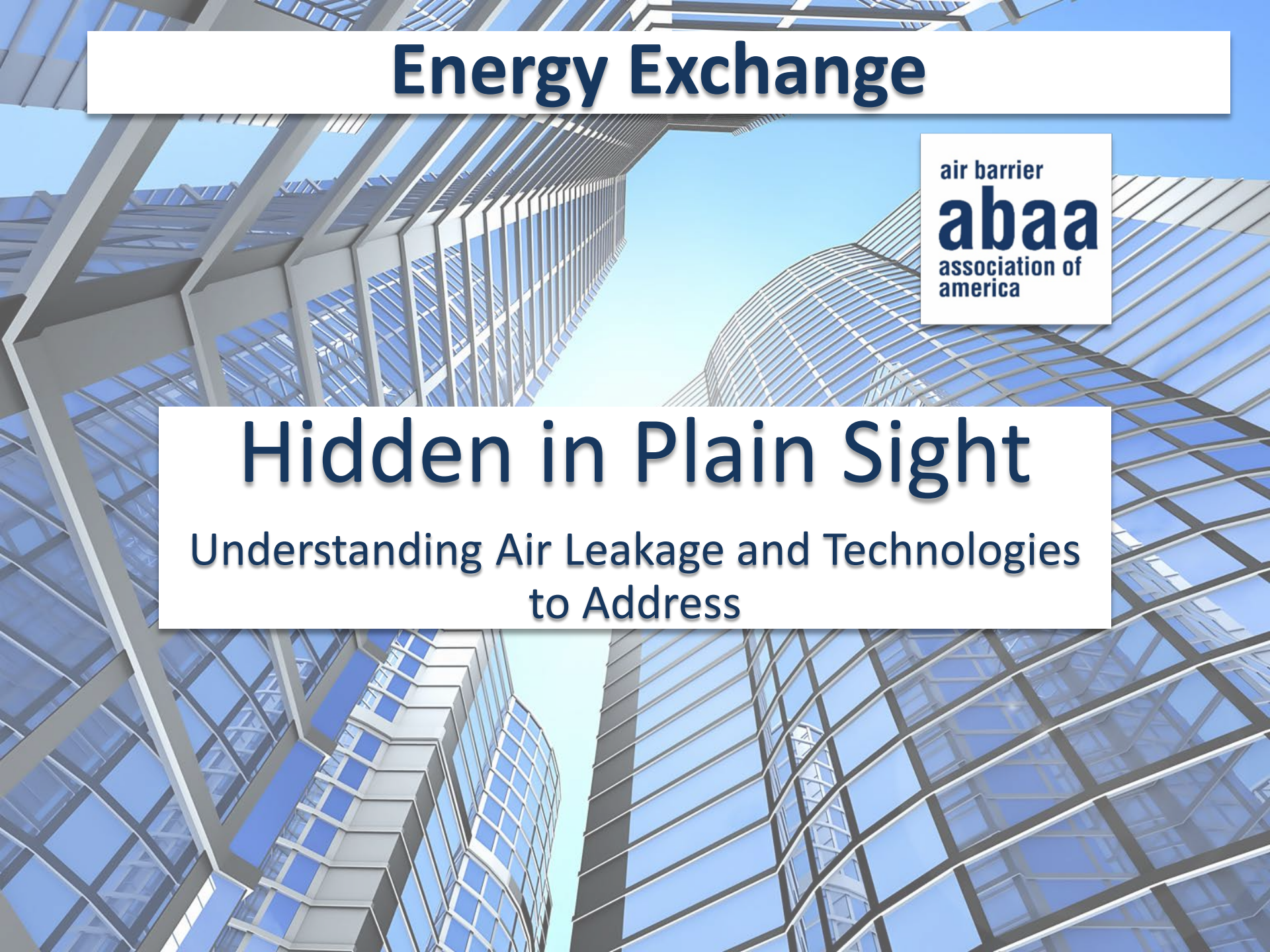
Energy Exchange



air barrier abaa association of america

Hidden in Plain Sight

Understanding Air Leakage and Technologies to Address

Understanding Air Leakage

This has nothing to do with air leakage

This is Air Leakage!

Understanding Air Leakage

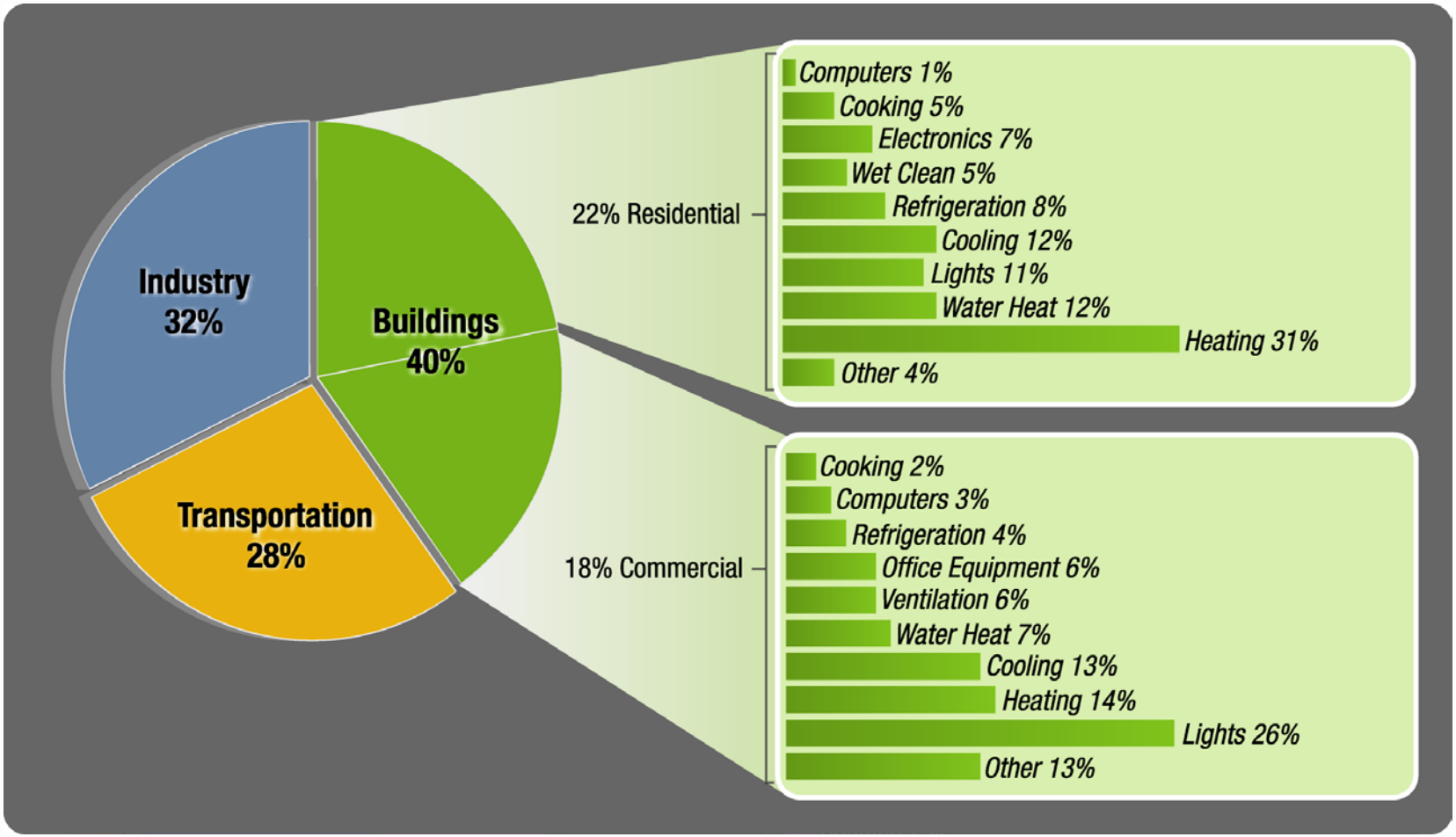
You cannot see air leakage!

You cannot see energy savings!

Understanding Air Leakage

40% of total US prime energy expended

70% of all US electric energy used



Building Energy Use

In 2013, 40% of total U.S. energy consumption was consumed in residential and commercial buildings, or about 40 quadrillion British thermal units (40,000,000,000,000,000 BTUs).

Commercial uses 18% (7.2 quadrillion)

Of that 43% used to heat and cool (3.1 quads)

15 – 40% due to air leakage (@40%=1.2 quads)

Residential uses 22%

Of that 27% used to heat and cool

10 – 40% due to air leakage

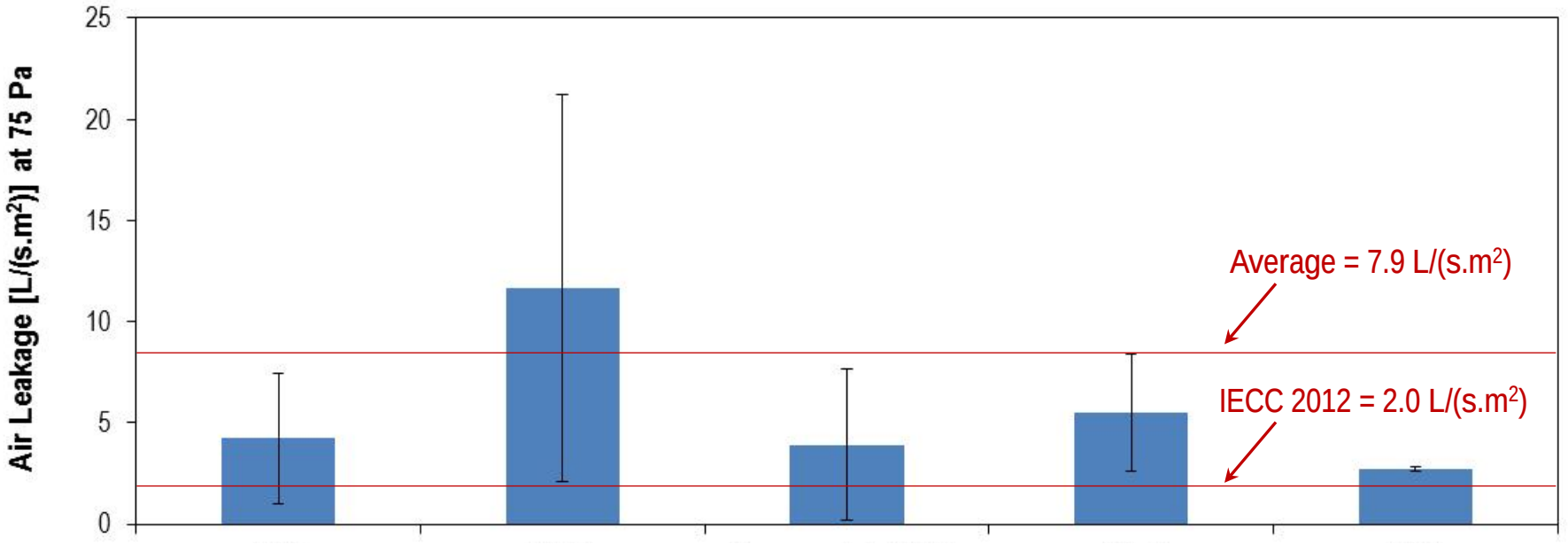
Energy Losses in the Building Envelope

Primary energy consumption attributable to fenestration and building envelope components in 2010

Building Component	Residential (quads)		Commercial (quads)	
	Heating	Cooling	Heating	Cooling
Roofs	1.00	0.49	0.88	0.05
Walls	1.54	0.34	1.48	-0.03
Foundation	1.17	-0.22	0.79	-0.21
Infiltration	2.26	0.59	1.29	-0.15
Window (conduction)	2.06	0.03	1.60	-0.30
Window (solar heat gain)	-0.66	1.14	-0.97	1.38

Adapted from the BTO Multi-Year Program Plan: https://energy.gov/eere/buildings/downloads/multi- year-program-plan

Air Leakage in Existing Buildings



NIST	**FSEC**	**Camroden Associates**	**Army Corp of Engineers**	**PSU**
Persily and Grot 1986 Persily et al. 1991 Musser and Persily 2002 n = 9	Cummings et al. 1996 Cummings et al. 2000 n = 88	Brennan et al. 1992 n = 23	n = 79	Bahnfleth et al. 1999 n = 2

NIST: National Institute of Standards and Technology
FSEC: Florida Solar Energy Center
PSU: Penn State University

Understanding Air Leakage

Air Barriers are the key to significant energy efficiency and impact all other energy saving measures

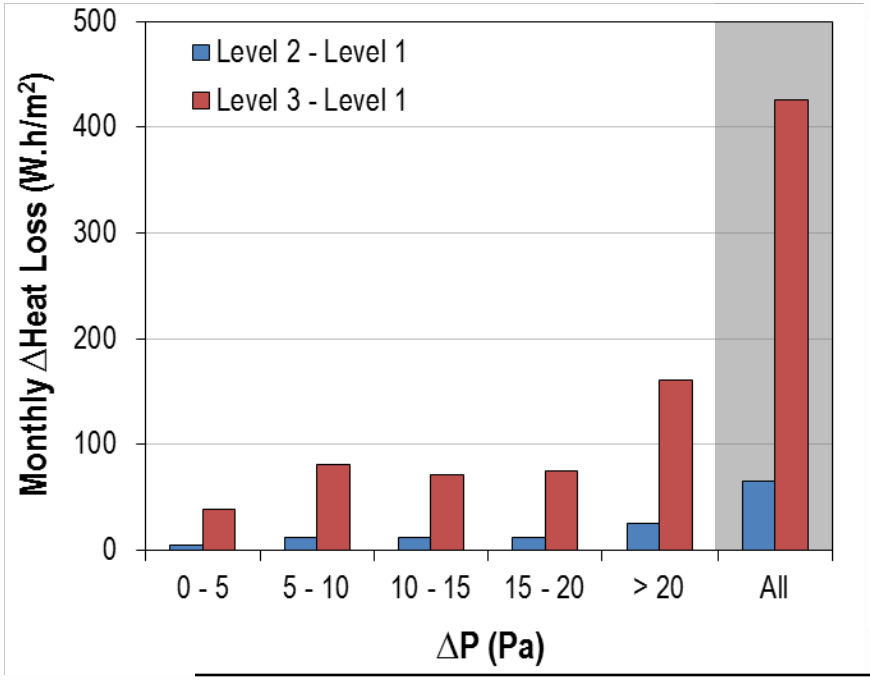
Air Barriers Impact

- Thermal insulation
- Window performance
- HVAC efficiency
- Occupant behavior

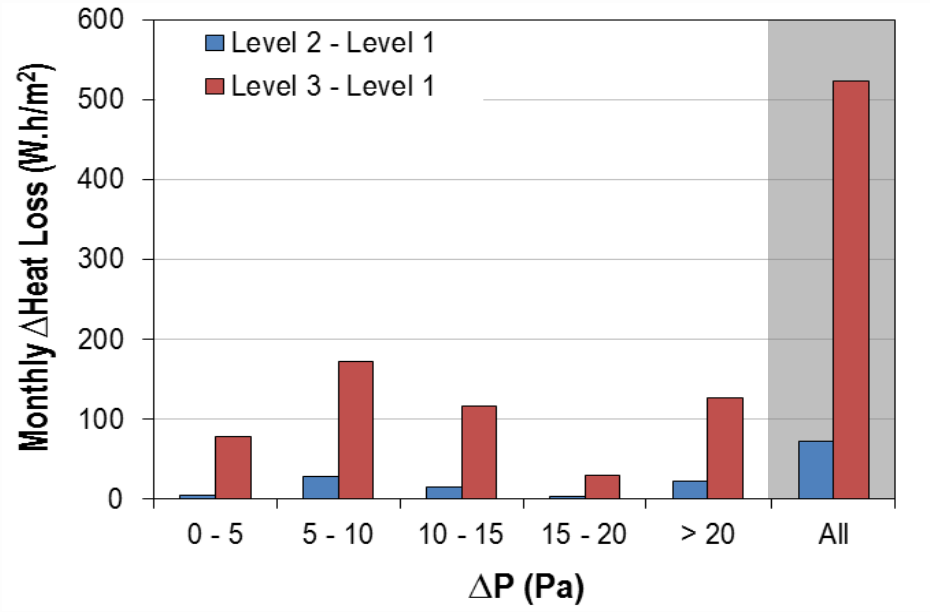
which all impact the energy use in a building

Phase 2: Preliminary Results

November 2011



December 2011



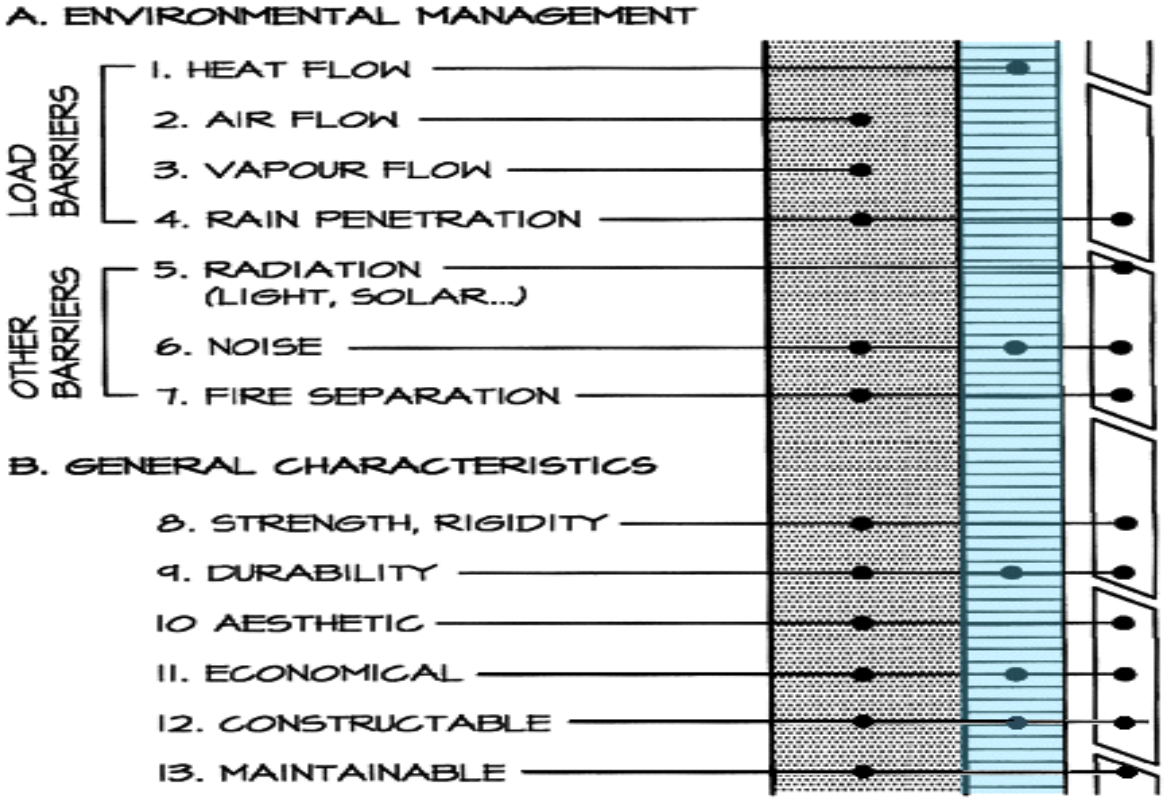
	Monthly Heat Loss (W.h/m²)		
Air leakage @ 75 Pa [L/(s.m²)]	Level 1 (< 0.02)	Level 2 ≅ 0.21	Level 3 ≅ 0.72
November 2011	564	629	990
December 2011	983	1057	1506

Understanding Air Leakage

Air Barriers cannot be dealt with without understanding that they are part of a wall (building) assembly”

N.B. Hutcheon’s CBD-48 - Requirements for Exterior Walls

Understanding Air Leakage



ENVELOPE REQUIREMENTS (PRIMARY FUNCTIONS)

Air Barriers

Six Sides of the Building

roof – walls - foundation

Air Barrier Performance Requirements

- ***Air Barrier Material*** 0.004
- CFM/ft²@ 1.56 lbs/ft² pressure difference (ISO 14857 ASTM E2178)
- ***Air Barrier Accessory*** – tapes, strips, caulking, etc. 0.004
- CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E283)
- ***Air Barrier Component*** – windows, doors, skylights, etc. 0.04
  CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E283)
- ***Air Barrier Assembly*** - wall assembly, roof assembly, foundation assembly 0.04
  CFM/ft²@ 1.56 lbs/ft² pressure difference (ASTM E2357)
- ***Air Barrier System*** (Whole Building) 0.40
  CFM/ft²@ 1.56 lbs/ft² pressure difference (ISO 9972, ASTM E 779 ABAA AB-500)

(Requirement for Air Barrier Systems needs to be updated to 0.10)

Air Barrier

- ***Materials***
- ***Accessories***
- ***Components***
- ***Assemblies***
- ***Sub-systems***
- ***Systems***

Air Barrier Materials

Peanut butter

- Kraft smooth peanut butter
- Applied at 20 mils wet
- Tested to ASTM E2178
- Air leakage result -

  0.0021 L/s·m^2

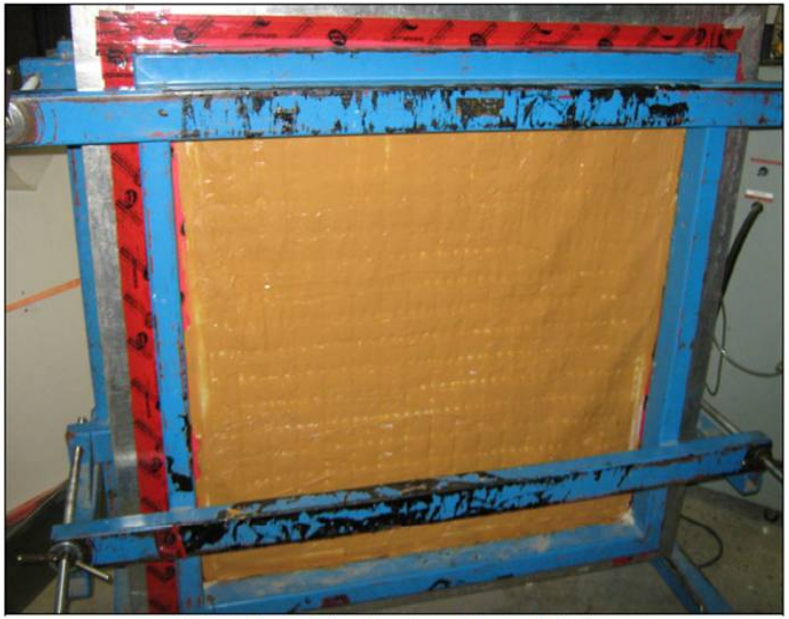


Figure 5 –Full Application of Peanut Butter

- Is an air barrier material but cannot be installed as a continuous one and **will not stand up to service-life conditions** – not an air barrier material!

Air Barrier Accessories

Materials and components that connect the air barrier materials and the air barrier assemblies

- *Tapes*
- *Strips*
- *Mastic*
- *Sealants*
- *Etc.*

Air Barrier Components

- ***Not only do they have to be airtight but you need to connect to them***
  - ***Doors***
  - ***Windows***
  - ***Skylights***
  - ***Curtain walls***
  - ***Etc.***

Air Barrier Sub-Systems

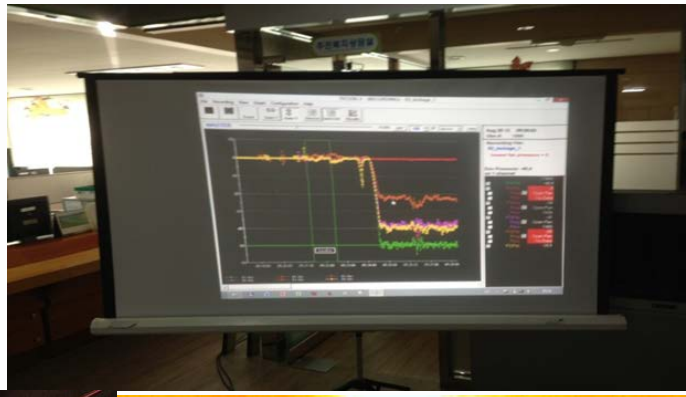
- ***Assembly sub systems***
  - ***Air leakage of penetrations, fasteners, etc***
  - ***Adhesive attachment***
  - ***Substitution of accessories***

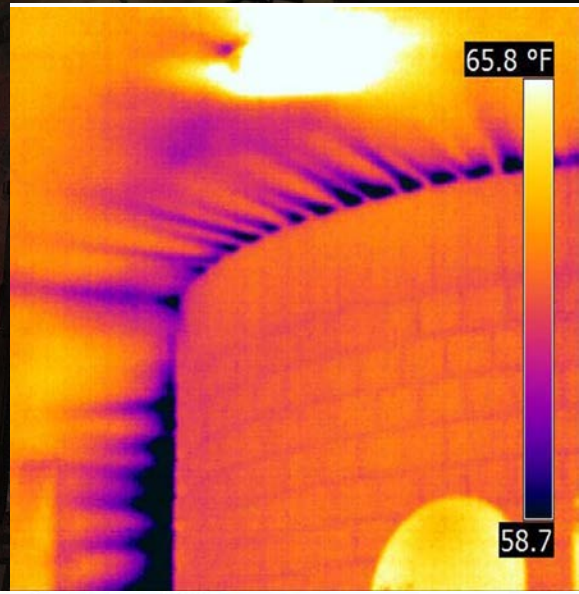
Air Barrier Assemblies

- ***Wall Assemblies***
  - ***ASTM E 2178***
- ***Roof Assemblies***
  - ***ASTM E 1680***
  - ***ASTM D 8052***
- ***Foundation Assemblies***
  - ***TBD***

Air Barrier System (Whole Building)

- ***System***
  - ***ASTM E779, ISO 9972, ABAA 001***





Air Barrier System Sub-Systems

- ***System - Sub-systems***
  - ***Compartmentalization***
    - ***Separate floors***
    - ***Separate units***
    - ***Separate common areas***

Air Barrier Future

- ***Whole Building Testing is where you start – Everything else leads to there***
- ***Then break it down to the needs to get there***
  - ***Air Tightness within a Building***
  - ***Key Requirements to make a good Air Barrier Assembly***
  - ***Airtightness of Components***
  - ***Sub Assembly Requirements***

Air Barrier Future

Air leakage is where the energy saving are both new and existing buildings

Actual energy savings required to actually save energy

Air barrier industry in its infancy

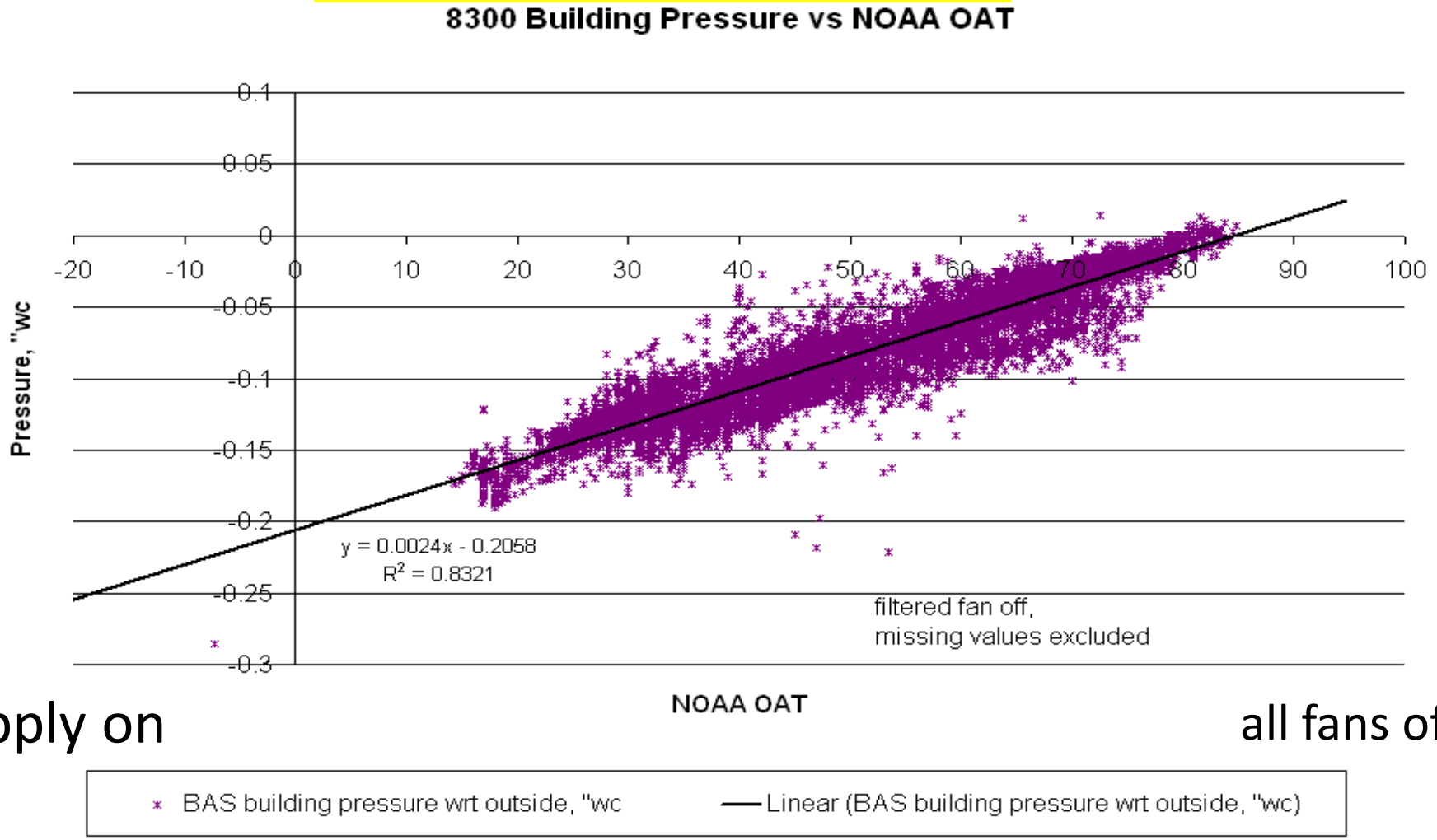
8300 bldg excerpt

Seal 2 details & close mechanical dampers
(Reduce pipe freeze and costs)

Envelope gaps & Mechanical cost

14 story

-40pa low +5pa at top
=> high leaks dominate

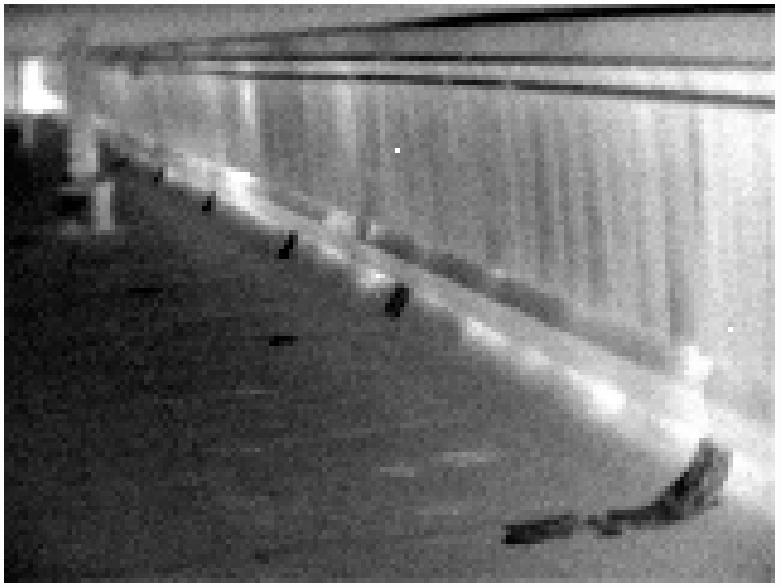


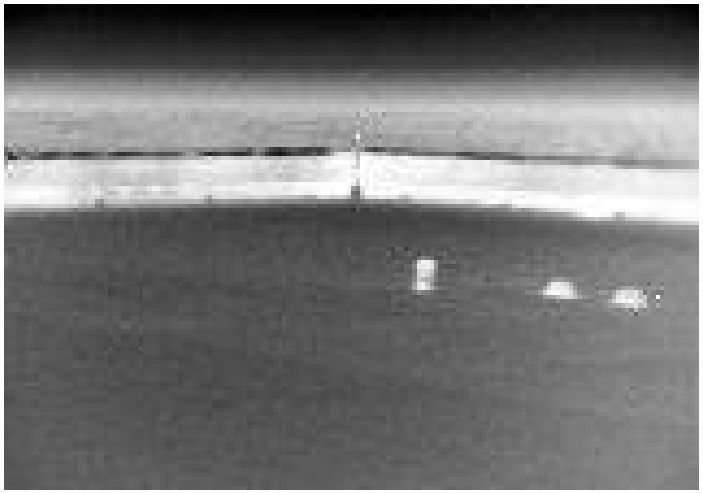
supply on

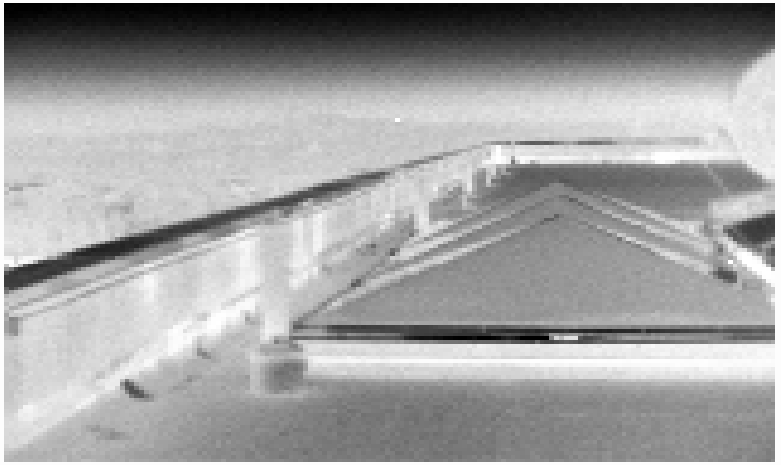
all fans off

>650,000 kwh/year extra cost

- Mechanical supply fans operated 24/7 in winter < 20F to stop pipe freezes (90 days)
- >20,000cfm of extra flow at night, conditioned.
- Mechanical system recommissioning requires sealing top leaks at parapet and low air leaks by pipe chase

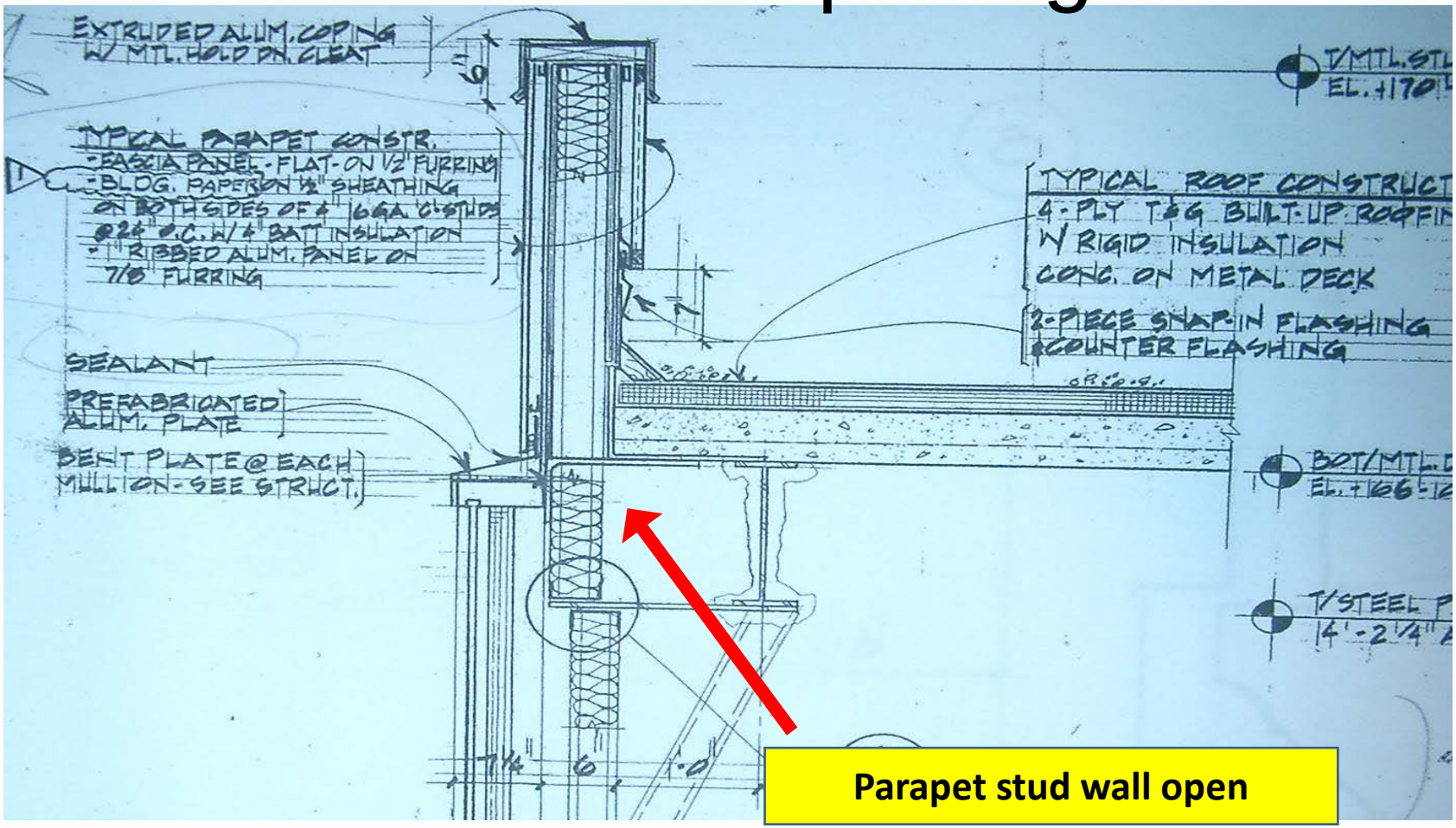






Look at roof parapet with IR, 33F

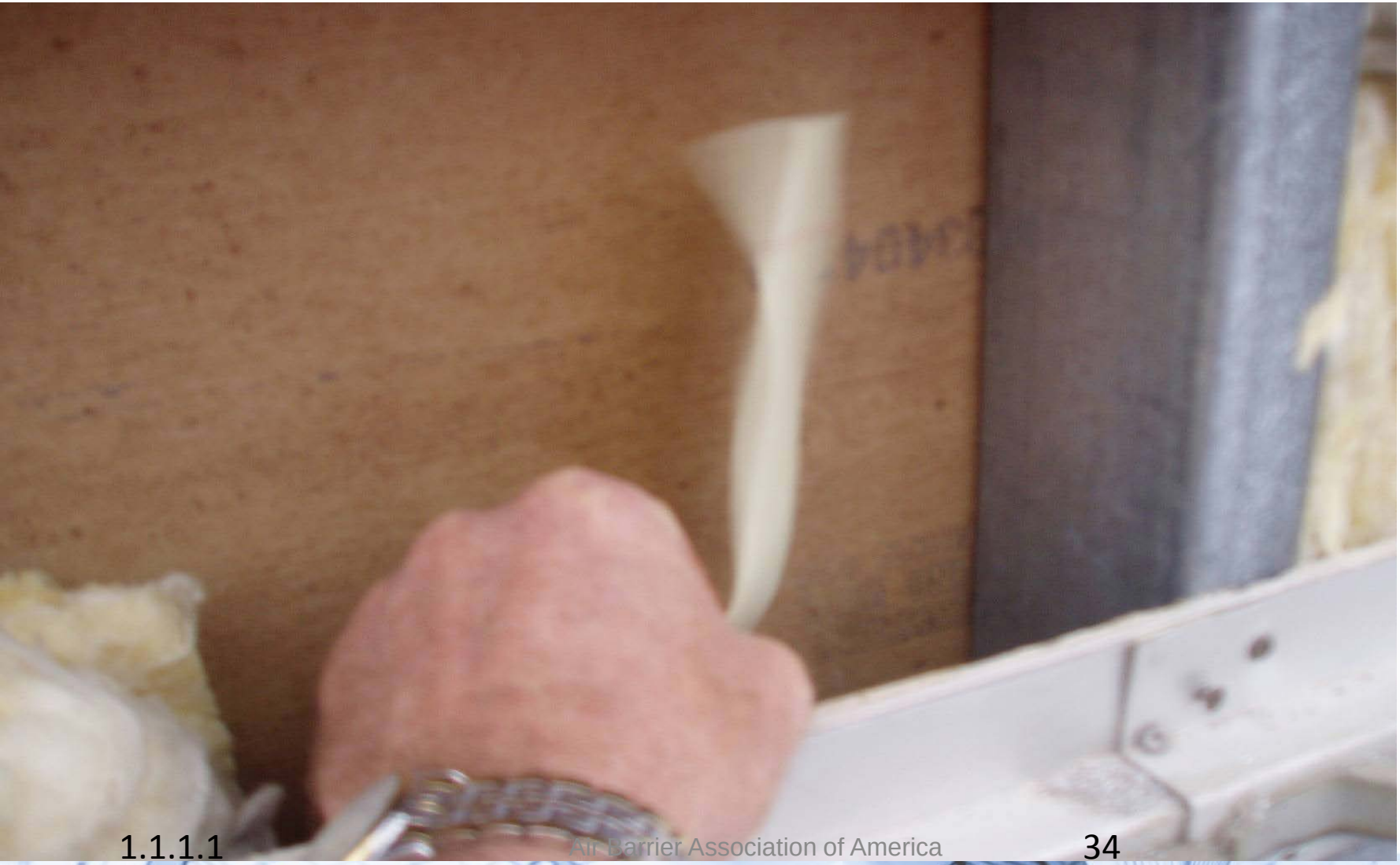
Plans show opening

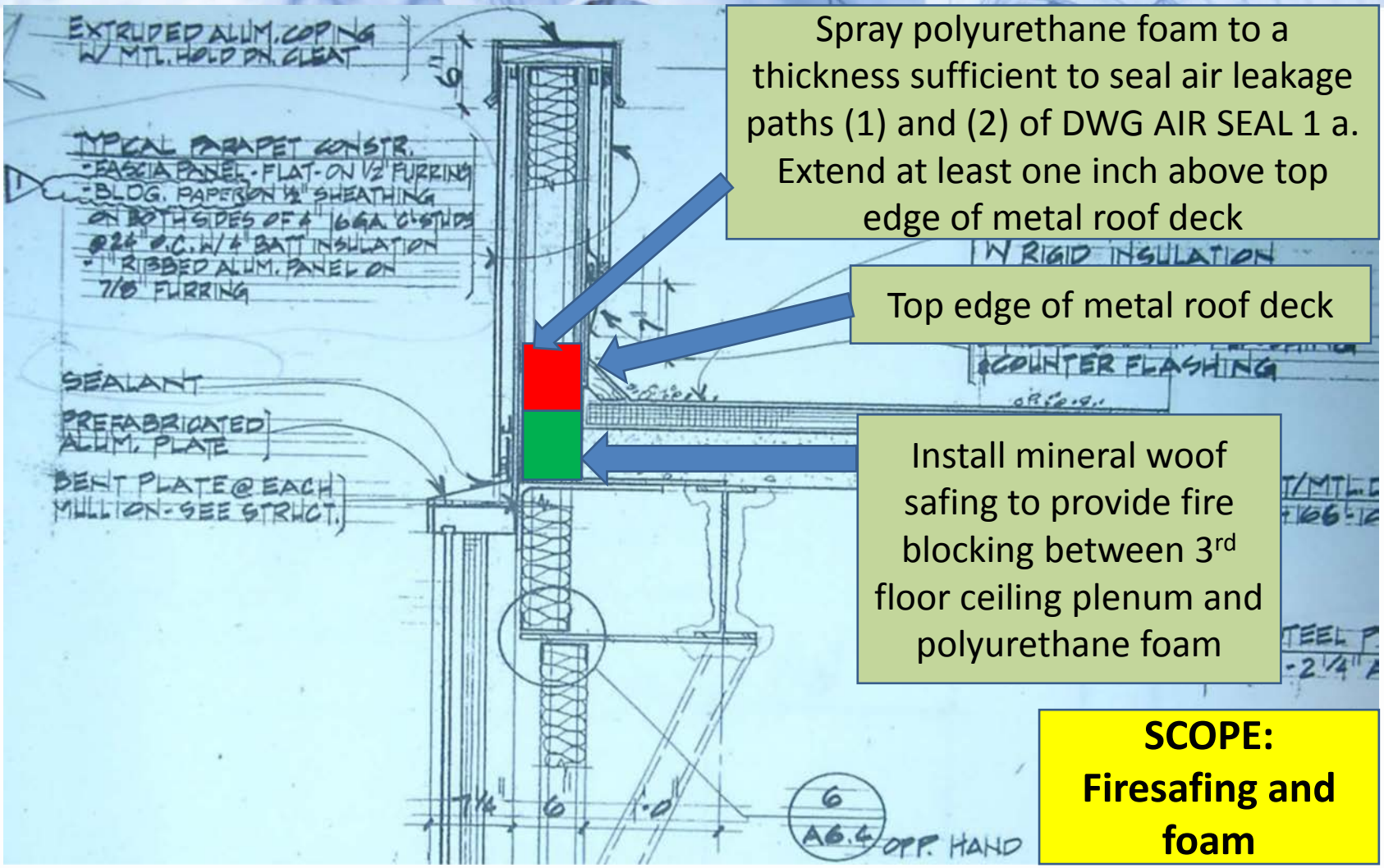


Parapet wall open to return plenum in design


Closer look at wall top
Roofer needed for access

Strong airflow out of top pulls in cold below (freezes 2nd floor pipes)





Spray polyurethane foam to a thickness sufficient to seal air leakage paths (1) and (2) of DWG AIR SEAL 1 a. Extend at least one inch above top edge of metal roof deck

Top edge of metal roof deck

Install mineral woof safing to provide fire blocking between 3rd floor ceiling plenum and polyurethane foam

SCOPE: Firesafing and foam

Foam seal over Mineral Wool

IR pre/post

2nd floor pipe freeze in beam enclosure

Beam enclosure open all around building

5/8 Gypsum bulkhead, sealed


Wall top open
at roof return
relief plenum

Accessed & sealed

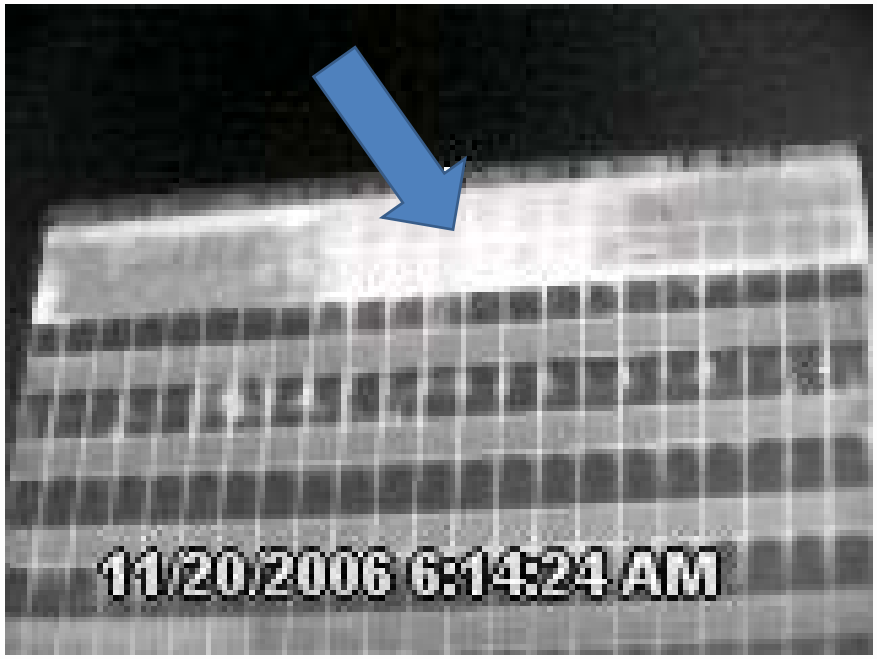
After all sealing

Is work complete?

Double check the hottest spot on the building (IR)

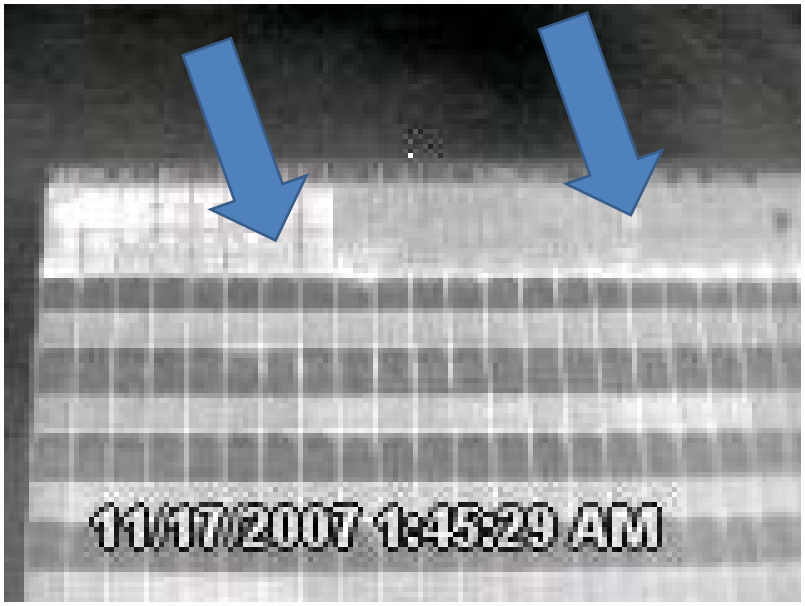
IR pre/post

Central section of return hot



Central section cool

Look here



Review after air sealing

- Top of the building still looks open

•Louvers must close completely

•Active components need maintenance

•Both Shell and Mechanical work are needed to manage the air.

Air Barriers Are The Future

Thank you

Mr. Laverne Dalgleish
ldalgleish@airbarrier.org