Field Applications of MF Infiltration Testing in the NE

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MA Amendments to Code

- Stretch Code = ERI path
- Ventilation clarification
- Third Party testing requirement

Expansion of ERI path options to include

- ENERGY STAR Homes
- Passive House*
- Adjustment of ERI target index for renewables

MA Amendments to Code

4 and 5 story buildings

- Stretch requires ERI path for 4 story residential and allows residential or commercial code for 5 story buildings
- Base allowes choice of Residential or Commerical Code for 4 and 5 story buildings.

- Clients:
- Builders and developers
  - Code (HERS, prescriptive, ERI)
  - Rebates (HERS)
  - Marketing (HERS, sometimes prescriptive)

ABA Work variety

Shack to high rise

- Old to new
- Short to tall
- Single family to Large MF

Number of tests

- Varies based on home type and test type.

- Planning for testing, when to test, if to test (exceptions?)
- We tell client what should be accepted by code enforcement and then carry it out.

- Problems: Not engaging the tester early, leads to problems.

Abstract

Toward an Understanding and Prediction of Air Flow in Buildings

Doctor of Philosophy, 2000

Joseph William Lstiburek

Civil Engineering

University of Toronto

This thesis makes two fundamental arguments in the analysis of air flow in buildings:

- buildings are complex three dimensional air flow networks driven by complex air pressure relationships; and
- the key to understanding air flow in buildings is the building air pressure field.

Under standard building analysis, interstitial air flow and interstitial air pressure fields are not often considered and exterior and interior walls, floors, and roof assemblies are either considered as monolithic or having openings resulting in flow across the specific assemblies. Buildings comprise multi-layer envelope assemblies with numerous air gaps or void spaces that are often connected to service chases. As a result, complex three dimensional flow paths and intricate air pressure relationships must be considered.

Blower Door

One tool

One Rater

Many applications

Many possibilities

Air leakage Testing with One fan

Individual Dwelling Unit

or Whole Building

Blower Doors

Multiple Doors

Multiple BD Jockeys

Even More applications

Even More Possibilities

^ Guarded testing with exterior entrances only

< Good help!

Testing with Multiple fans

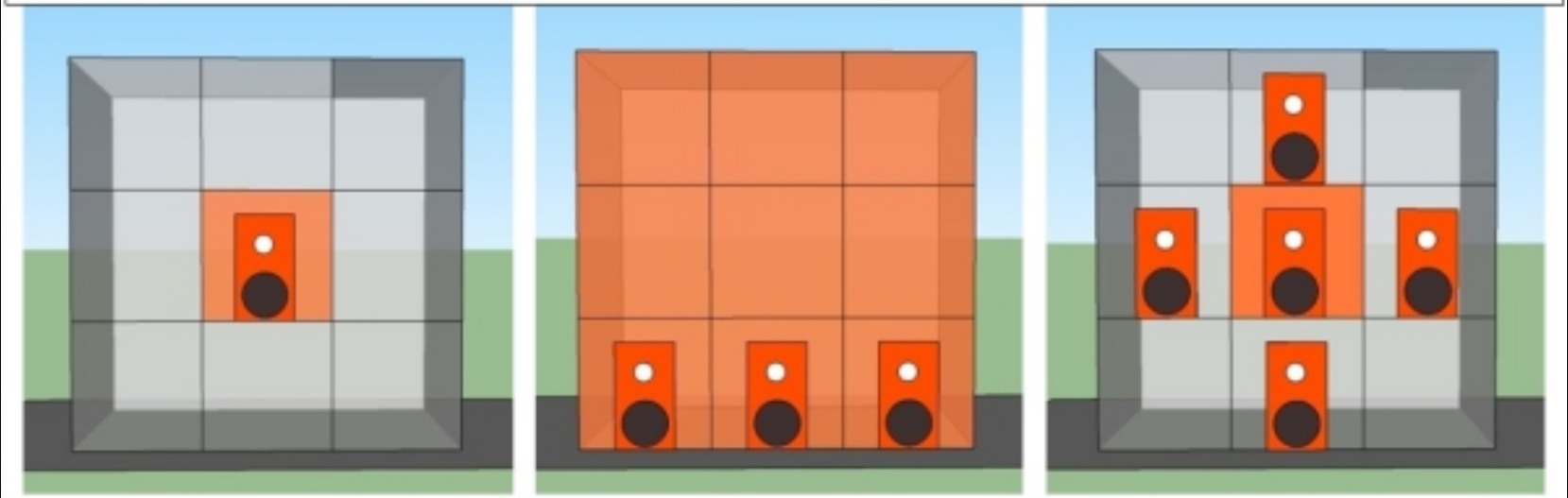
Guarded testing with center loaded corridors and common stairs

Testing with Multiple Fans

Larger and Leakier Whole Building Tests and Guarded testing in larger buildings

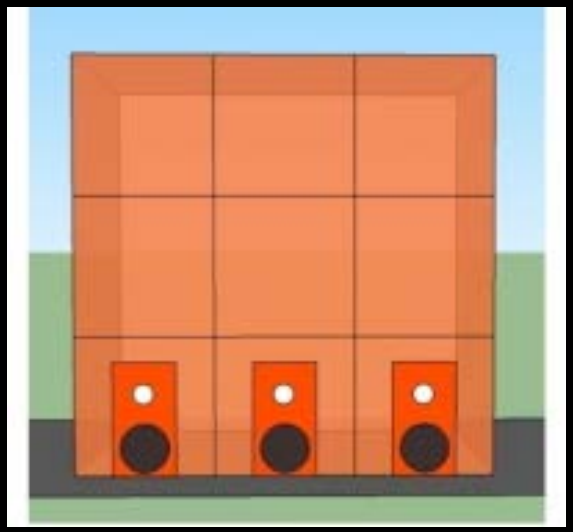
Whole Building, Guarded and … Compartmentalization (whew)

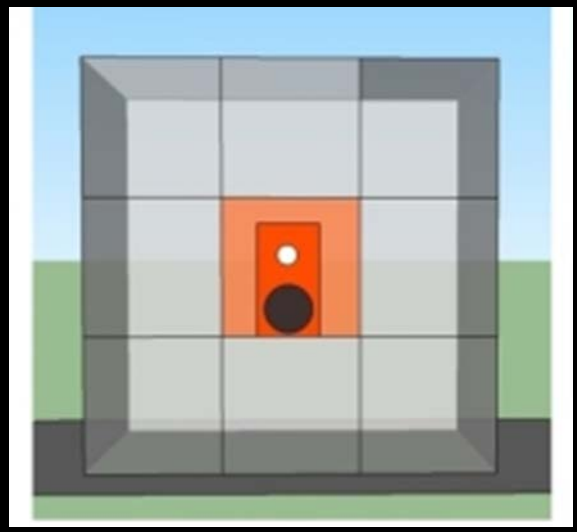
Whole-building and **guarded** blower door testing are two methods that use multiple blower doors to isolate and measure leakage from the exterior envelope only. These methods require multiple blower doors and operators and must be coordinated by an experienced team.
Compartmentalization of single-unit testing quantifies leakage from the exterior walls as well as the interior demising walls, floors, and ceilings of a unit.



Compartmentalization testing	Whole-building testing	Guarded blower door testing
Single blower door and operator	Requires multiple blower doors and operators	

Faster Guarded testing (leakage to outside)





Whole Building + Individual units

Pressure equalized

Sampling

Cost Savings

- Comprehensive of variety of units and maybe not appropriate in critical situations like ventilation verification.

Strict Protocol

- Code enforcement approval – RESNET Standard for Sampling.

3 ACH50 and compartmentalization

- Most MF dwelling units are NOT currently anywhere close to this 3ACH50 limit when measured for compartmentalization
- Too much of a stretch for MF?

Testing for code only

Timing

- Last minute Failures
- Testing too early
- Repeat testing
- Choosing style of testing
  - Guarded,
  - whole building,
  - compartmentlaization

In-field failures

Discontinuity between types of thermal boundaries

- Common and interior walls
- Gaps between dissimilar boundaries
- Resilient channel

Penetrations in thermal boundary

- Fixtures
- Ducts and registers
- Shafts
- Wiring
- Plumbing

Single-Point vs. Multi-Point

One Pressure vs Multi-pressure

$$Q = K(\Delta P)^n$$

– Upcoming 10% penalty for 1-point tests per RESNET/ANSI 380

Air sealing Common walls and fire rated assemblies

- Firecode doesn't meet air sealing requirements of energy code. Need to use air barrier materials.
- Airtight fire rated assemblies
- Common walls leak to the outside, attic basement, garages, and they leak between units

Compartmentalization is Good

- smells
- smoke
- sound
- ventilation control
- heating and cooling

More possibilities? New idea

- Can you simultaneously determine leakage rates to inside from leakage rates to outside?
- Can you detemine both of these and determine the flow exponent of each at the same time?

$$K_{ext}(\Delta P_{ext,1})^{n_{ext}} + K_{pan}(\Delta P_{ext,1})^{n_{pan}} = -K_{int}(\Delta P_{int,1})^{n_{int}}$$

$$K_{ext}(\Delta P_{ext,2})^{n_{ext}} + K_{pan}(\Delta P_{ext,2})^{n_{pan}} = -K_{int}(\Delta P_{int,2})^{n_{int}}$$

$$K_{ext}(\Delta P_{ext,3})^{n_{ext}} + K_{pan}(\Delta P_{ext,3})^{n_{pan}} = -K_{int}(\Delta P_{int,3})^{n_{int}}$$

$$K_{ext}(\Delta P_{ext,4})^{n_{ext}} + K_{pan}(\Delta P_{ext,4})^{n_{pan}} = -K_{int}(\Delta P_{int,4})^{n_{int}}$$

Questions……

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