ANALYSIS OF THE NIST COMMERCIAL AND INSTITUTIONAL BUILDING ENVELOPE LEAKAGE DATABASE

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3rd TightVent Workshop on Building and Ductwork Airtightness

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Background

- Why do we care about airtightness?
  - Estimation of infiltration rates for IAQ & energy analysis
  - Protection of building air from external threats
  - Leakage through walls is a bad way to ventilate
- Persily (1998) debunked myth of airtight U.S. commercial buildings but many still assume it
- Lack of whole building airtightness or continuous air barrier requirement in U.S. *until recently*

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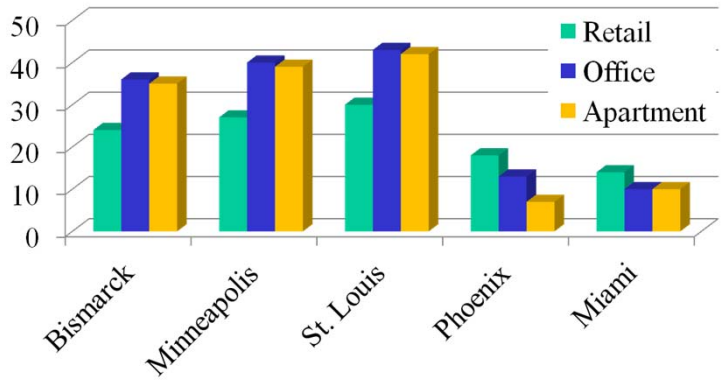
Energy Impacts

% Reduction in Annual Energy Use for Target vs. Baseline Airtightness



Significant energy savings are possible through reducing air leakage – depends on building and climate (Emmerich et al. 2007)

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NIST U.S. Commercial Building Envelope Leakage Database

- **Collection of whole building measurements by both researchers and practitioners**
- **NOT a random sample**
- **Includes building information:** location, year of construction, building type, wall construction, air barrier (yes or no, type), green building label, stories, floor area, volume
- **Some building information incomplete**

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What's new (since 2011)?

- New envelope airtightness data for **159** commercial and institutional buildings.
- Many are new small commercial and educational buildings in northeast
- *Some mid- and high-rise*
- Many are 'green buildings'
- Many were designed and built with 'air barriers'
- Converted data from 5-sided to 6-sided

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Summary of Data

Dataset	Count	Mean	Std Dev.	Min	Max
		(m^3/h-m^2 at 75 Pa)			
Old (2011)	228	16.7	12.7	1.6	77.9
New	159	8.0	6.6	0.5	32.3
ALL	**387**	**13.1**	**11.4**	**0.5**	**77.9**

Normalized by ***total*** **envelope surface area (6-sided)**
(x 0.055 for cfm/ft^2 at 0.3 in. H_20)

Over 50 % tighter than 2011 data on average

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Impact of 'Air Barrier'

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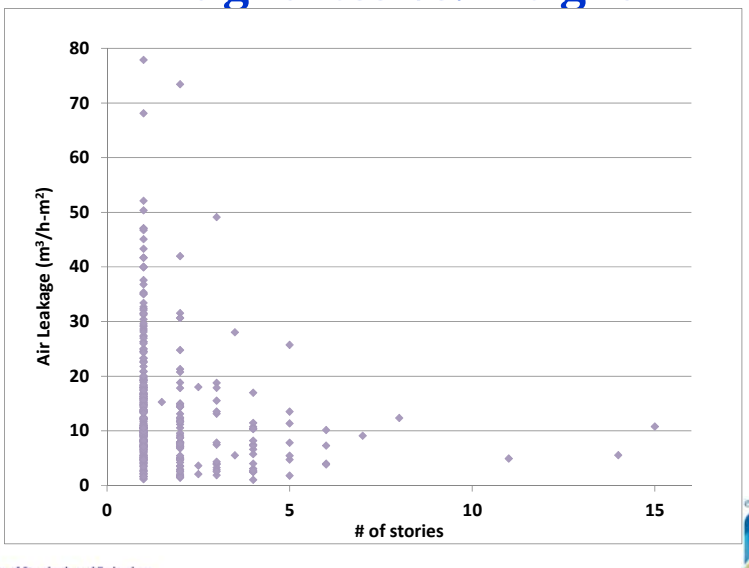
Airtightness vs. Height



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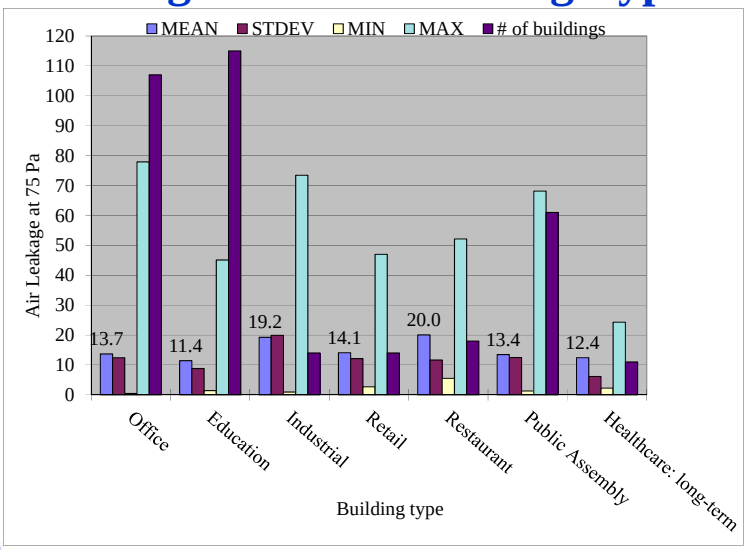
Airtightness vs. Building Type



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What about green buildings?

23 green buildings in new data vs. 1 in 2011 data

- Average leakage at 75 Pa is 5.2 ± 3.6 $m^3/h \cdot m^2$ compared to 13.1 ± 11.4 $m^3/h \cdot m^2$ for all (normalized by 6-sided enclosure area)

Are they tighter because they are green?

- Not a random sample!!!
- Few, if any, requirements for tightness in green building programs in the past
- 20 of the green buildings have air barriers

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Future database activities and issues

Keep expanding database with new data and complete analysis of new data

Analyze airtightness retrofits of existing commercial buildings

Analyze multifamily housing data

Put database online (for users and input)

Standardize building information

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Recent Code and Standard Developments

- Airtightness requirements are spreading but are inconsistent and still need improvement
- ASHRAE 189.1 addendum h requires whole building airtightness testing (exception for serious commissioning)
- ASHRAE 90.1 draft addendum provides credit for reduced leakage in energy simulation method and new proposal for commissioning requirements

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Summary

- Airtightness of 387 U.S. commercial and institutional buildings
  - 159 buildings added since 2011 are 50 % tighter on average than previous 228 buildings
  - About half of the new data are from buildings with air barriers which are almost 70 % tighter on average
- Caveats – not random sample, most individual records are not complete
- Growing number of airtightness requirements in U.S.

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References and Acknowledgments

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Emmerich, S.J., Anis, W., McDowell, T.P. 2007. Simulation of the impact of commercial building envelope airtightness on building energy utilization. ASHRAE Transactions, Vol. 118 (2).

Persily, A.K. 1998. Airtightness of Commercial and Institutional Buildings: Blowing Holes in the Myth of Tight Buildings. Proceedings of Thermal Performance of the Exterior Envelopes of Buildings VII.

Data from FSEC, Wagdy Anis, Terry Brennan, Dave Bohac, PSU, USACE, Efficiency Vermont, Henri Fennell, John Haehnel, Phil Emory, Jeff Knutson, and Jeff Speert

Questions?

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