lead to more energy use but also a need for more installed power for heating or cooling.

› There are also other reasons for quality control: proper functioning of the building and installation and prevention of cold spots which can lead to moisture and mould (mold) grow.

QUALITY INITIATIVES VENTILATION: JOINT EFFORT ASSOCIATIONS

Because 50% of ventilation systems was not according to specifications, in 2012 a plan was made with all significant associations to make sure every ventilation system in 2015 has a good performance.

This was ended in November 2014 by the ministry because of:

› Lack of performance tests, few figures of housing corporations and none of home owners
› No demand of tenants and home owners about quality of ventilation: no incentive to building parties.

› Solution according to ministry: shift to private compliance test
NEW SYSTEM OF QUALITY ASSURANCE IN THE NETHERLANDS

- Ministry of BZK is preparing a new system of quality assurance.
- A shift of activities municipality toward private quality assurance which make use of approved instruments to find out if a building is according to building regulations.

- A possible instrument is the combination of BRL 5019 (check of the building plans) and BRL 5006 (building site supervision).

- Pilots are now conducted.

ALTERNATIVE: PERFORMANCE GUARANTEE, ZERO ENERGY BILL

- Energy cost in Dutch houses is about 45,000 Euro in 20 years.
- Contractor retrofits about this amount of money and gives performance guarantee of zero energy bill within certain boundaries.
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› Compliance airtightness: Bas Knoll

THANK YOU FOR YOUR ATTENTION