National Institute of Building Sciences

Provider Number: G168

Adding Air Barrier and Thermal Improvements to Existing Facilities

TU2C

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January 9th, 2019

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

BUILDING INNOVATION 2019
National Institute of BUILDING SCIENCES
CONFERENCE & EXPO

Course Description

In order to meet energy savings and reduce carbon footprints, facility owners are looking at options to increase the thermal performance and interior air quality of these facilities, especially those buildings constructed prior to the induction of an energy code. This presentation will provide an in-depth examination of design considerations with a focus on addressing ongoing air and moisture infiltration caused by the lack of continuous air barriers and thermal insulation. The presentation will discuss unique solutions to improve the overall building performances and aesthetics, coordinate construction in an occupied facility.

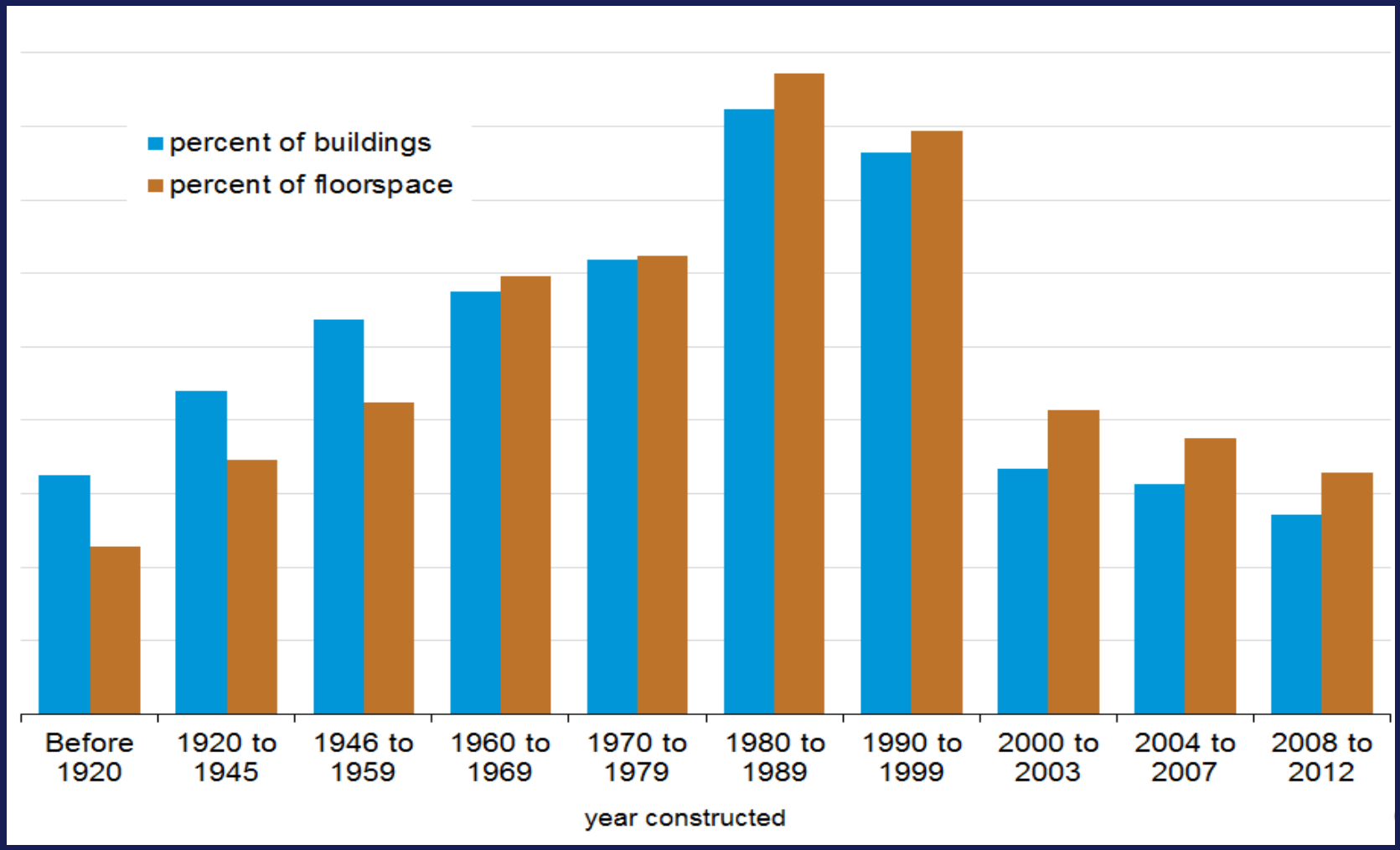
CONTINUING EDUCATION AIA

Learning Objectives

At the end of the this course, participants will be able to:

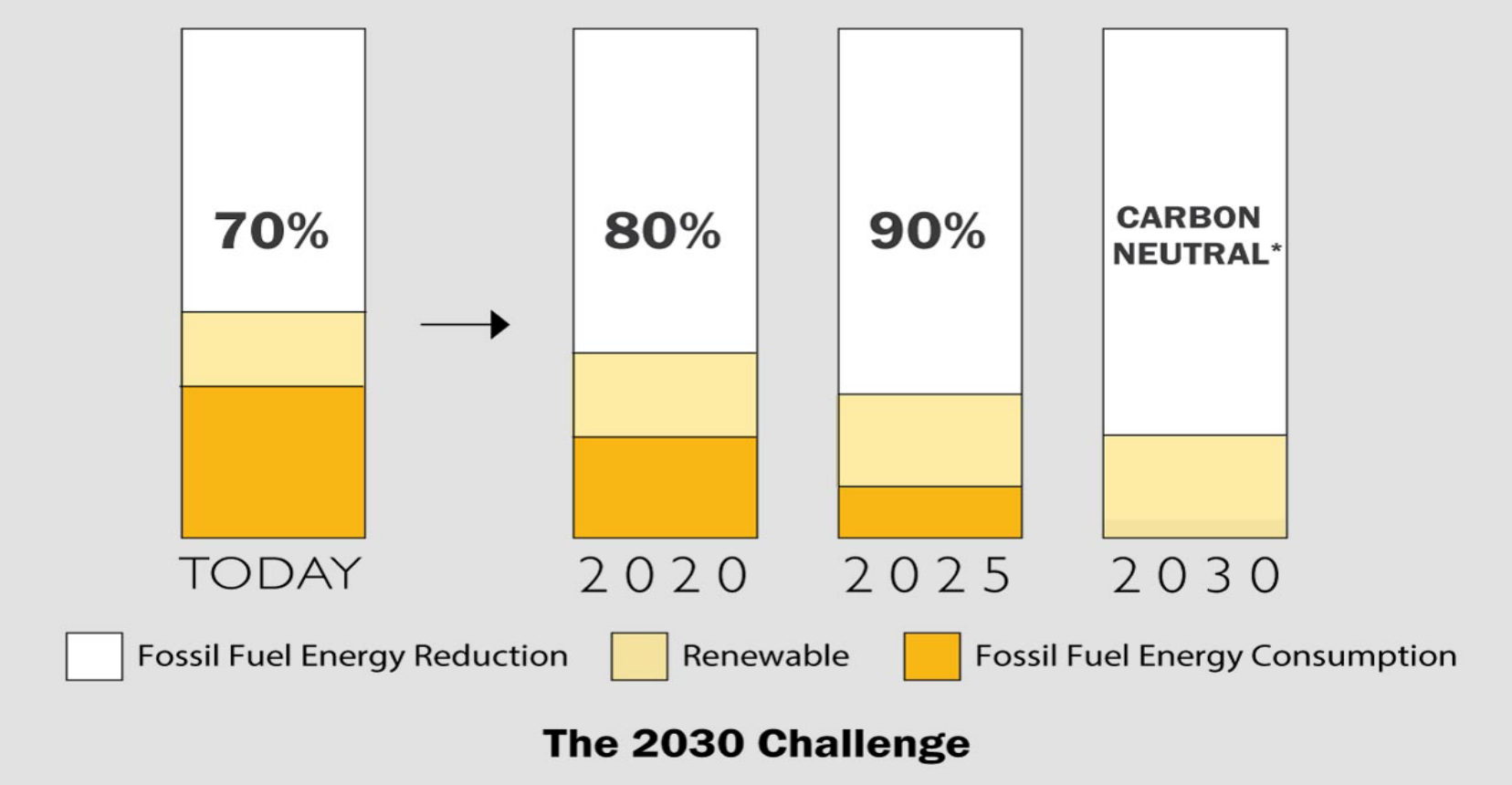
1. Improving thermal performance and interior air quality of buildings
2. Unique solutions to improve overall building performances and aesthetics
3. Coordinating construction with an occupied campus, and complying with campus funding levels
4. Attendees will learn the steps that can be performed at their own campuses and facilities to improve their buildings' performances

AGE OF BUILDING STOCK



Source: US Energy Information Administration. 2012 Commercial Building Energy Consumption Survey

2030 CHALLENGE



Source: 2015 2030 Inc. / Architecture 2030.

Solid Masonry Wall

Precast Concrete Panels

Metal Stud Framed Wall

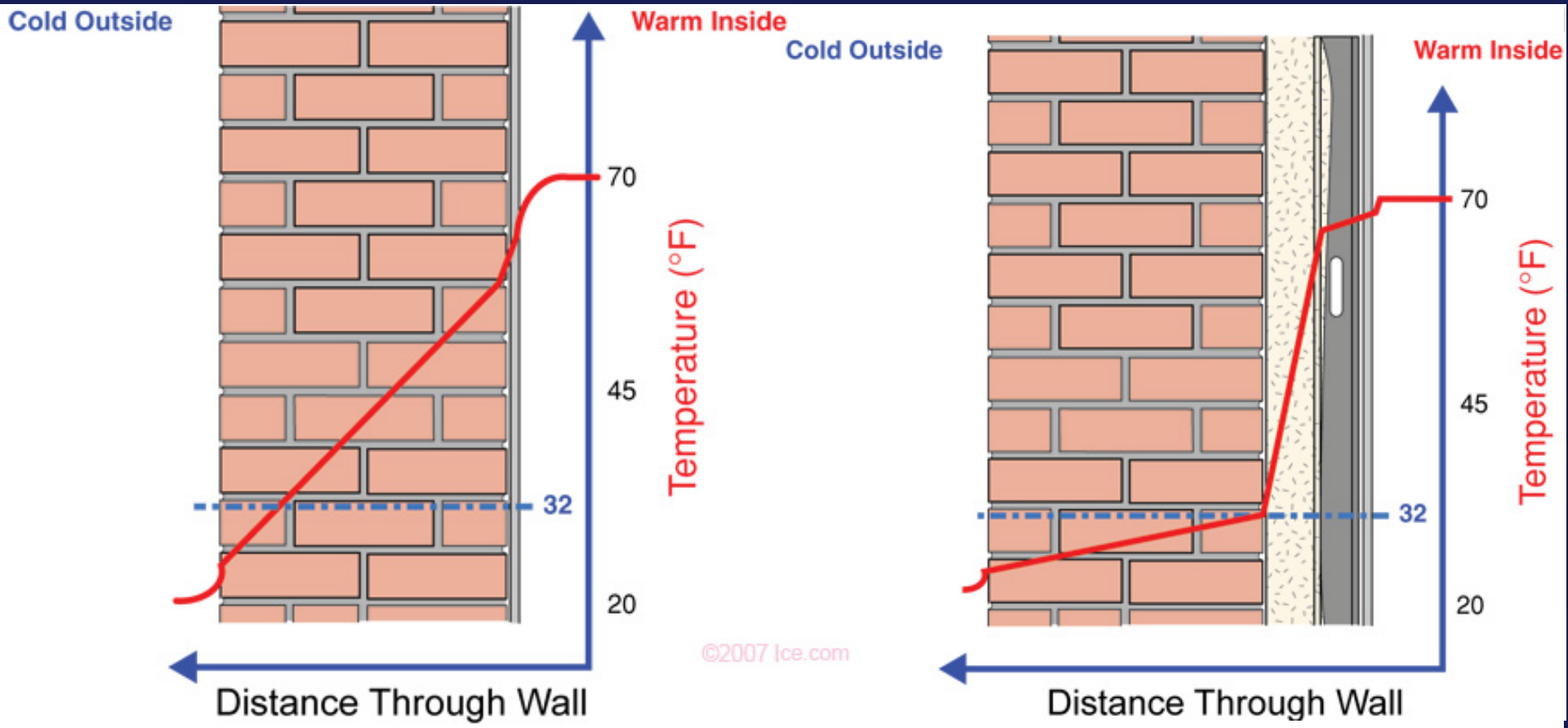
Wood Stud Frame Wall

Masonry

EXISTING WALL SUBSTRATES

- Configuration
- Condition
- Material Quality
- Installation Quality
- Weathering
- Maintenance

CHANGE IN PERFORMANCE



Source: Building Science Corporation

Renovated Building-Type 1 (SPF):

- Basement and four floors
- Foot Print – 10,400 sf
- Assembly space, offices and 73 single dormitory rooms

Renovated Building-Type 2 (FG Batt):

- Basement and four floors
- Foot Print – 9,600 sf
- Assembly space, offices and 72 single dormitory rooms

Unrenovated Building:

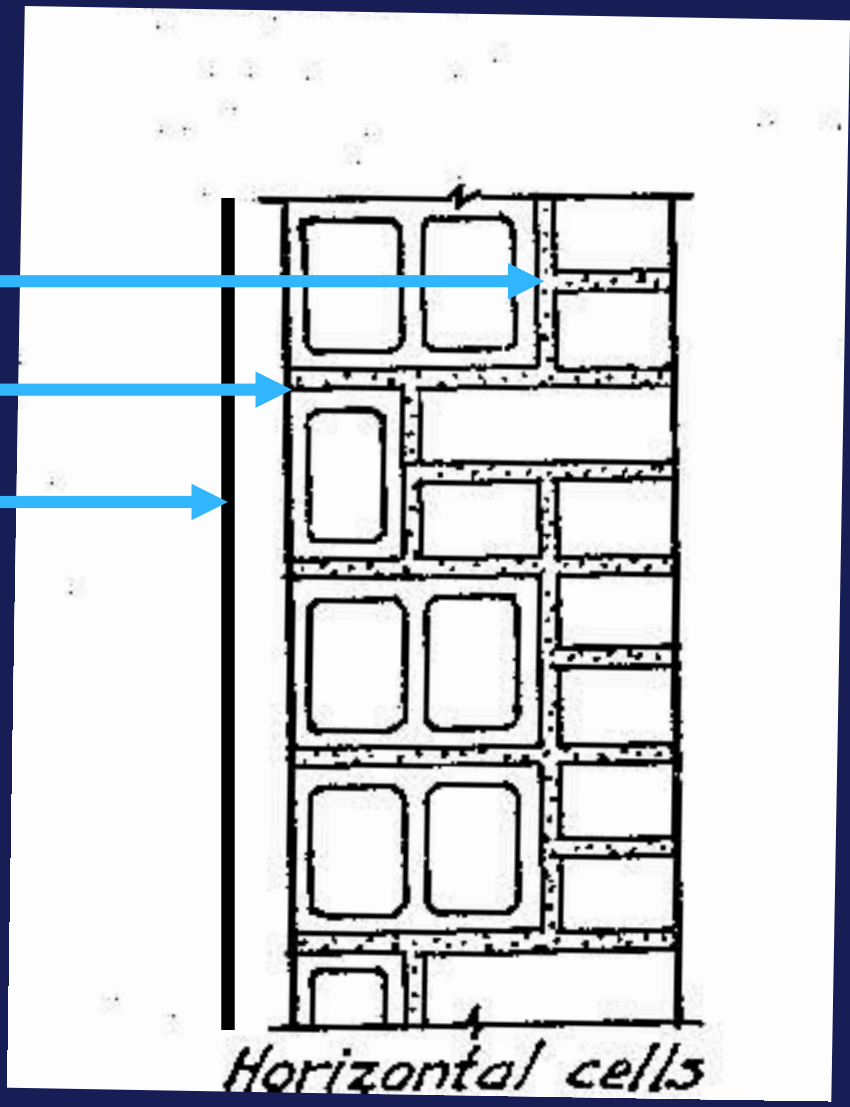
- Basement and four floors
- Foot Print –10,400 sf
- Assembly space, offices and 85 single dormitory rooms

Wall Assemblies

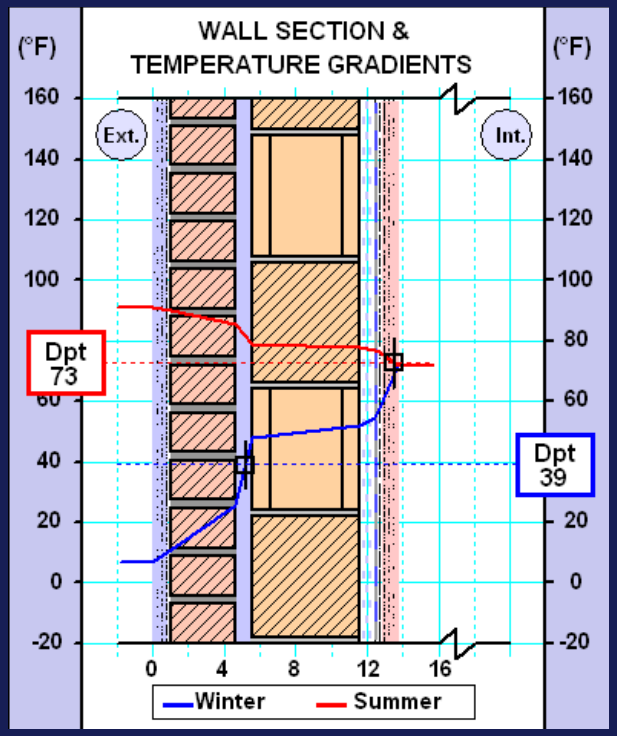
	Unrenovated	Renovated SPF	Renovated FG Batt
Red Brick Exterior Wythe	P	P	P
Terra Cotta Block	P	P	P
Plaster	P	Removed	Removed
Insulation	–	1’’ closed cell polyurethane spray foam	3’’ fiberglass batt
Vapor Retarder	–	–	Polyethylene
Gypsum Sheathing	–		
Paint	Acrylic Latex	Acrylic Latex	Acrylic Latex

Original Building Construction

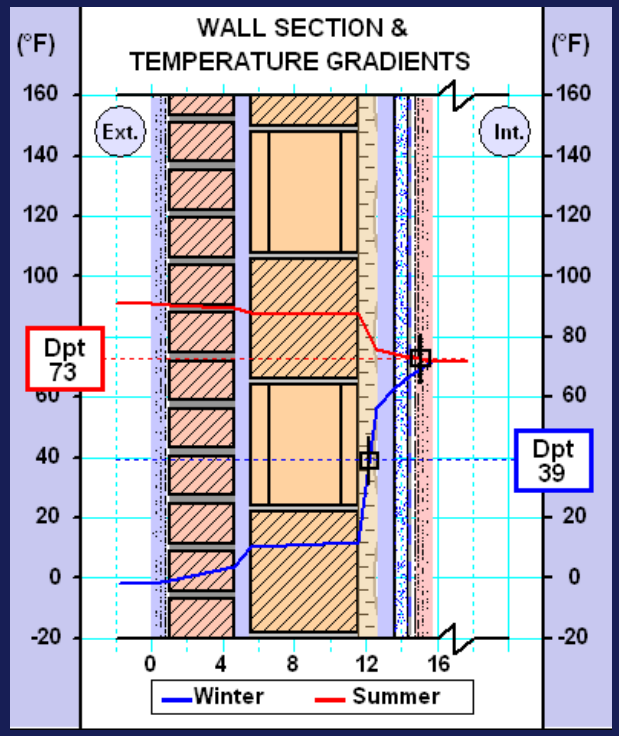
- Exterior Brick Masonry
- Terra Cotta Back Up Wall
- Interior Plaster Finish



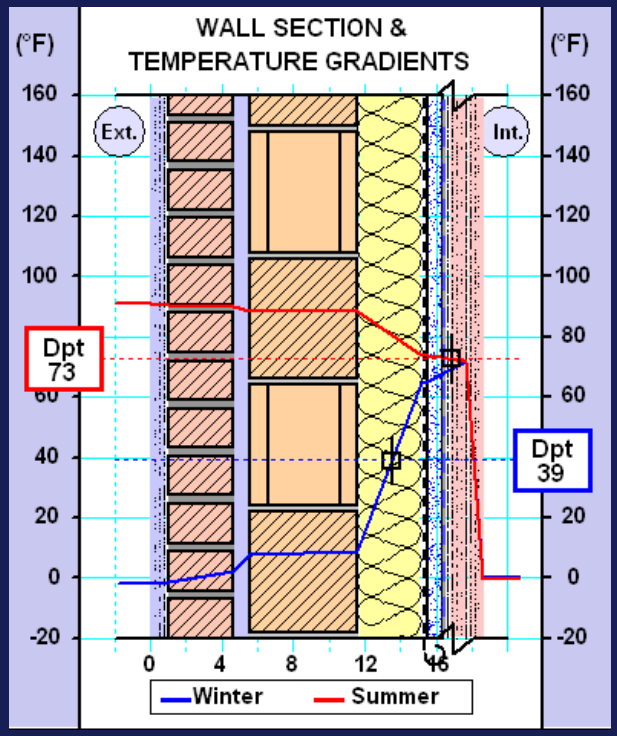
Static Dewpoint Analysis



Unrenovated

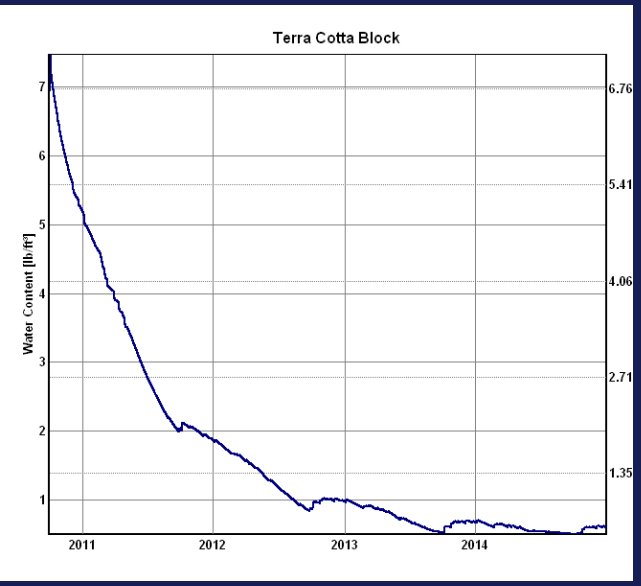


Renovated- SPF

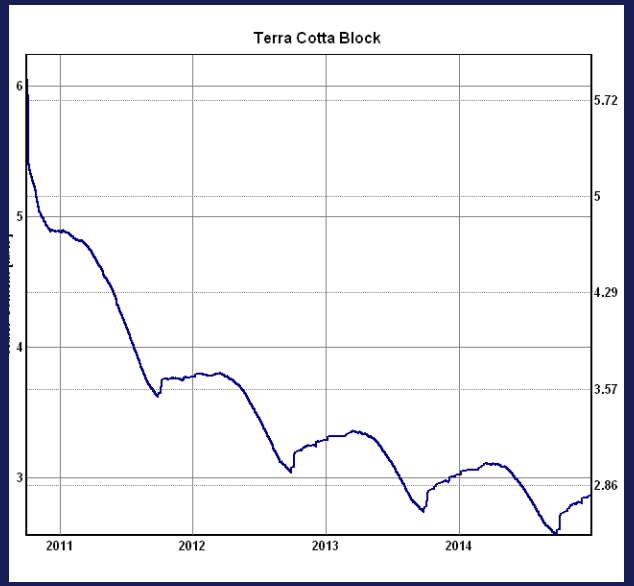


Renovated- FG Batt

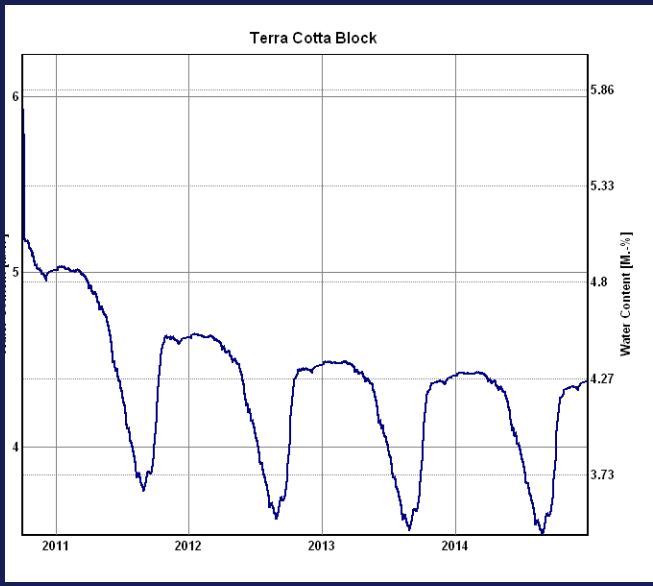
Comparison: Terra Cotta



Unrenovated



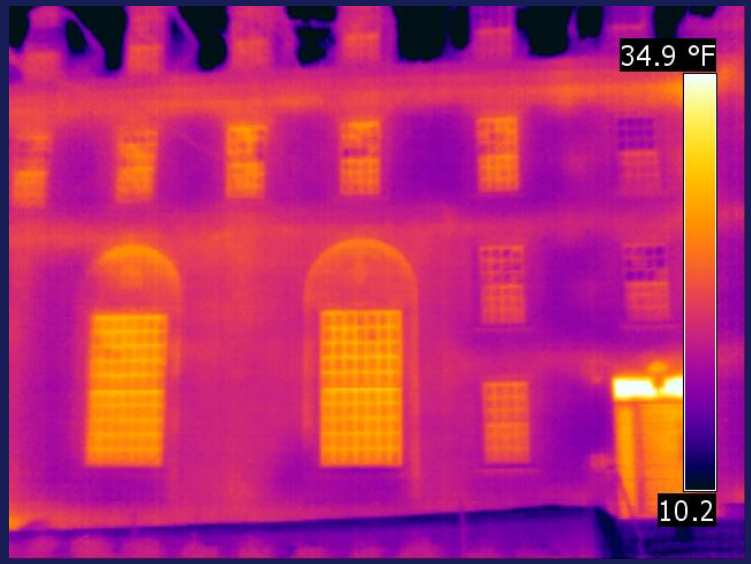
Renovated- SPF



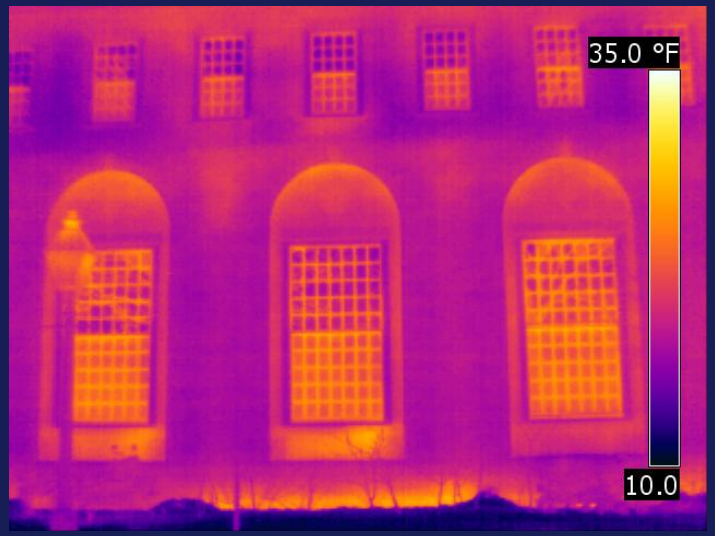
Renovated- FG Batt

Comparison: North Elevation

Unrenovated

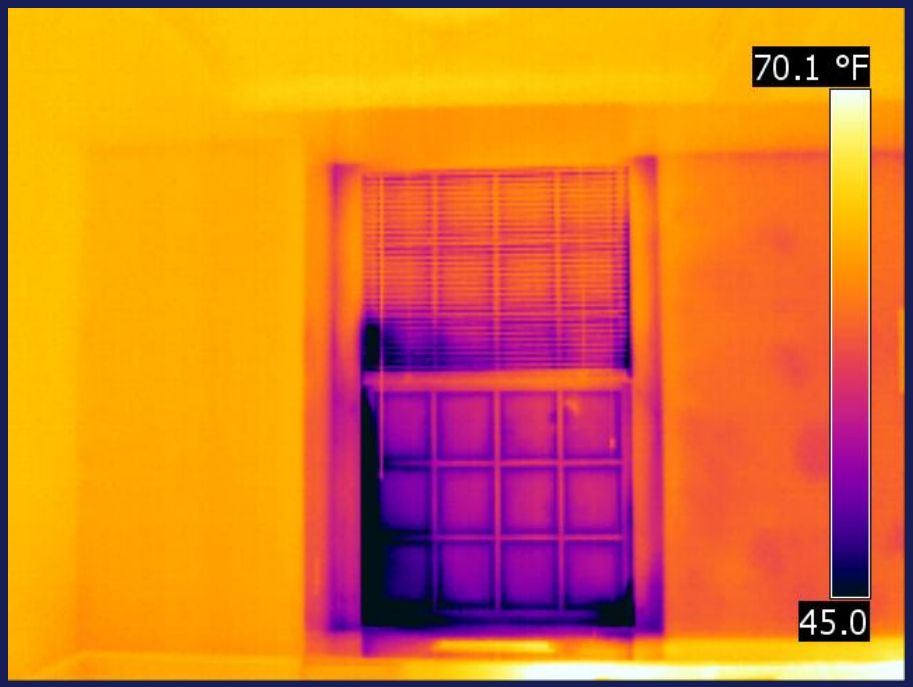


Renovated SPF



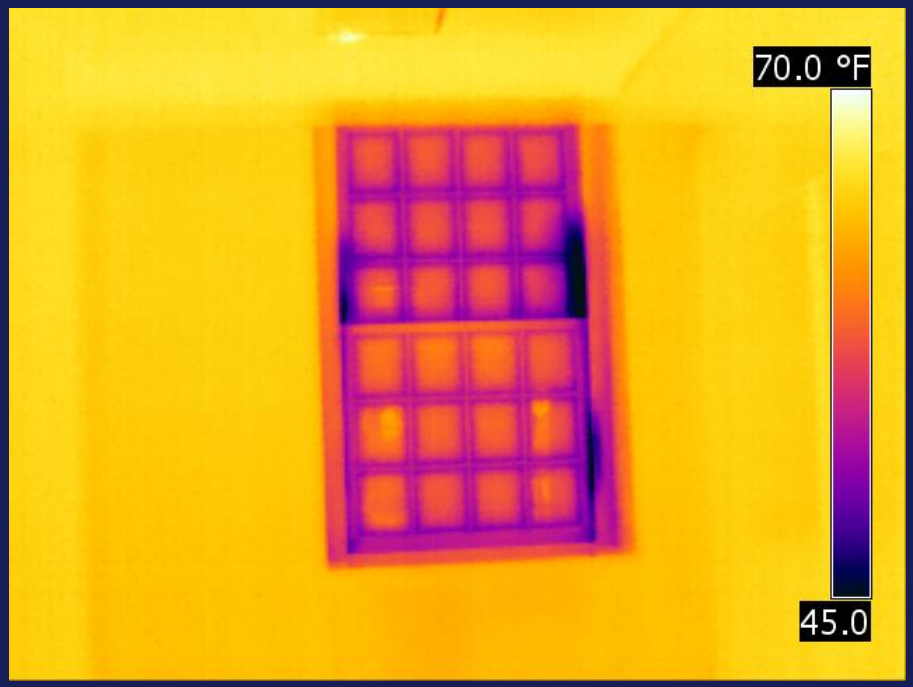
Renovated FG Batt

Unrenovated vs. Renovated SPF



Room Temp: 69 °F

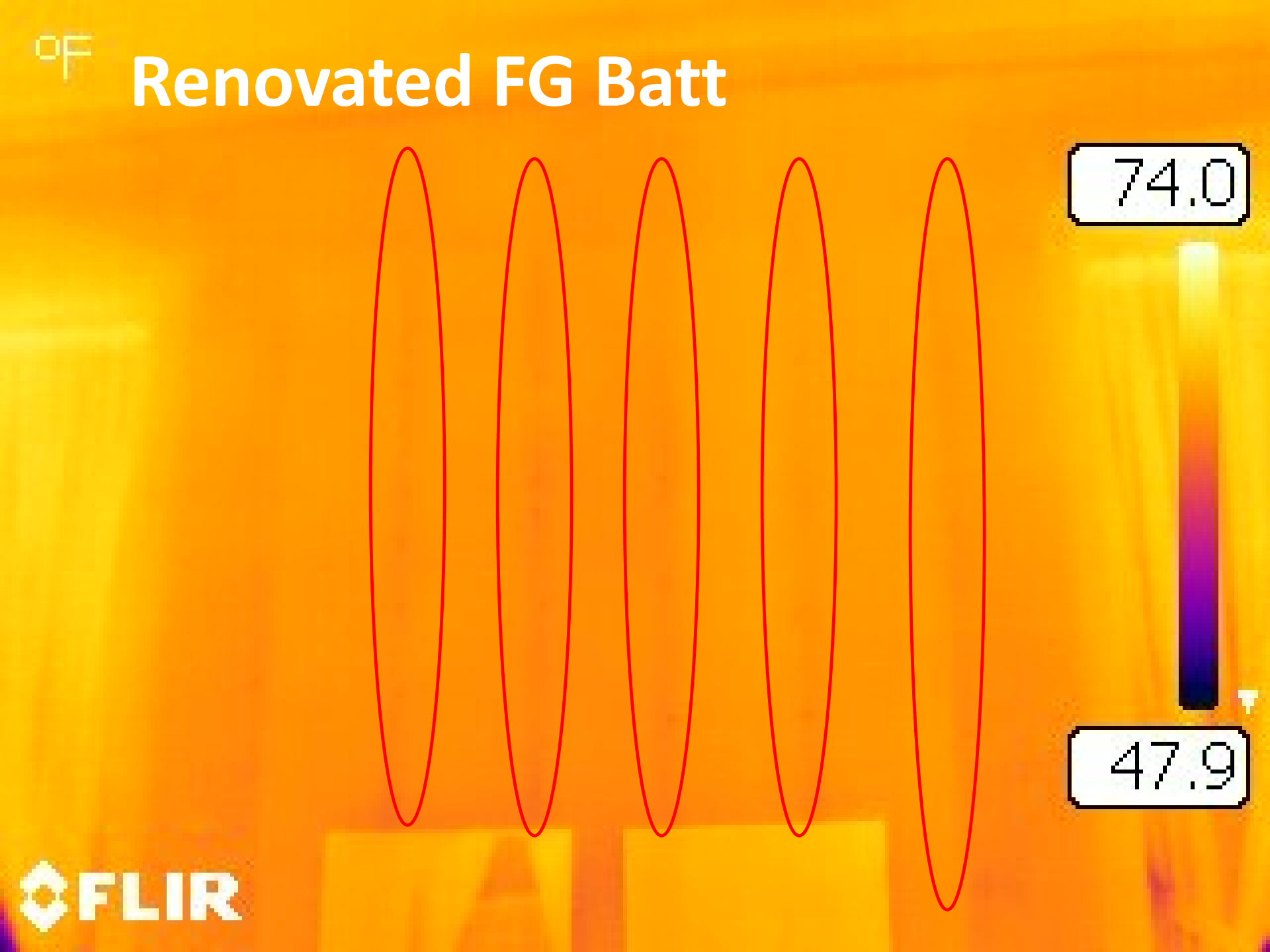
Wall Temp: 58.6 °F



Room Temp: 65.4 °F

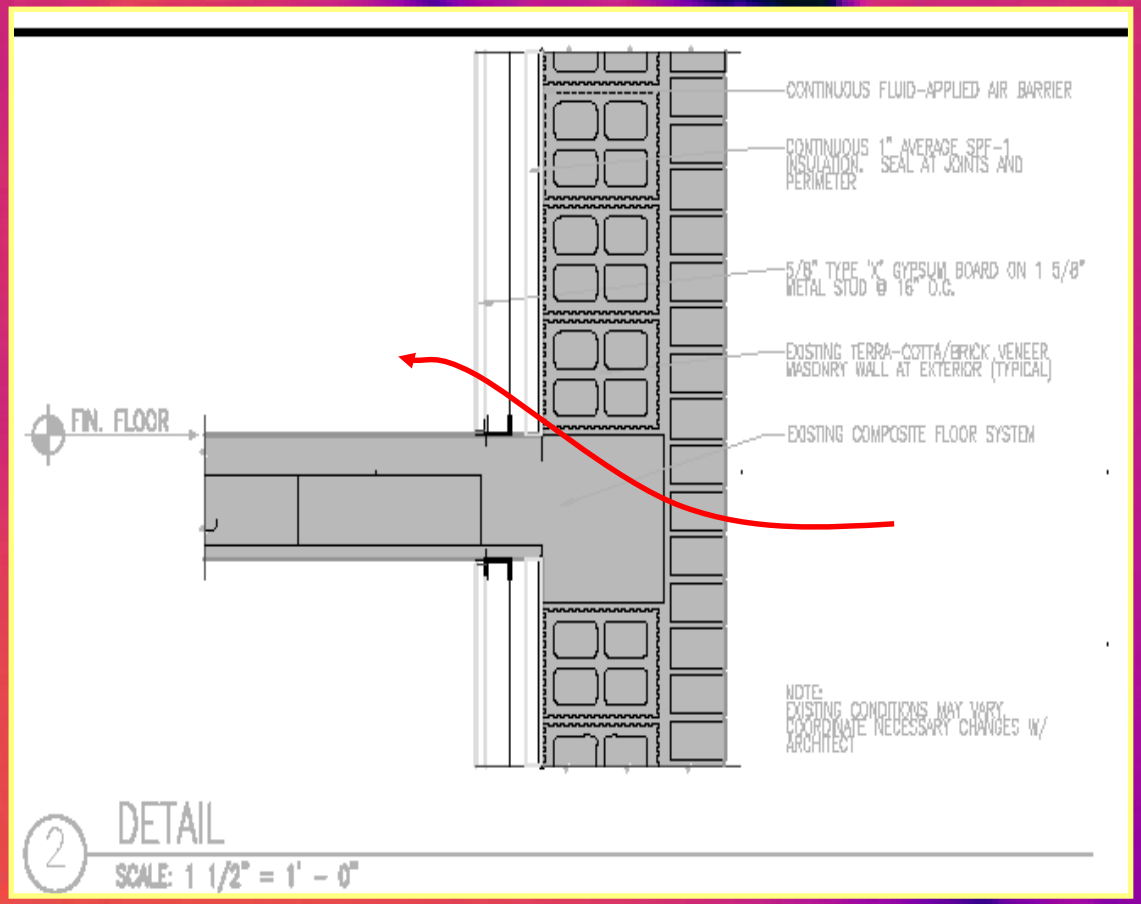
Wall Temp: 64.5 °F

Renovated FG Batt



°F

Renovated SPF



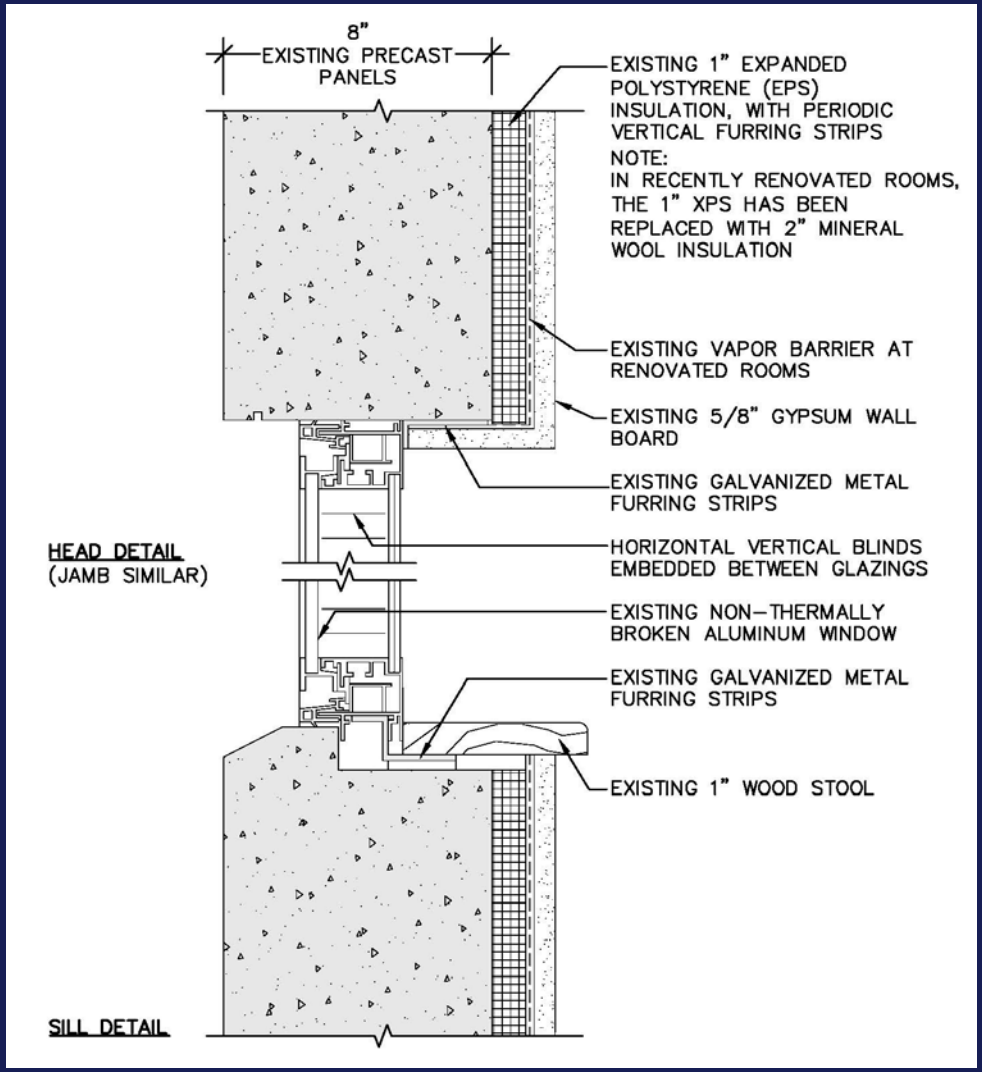
70.1

47.9

FLIR

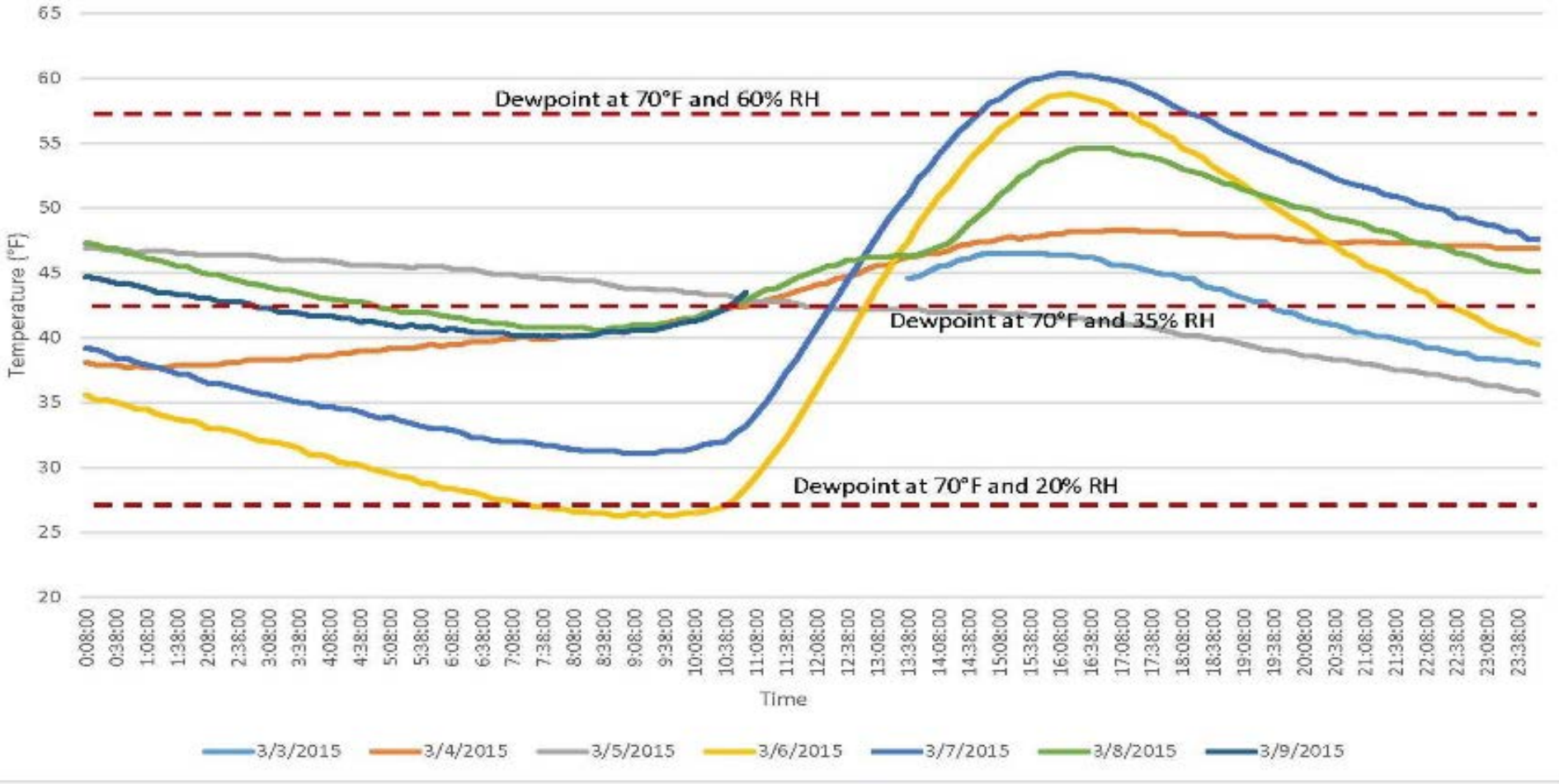
Precast Concrete Walls

Existing Conditions

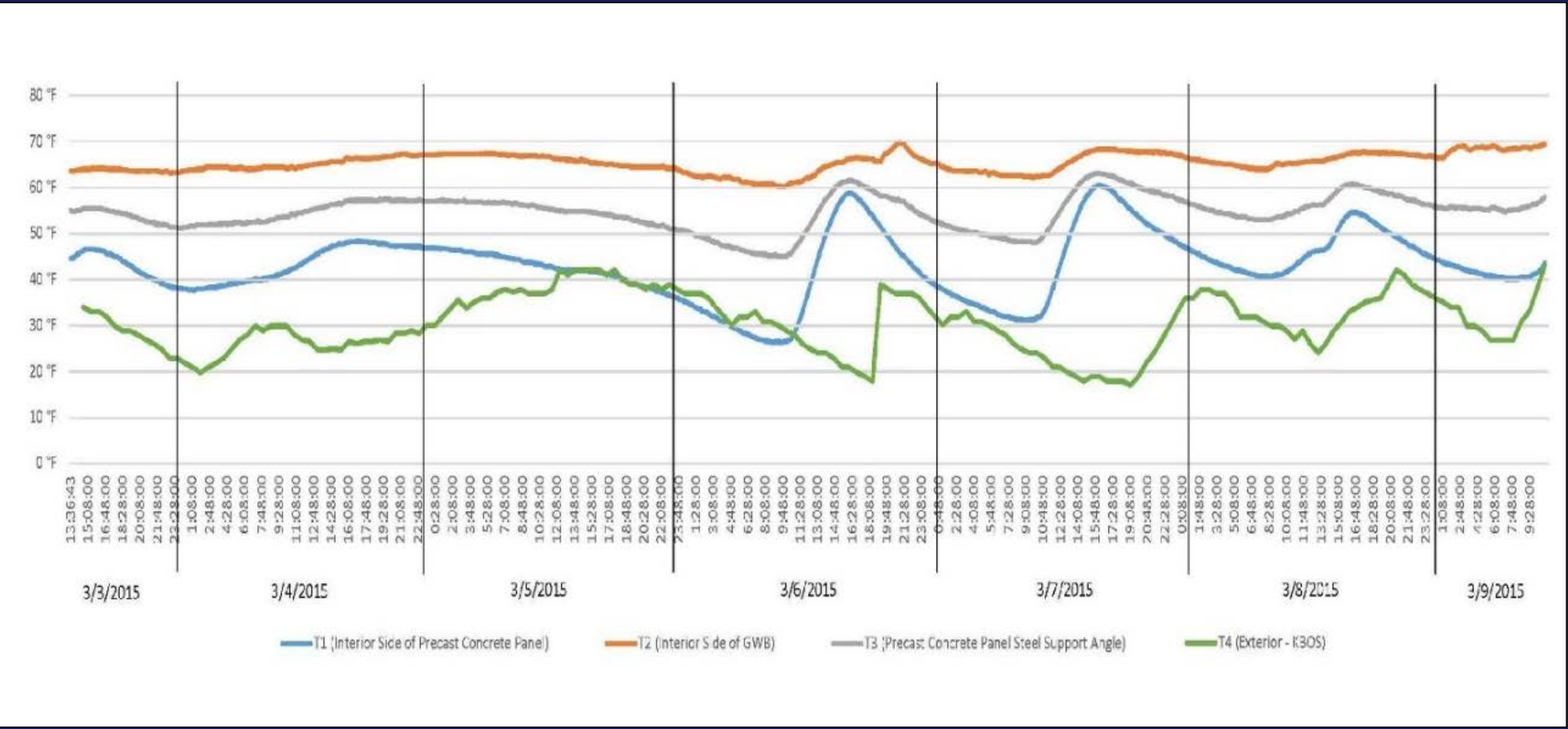


Existing Conditions

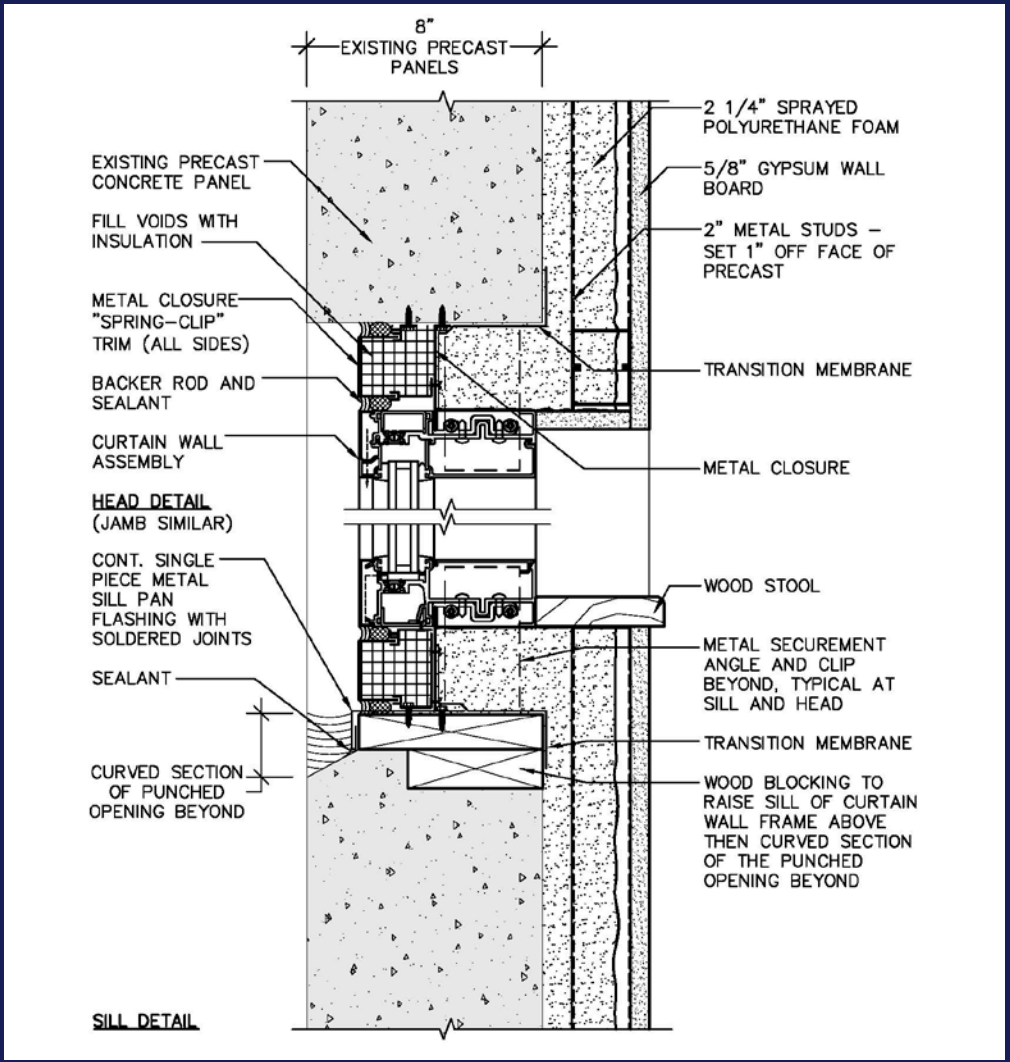
TEMPERATURE AND DEW POINT



DATA LOGGER TEMPERATURE READING



Proposed Wall Assembly



Proposed Wall Assembly

Alternate Wall Assembly

Metal Stud and Wood-Framed Walls

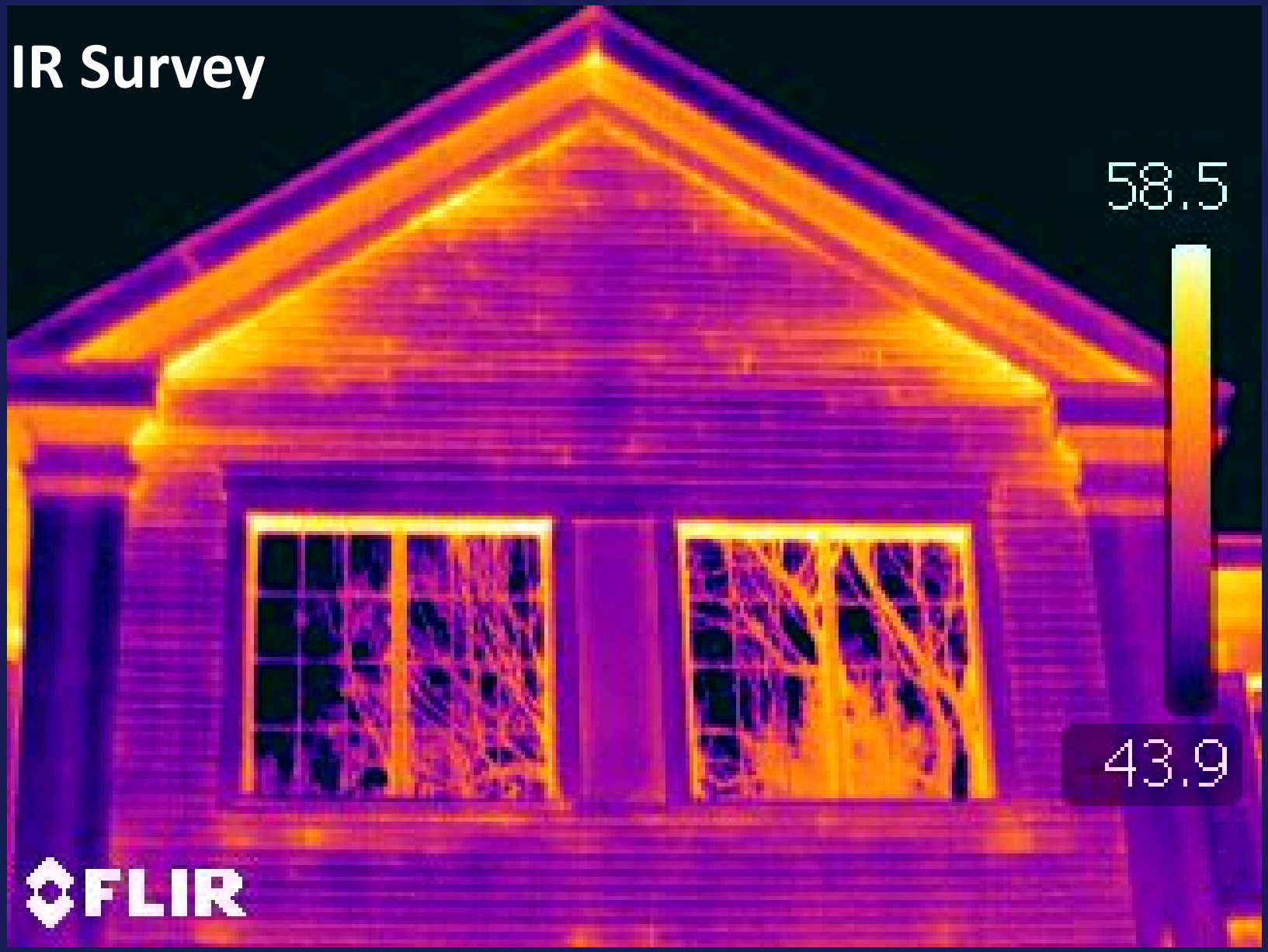
Image 9: Infrared image highlighting the thermal bridging caused by the metal studs

Building Enclosure Function: base equal to 8.06; with CI, equivalent to R-16

TABLE A3.3 Assembly U-Factors for Steel-Frame Walls

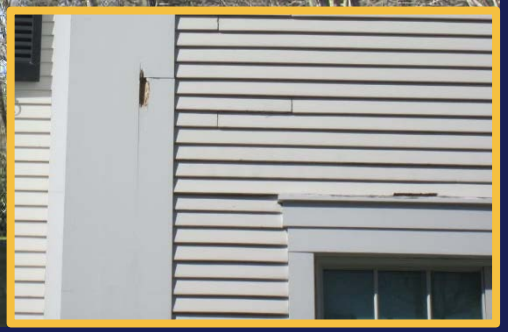
Framing Type and Spacing Width (Actual Depth)	Cavity Insulation R-Value: Rated (Effective Installed [see Table A9.2B])	Overall U-Factor for Entire Base Wall Assembly	Overall U-Factor for Assembly of Base Wall Plus Continuous Insulation (Uninterrupted by Framing), Rated R-Value of Continuous Insulation																		
			R-1.00	R-2.00	R-3.00	R-4.00	R-5.00	R-6.00	R-7.00	R-8.00	R-9.00	R-10.00	R-11.00	R-12.00	R-13.00	R-14.00	R-15.00	R-20.00	R-25.00	R-30.00	R-35.00	R-40.00
Steel Framing at 16 in. on center																					
3.5 in. depth	None (0.0)	**0.352**	0.260	0.207	0.171	0.146	0.128	0.113	0.102	0.092	0.084	0.078	0.072	0.067	0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
	R-11 (5.5)	**0.132**	0.117	0.105	0.095	0.087	0.080	0.074	0.069	0.064	0.060	0.057	0.054	0.051	0.049	0.046	0.044	0.036	0.031	0.027	0.024	0.021
	R-13 (6.0)	**0.124**	0.111	0.100	0.091	0.083	0.077	0.071	0.066	0.062	0.059	0.055	0.052	0.050	0.048	0.045	0.043	0.036	0.030	0.026	0.023	0.021
	R-15 (6.4)	**0.118**	0.106	0.096	0.087	0.080	0.074	0.069	0.065	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.043	0.035	0.030	0.026	0.023	0.021
6.0 in. depth	R-19 (7.1)	**0.109**	0.099	0.090	0.082	0.076	0.071	0.066	0.062	0.058	0.055	0.052	0.050	0.047	0.045	0.043	0.041	0.034	0.029	0.026	0.023	0.020
	R-21 (7.4)	**0.106**	0.096	0.087	0.080	0.074	0.069	0.065	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.022	0.020
Steel Framing at 24 in. on center																					
3.5 in. depth	None (0.0)	**0.338**	0.253	0.202	0.168	0.144	0.126	0.112	0.100	0.091	0.084	0.077	0.072	0.067	0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
	R-11 (6.6)	**0.116**	0.104	0.094	0.086	0.079	0.073	0.068	0.064	0.060	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.035	0.030	0.026	0.023	0.021
	R-13 (7.2)	**0.108**	0.098	0.089	0.082	0.075	0.070	0.066	0.062	0.058	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.023	0.020
	R-15 (7.8)	**0.102**	0.092	0.084	0.078	0.072	0.067	0.063	0.059	0.056	0.053	0.050	0.048	0.046	0.044	0.042	0.040	0.034	0.029	0.025	0.022	0.020
6.0 in. depth	R-19 (8.6)	**0.094**	0.086	0.079	0.073	0.068	0.064	0.060	0.057	0.054	0.051	0.048	0.046	0.044	0.042	0.041	0.039	0.033	0.028	0.025	0.022	0.020
	R-21 (9.0)	**0.090**	0.083	0.077	0.071	0.066	0.062	0.059	0.055	0.052	0.050	0.048	0.045	0.043	0.042	0.040	0.038	0.032	0.028	0.024	0.022	0.020

IR Survey



Test Cuts

Test Cuts



Construction

Construction

Construction

Construction

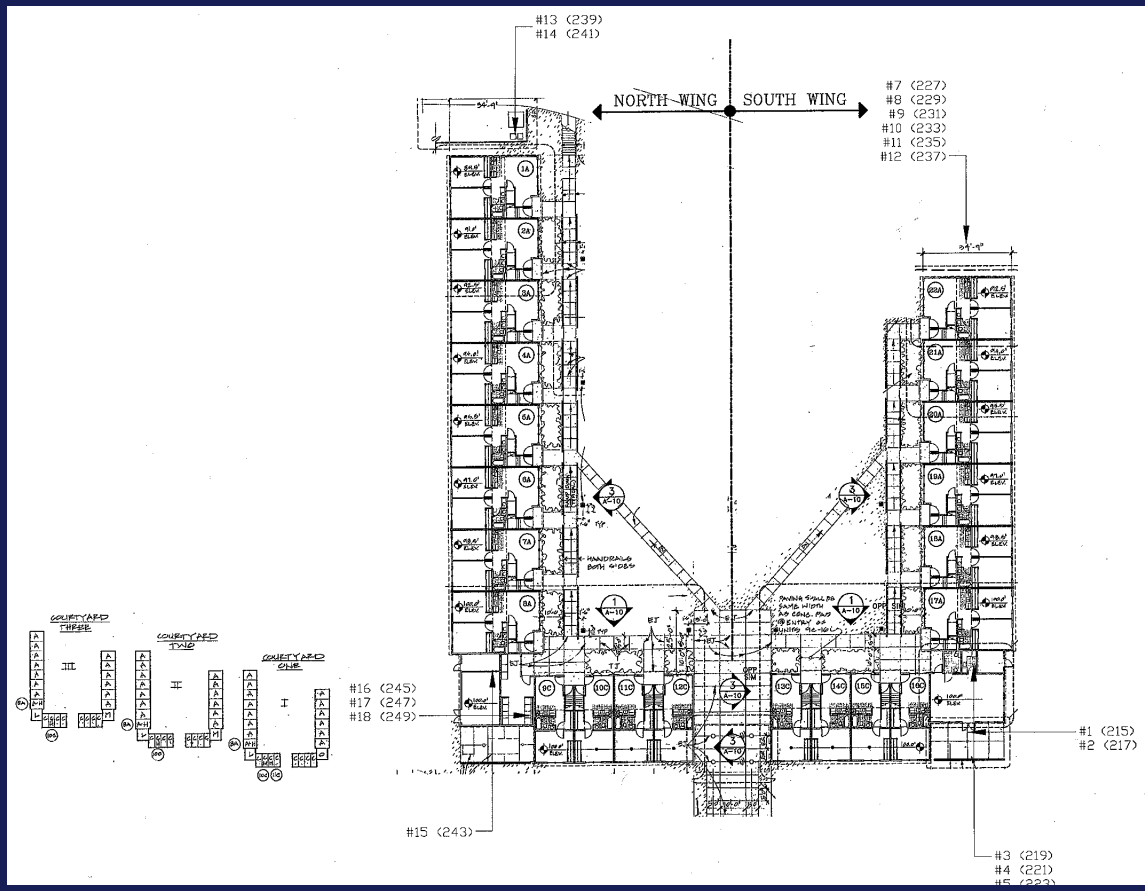
Construction

Wood Framed

Background – History

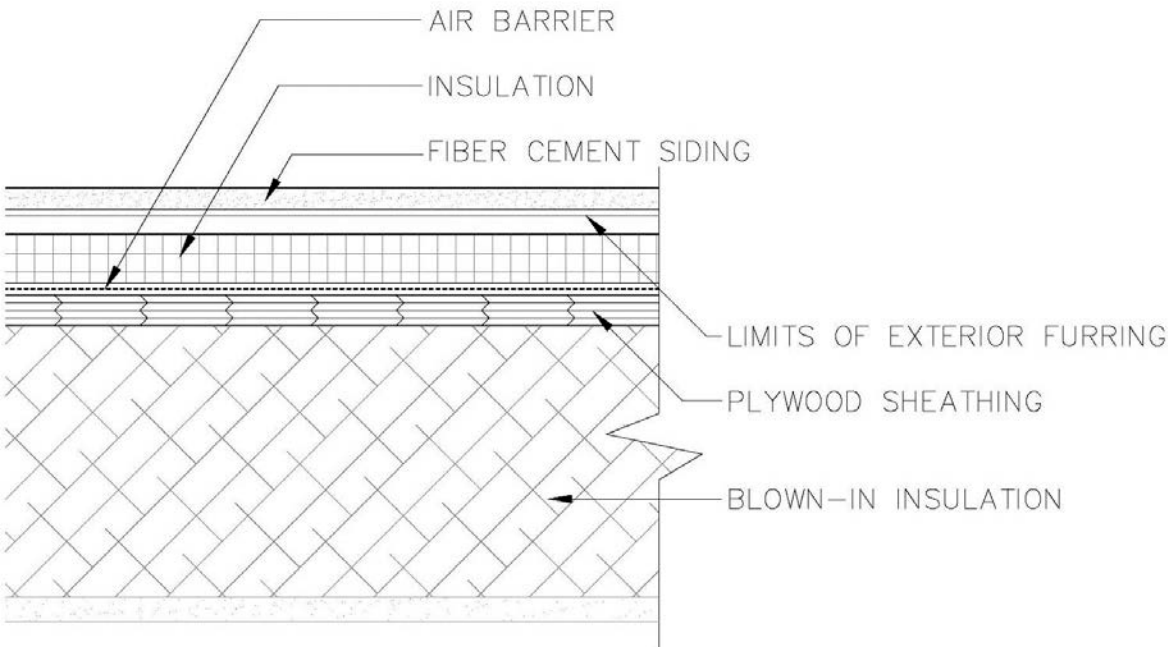
- Typical three story dorm building – east / courtyard elevation.
- Typical two story dorm buildings, photo shows the south elevation of the north wing.


Spot 26.6 °F
46.4
17.8
FLIR


#13 (239)
#14 (241)
NORTH WING
SOUTH WING
#7 (227)
#8 (229)
#9 (231)
#10 (233)
#11 (235)
#12 (237)
COURTYARD THREE
COURTYARD TWO
COURTYARD ONE
#16 (245)
#17 (247)
#18 (249)
#15 (243)
#1 (215)
#2 (217)
#3 (219)
#4 (221)

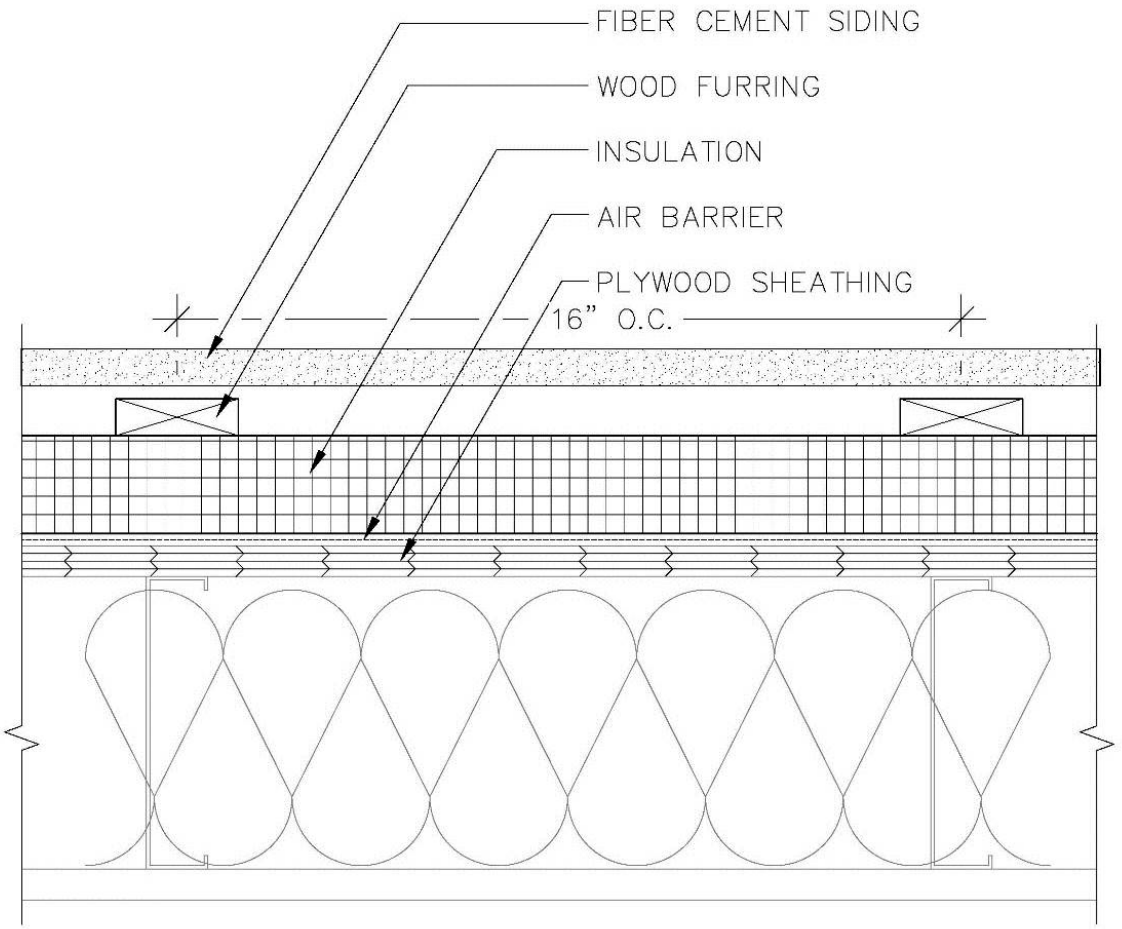
RWU Bayside Wall System

- Siding attached through furring and into existing wood studs
- Insulation between furring members



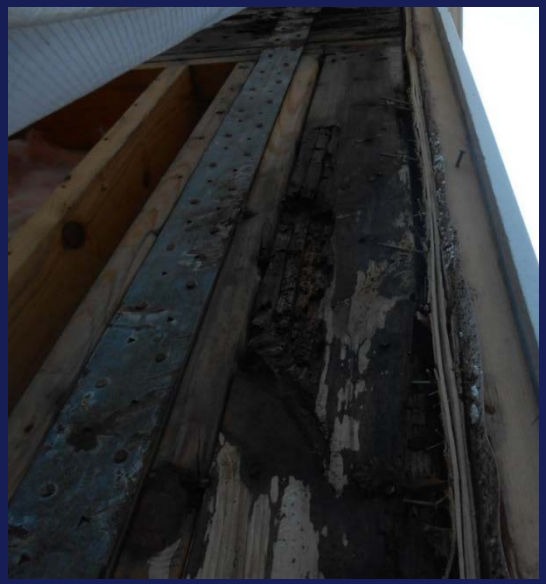
Preferred Design

- Siding attached through furring and into existing wood studs
- Insulation continuous behind furring members



Construction

Construction



Construction

Construction

Construction

Testing

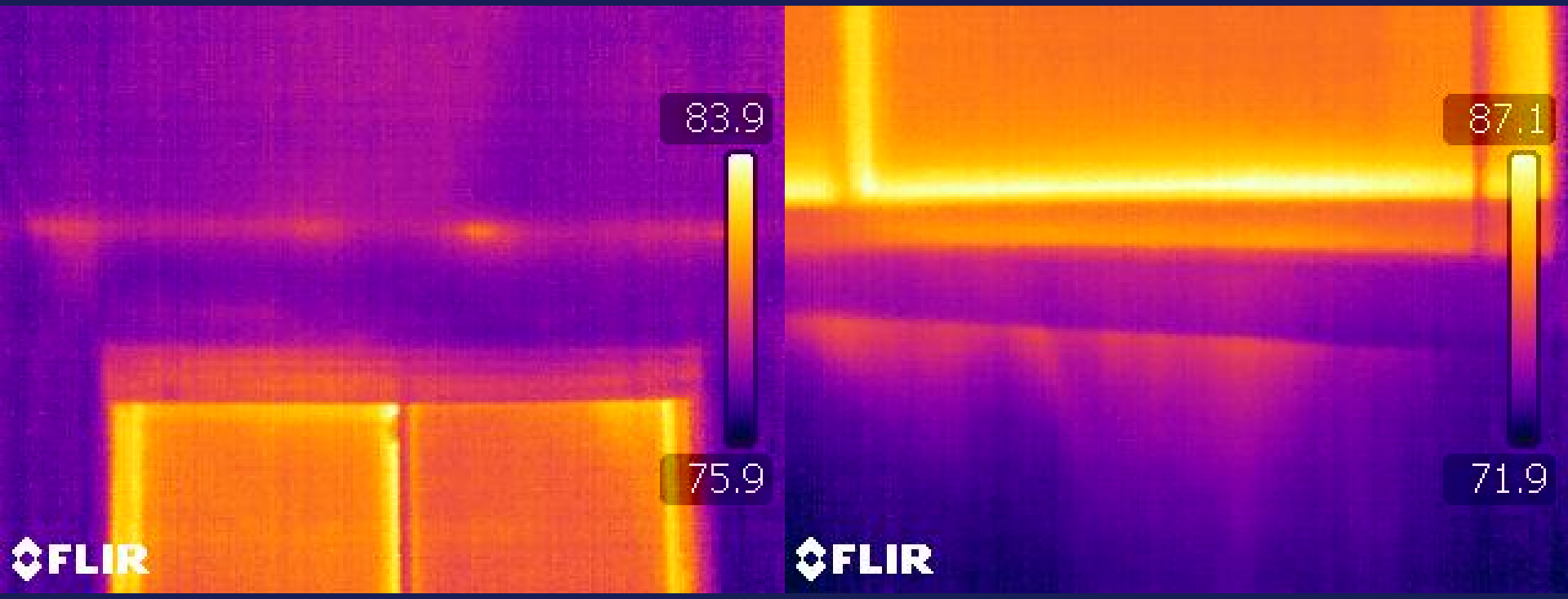
After Year 1 – Phase 1

Complex 2 undergoing renovations

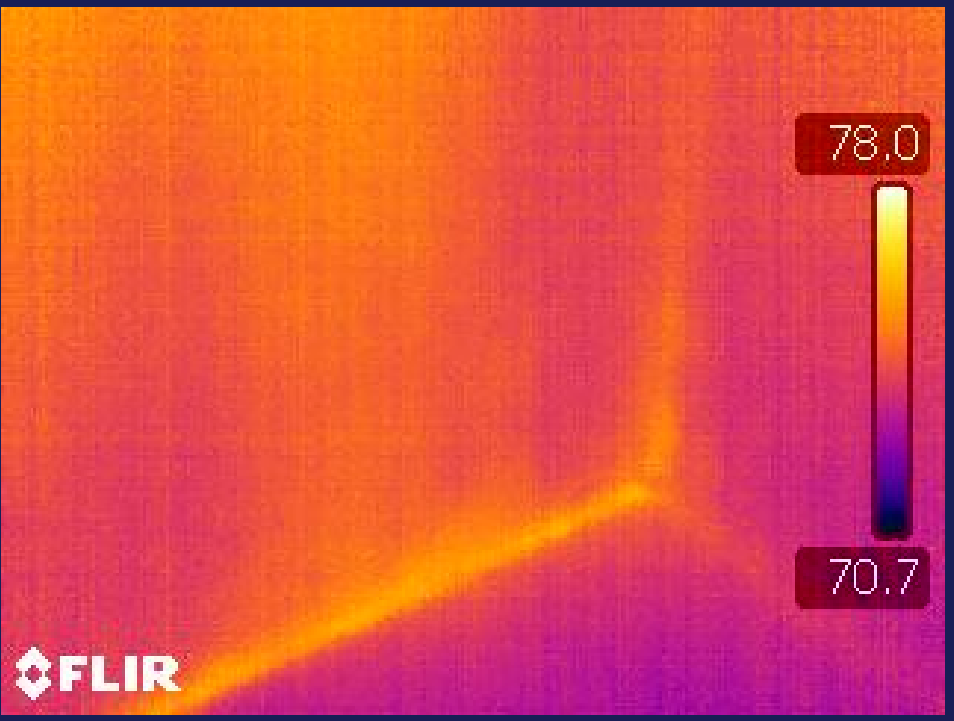
Complex 1 renovations complete

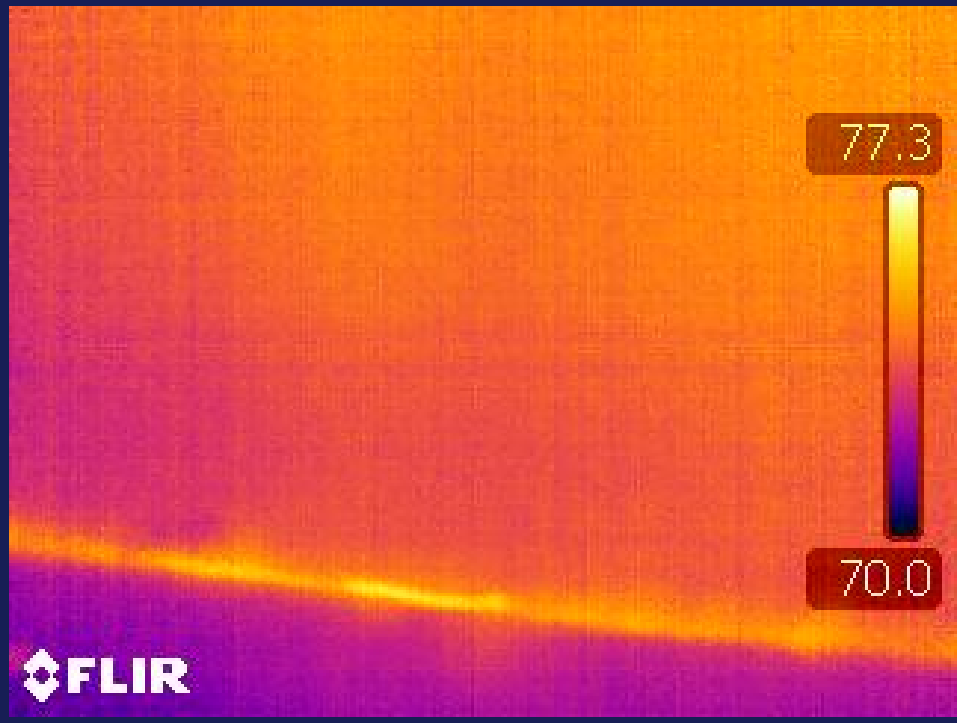
Complex 3 awaiting renovations

Air Infiltration at Penetrations

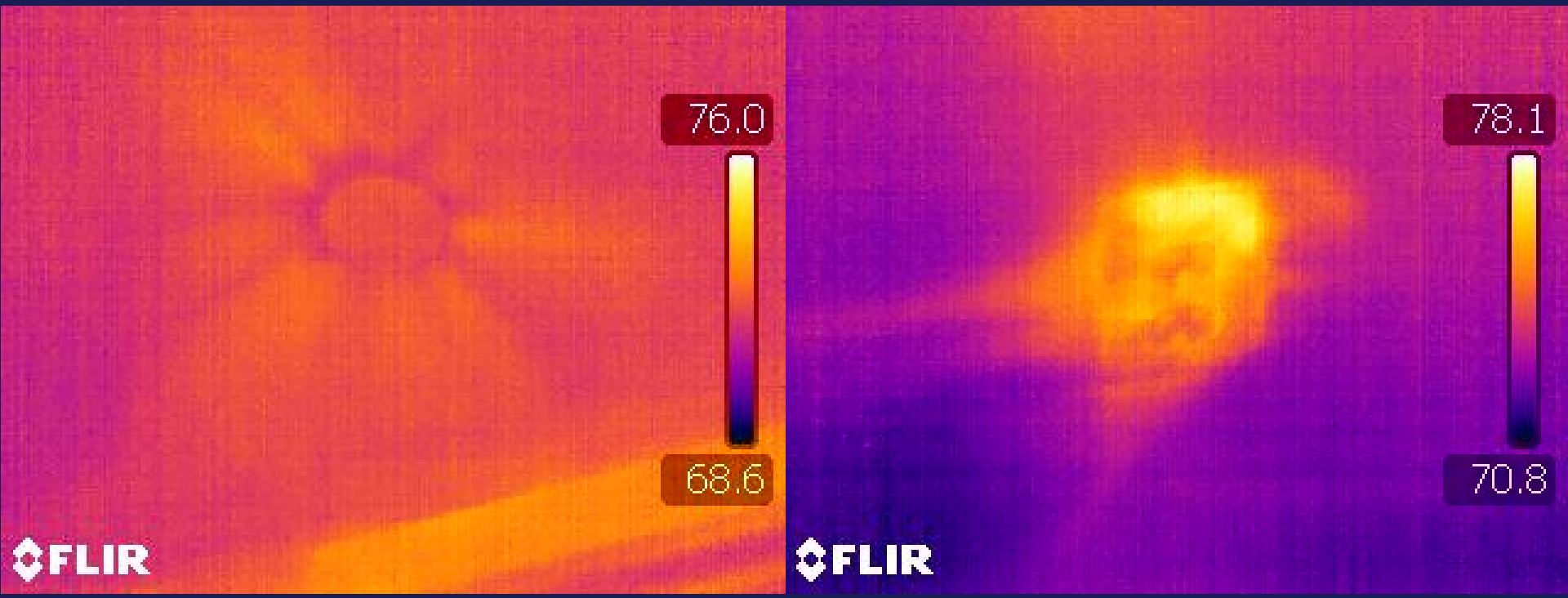


Air Infiltration at Floor





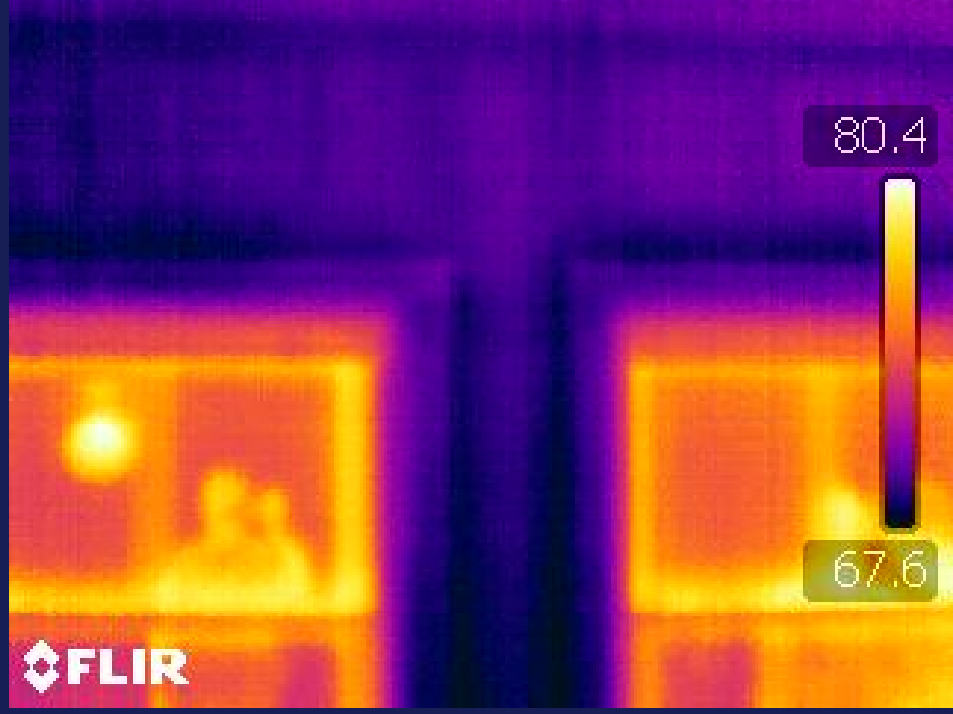
Air Infiltration at Penetrations

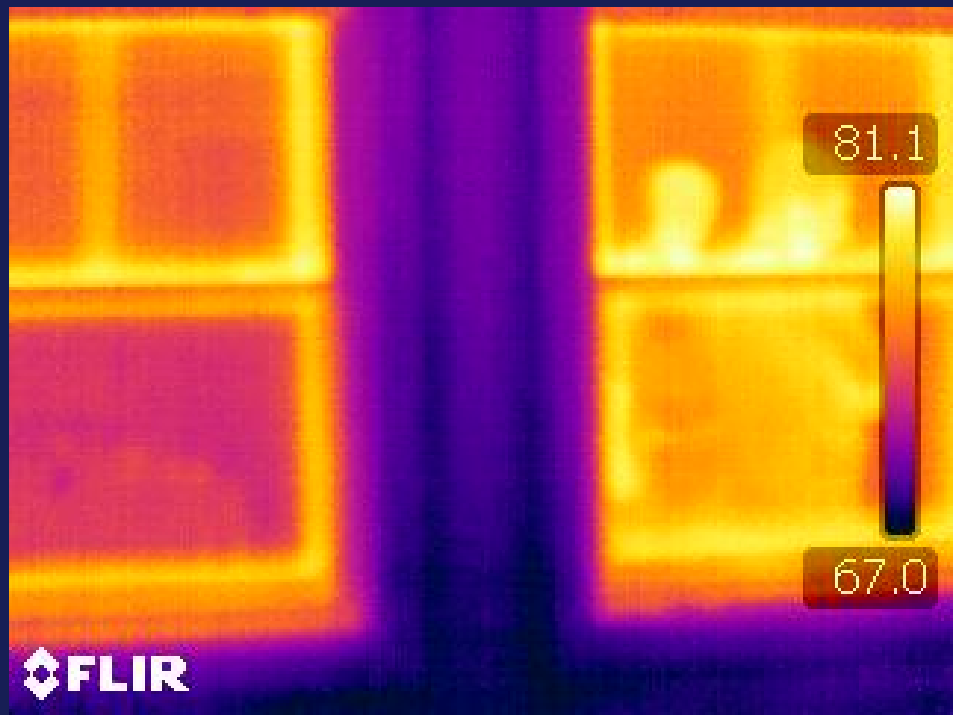


Smoke Entry Under Wall Sill Plate

Testing

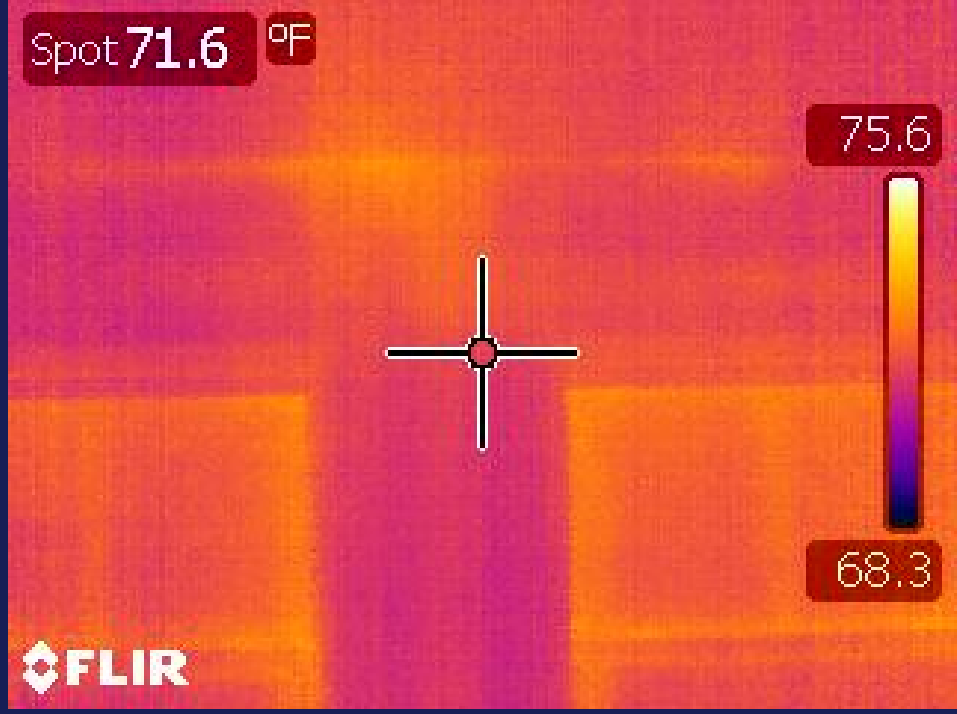
- ASTM 779-10
  Blower Door Test
- Renovated Dorm

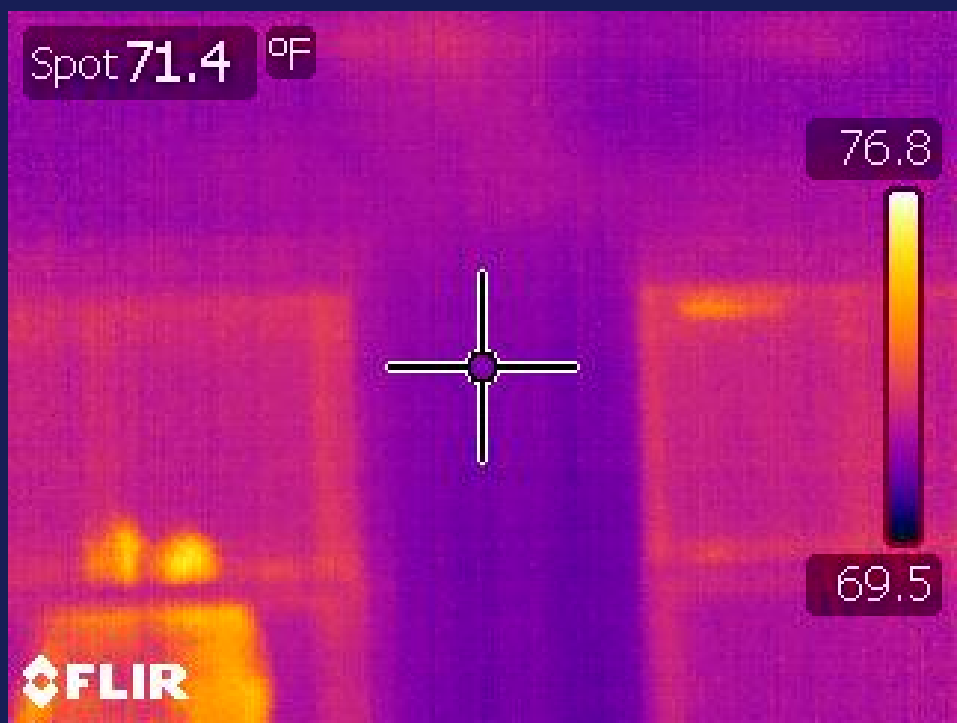


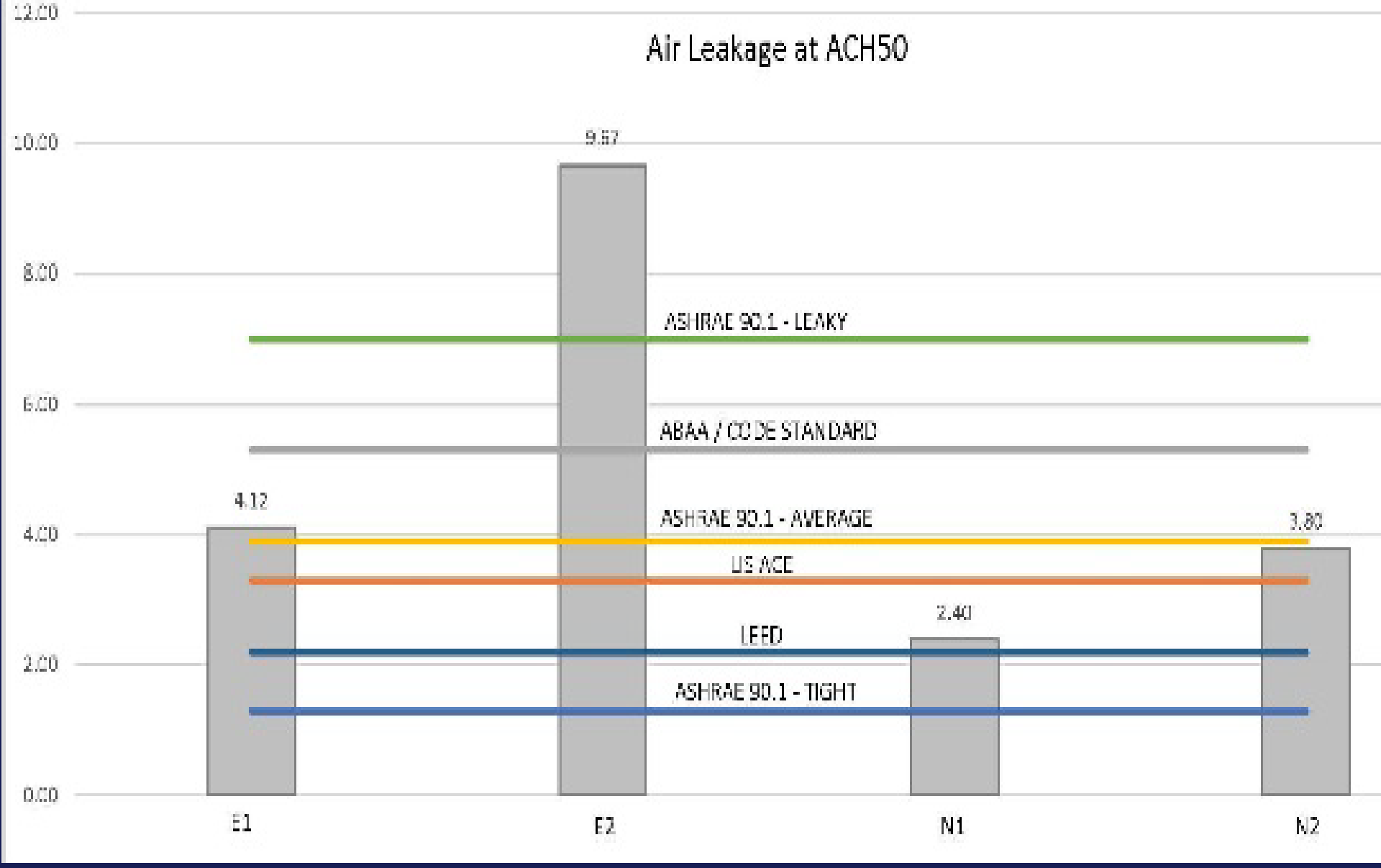


Testing

- ASTM 779-10 Blower Door Test
- Renovated Dorm






Air Leakage at ACH50
12.00
10.00
8.00
6.00
4.00
2.00
0.00
9.67
4.12
2.40
3.80
ASHRAE 90.1 - LEAKY
ABAA / CODE STANDARD
ASHRAE 90.1 - AVERAGE
US ACE
LEED
ASHRAE 90.1 - TIGHT
E1
E2
N1
N2

QUESTIONS?

BUILDING INNOVATION 2019

National Institute of BUILDING SCIENCES

CONFERENCE & EXPO

This concludes The American Institute of Architects
Continuing Education Systems Course

CELEBRATING 50 YEARS

GALE

CONTINUING EDUCATION AIA