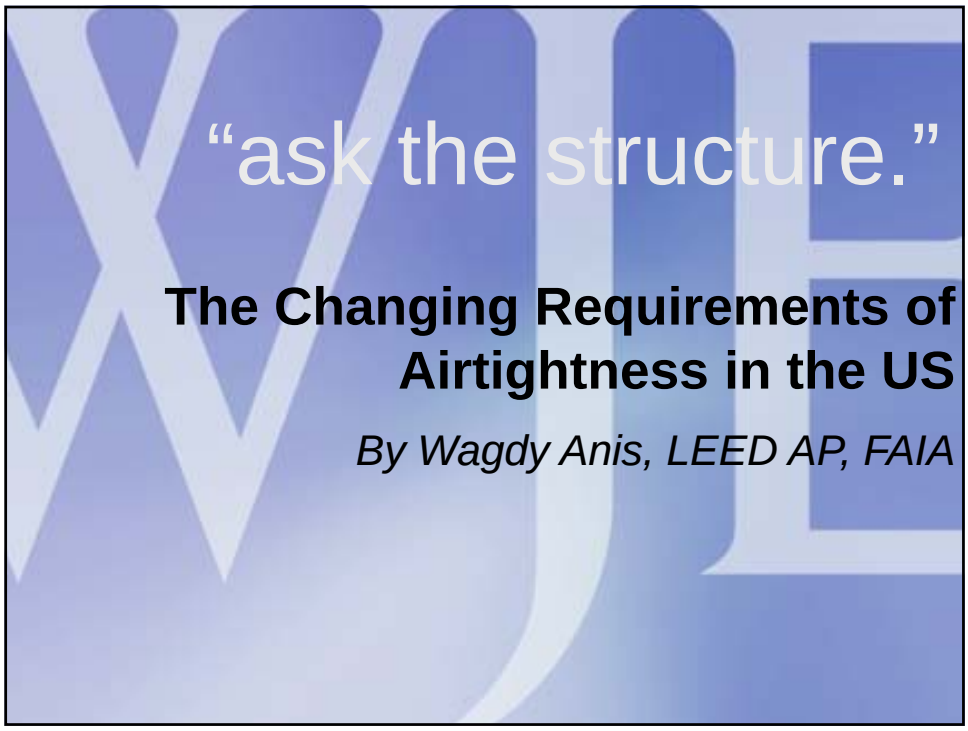

CREDITS

- Tamura and Shaw 1976
- Persily and Grot 1986
- Emmerich and Persily 2005
- Musser and Persily
- Cummings FSEC
- Brennan
- Dittus and Bailey
- Zhivov and Herron

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Building Envelope Deterioration

Condensation on Cold Surfaces in Plenums

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Air Leakage Problems – Mold

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CBD-72. Control of Air Leakage Is Important
G. Kirby Garden - 1965

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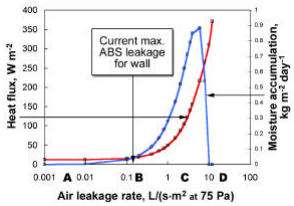
- IN 1977, G. HANDEGORD AT THE IRC-NRC CONCLUDED IN A PAPER ENTITLED “THE NEED FOR AIR-TIGHTNESS IN BUILDINGS”, THAT AIR LEAKAGE THROUGH CONSTRUCTION IS THE PRINCIPAL MEANS BY WHICH WATER VAPOR MOVES TO COLD SURFACES. **IT IS THE MAJOR CAUSE OF CONDENSATION IN BUILDINGS**.

Wiss, Janney, Elstner, Assoc., Inc.

The Genesis of Air Barriers in the US

April 10, 2012

The Canadian Model National Building Code Incorporated Air Barrier Requirements in 1985 (without maximum air permeance requirements)
1995 adopted 0.2 L/s*m2 @ 75 Pa



Wagdy Anis The Changing Requirements of Airtightness in the US

The Genesis of Air Barriers in the US

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The Louis B. Mayer Research Laboratories building at the Dana-Farber Cancer Institute opened in 1988

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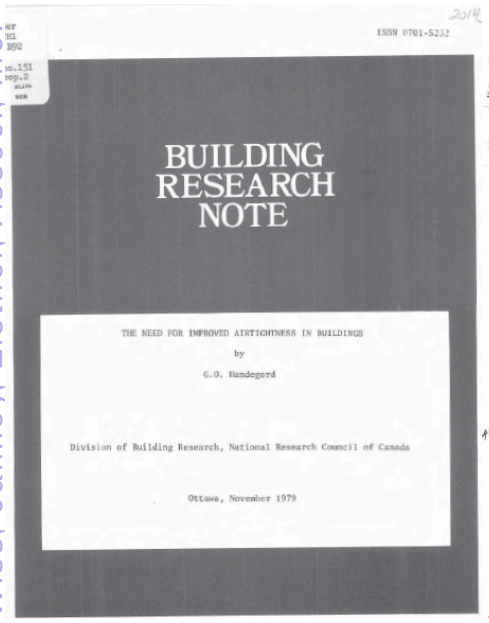
Louis B. Mayer Building - Dana Farber 1988
Icicles growing out of weep holes and dropping to sidewalk
Lazar Meir – Born 1888, Minsk, Russian Empire

Wagdy Anis
The Changing Requirements of Airtightness in the US


BUILDING RESEARCH NOTE

THE NEED FOR IMPROVED AIRTIGHTNESS IN BUILDINGS

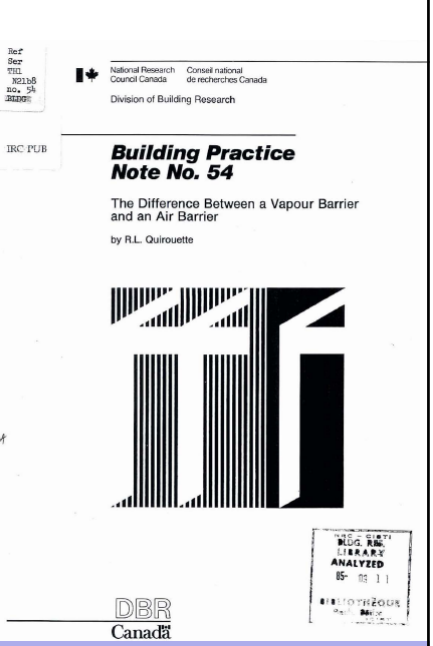
by

G.O. Handegord

Division of Building Research, National Research Council of Canada

Ottawa, November 1979

ISSN 0701-5232


National Research Council Canada / Conseil national de recherches Canada

Division of Building Research

IRC/PUB

Building Practice Note No. 54

The Difference Between a Vapour Barrier and an Air Barrier

by R.L. Quirouette

DBR Canada

Other failures: Library in Waltham MA. Could not keep temperature above 45 F on North side

Hospital Building in Boston: Discomfort in Patient Bedrooms

Success: First air barrier design Tufts University Tisch library Could not keep front door shut Roof membrane billowed and failed

Wiss, Janney, Elstner, Assoc., Inc.

Two half-day seminars for all SBRA Employees

June 20, 1996 - Lecturers:

Mark Bomberg
Bill Brown
Michel Perrault
Joe Lstiburek

Tim Mayo and Ned Nissen observers

Dinner at my house!

Wiss, Janney, Elstner, Assoc., Inc.

MA Energy Code
January 2001

Education BBRS and MA DOER - 85 seminars and consultations

Air Barriers 1, 2, 3 and 4 : 2003 with BSA
Air Barriers 1, 2, 3, 4 with BETEC

L-2 Requirements in England required testing

Energy Code for Commercial and High-Rise Residential New Construction

(780 CMR 13)

January 1, 2001 effective date runs concurrently with present code until July 1, 2001

Air Leakage Requirements - 1304.3

- An air barrier is required in the building envelope - to control air leakage into or out of conditioned space
  - must be continuous
  - barrier materials with air permeability no greater than 0.004 cfm/ft^2 @ 0.3" water (0.02 l/s/m^2 @75 Pa)
  - capable of withstanding combined design wind, stack and HVAC positive/negative pressures
  - durable or maintainable
  - connections between different assemblies must be air-tight and flexible
  - also required for interior partitions separating spaces with significantly different temperature or humidity levels (e.g. - indoor pools)
  - penetrations must be made air-tight
- stairwell & elevator lobby doors must meet criteria for exterior doors, and must be equipped with weather-seals.

Air Leakage Requirements - cont'd

- Air-tight Dampers
  - activated by building fire-alarm system and local smoke detector; must fail in open position
  - where air barrier is penetrated by:
    - fixed open louvers (e.g.- elevator shaft)
    - mechanical system components when leakage can occur during inactive periods (atrium exhausts and intakes, etc.)
    - fresh air intakes, exhaust outlets, stair shafts, etc.

Air Leakage Requirements - cont'd

- Lighting fixtures are required to be airtight when installed through the air barrier
  - Type IC with no penetrations

    or
  - Type IC and labeled as meeting ASTM E 283 "MEC" requirements or "Washington State" compliant)

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Literature

Banker & Tradesman Structures/1999
Air Leakage in Buildings
Banker & Tradesman - Structures/2000
The New Energy Code for Commercial Buildings in MA
ASHRAE Journal (cover story) December 2001
The Impact of Airtightness on System Design
Whole Building Design Guide, January 2005
Air Barrier Systems in Buildings
ASHRAE Journal, March 2005
Commissioning the Air Barrier System
RCI Interface, March 2005
Moisture Control Requirements in Codes
Building Envelope Forum, March 2006
Air Barriers for the South
Medical Construction & Design, March 2006
Controlling Infiltration - The Role of an Air Barrier
NIBS Guideline 3, 2006
Exterior Enclosure Technical Requirements for the Commissioning Process
Texas Architect, December 2008
Commissioning the Building Enclosure
Journal Of Building Enclosure Design, 2009
Under Floor Air Distribution Systems

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Literature

UFGS two spec sections, Div 1 and Div 7
UFC 3-100-01 2011
ASHRAE Indoor Air Quality Design Guide
ASHRAE Publications 2009
JBED Summer Edition 2007 article: Air Barriers: Wall meets Roof
Controlling Infiltration: The Role of the Air Barrier
Medical Construction and Design: March 2006
Vapor and Air Barriers for Southern Buildings
Building Envelope Forum: March 2006
NISTIR 7238: Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use
Who's Responsible for the Building Enclosure?
ASHRAE Journal, July 2005

Wiss, Janney, Elstner, Assoc., Inc.

Code Change

EC-74 - IECC Failed attempt to include Air Barriers in 2006 IECC

ASHRAE Standard 90.1 - 2007 Addendum z Failed attempt to include air barriers after 6 years work – Successful Appeal

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Success!

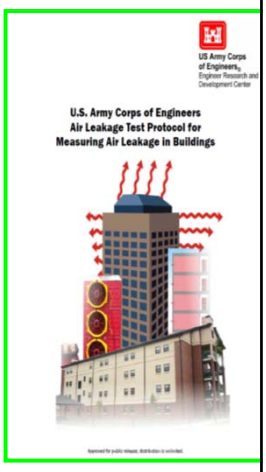
ASHRAE Standard 189.1
ASHRAE Advanced Energy Design Guides
NBI– E-Benchmark, Core Performance
ASHRAE Standard 90.1 2010 (no whole building number)
IECC 2012
USGBC LEED 3.0 references ASHRAE 90.1 – 2010
New ASHRAE 90.1 addendum ag, for Appendix G allows airtightness modeling
Igcc testing requirements
189.1 addendum testing/commissioning requirements
State of Washington Testing Requirements
USACE testing requirements
USACE Test Protocol
GSA P-100 requires testing
UFC 3-100-01 Architecture testing requirements
UFGS specs include testing requirements
ASTM Test procedure for commercial buildings

Requirements [cfm/ft² @ 0.3 in w.g., 75Pa]	(ASTM E2178)	(ASTM E2357 or E1677)	Building (ASTM E779)
NBC (National Building Code of Canada)	**0.004**	--	--
Massachusetts, Minnesota, New Hampshire, Georgia, Oregon, Washington, New York, *etc*…	**0.004**	--	--
ASHRAE 90.1 (2010)	0.004	0.04	--
USACE* (2008) **NAVFAC** (2011)	**0.004**	-- ***AND***	**0.25**
Washington State (2010)	**0.004**	-- ***AND***	**0.25**
GSA (2010) **USAF** (2011)	**0.004** *or*	**0.04** ***AND***	**0.40**
ASHRAE 189.1 (2009) **IECC** (2012)	**0.004** *or*	**0.04** *or*	**0.40 Now 0.25**
IgCC (2012)	--	--	**0.25**

*USACE – US Army Corps of Engineers

Continuous Air Barriers

- Air barrier materials not to exceed **0.004 cfm/ft²** @ 0.3 wg [0.02 L/s*m² @ 75Pa]
- Air barrier materials and assemblies must be joined and sealed in a flexible manner
- Structurally supported
- Durable…..



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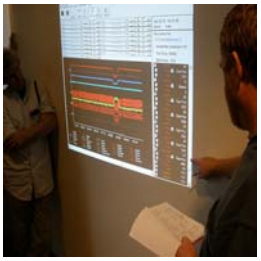
Whole Building Testing

- Air leakage rate must not exceed **0.25 cfm/ft²** @ 0.3" wg [1.25 L/sm² @ 75Pa]
- Use Infrared Thermography to identify potential leakage pathways



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- **2009 ASHRAE Fundamentals:**
  - *"Tight": 0.1 cfm/ft² @ 75Pa*
  - *"Average": 0.3 cfm/ft² @ 75Pa*
  - *"Leaky": 0.6 cfm/ft² @ 75Pa*
- **NIST Studies** - existing commercial buildings:
  - *Average between 0.7 - 2.5 cfm/ft² @ 75Pa*

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