

Lessons Learned



**Two Passive House Case Studies for New and Retrofit
Affordable Senior Housing in Pittsburgh**
Laura Nettleton • Rebecca Griffith

LESSONS FROM PITTSBURGH

Two Passive House Retrofits

\$170/SF



Morningside Crossing

\$185/SF



Glassport Retirement Residence

THREE BUILDINGS IN ONE

Morningside Crossing

New Wing

1897 School

1929 Addition





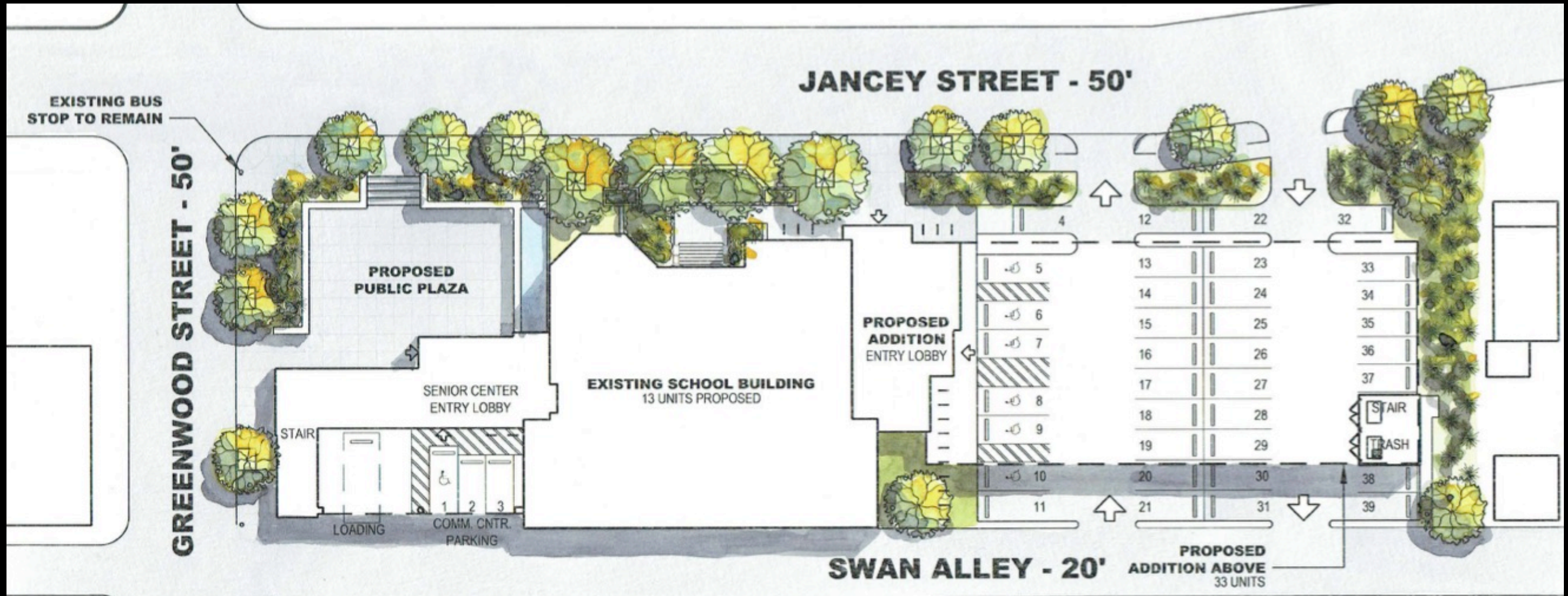
MORNINGSIDE
CROSSING

MORNINGSIDE PUBLIC SCHOOL

THREE BUILDINGS IN ONE

Morningside Crossing

New Wing



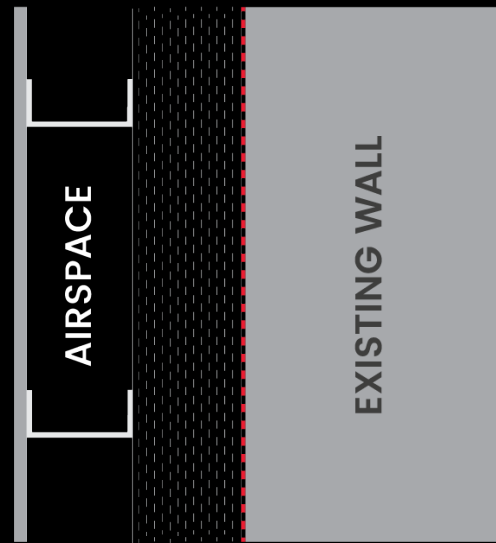




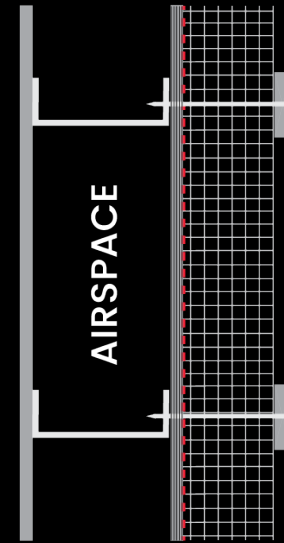
MORNINGSIDE CROSSING

Walls

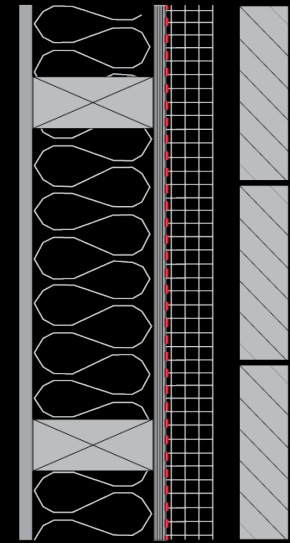
Morningside Crossing: Three Walls



1897



1929



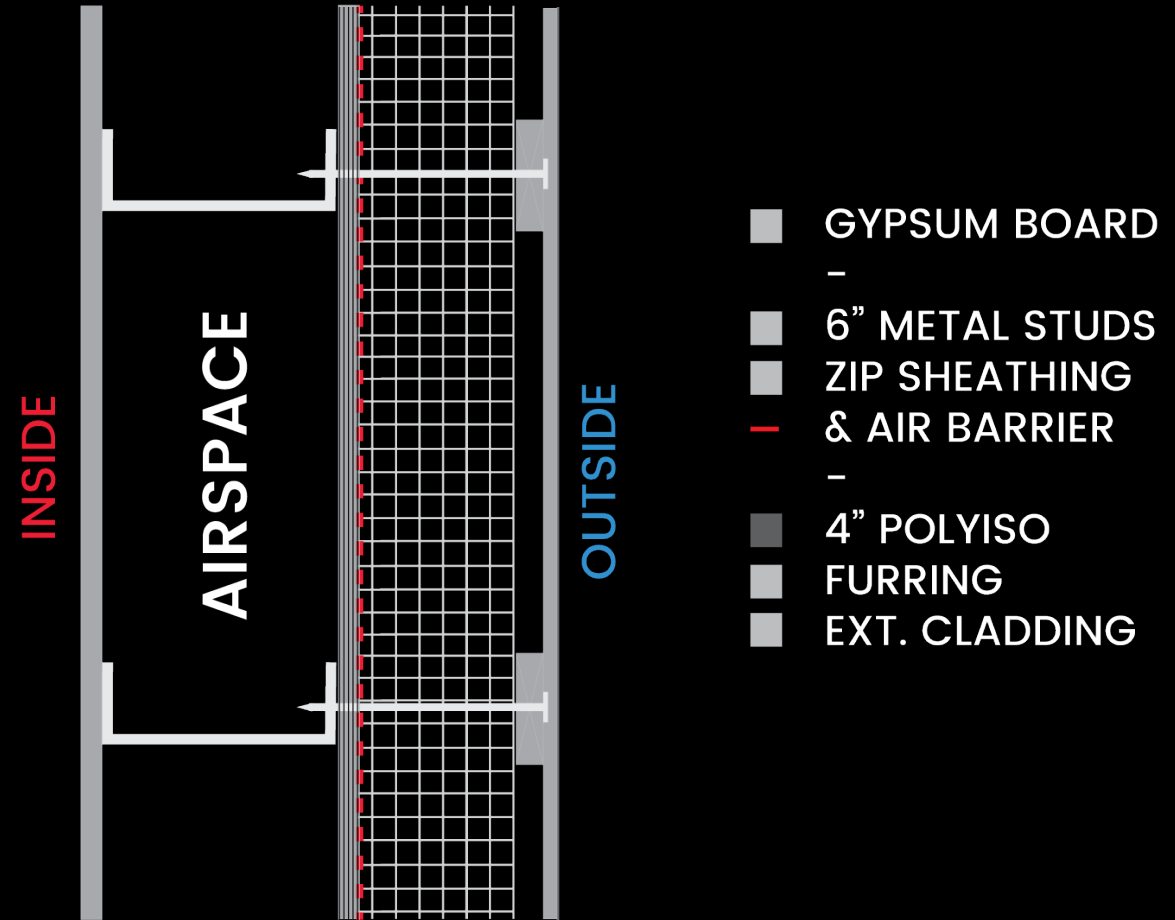
2018

1897 Wall

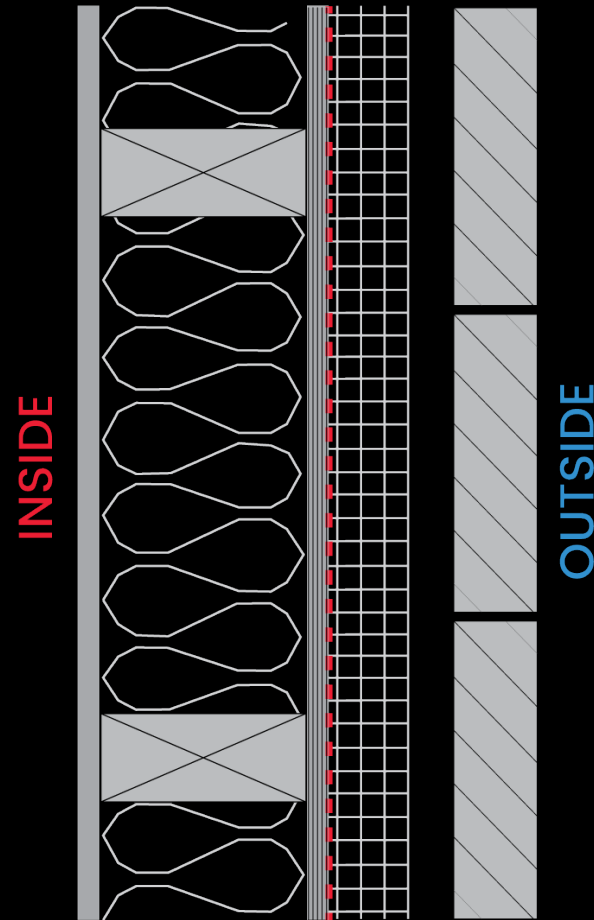
Walls



Walls



Walls



- GYPSUM BOARD
-
- 2x6 STUDS
- GLASS BATT INSUL
- ZIP SHEATHING & AIR BARRIER
-
- 2" POLYISO
-
- EXT. CLADDING



Greenwood St
Jancey St



Greenwood St
Jancey St







Greenwood St
Janney St

SCHOOL
CLOSED

NO PARKING
ANYTIME



Greenwood St
Jancey St

KOBELCO

SCHOOL
CLOSED



Greenwood St
Jancey St



Greenwood St
Jancey St

NOBELLO



Greenwood St
Jancey St



GRADALL
1590-48

ROAD
CLOSED
←
DETOUR

Greenwood St
Janciey St





Pleasant St
Jancey St

CHRISTMAS TREES



Greenwood St
Jancey St

JLG LIFT

TRAKELICH





Greenwood St
Jancéy St

DPV-27
MICH



Greenwood St
Jancey St

GRADALL
6340-42

JMC LIFT

JMC LIFT



Greenwood St
Jancey St



Greenwood St
Jancey St

SOLA
Sustainable
Office
Leasing
(412) 765-4130

GM 1-877-GM-LIFT

WASTE
CITY OF PITTSBURGH



Greenwood St
Jancey St

VI
AG

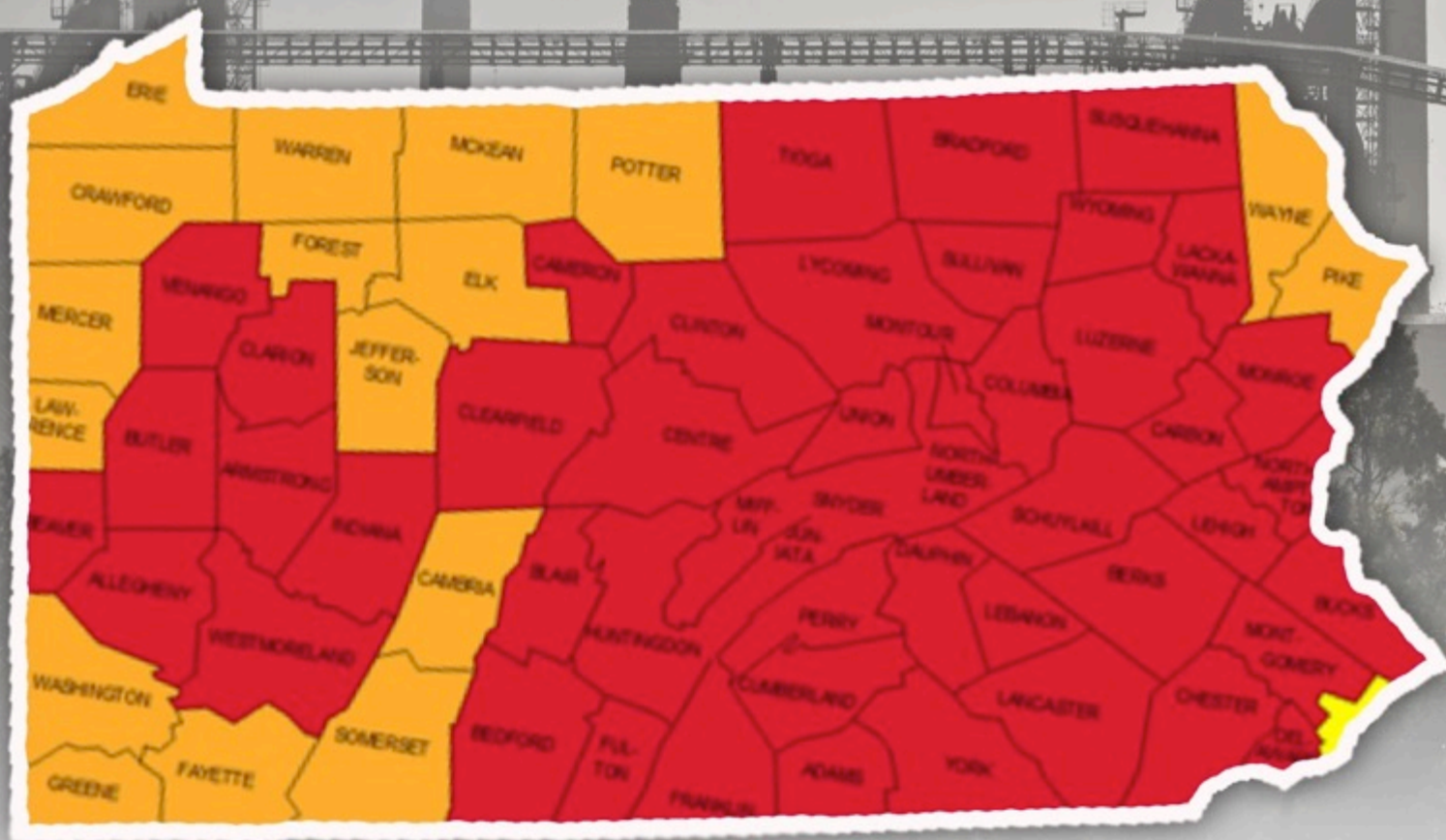


Greenway St
Jancey St

NOW LEASING
SOTA
CONSTRUCTION
(412) 766-4630
www.sotacoreconstruction.com

GRADALL
5340

Indoor pollution control outdoor contaminants







Duquesne University, Rockwell Hall

Location Average

Pittsburgh Last Updated 18 minutes ago Average

CO₂

402

EXCELLENT INDOOR

PM 2.5 GOOD 1 µg/m³

TOTAL VOC GOOD 0.06 mg/m³

PM 10 GOOD 0 µg/m³

TEMPERATURE 73 °F

HUMIDITY 50.67 %RH

Location Readings PRO

GRAPH AVERAGE DATA CALENDAR (BETA) REPORT (BETA)

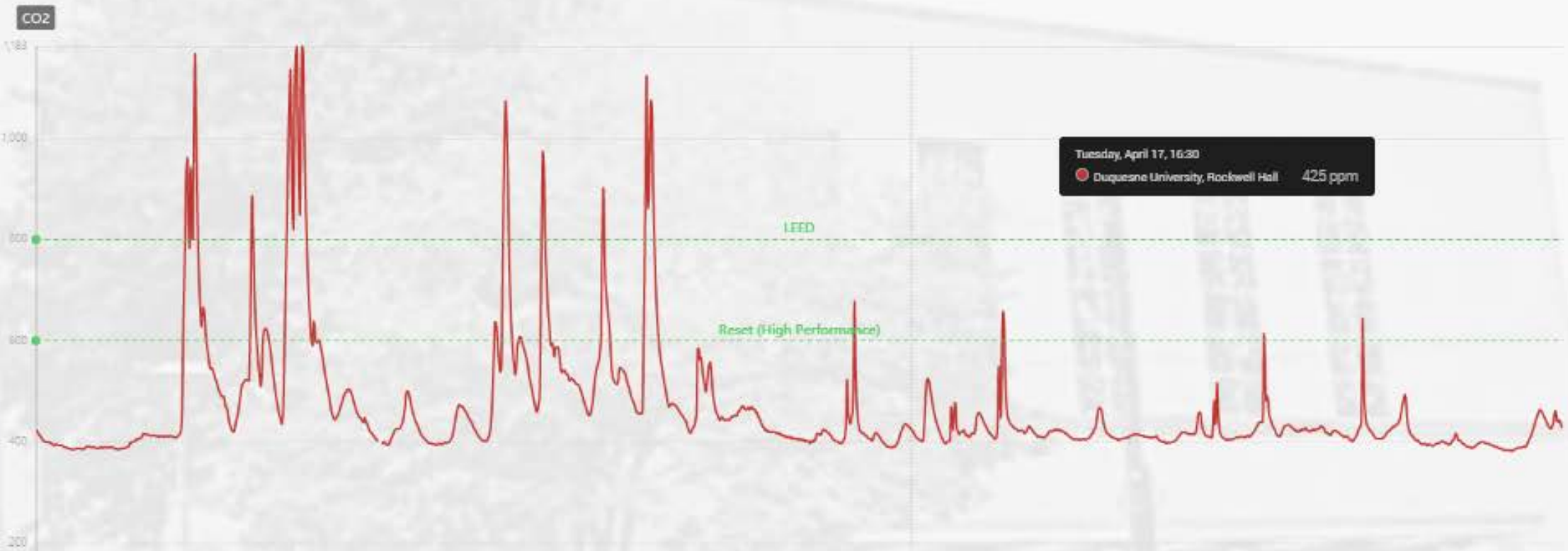
Graph Settings

Indicator: CO₂ Range: Start 18/04/01 End 18/04/30 Hour: All Hours Working Hours Non-Working Hours

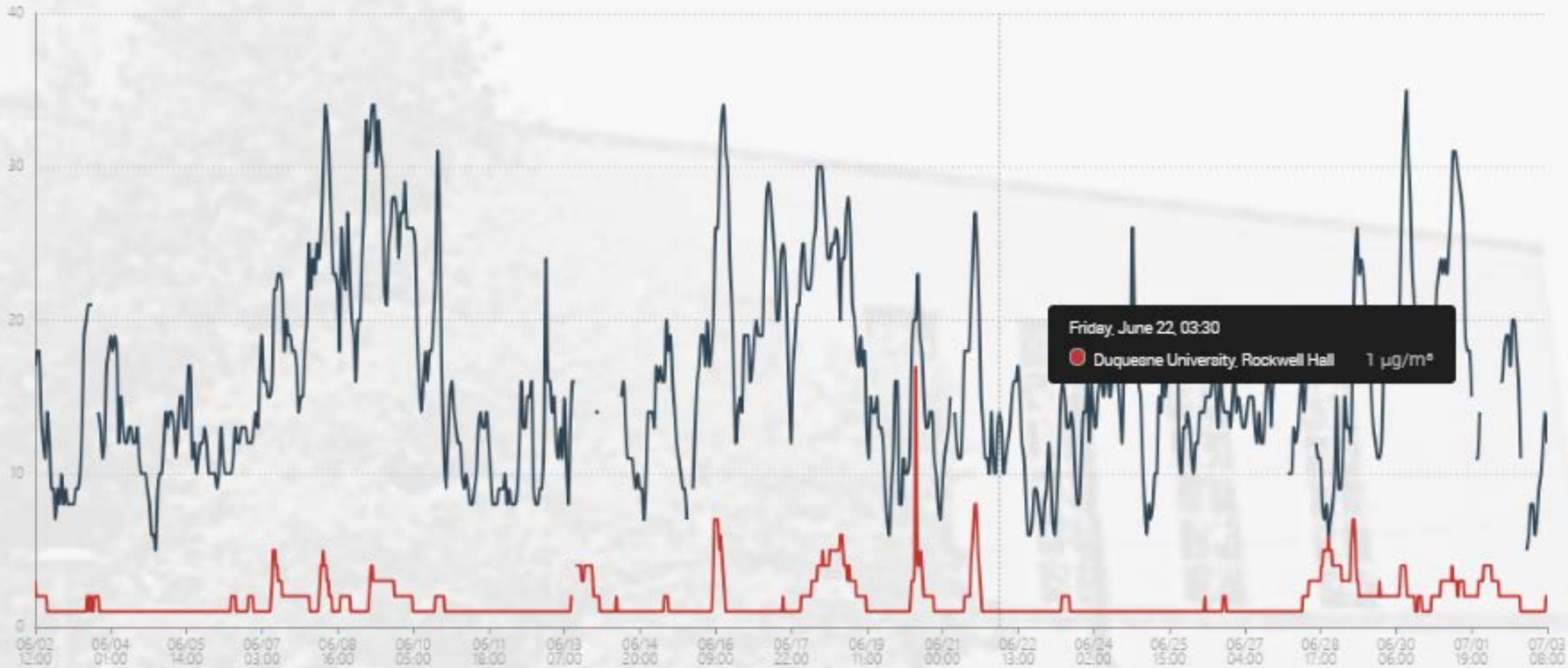
Reference: Location Average Outdoor Standard Thresholds (Select up to 2): Reset (High Performance) LEED

● Duquesne University, Rockwell Hall ● 301 39th Street, Pittsburgh, PA

(GMT-04:00 America/New_York)



PM2.5



Friday, June 22, 03:30
● Duquesne University, Rockwell Hall 1 µg/m³

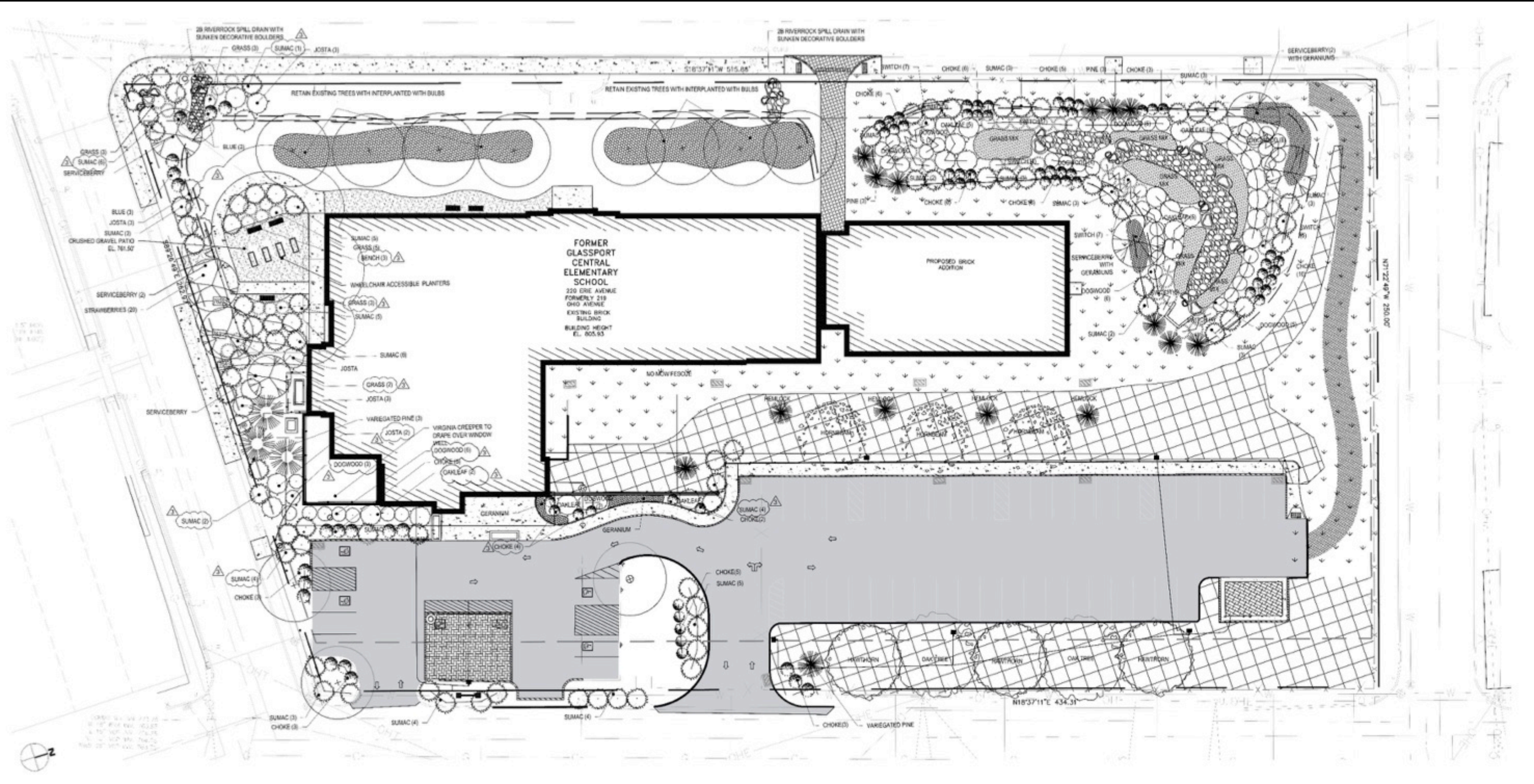
TWO BUILDINGS IN ONE

Glassport Retirement Residence

New Wing

Existing School









RETIREMENT RESIDENCE OF
GLASSPORT







DELTA VENT SA

DELTA VENT SA

GLASSPORT GYM AREA WALL

Need for New Wall

1. Contractor wanted plumb surface for insulation attachment.
2. Contractor concerned about air sealing uneven wall surface.
3. Existing wall contained holes and protrusions.
4. Two plaster walls not in same plane.



GLASSPORT GYM AREA WALL

Demolition



GLASSPORT GYM AREA WALL

Demolition



GLASSPORT GYM AREA WALL

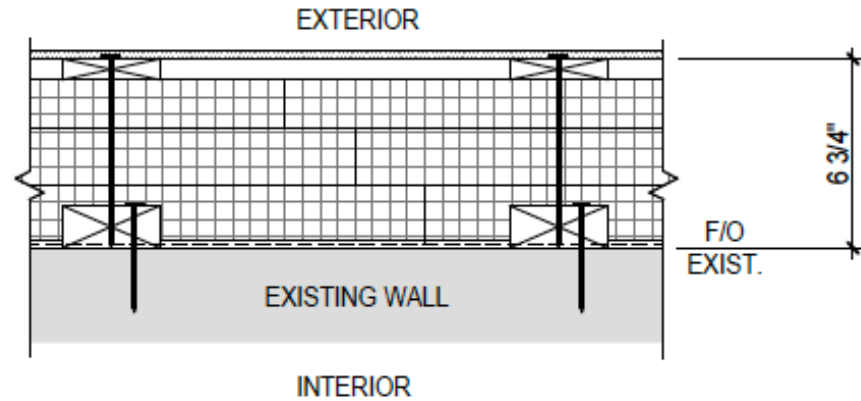
Demolition



Evolution: Original Concept

E6

EXTERIOR WALL
CLADDING OVER
EXISTING WALL W/ INSUL



- CLADDING PER ELEVATIONS
- 1x4 TREATED WOOD FURRING (FASTEN THRU TO NAILER) AT EXPOSED FASTENER CLADDING, PROVIDE SECOND (PERPENDICULAR) LAYER OF FURRING
- 6" TYPE II EXPANDED POLYSTYRENE RIGID INSULATION (EPS) R-4.2 PER INCH (R-25.5 MIN.) / INSTALLED IN OVERLAPPING LAYERS
- 2x4 TREATED WOOD NAILER ATTACHED TO EXISTING WALL
- SELF-ADHERED WATER-RESISTIVE BARRIER (AIR-BARRIER, VAPOR-PERMEABLE)
- EXISTING CONSTRUCTION

Assembly no.	Building assembly description				Interior insulation?	
01ud	E6 (Existing Wall w/ 6" Ext. Insulation)				<input type="checkbox"/>	
Orientation of building element		Heat transmission resistance [hr.ft ² .F/BTU]				
2-Wall		interior R _{si}	0.74			
Adjacent to		exterior R _{se}	0.23			
1-Outdoor air						
Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]
EPS Type II	4.20					4.50
EPS Type II	4.20	2x4 Nailer 16" o.c.	1.28			1.50
Existing Masonry	0.21					16.00
Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
78%		22.0%				22.00 in
U-value supplement		BTU/hr.ft ² .°F		R-value:		27.9 hr.ft ² .°F/BTU

Evolution: New Concept

E6*

EXTERIOR WALL
CLADDING OVER
EXISTING WALL W/ INSUL

- CLADDING PER ELEVATIONS
- 1x4 TREATED WOOD FURRING (FASTEN THRU TO NAILER) AT EXPOSED FASTENER CLADDING, PROVIDE SECOND (PERPENDICULAR) LAYER OF FURRING
- ~~4"~~ TYPE II EXPANDED POLYSTYRENE RIGID INSULATION (EPS) R-4.2 PER INCH (R-25.5 MIN.) / INSTALLED IN OVERLAPPING LAYERS
- SELF-ADHERED WATER-RESISTIVE BARRIER (AIR-BARRIER, VAPOR-PERMEABLE)
- 1/2" EXTERIOR SHEATHING
- 2x4 WOOD STUDS @ 16" O.C. (BRACE TO EXISTING WALL @ 48" VERT./HORIIZ.)
- 3-1/2" MINERAL WOOL BATT INSULATION R-4.2 PER INCH (R-15 MIN.)
- AIR GAP FROM EXISTING WALL CONSTRUCTION AS NECESSARY TO ALLOW VERTICAL/PLUMB WALL

Assembly no.	02ud				Building assembly description	E6-REVISED (Existing Wall w/ Cavity Framing/Insulation & 4" Ext. Insulation)		Interior insulation?	<input type="checkbox"/>
					Heat transmission resistance [hr.ft ² .F/BTU]				
Orientation of building element	2-Wall		interior R _{si}	0.74					
Adjacent to	1-Outdoor air		exterior R _{se}	0.23					
Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]			
EPS Type II	4.20					4.00			
Plywood	4.20					0.50			
Mineral Wool Batt	4.00	2x4 stud 16" o.c.	1.28			3.50			
Existing Masonry	0.21					16.00			
Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total			
78%		22.0%				24.00 in			
U-value supplement					BTU/hr.ft ² .°F		R-value: 33.7 hr.ft ² .°F/BTU		

GLASSPORT GYM AREA WALL

New Wall



GLASSPORT GYM AREA WALL

New Wall



GLASSPORT GYM AREA WALL

New Wall



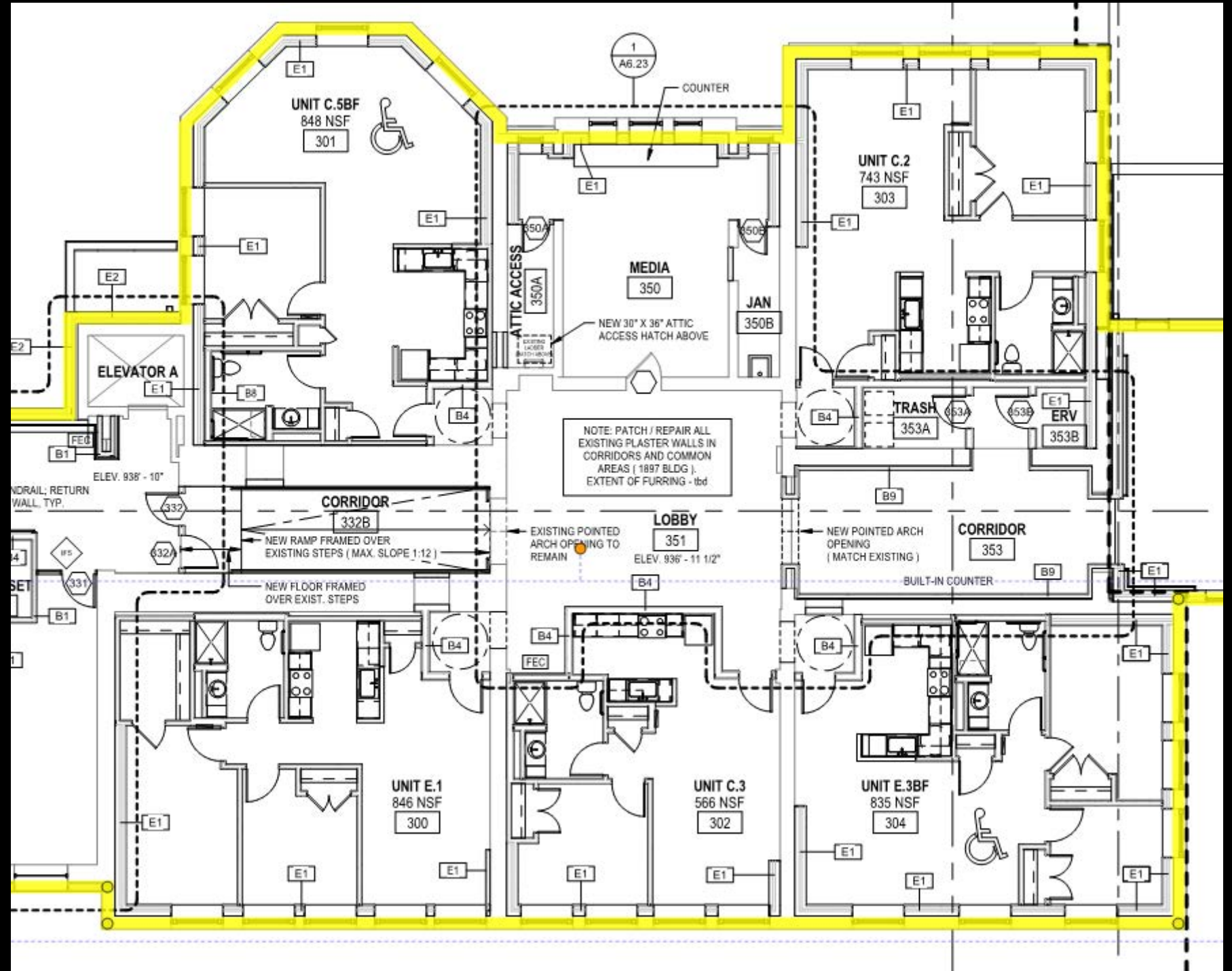
MORNINGSIDE INTERSECTING WALLS

Existing Conditions



MORNINGSIDE INTERSECTING WALLS

Ideal Conditions



Our Approach



MORNINGSIDE INTERSECTING WALLS

Our Approach

1. 'Sleeve' insulation and air barrier on either side of existing masonry bearing walls.



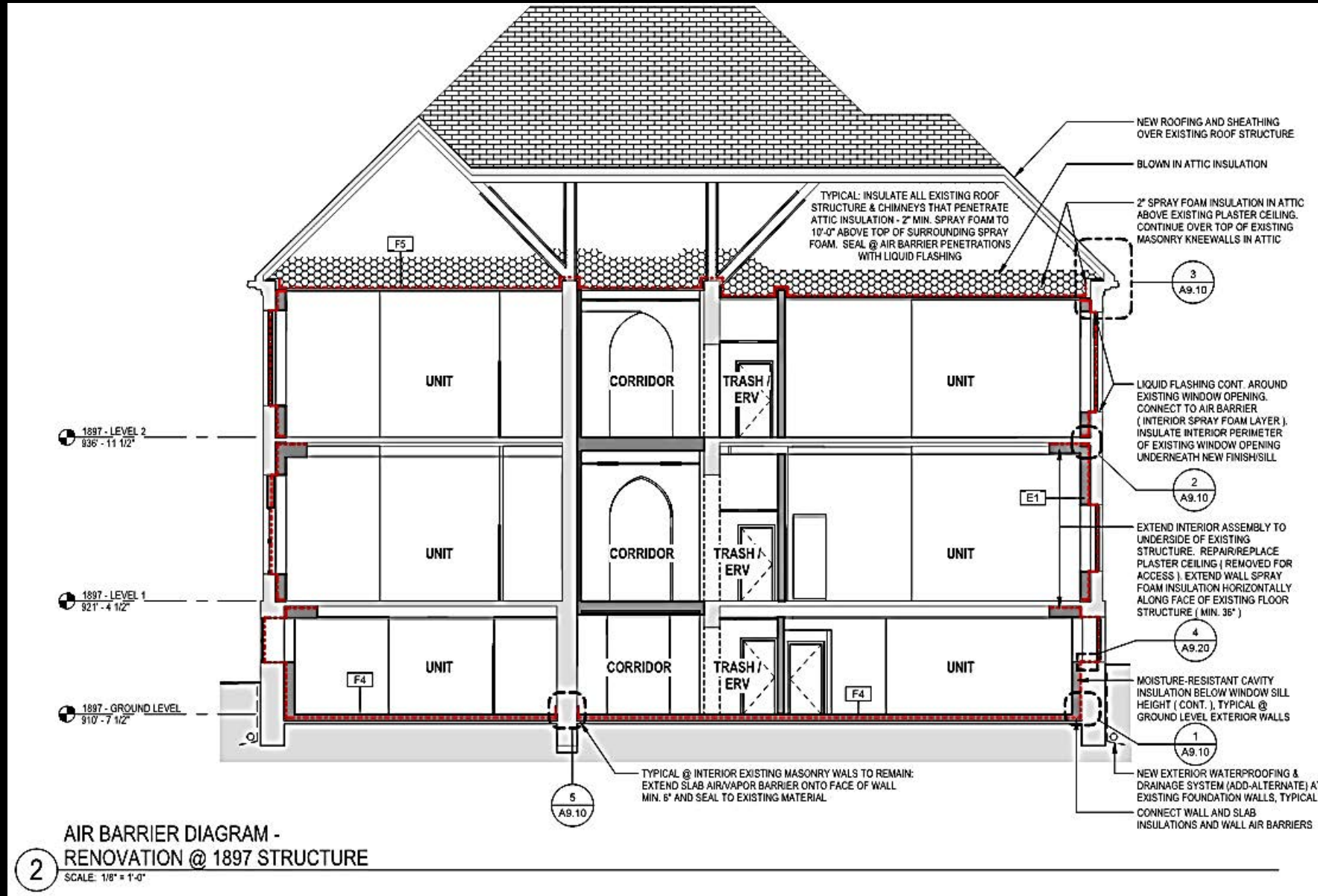
MORNINGSIDE INTERSECTING WALLS

Solutions: Exterior Walls



MORNINGSIDE INTERSECTING WALLS

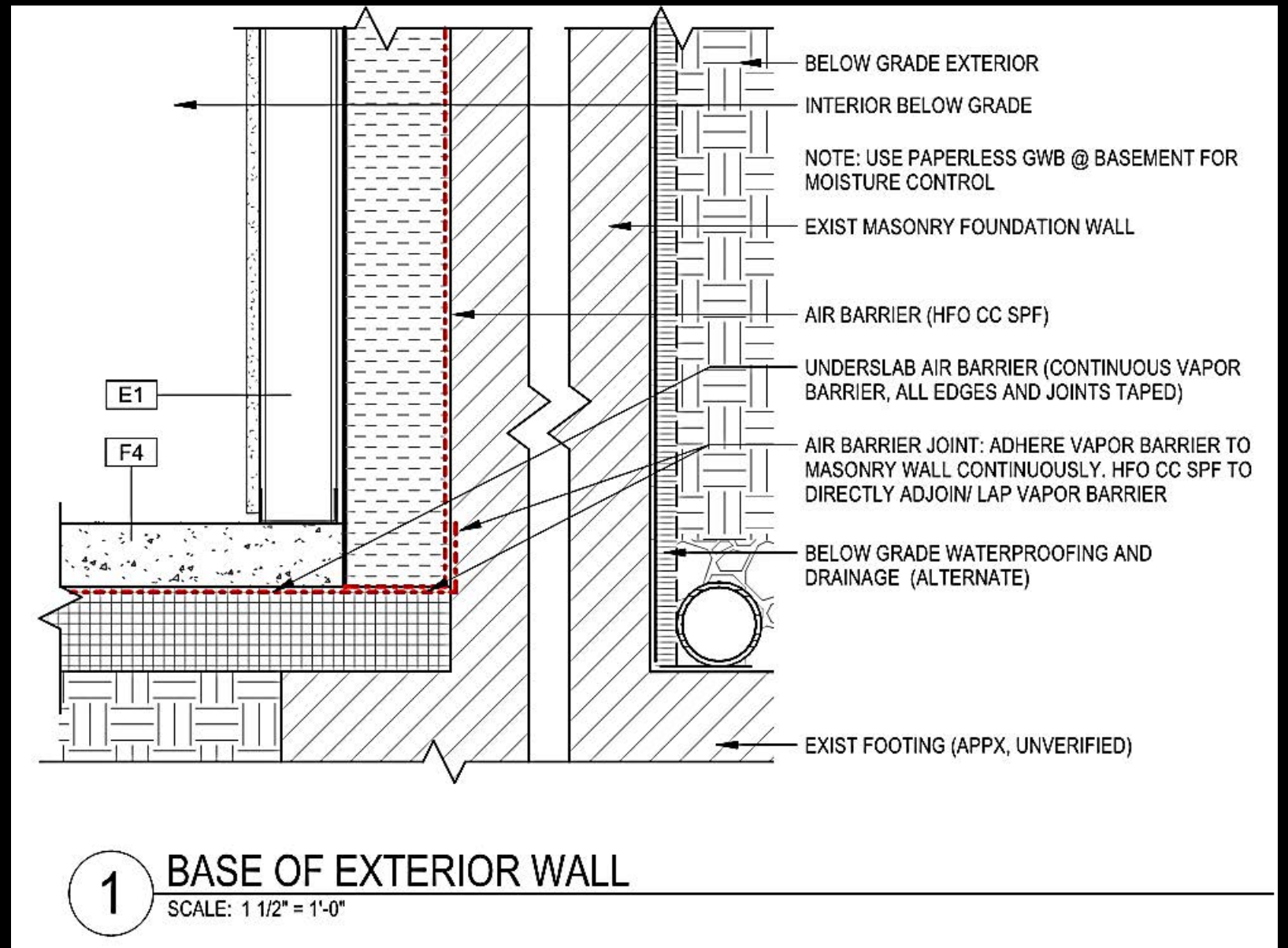
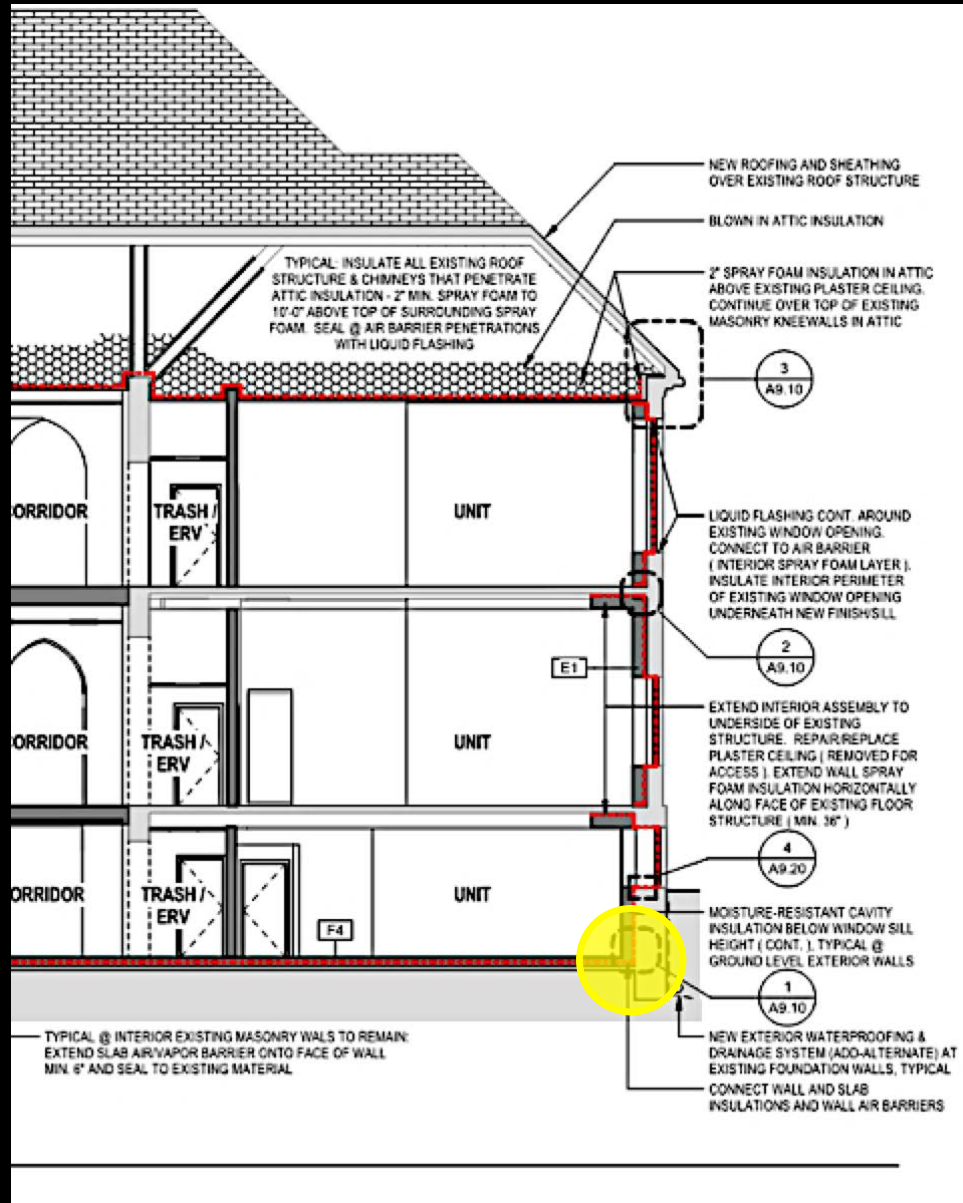
Our Approach



2 AIR BARRIER DIAGRAM - RENOVATION @ 1897 STRUCTURE
SCALE: 1/8" = 1'-0"

MORNINGSIDE INTERSECTING WALLS

Our Approach



MORNINGSIDE INTERSECTING WALLS

Existing Conditions



MORNINGSIDE INTERSECTING WALLS

Solutions: Underslab

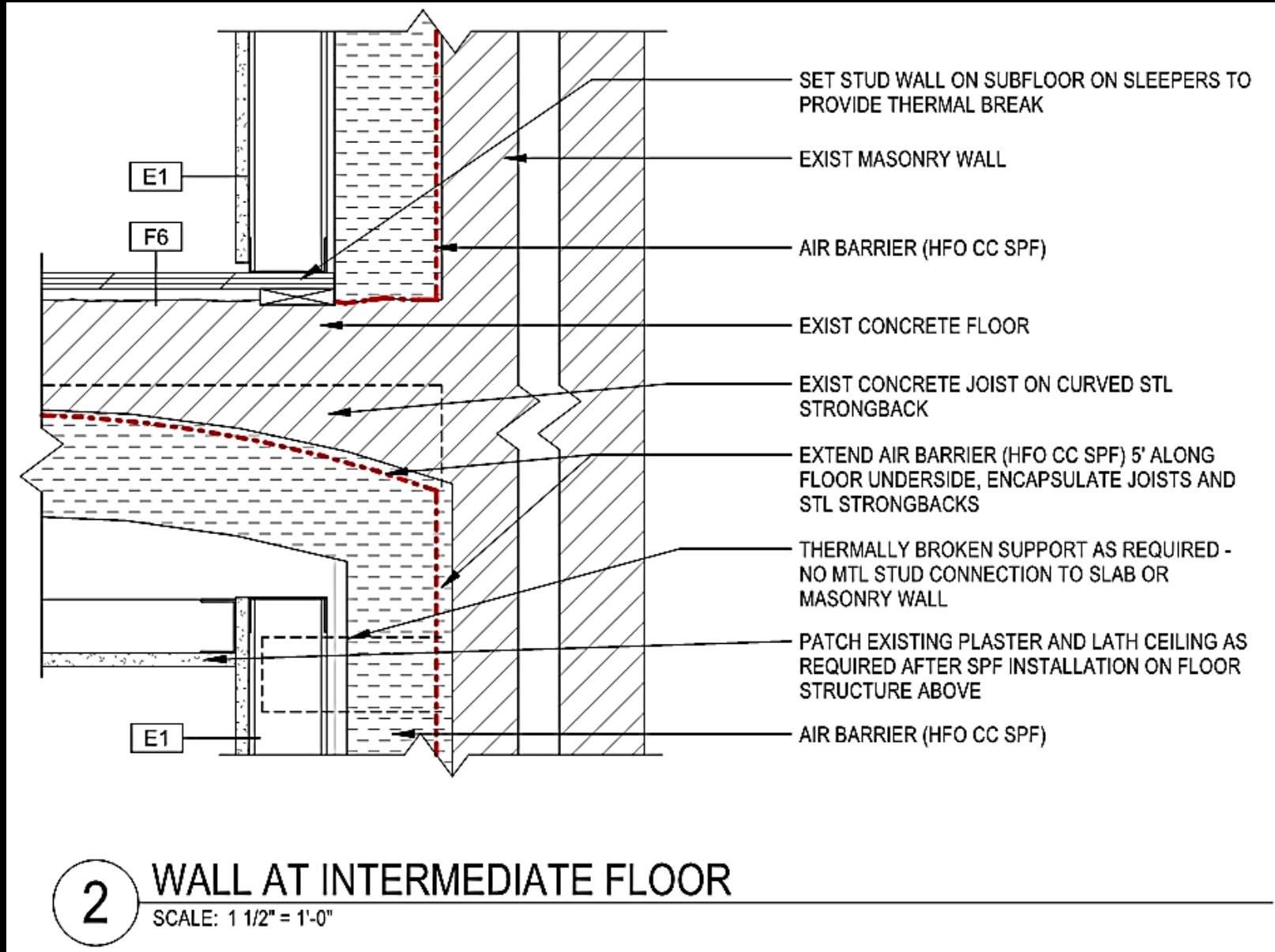
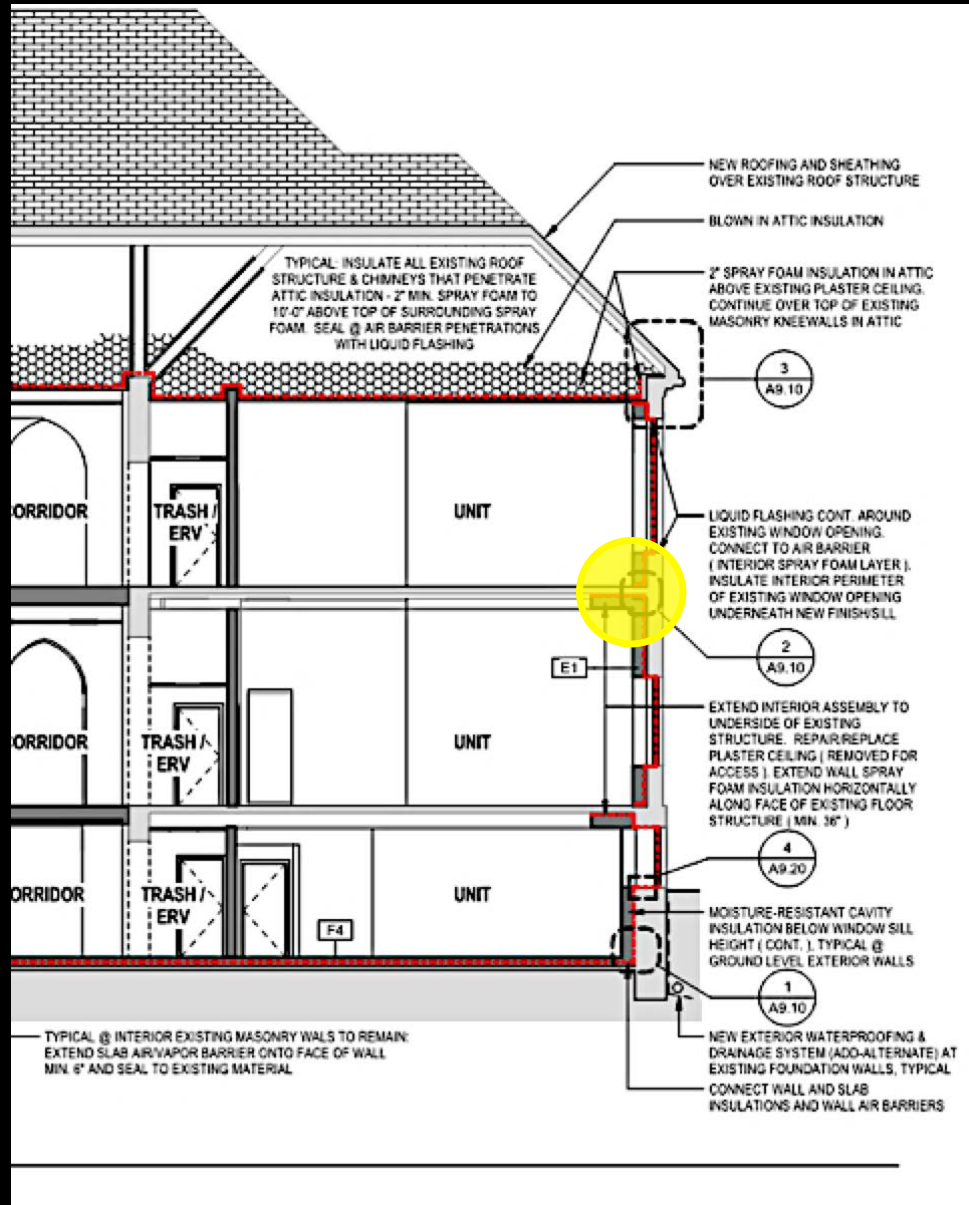


MORNINGSIDE INTERSECTING WALLS

Solutions: Underslab



Our Approach



MORNINGSIDE INTERSECTING WALLS

Existing Conditions



MORNINGSIDE INTERSECTING WALLS

Solutions: Wall to Ceiling



MORNINGSIDE INTERSECTING WALLS

Solutions: Wall to Ceiling



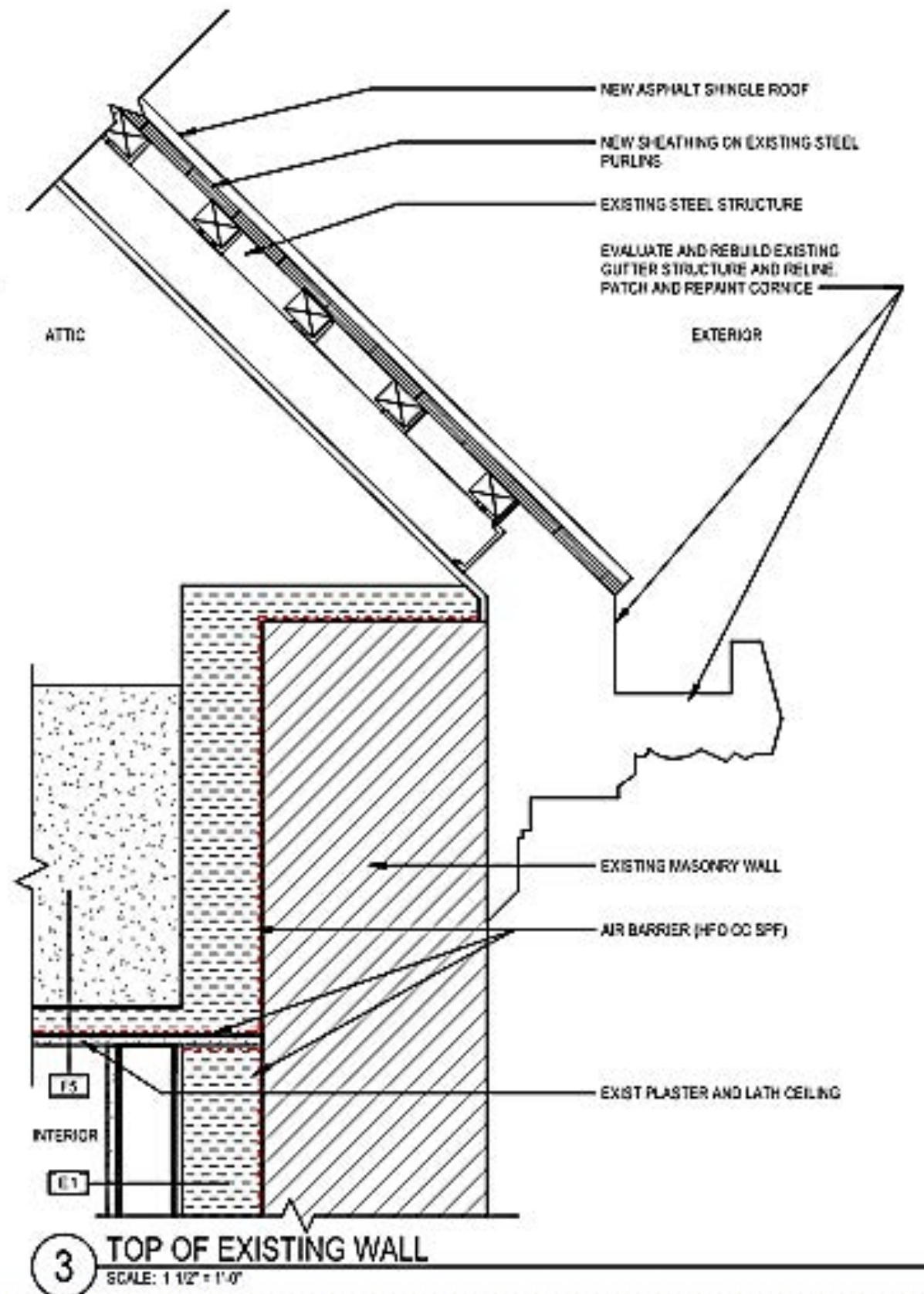
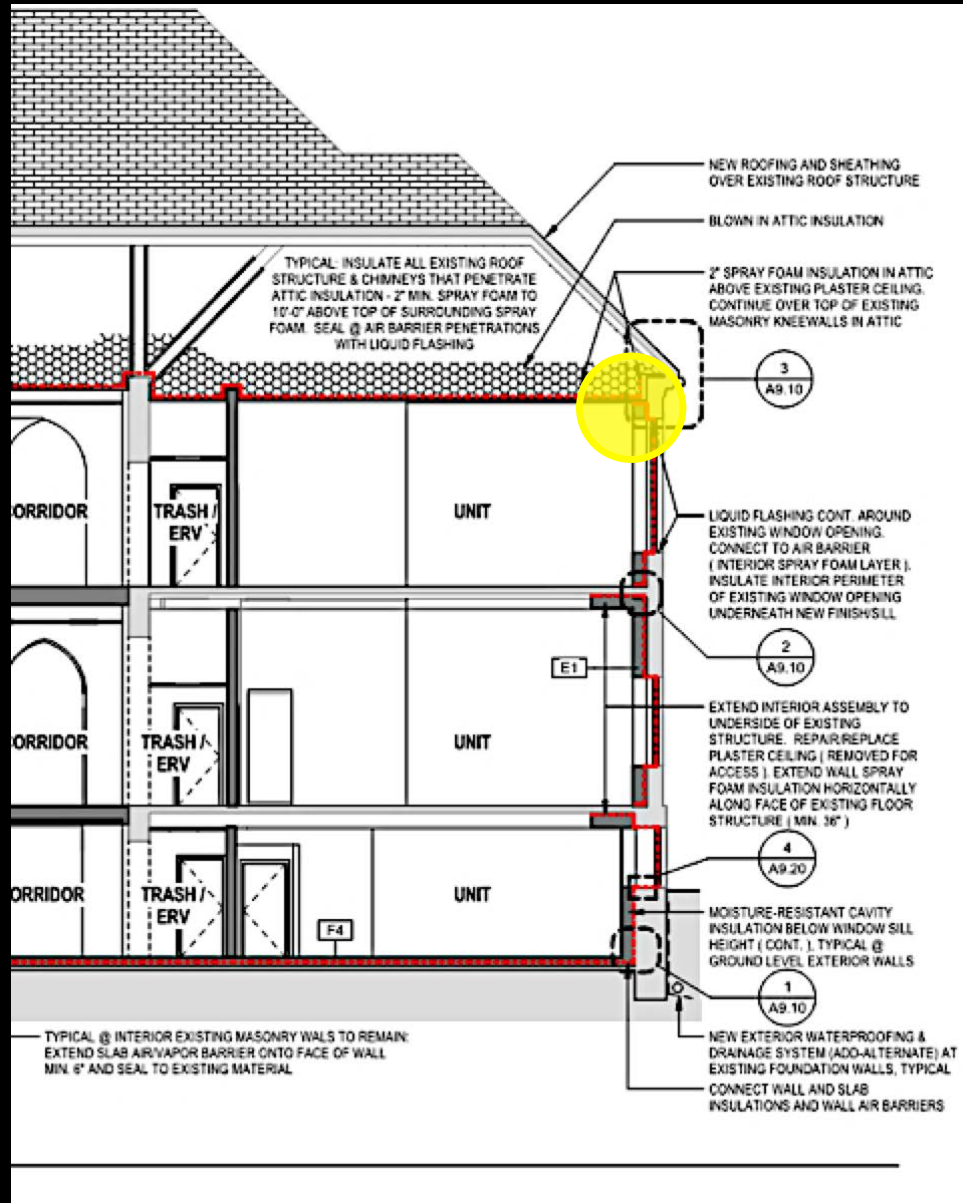
MORNINGSIDE INTERSECTING WALLS

Solutions: Wall to Ceiling



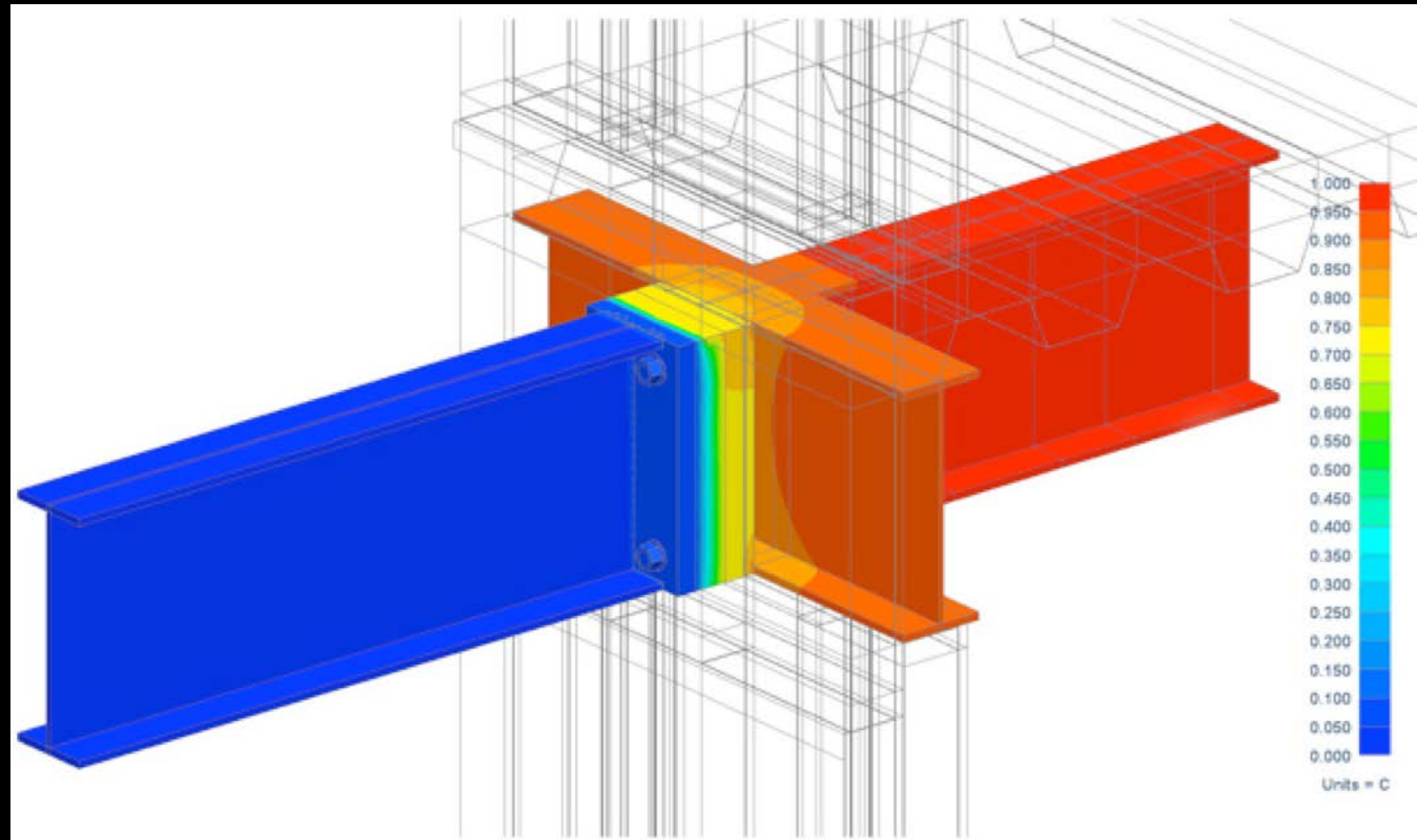
MORNINGSIDE INTERSECTING WALLS

Our Approach



MORNINGSIDE THERMAL BREAK

Steel to Steel



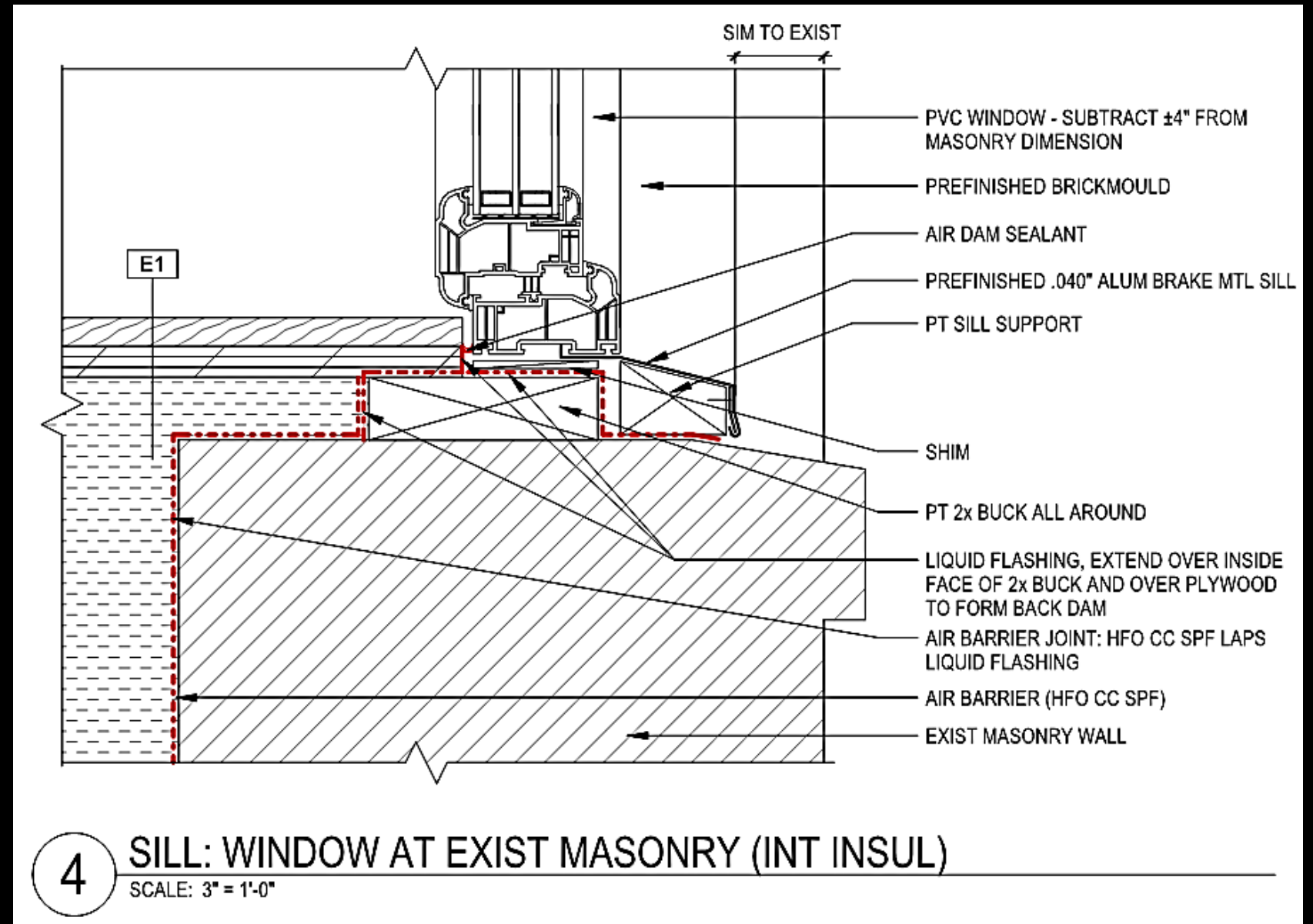
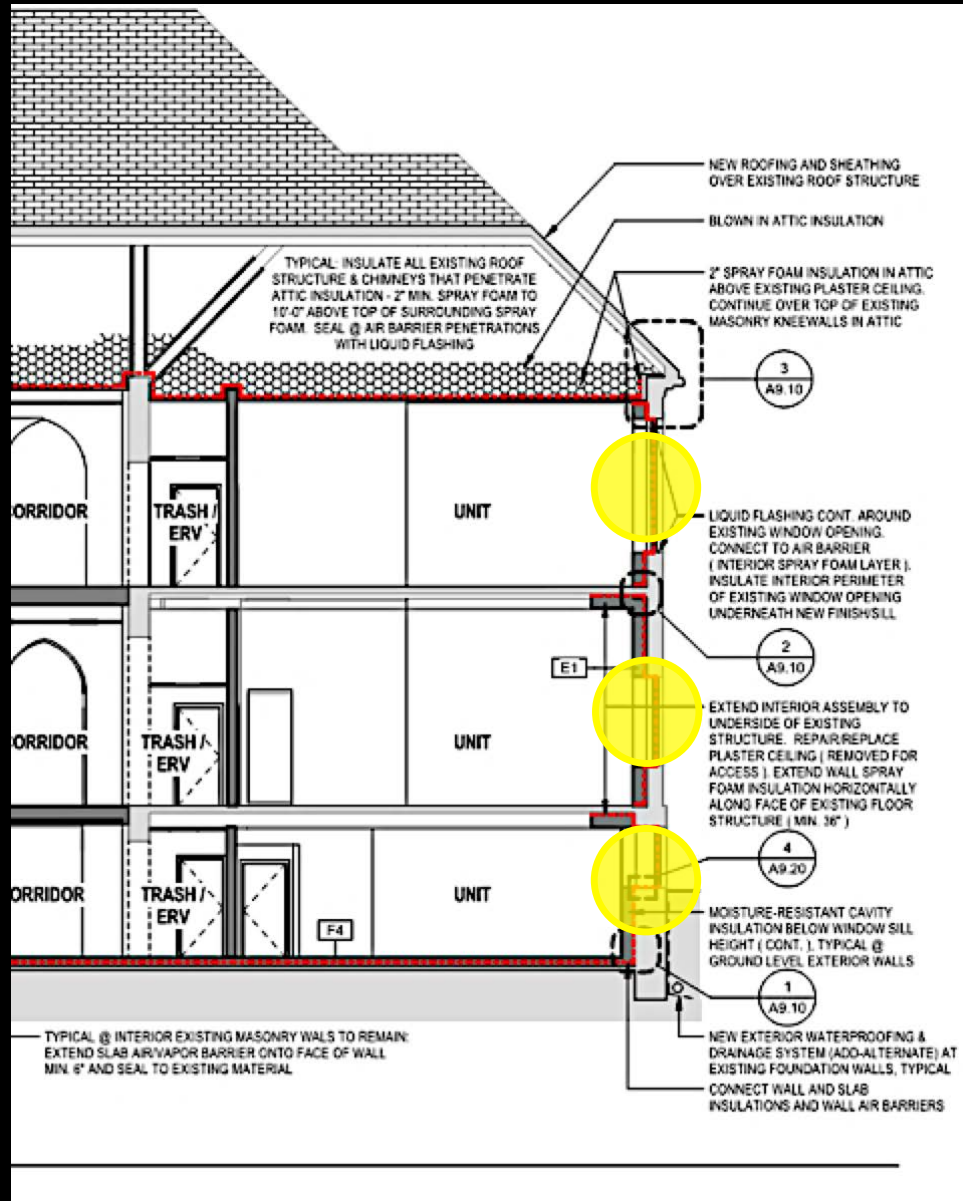
MORNINGSIDE THERMAL BREAK

Steel to Steel



MORNINGSIDE WINDOW ADVENTURE

Our 1st Solution



MORNINGSIDE WINDOW ADVENTURE

A Wake Up Call



MORNINGSIDE WINDOW ADVENTURE

A Wake Up Call

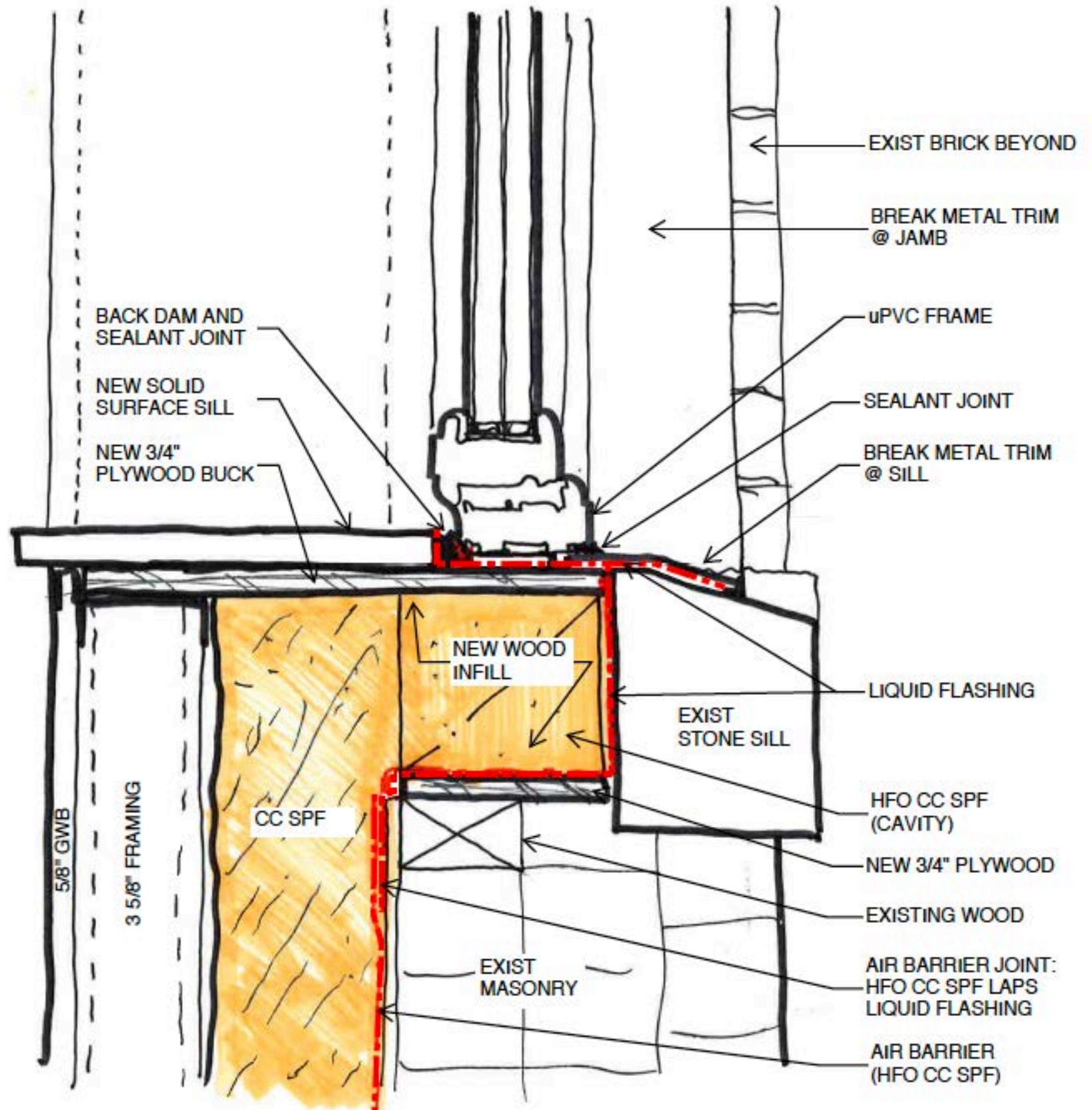


MORNINGSIDE WINDOW ADVENTURE

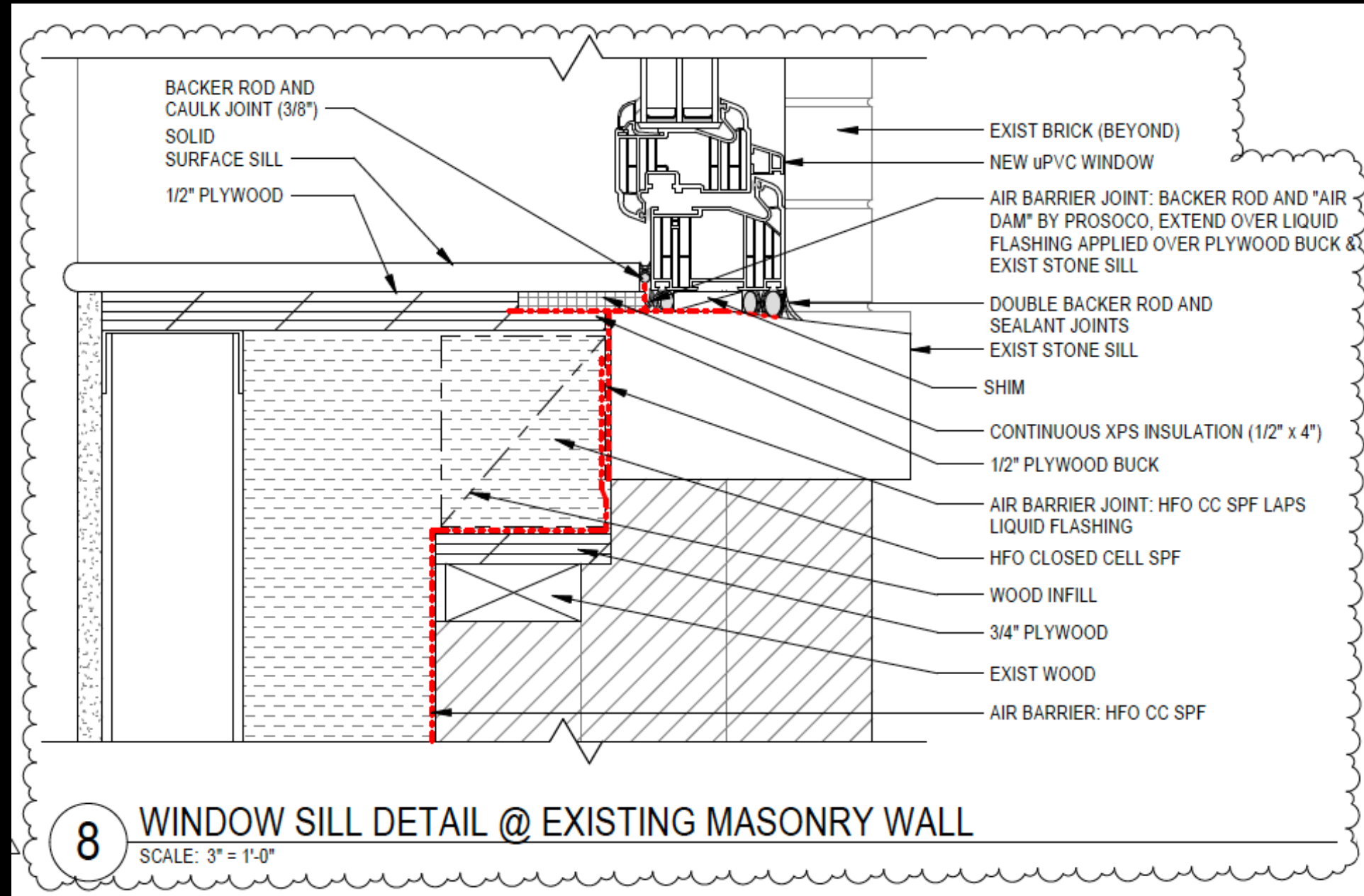
A Wake Up Call



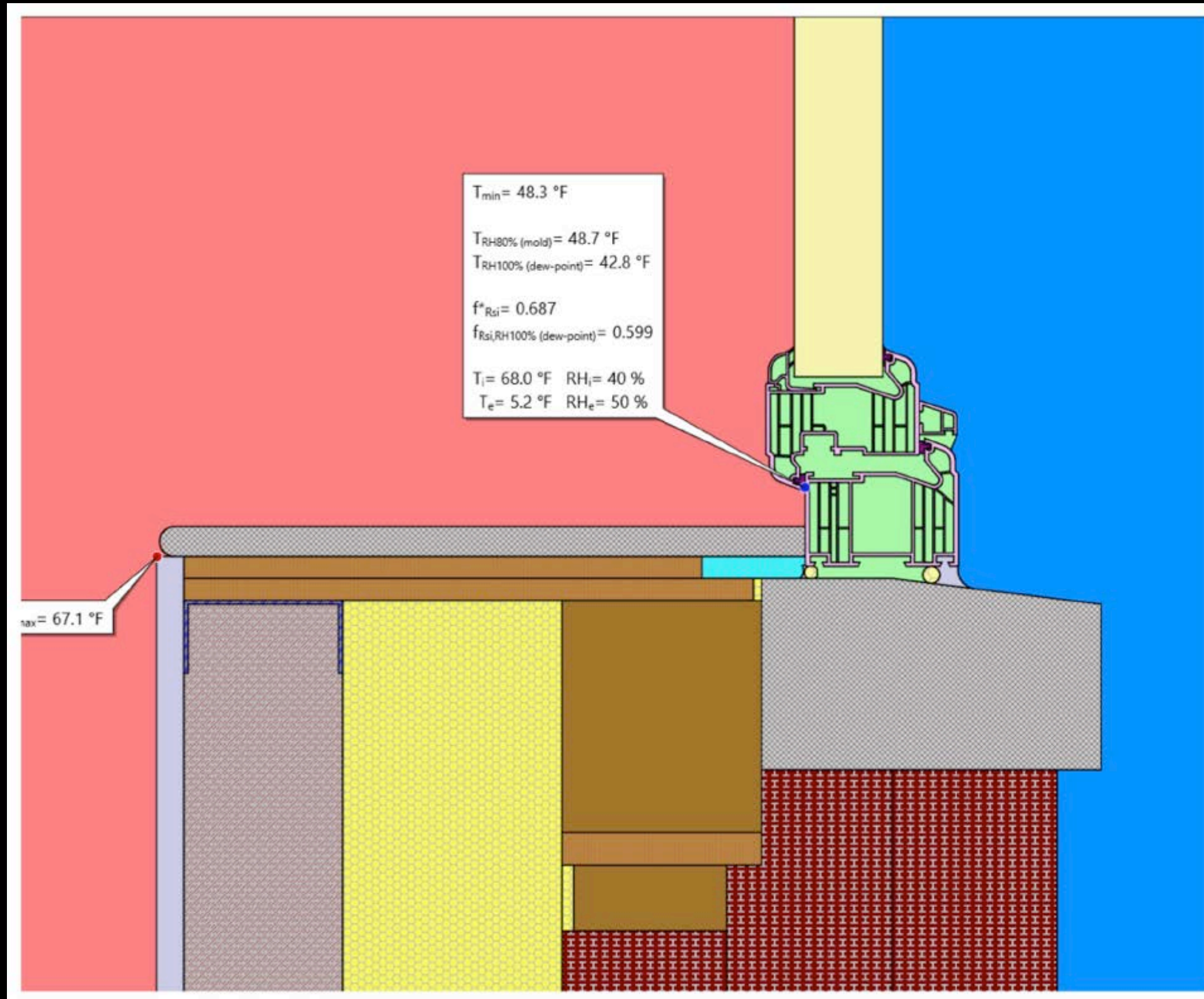
The Evolution



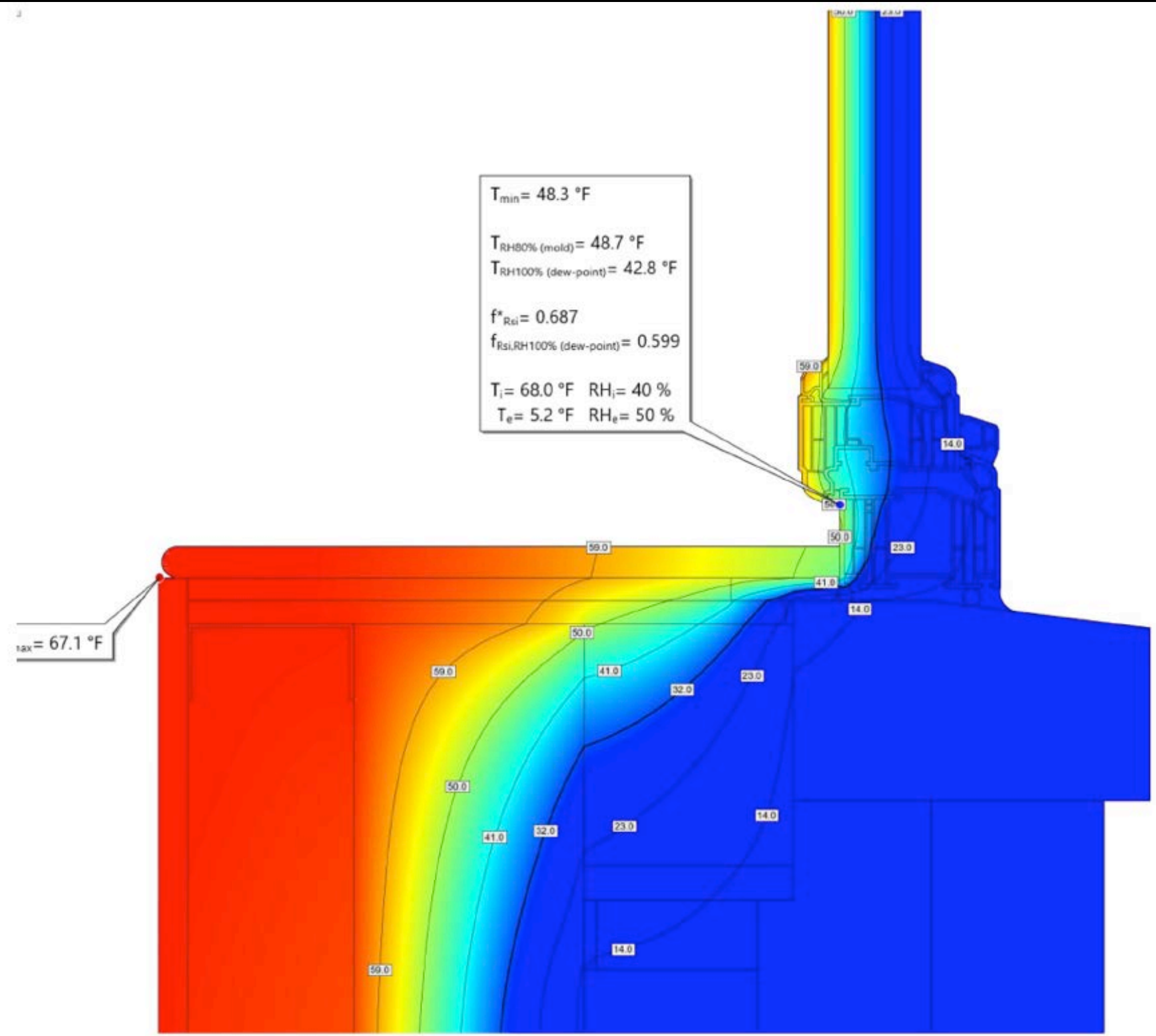
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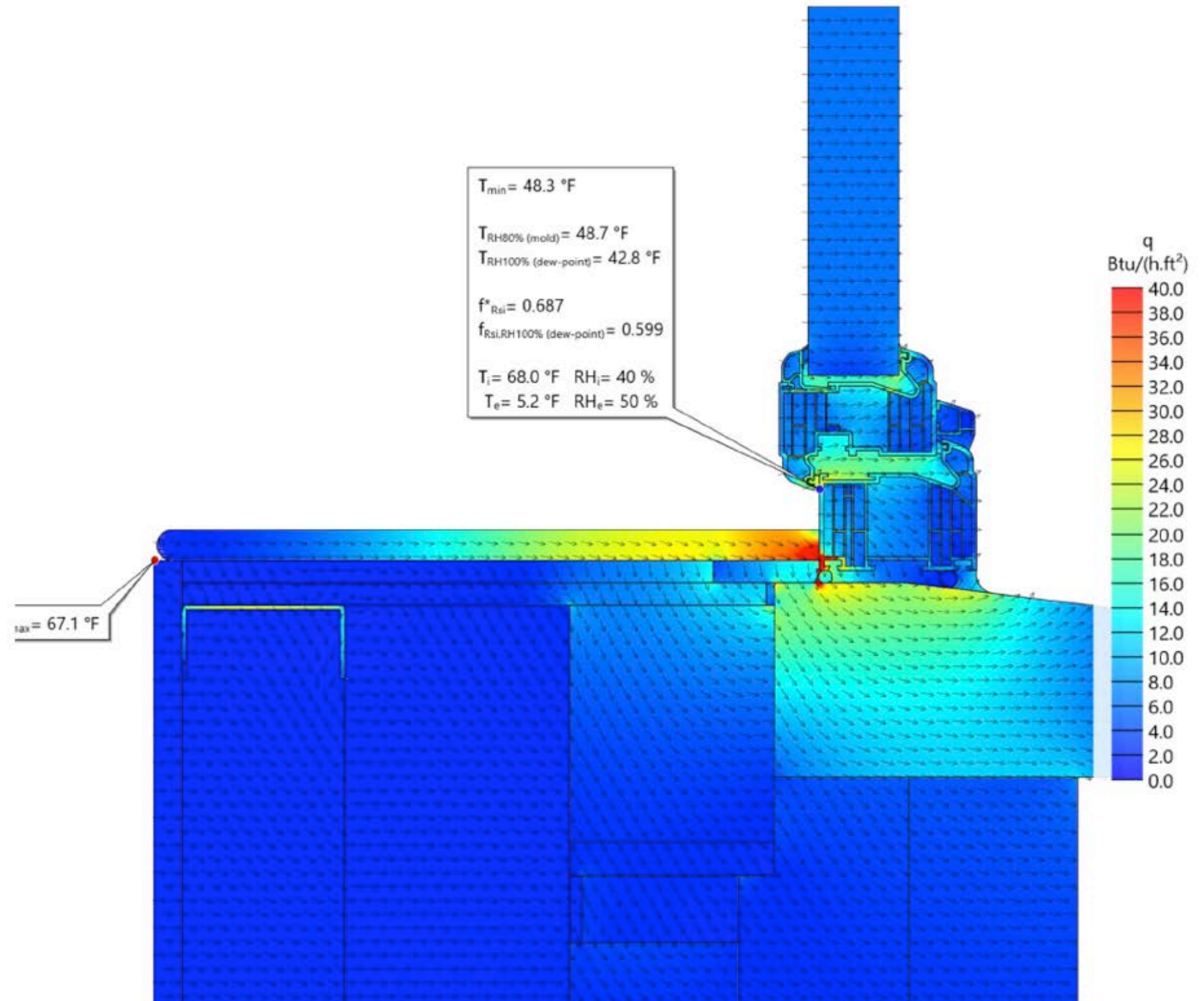
The Evolution



The Evolution



The Evolution



MORNINGSIDE WINDOW ADVENTURE

The Evolution



MORNINGSIDE WINDOW ADVENTURE

The Evolution



MORNINGSIDE WINDOW ADVENTURE

The Evolution



MORNINGSIDE WINDOW ADVENTURE

The Evolution



10	Passive House Premium ROM			PH	PH	46		Comments
11	C.S.I. Description			Upgrade	Upgrade	Cost per	Cost per	
12				Cost	% Delta	SF	Unit	
13								
14	02	Existing Conditions		\$ -	No Change	\$ -	\$ -	
15	03	Concrete		\$ 91,054	+19.2%	\$ 1.55	\$ 1,979.42	4" insul + 3" SOG overlay
16	04	Masonry		\$ -	No Change	\$ -	\$ -	
17	05	Metals		\$ 11,300	+3.8%	\$ 0.19	\$ 245.65	Thermal break steel connections
18	06	Wood, Plastics, and Composites		\$ 44,144	+5.0%	\$ 0.75	\$ 959.65	Additional flooring overlay, window bucks, ZIP VB premium
19	07	Thermal and Moisture Protection		\$ 218,432	+26.7%	\$ 3.71	\$ 4,748.52	Roof Insulation 70, Podium Insulation 40, Spray insulation @ attic ceilings 20, Spray at building walls ILO fiberglass 42, Exterior Additon 2" - 24; misc caulking/sealing 12
20	08	Openings		\$ 57,118	+10.1%	\$ 0.97	\$ 1,241.70	PH windows premium
21	09	Finishes		\$ -	No Change	\$ -	\$ -	
22	10	Specialties		\$ -	No Change	\$ -	\$ -	
23	11	Equipment		\$ -	No Change	\$ -	\$ -	
24	12	Furnishings		\$ -	No Change	\$ -	\$ -	
25	13	Special Construction		\$ -	No Change	\$ -	\$ -	
26	14	Conveying Equipment		\$ -	No Change	\$ -	\$ -	
27	21	Fire Suppression		\$ -	No Change	\$ -	\$ -	
28	22	Plumbing		\$ -	No Change	\$ -	\$ -	
29	23	Heating Ventilating and Air Conditioning		\$ (110,000)	(15.3%)	\$ (1.87)	\$ (2,391.30)	Ballpark
30	25	Integrated Automation		\$ -	No Change	\$ -	\$ -	

30	25	Integrated Automation	\$ -	No Change	\$ -	\$ -
31	26	Electrical	\$ -	No Change	\$ -	\$ -
32	31	Earthwork	\$ -	No Change	\$ -	\$ -
33	32	Exterior Improvements	\$ -	No Change	\$ -	\$ -
34	33	Utilities	\$ -	No Change	\$ -	\$ -
35						
36		Subtotal Trades Cost	\$ 312,048	3.6%	\$ 5.30	\$ 6,783.65
37						
38		Fabreeka Pads	\$ 9,481	N/A	\$ 0.16	\$ 206.12
39		Added Sealing Existing Building	\$ 16,839	N/A	\$ 0.29	\$ 366.06
40		Polyiso @ Specific Walls	\$ 16,225	N/A	\$ 0.28	\$ 352.72
41		Ceiling Modifications @ Existing	\$ 8,640	N/A	\$ 0.15	\$ 187.83
42		Insulated Headers	\$ 3,870	N/A	\$ 0.07	\$ 84.13
43		2 pass spray foam	\$ 8,727	N/A	\$ 0.15	\$ 189.72
44		Added Liquid Flashing	\$ 12,840	N/A	\$ 0.22	\$ 279.13
45						
46		Subtotal Cost	\$ 76,622	0.9%	\$ 1.30	\$ 1,665.70
47						
48						
49		Total Cost	\$ 388,670	4.5%	\$ 6.60	\$ 8,449.35

PENNSYLVANIA

Policy Context: PHFA

Pennsylvania Housing Finance Agency

Passive House confers advantage in competition for LIHTCs (Low Income Housing Tax Credits).

PHFA's LIHTCs are highly competitive: only 1 in 4 project proposals are awarded LIHTCs.

Projects that pursue Passive House earn 10 bonus points out of a total of 130 possible points.

59 of 179 projects pursued Passive House during first two years of PHFA's new policy.

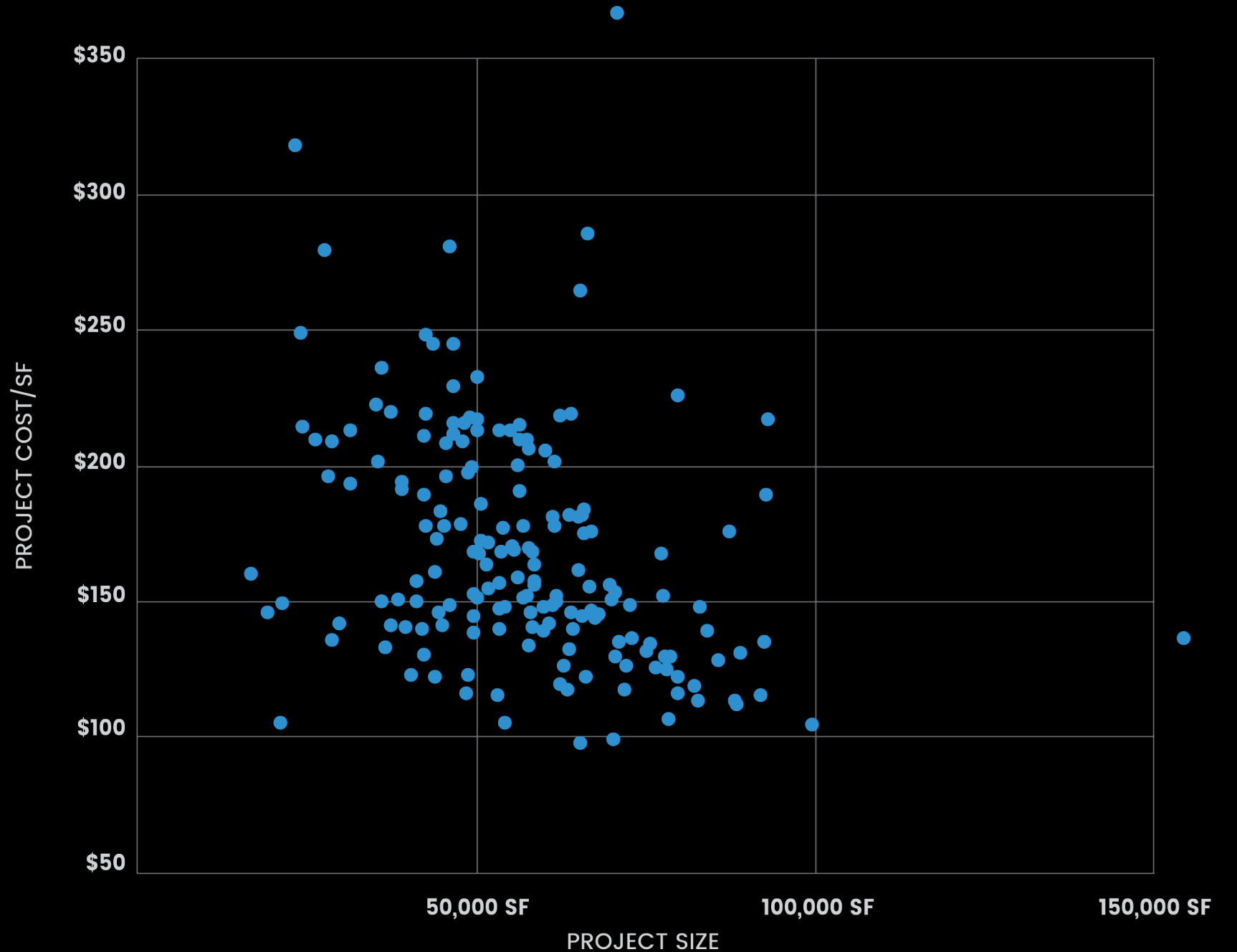
Competition spurred innovation. Innovation cut costs.

PENNSYLVANIA

Policy Context

179 Projects Proposed to Pennsylvania Housing Finance Agency, 2015-2016.

Projected Construction Cost

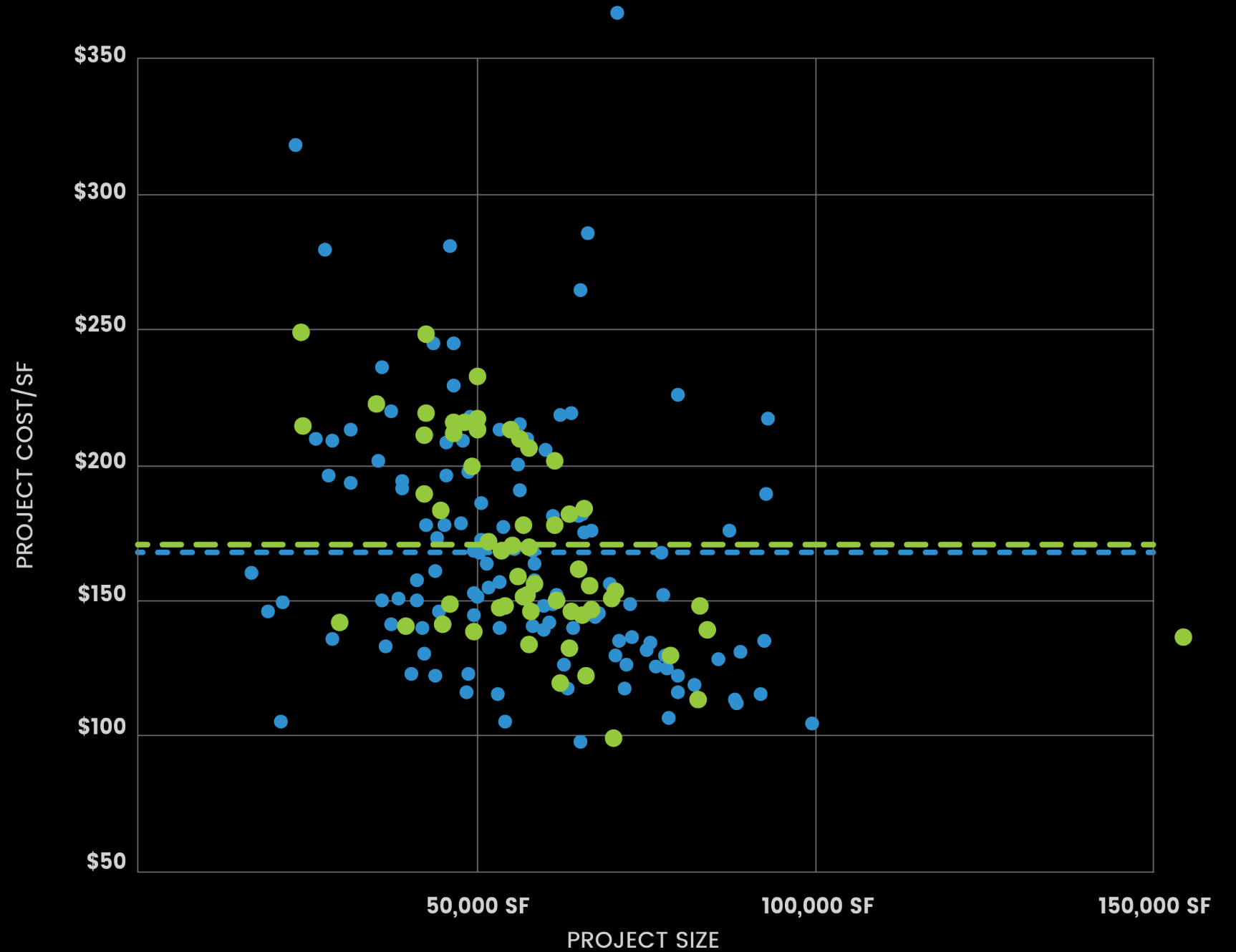


PENNSYLVANIA

Policy Context

59 Passive House Projects Proposed to PHFA, 2015-2016.

Passive House vs. Conventional –
Less than 2% Difference in Construction Cost.



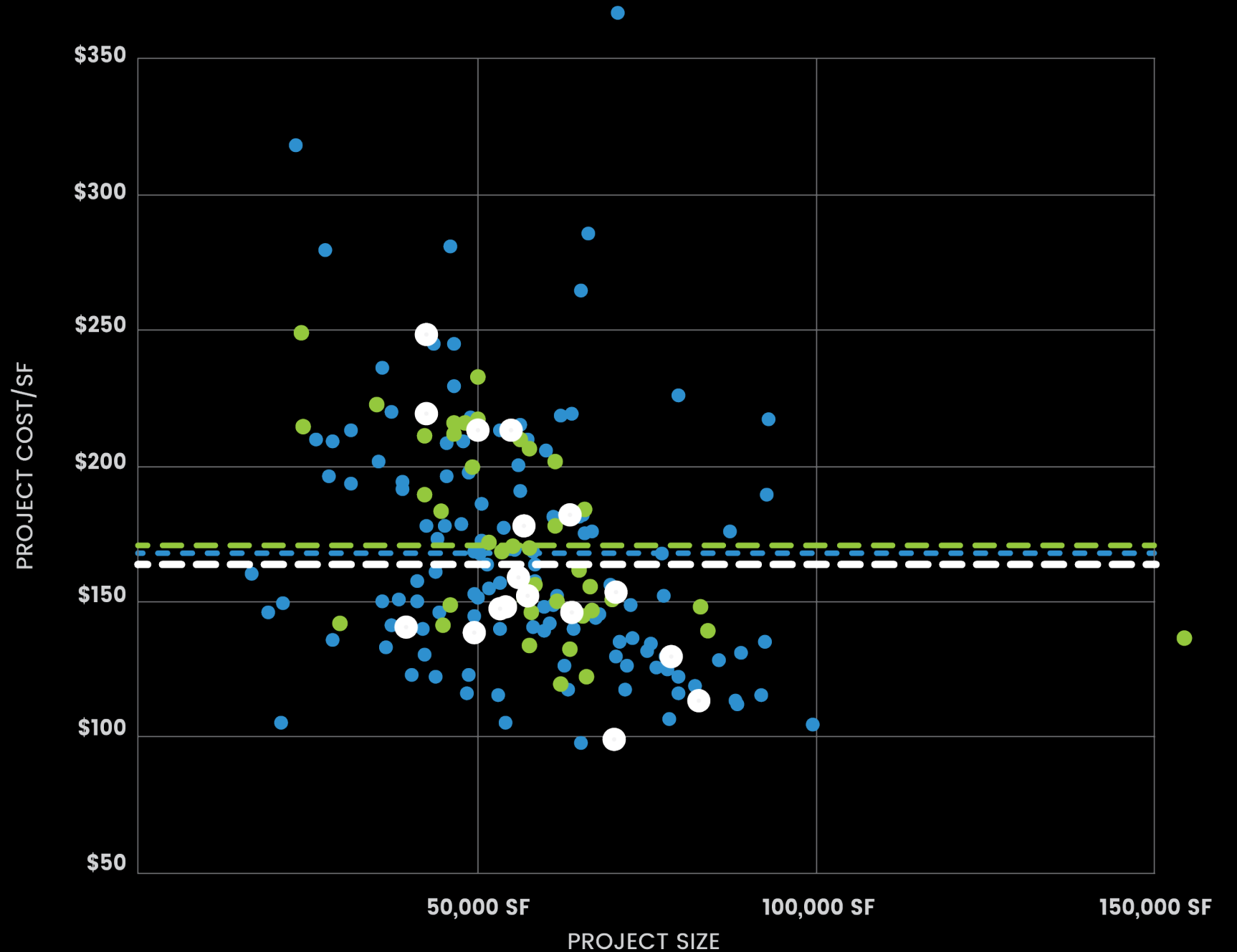
■ PASSIVE HOUSE (Total=59)
■ CONVENTIONAL (Total=120)

--- AVG PASSIVE HOUSE = \$171/SF
--- AVG CONVENTIONAL = \$168/SF

PENNSYLVANIA

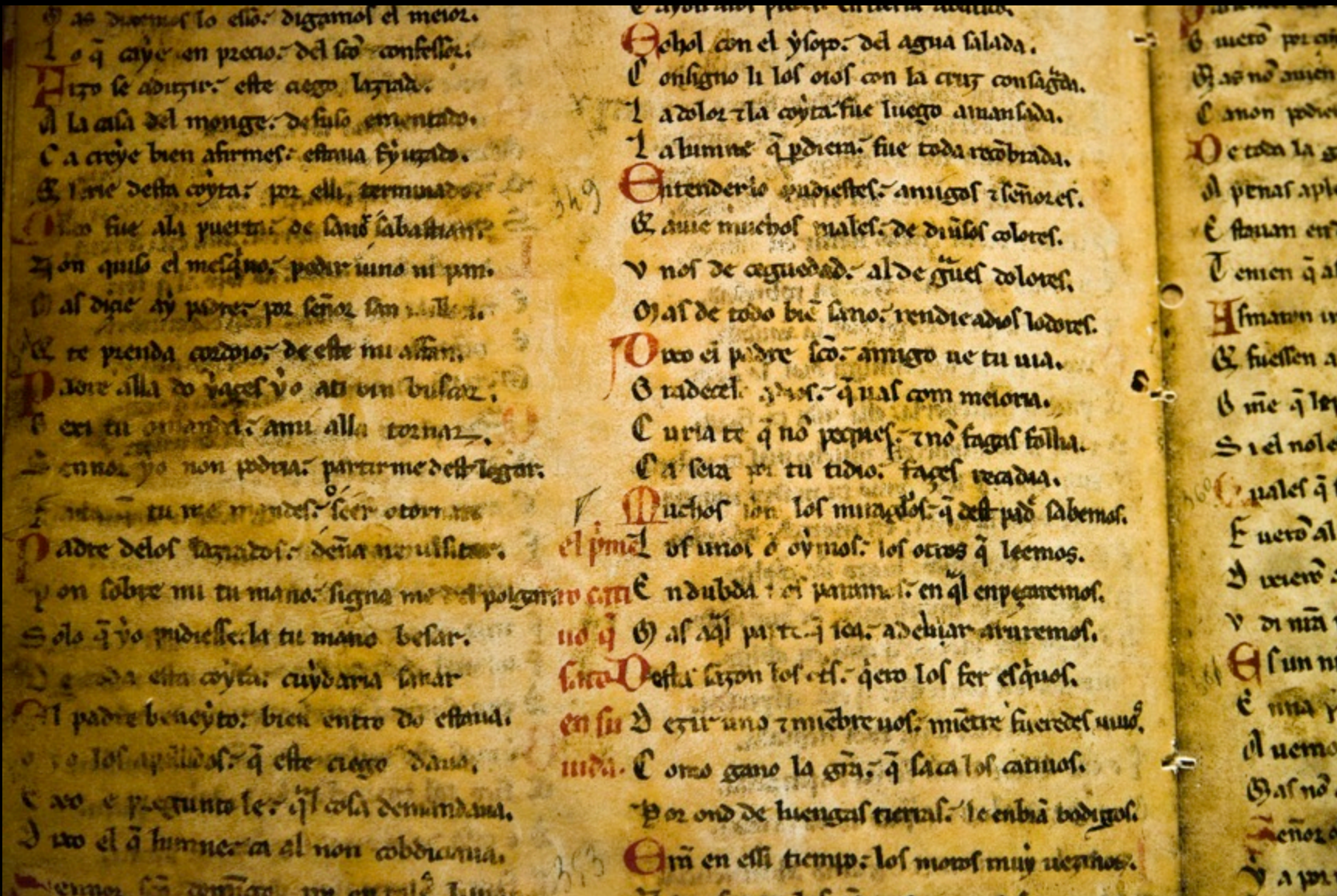
Policy Context

18 Passive House Projects Awarded by PHFA, 2015-2016.



- PASSIVE HOUSE (Total=59)
- PH AWARDED (Total=18)
- CONVENTIONAL (Total=120)
- AVG PASSIVE HOUSE = \$171/SF
- AVG CONVENTIONAL = \$168/SF
- AVG PH AWARDED = \$163.50/SF

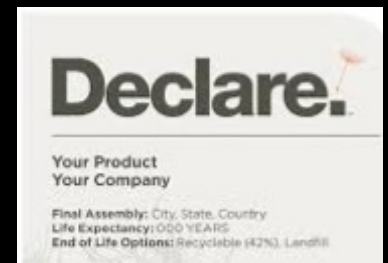
The Market Is Changing...



The Market Is Changing...



The Market Is Changing...



Lessons Learned



**Two Passive House Case Studies for New and Retrofit
Affordable Senior Housing in Pittsburgh**

Laura Nettleton • Rebecca Griffith