Impact of Large Building Airtightness Requirements
Buildings XIII Conference
December 6th, 2016

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Outline

- Intro to Requirements
- Measured Performance
- Industry Impact
- What it Is, and What it Isn’t
  - Airtightness vs Air Leakage
Why We Care

→ Infiltration and Exfiltration Affect:
  → Building Energy Consumption – Heat Loss and Gains ($)
  → Indoor Air Quality - Pollutants
  → Building Durability - Condensation
  → Occupant Comfort - Thermal & Acoustics
Many Air Barrier Systems Available

Loose Sheet Applied Membrane – Taped Joints & Strapping
Sealed Gypsum Sheathing – Sealant Filler at Joints
Liquid Applied Sealants/Membranes
Mass Walls (concrete)

BUT, IT'S THE DETAILS THAT MATTER

Self-Adhered vapor permeable membrane
Self-Adhered vapor impermeable membrane
Sprayfoam
Curtainwall, window-wall & glazing systems
Materials → Components → Accessories

Whole Building Airtightness
Standards & Qualifications

→ Washington State & Seattle, ABAA Target, GSA, IBC/IECC Option
< 2.0 L/(s·m²) [0.40 cfm/ft²] @ 75 Pa

→ US Army Corps of Engineers & IGCC
< 1.26 L/(s·m²) [0.25 cfm/ft²] at 75 Pa

→ Passive House
0.6 ACH50
(~0.60 L/(s·m²) [0.12 cfm/ft²] at 75 Pa)

→ LEED, 6-sided apartment test
(~1.25 L/(s·m²) [0.25 cfm/ft²] at 50 Pa)

→ UK (AATMA) Large Buildings
~0.70 to 1.75 L/(s·m²) at 75 Pa
[~0.14 to 0.34 cfm/ft² at 75 Pa]
Measured Performance
Where We’re At – The Numbers

- Airtightness testing data was compiled in a database from the following sources:
  - Published literature
  - Industry members
  - Unpublished data provided by the project team

- 721 Airtightness Tests
- 584 Unique Buildings
- 566 Acceptable Tests for Comparison
Where We’re At – The Numbers

Building Types

- Commercial: 46%
- Multi-Family: 25%
- Institutional: 20%
- Military: 9%

Sample of 566 buildings
Where We’re At – The Numbers

Building Locations

- 66% USA
- 18% UK
- 16% Canada

Sample of 566 buildings
Where We’re At – The Numbers

Airtightness vs Year of Construction

Sample of 179 Buildings
Where We’re At – The Numbers

Airtightness vs Height of Building

Sample of 420 Buildings
- Individual Buildings
- Average

Airtightness vs Height of All Buildings

Airtightness [L/(s·m²) @ 75 Pa]

Airtightness [cfm/ft² @ 75 Pa]
Impact of Requirements

Airtightness [L/s·m² @ 75 Pa]

- Maximum off scale at 25

- Research (214 Buildings)
- USACE (260 Buildings)
- Washington (44 Buildings)

- Performance Requirement
- Third Quartile
- Median
- First Quartile
- Minimum

Airtightness [cfm/ft² @ 75 Pa]
Impact of Requirements

- No Requirement, Post 2000 Construction (31 Buildings)
- USACE (245 Buildings)
- Washington (38 Buildings)
Performance of Air Barrier Systems

Airtightness \[L/(s\cdot m^2) \text{ @ 75 Pa}\]

- Liquid Applied (10 Buildings)
- Sealed Sheathing (11 Buildings)
- Sheet Applied (28 Buildings)
- Curtain Wall/Window Wall/Storefront (15 Buildings)

- Leakiest Tested
- Tightest Tested
- WA State Requirement
- Median

54 Buildings, Oct 2015 RDH Seattle Data
Impact of Testing
The Life of a Building
The Life of a Building

Design
Construction
Measurement & Verification
Operation
Maintenance & Renewals
Demolition

Upstream Effects

Material Selection
Assembly Design
Quality Control
Changes in Air Barrier System Selection

→ Seeing shifts from Mechanically Attached to Self-Adhesive & Liquid Applied membranes
New AB/WRB Materials

→ Many new self-adhered and liquid applied vapour permeable sheathing membranes available on the market.
Changes in Quality Control

→ Noticeable improvements as soon as somebody cares – specific people designated to look at air barrier

→ Coordination between all team members essential
Impact of Requirements

Does airtightness requirement increase cost?

- No, or not significantly: 61%
- Yes, significant: 39%
- Yes, moderate: 0%

Opinions of the Current Airtightness Target
(< 0.40 cfm/ft² at 75 Pa) [< 2.0 L/s·m² at 75 Pa]

- Okay As Is: 56%
- Too Stringent: 11%
- Too Lenient: 33%
- Other: 0%
Impact of Requirements

- Beneficial and Worthwhile: 84%
- Not Beneficial and Not Worthwhile: 5%
- Beneficial, but Not Worthwhile: 11%
The Life of a Building

- Design
- Construction
- Measurement & Verification
- Operation
- Maintenance & Renewals
- Demolition

Upstream Effects

Material Selection
Assembly Design
Quality Control
The Life of a Building

- Design
- Construction
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Downstream Effects

Energy Consumption
Indoor Air Quality
Acoustics
Durability
What it Is, and What it Isn’t

Airtightness vs Air Leakage
Airtightness vs Air Leakage

→ In-service air leakage is the combination of airtightness and pressure differences created by the driving forces of airflow

Stack Effect (-5°C) + Wind (4 m/s) + Mechanical Systems (5 Pa) = Cumulative
Determining Air Leakage from Airtightness

→ Difficult to extrapolate from airtightness test results to air leakage rates

Graph showing normalized airflow vs. pressure difference with three lines representing leaky, average, and tight conditions. The graph includes a test pressure and in-service pressure differences.
Airtightness testing helps with modelling inputs, but doesn’t give us the whole answer.
Summary

→ Airtightness performance and testing requirements have been successfully implemented in jurisdictions such as Washington State, the USACE, and the GSA.

→ Target of 2.0 L/(s·m²) (0.40 cfm/ft²) at 75 Pa is common and demonstrated to be consistently achievable.

→ Overall perceptions of whole building airtightness testing seem positive.

→ Airtightness is part of the puzzle for understanding building airflow & energy efficiency, but further research required to tie directly to indoor air quality and energy savings.
Discussion + Questions

FOR FURTHER INFORMATION PLEASE VISIT
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