

# DURABILITY AND MEASUREMENT UNCERTAINTY OF AIRTIGHTNESS IN EXTREMELY AIRTIGHT DWELLINGS

Wolf Bracke, Jelle Laverge, Nathan Van Den Bossche, Arnold Janssens

presenter: Wolf Bracke / 30 January 2020

## OUTLINE

- **Introduction**
- Test repeatability and seasonal variations
- Durability of airtightness
- Conclusions

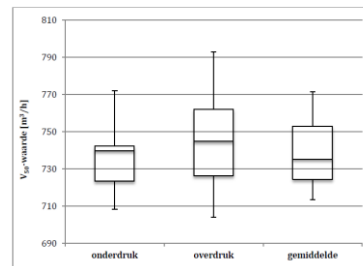
# INTRODUCTION

- Airtightness important to meet energy performance requirements
- Increasing number of new houses with airtightness test
- Result of test may have financial consequences (fines, subsidies)
- Reliability of test?
- Long-term performance of airtightness, specifically for airtight houses?

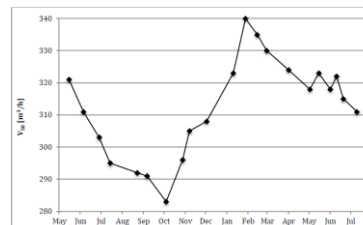
3

# LITERATURE REVIEW

- Repeatability (EN13829, method A)
  - St. deviation: 2%
  - Max. variation: 4%
- Reproducibility (EN13829, method A)
  - St. deviation: 3%
  - Max. variation: 8%
- Seasonal variation
  - Max. variations: 18%
  - Swelling-shrinkage of wood
- Durability
  - No conclusive results



(Delmotte and Laverge 2011)



(Kim and Shaw 1986)

4

## OUTLINE

- Introduction
- **Test repeatability and seasonal variations**
- Durability of airtightness
- Conclusions

## TEST OBJECTS

- Semi-detached passive show house
  - Masonry construction
  - $ACH_{50} = 0.55$  ( $^{\circ}2009$ )
- Detached passive show house
  - Woodframe construction
  - $ACH_{50} = 0.21$  ( $^{\circ}2009$ )



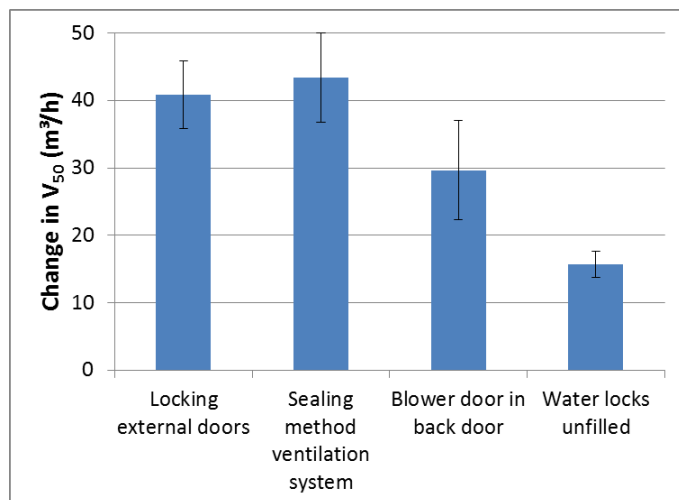
## INFLUENCE OF BUILDING PREPARATION

- EN13829: room for interpretation
  - locking of external doors
  - disconnecting the ventilation system: central or decentral air supply/exhaust
  - position of blower door
- filling water locks



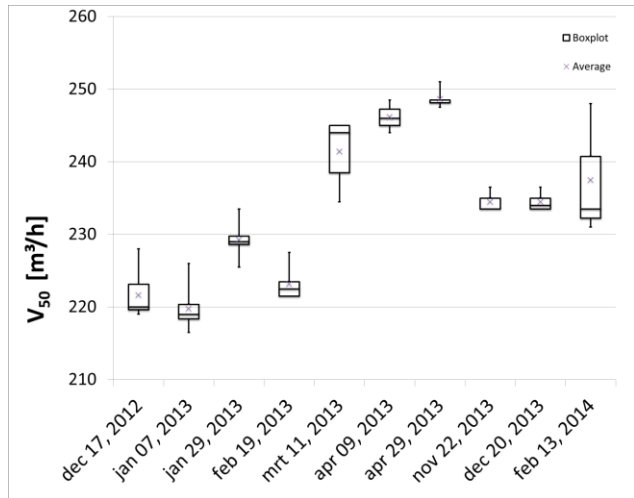
## INFLUENCE OF BUILDING PREPARATION

- Apparently small differences in preparation
- Relatively large impact on measured leakage in passive houses
- $\Delta V_{50}$  of 50 m<sup>3</sup>/h represents 20 to 35% change in ACH50



# REPEATABILITY AND SEASONAL VARIATION MASONRY HOUSE

- 10 days in 15 months
- 58 tests in total
- Repeatability in line with literature
  - Day 1: 12 measurements
  - Stdev: 1%, max var: 4%
- Variation result of changes in ductwork connections?

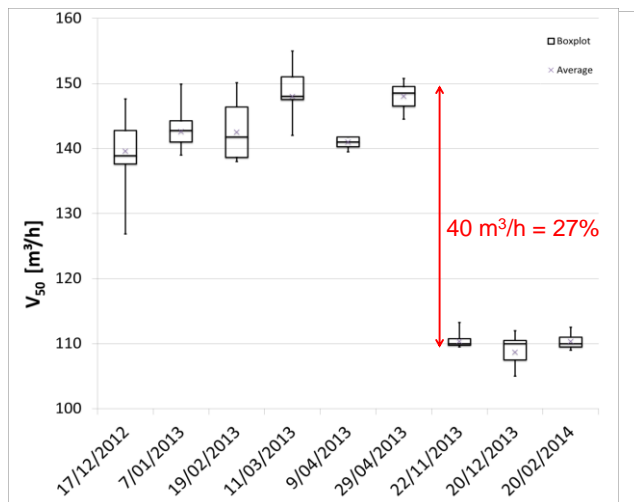


9

9

# REPEATABILITY AND SEASONAL VARIATION MASONRY HOUSE

- 9 test days in 15 months
- 53 tests in total
- Repeatability in line with literature
  - Day 2: 12 measurements
  - Stdev: 2%, max var: 5%
- No seasonal variation



10

10

## OUTLINE

- Introduction
- Test repeatability and seasonal variations
- **Durability of airtightness**
- Conclusions

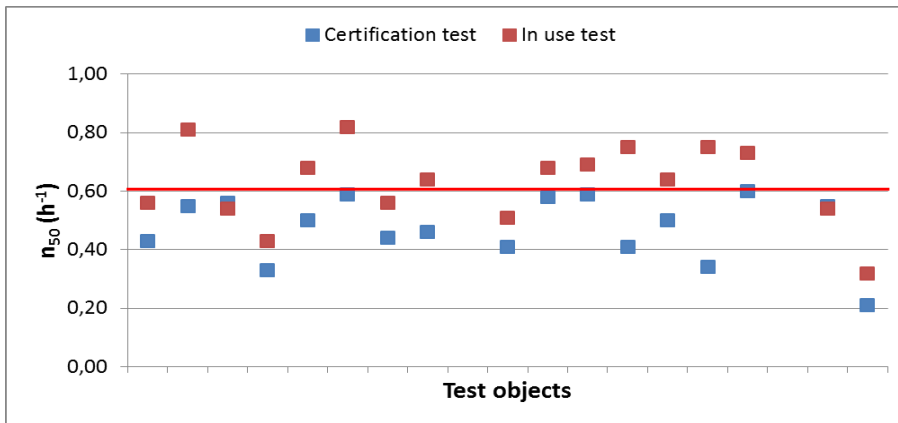
## TEST OBJECTS FOR ANALYSIS OF DURABILITY

- 15 inhabited dwellings from passive house estates
  - +2 show houses
- Semi-detached and terraced masonry construction
- Age 3 - 27 months
- New test results compared to original certification tests



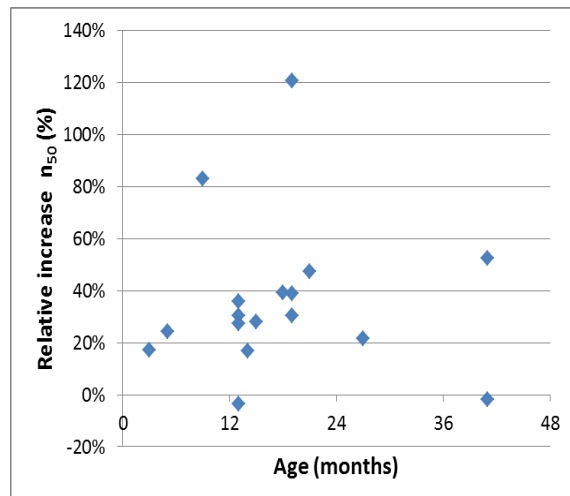
## DURABILITY OF AIRTIGHTNESS

- Average increase in air leakage by 32%
- Workmanship reproducibility: stdev original measurements = 19%



## DURABILITY OF AIRTIGHTNESS: RELATIVE INCREASE

- No significant relation with age
- Part of increase might be explained by differences in building preparation
  - Ventilation systems
  - Locking doors
- Observed leakage
  - Operable doors
  - Service penetration



# CONCLUSIONS

- Study on air leakage in extremely airtight houses
- Relative repeatability intervals in line with literature
  - More specific building preparation guidelines needed for better reproducibility of ambitious leakage requirements
- No clear evidence of seasonal variation of air leakage
- Long-term performance of airtightness
  - 90% of houses showed larger leakage over time
  - Relative degradation of airtightness, but small in absolute values
  - Hard to exclude the impact of building preparation

## Wolf Bracke


Researcher

DEPARTMENT OF ARCHITECTURE & ENGINEERING


RESEARCH GROUP: BUILDING PHYSICS, CONSTRUCTION & CLIMATE CONTROL

E wolf.bracke@ugent.be

T +32 9 264 37 52

 Ghent University

 @ugent

 Ghent University

[www.ugent.be](http://www.ugent.be)