A Survey of High-Performance Building Retrofits in the North-East US

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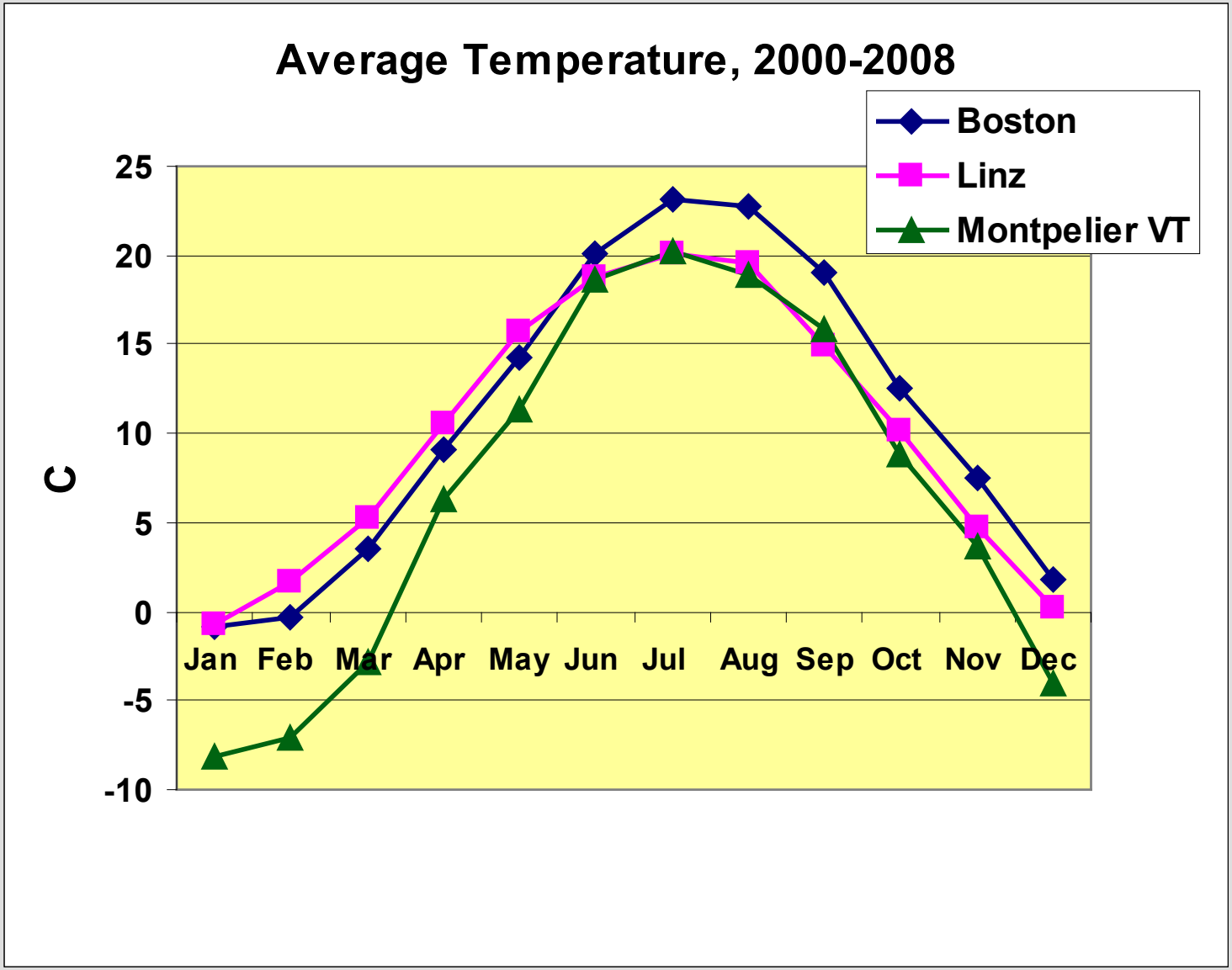
North-East US *vs* Linz Austria Climate



Bill Maclay, Principal
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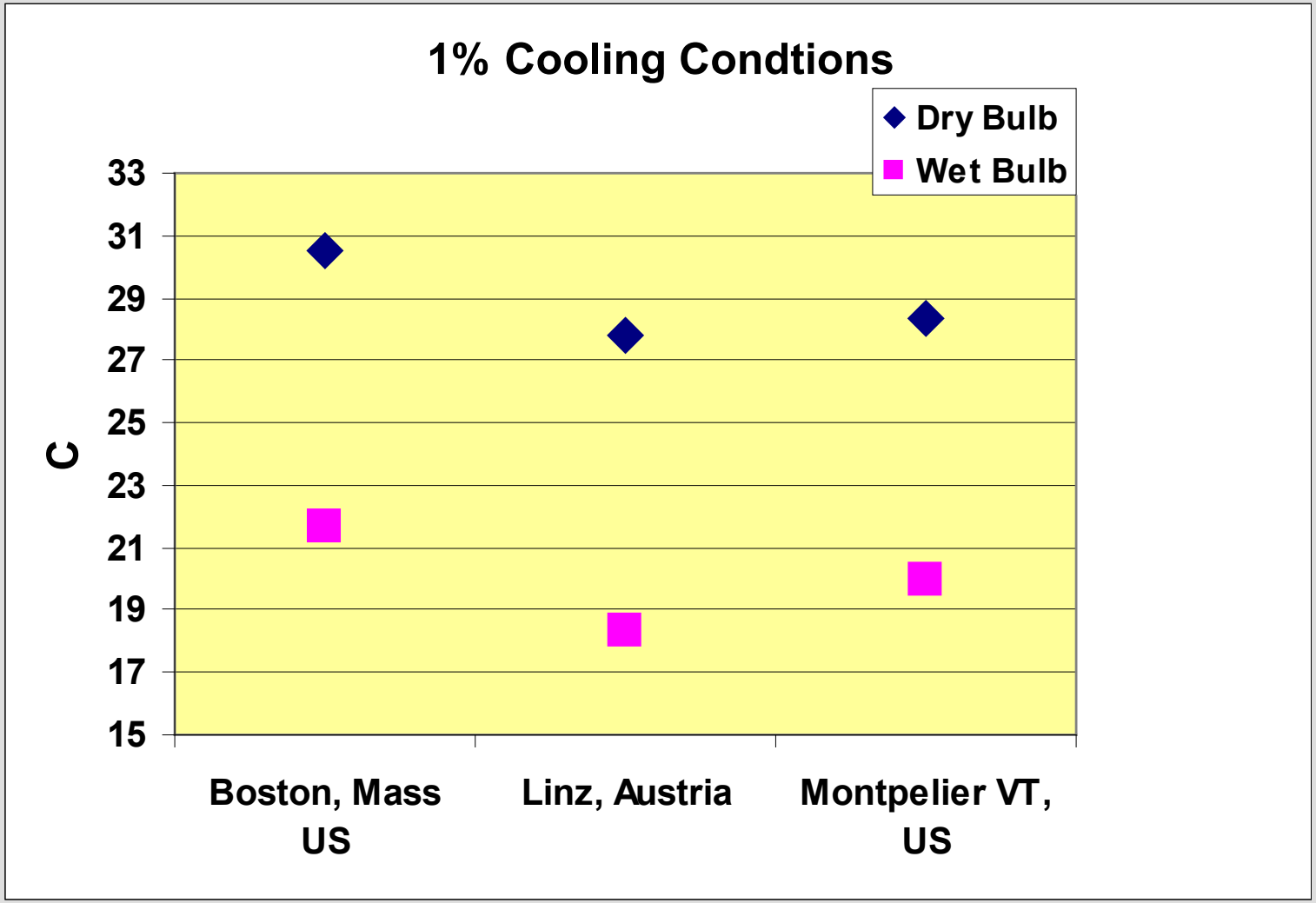
North-East US *vs* Linz Austria Climate



Bill Maclay, Principal
Maclay Architects

University of Vermont School of Natural Resources Renovation, George D. Aiken Center

William Maclay, Maclay Architects

BUILDING TYPE:
University Office and Classroom

SCOPE
Renovation of 1960's era building & Addition

PROJECT SIZE	**3,900 sq.m**
PROJECT COST	**$7,750,000 (562,000Euro)**
	$1980 (1430 Euro)/sq.m

ENERGY INTENSITY (existing): 281 kWh/sq.m-a
ENERGY INTENSITY (modeled): 73 kWh/sq.m-a

MECHANICAL SYSTEMS:

- **District heating and cooling from University system.**
- **Fan coils in offices, oversized so fan does not run for heating.**
- **Heat and moisture recovery ventilation.**
- **Occupancy control of temperature and ventilation**
- **Daylighting and occupancy control of lighting**

South Elevation View

Proposed Elevation

0 8' 16' 32'
SCALE: 3/32"= 1'-0"

George D. Aiken Center - University of Vermont

WILLIAM MACLAY ARCHITECTS & PLANNERS - 4509 Main Street, Waitsfield, VT 05673 - 1.802.496.4004 - www.maclayarchitects.com

South Elevation

1/08/09


George D. Aiken Center

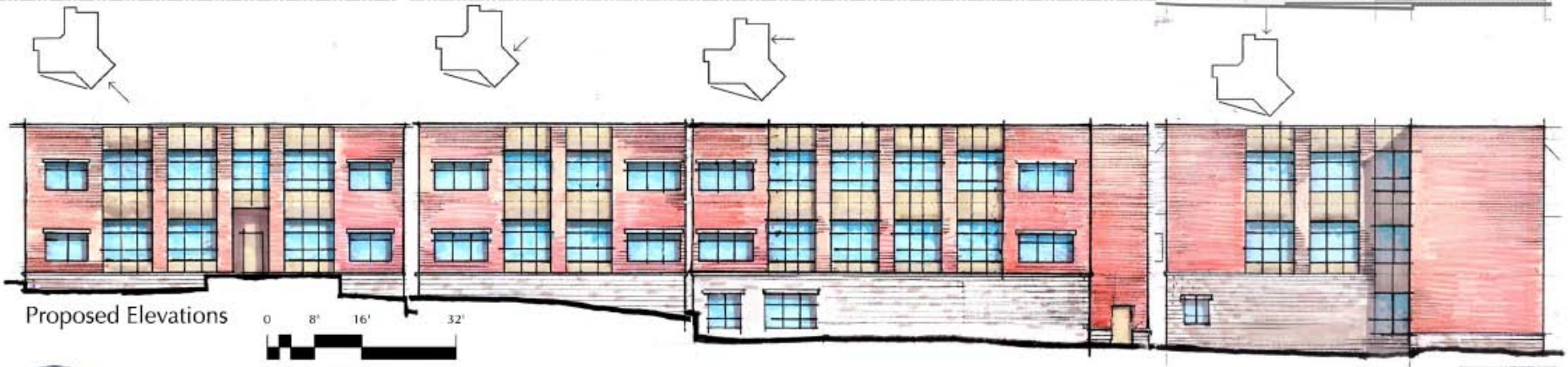
South East elevation view

North East elevation view

East elevation view

North elevation view

Existing Elevations



Proposed Elevations

0 8' 16' 32'

SCALE: 1/16" = 1'-0"

George D. Aiken Center - University of Vermont

Elevation Concepts Part 1 of 2

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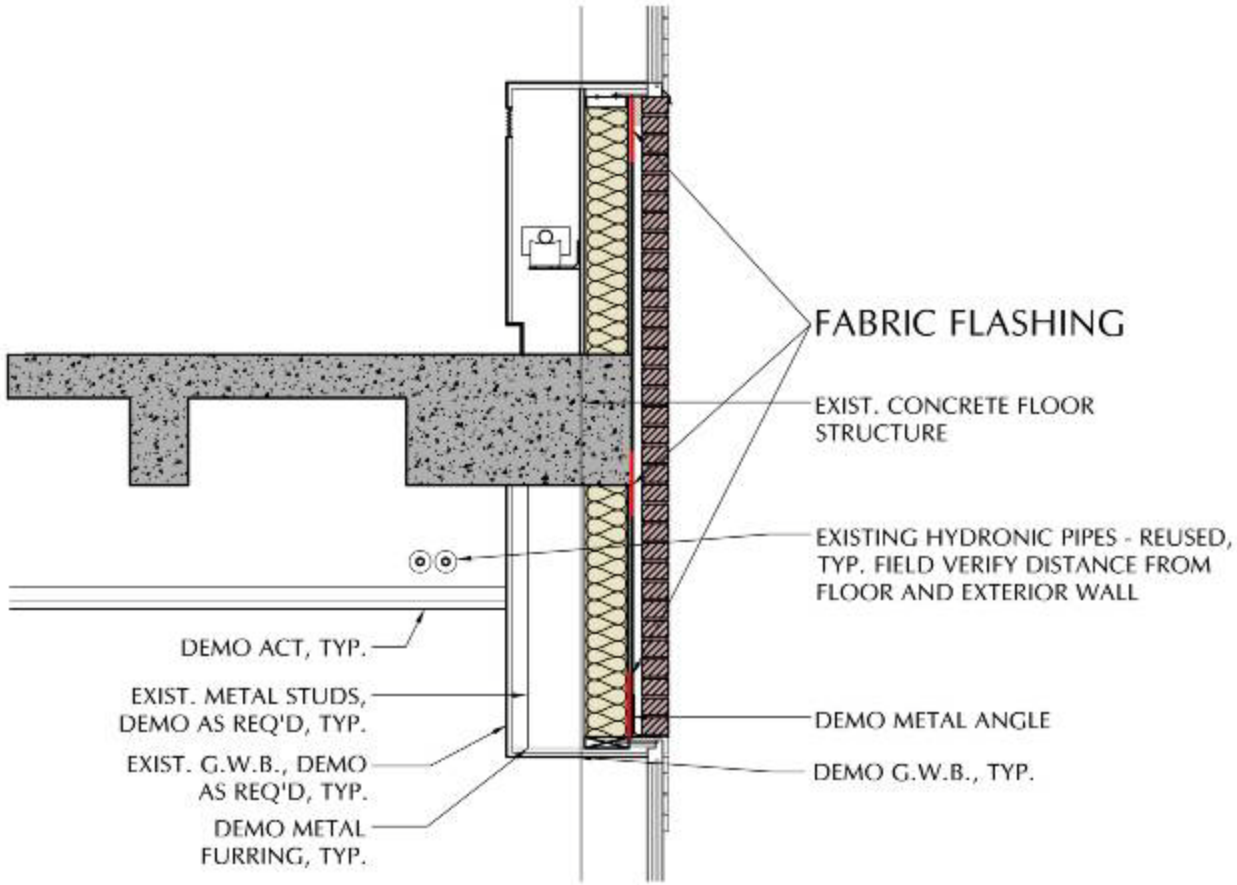
11/18/09


LINCOLN BROWN ILLUSTRATION

Aiken Existing Conditions

Aiken Existing Detail at Floor Slab

U = 1.4 W/sq.m-K

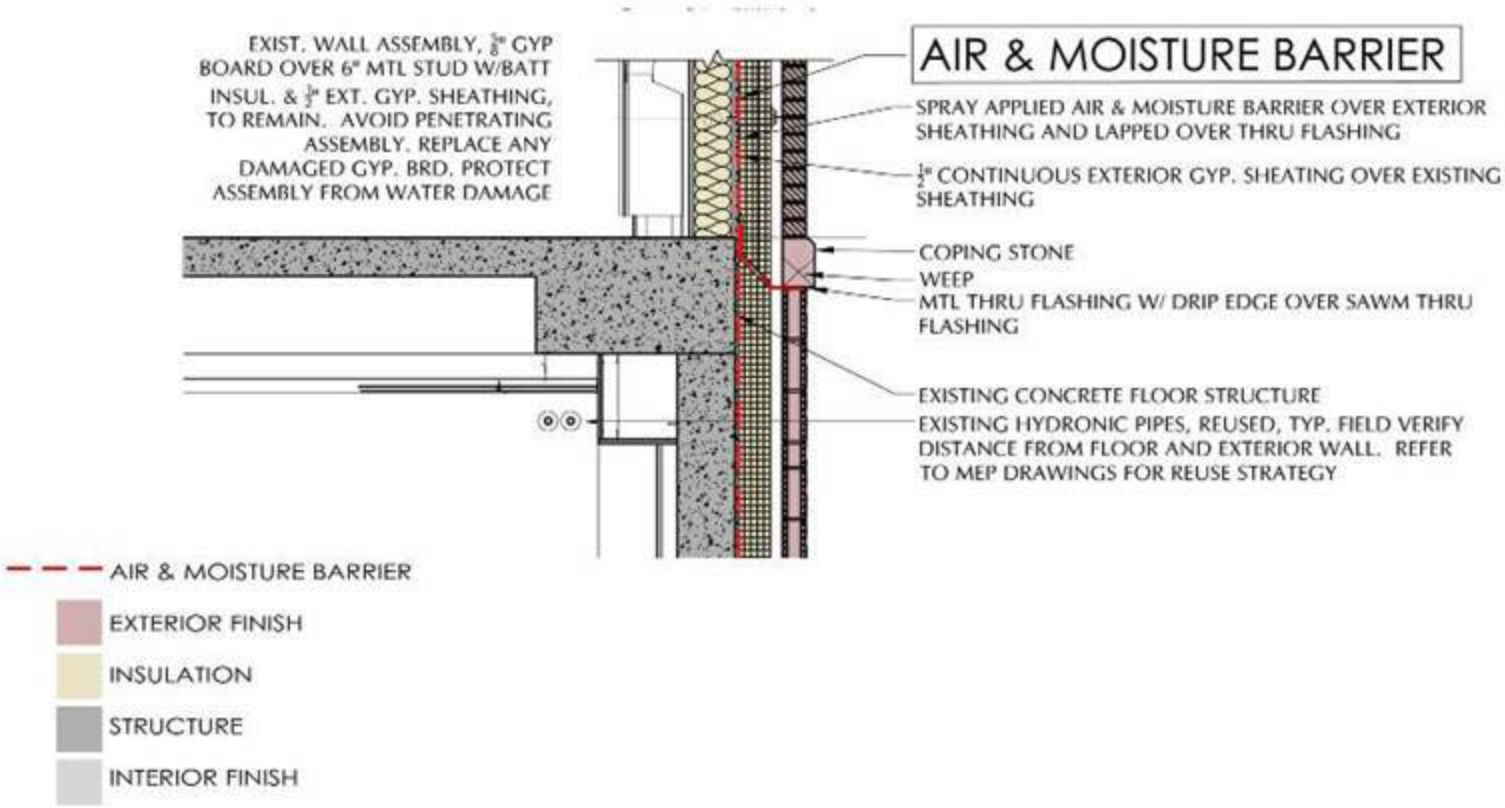


EXTERIOR FINISH
INSULATION
STRUCTURE
INTERIOR FINISH

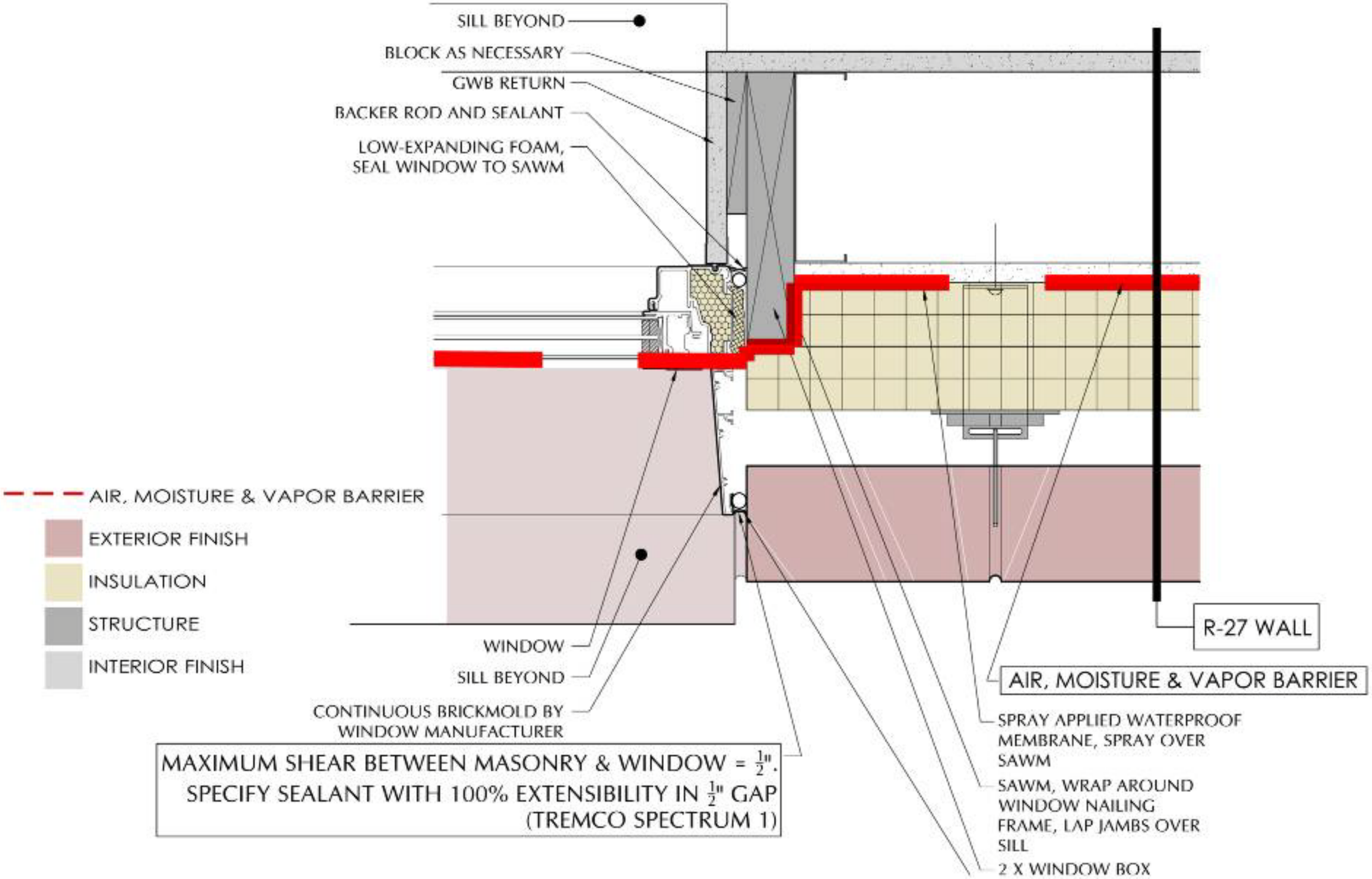
WALL SECTION AT FLOOR SLAB- EXISTING

Aiken New Detail at Floor Slab

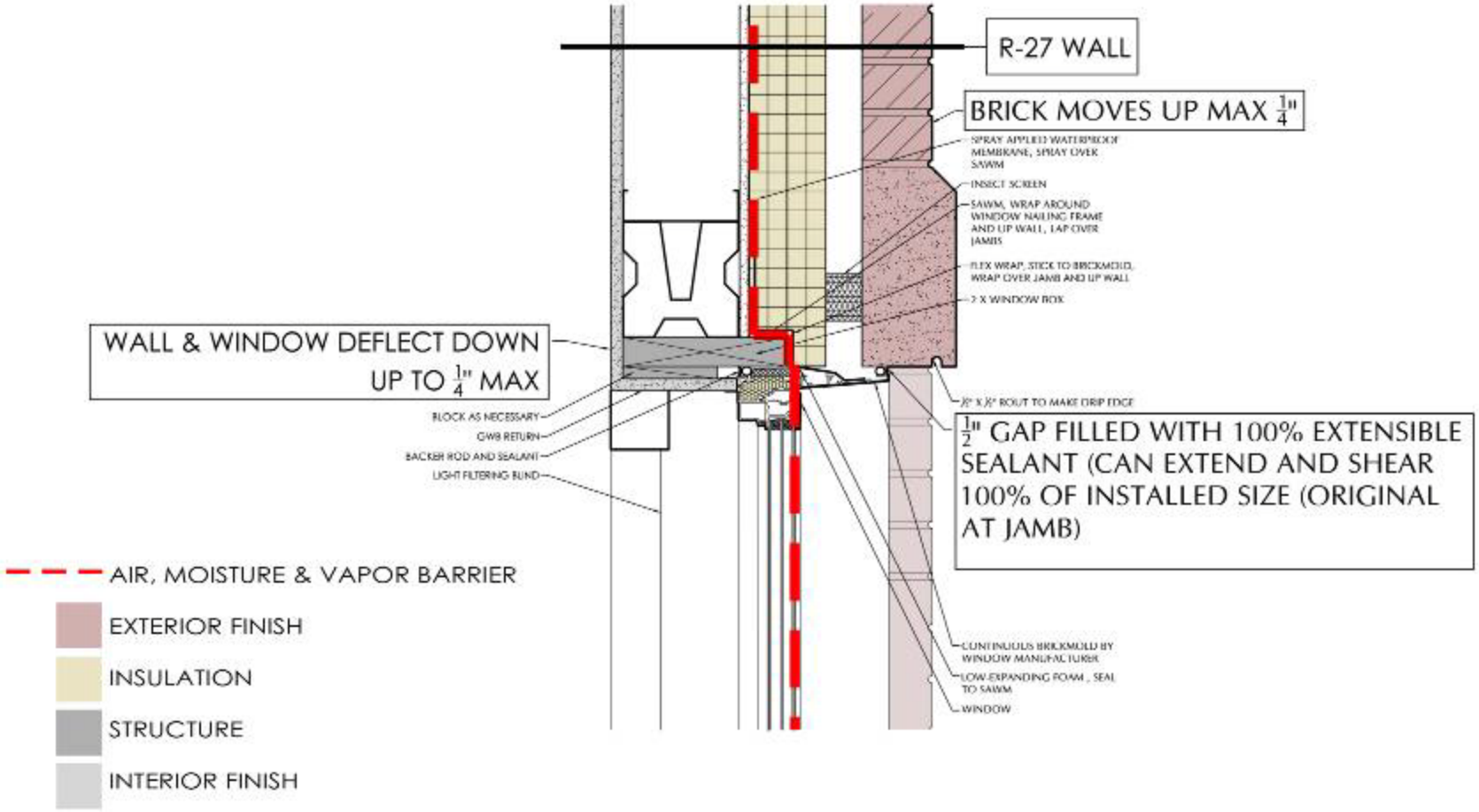
U = 0.23 W/sq.m-K



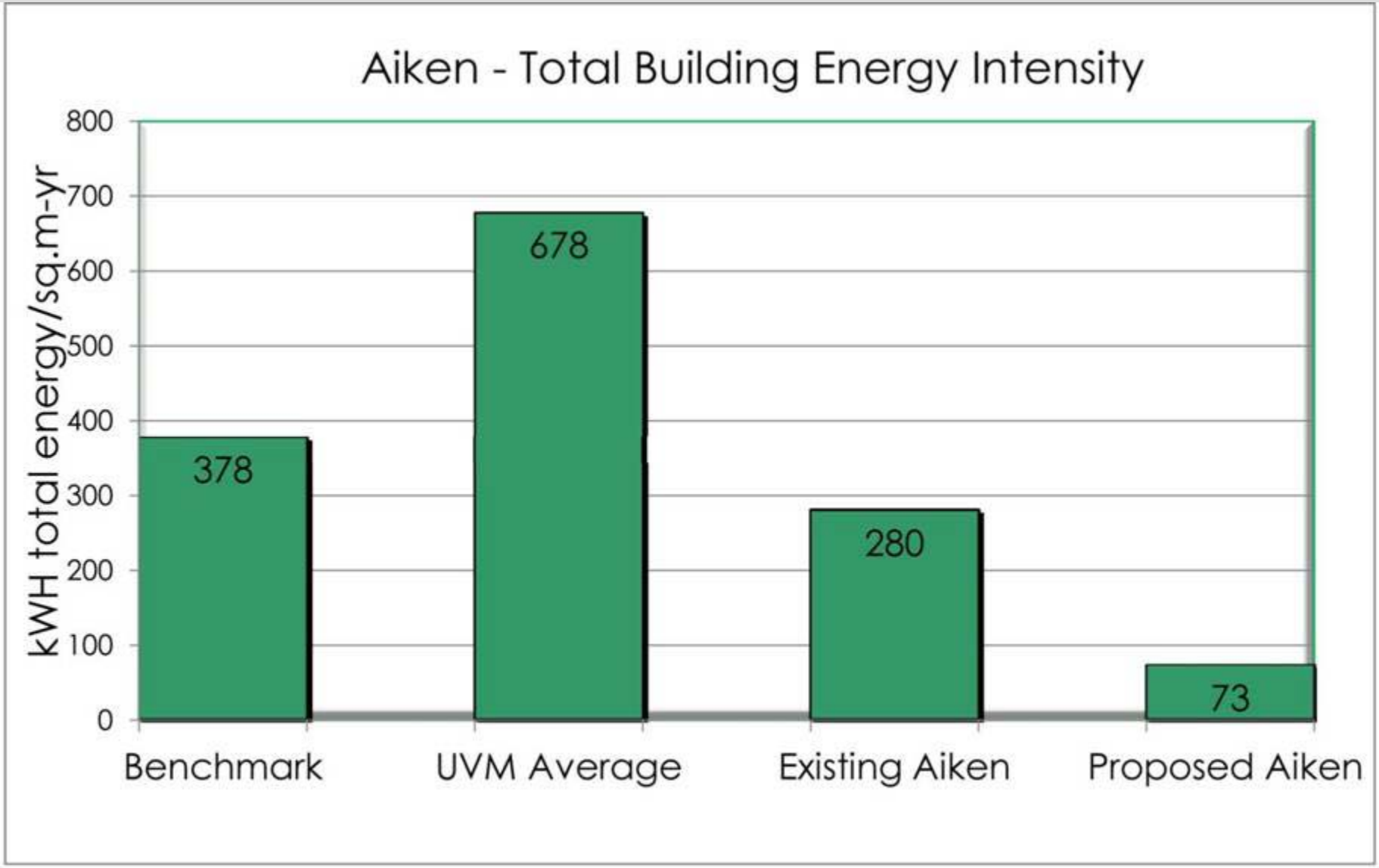
WALL SECTION AT FLOOR SLAB- NEW CONSTRUCTION



3: WINDOW JAMB DETAIL- NEW CONSTRUCTION



2: WINDOW HEAD- NEW CONSTRUCTION


Aiken - Total Building Energy Intensity
kWH total energy/sq.m-yr
800
700
600
500
400
300
200
100
0
378
678
280
73
Benchmark
UVM Average
Existing Aiken
Proposed Aiken

Bennington Downtown State Office Building

Bennington Downtown State Office Building

BUILDING TYPE: Historic Building, State Offices and Community College

SCOPE: Renovation & Addition

PROJECT SIZE: 2,200 sq.m, 45% new construction
PROJECT COST: $2,700,000 (1,957,000 Euro) in 2001
$1280 (928 Euro) /sq.m.

ENERGY INTENSITY: 150 kWh/sq.m-a

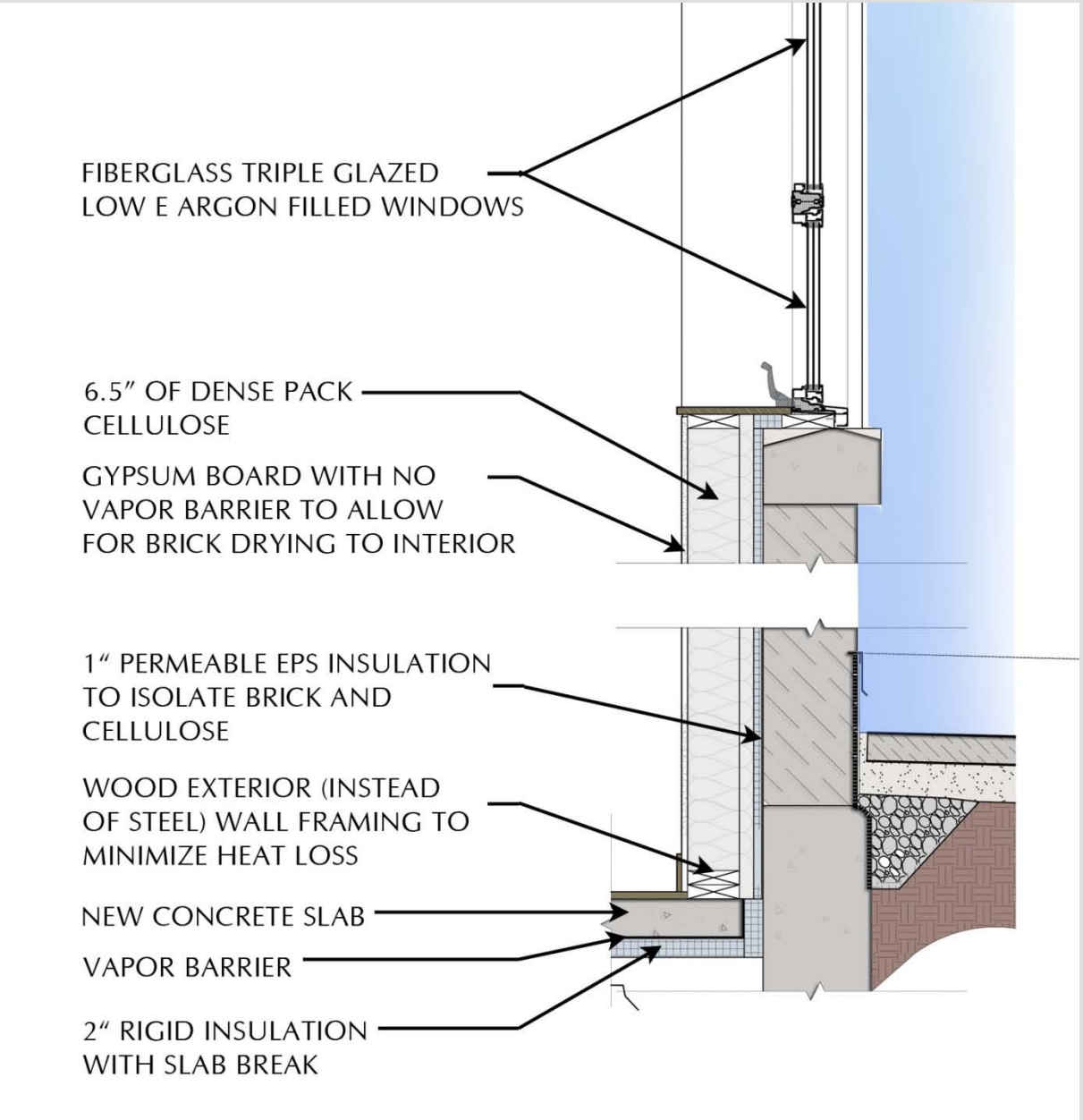
MECHANICAL SYSTEMS:

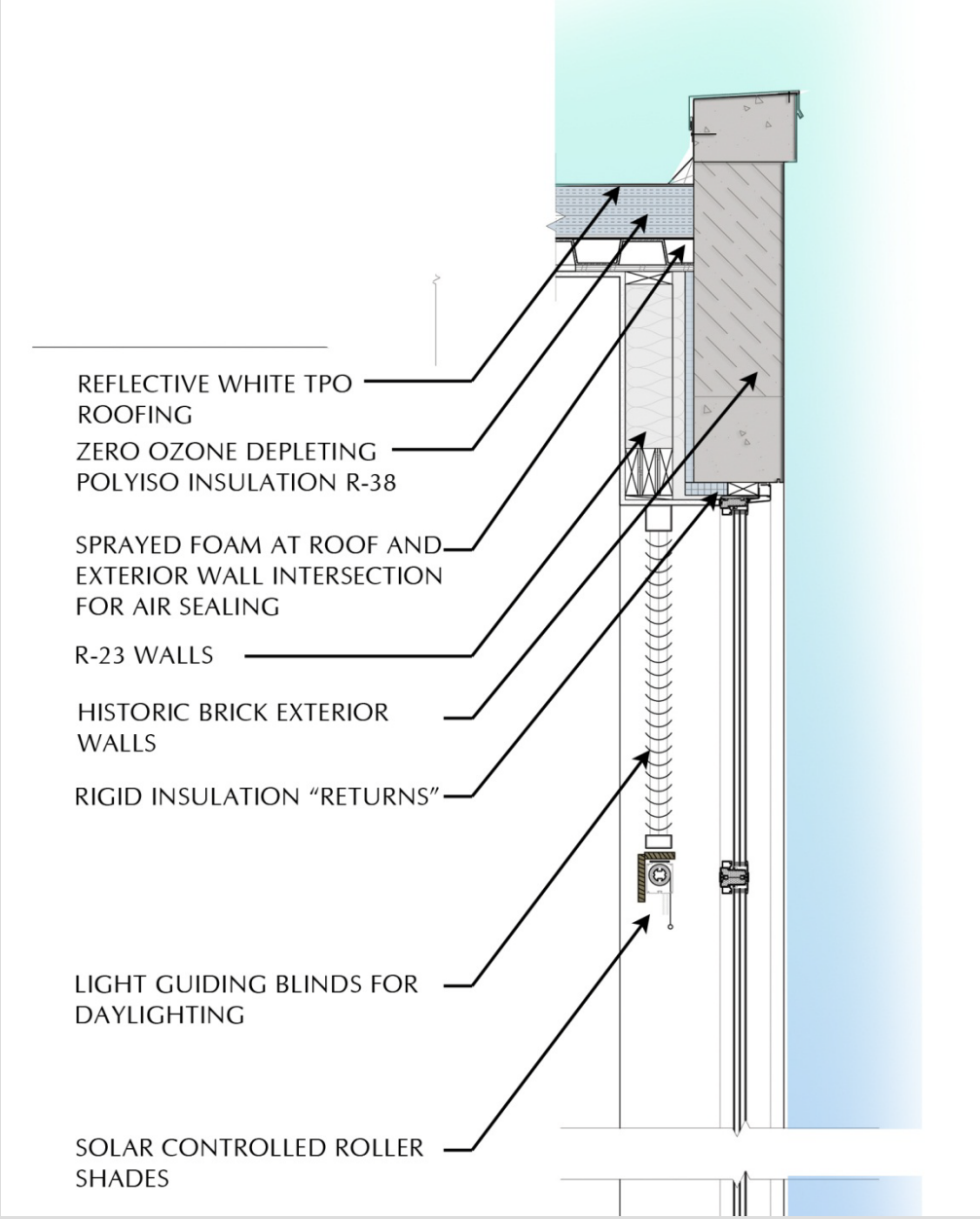
- Earth coupled heat pump with gas backup; open loop due to very high water table, underground river only 8 m below surface
- Heat and moisture recovery ventilation
- Daylighting and occupancy control of lighting

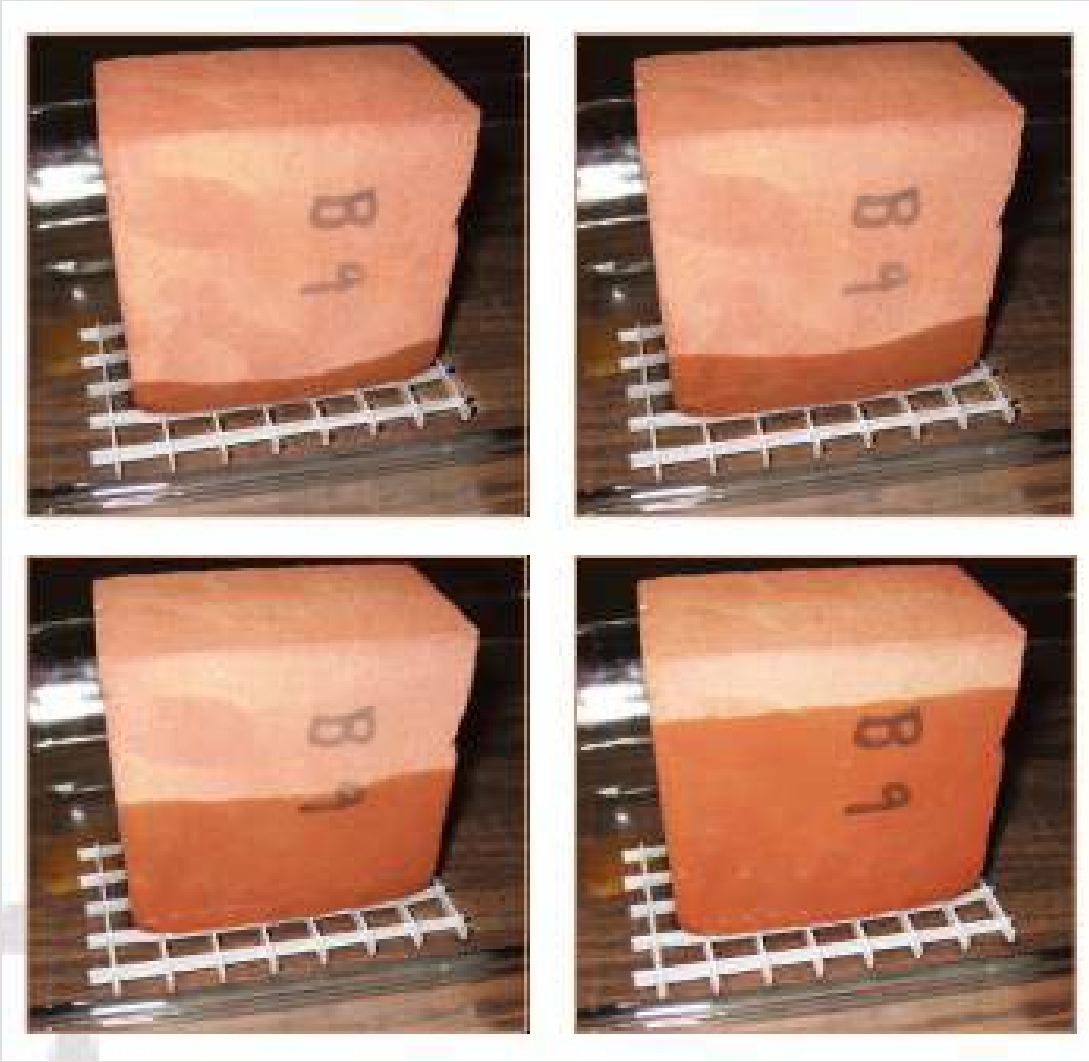
Historic automotive showroom & garage

Contributing building to downtown historic district

- Historic industrial windows
- Retrofit with high-performance windows
- Masonry & parapet restoration
- Energy conservation


FIBERGLASS TRIPLE GLAZED
LOW E ARGON FILLED WINDOWS
6.5" OF DENSE PACK
CELLULOSE
GYPSUM BOARD WITH NO
VAPOR BARRIER TO ALLOW
FOR BRICK DRYING TO INTERIOR
1" PERMEABLE EPS INSULATION
TO ISOLATE BRICK AND
CELLULOSE
WOOD EXTERIOR (INSTEAD
OF STEEL) WALL FRAMING TO
MINIMIZE HEAT LOSS
NEW CONCRETE SLAB
VAPOR BARRIER
2" RIGID INSULATION
WITH SLAB BREAK

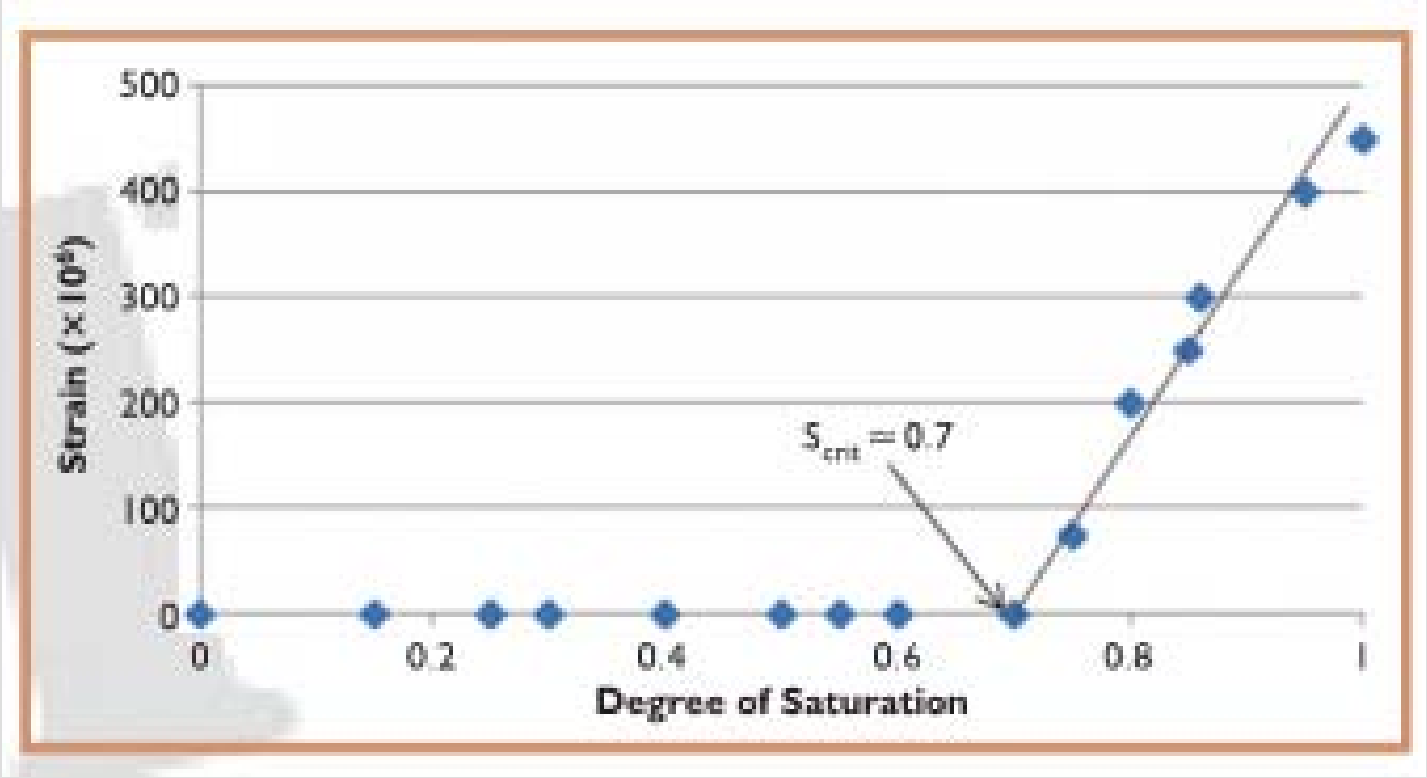

REFLECTIVE WHITE TPO ROOFING
ZERO OZONE DEPLETING POLYISO INSULATION R-38
SPRAYED FOAM AT ROOF AND EXTERIOR WALL INTERSECTION FOR AIR SEALING
R-23 WALLS
HISTORIC BRICK EXTERIOR WALLS
RIGID INSULATION "RETURNS"
LIGHT GUIDING BLINDS FOR DAYLIGHTING
SOLAR CONTROLLED ROLLER SHADES



Measuring capillary uptake of brick – Building Science Corporation

www.buildingscience.com

Photo 1: Measuring Brick Expansion Under Freeze/Thaw Cycling.


500
400
300
200
100
0
Strain (× 10⁶)
S_crit = 0.7
0
0.2
0.4
0.6
0.8
1
Degree of Saturation

Ross House:
Deep Energy Retrofit goes for Zero

Coldham & Hartman Architects
Location: Western Massachussets

Ross House
BUILDING TYPE:

Older typical US Housing Stock
Wood frame, 1884

SCOPE: Deep Energy Retrofit + PV = Net Zero

PROJECT SIZE: 250 sq. m
PROJECT COST: $600,000 (435,000 Euro), including 12.4 kWp PV
$2400 (1740 Euro)/sq.m.

ENERGY INTENSITY: 33 kWh/sq.m-a

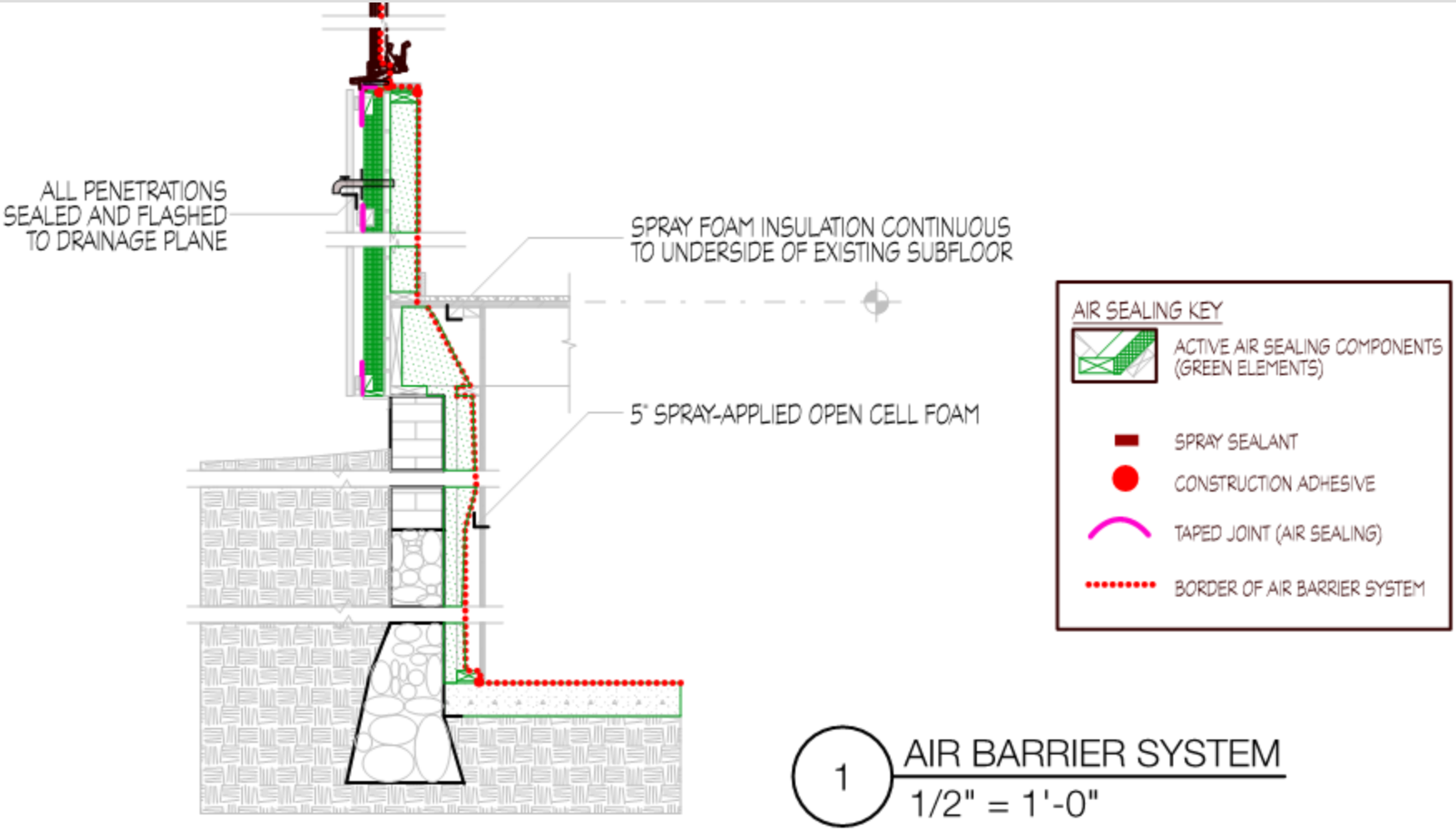
Existing House, built 1884

Retrofit Targets:

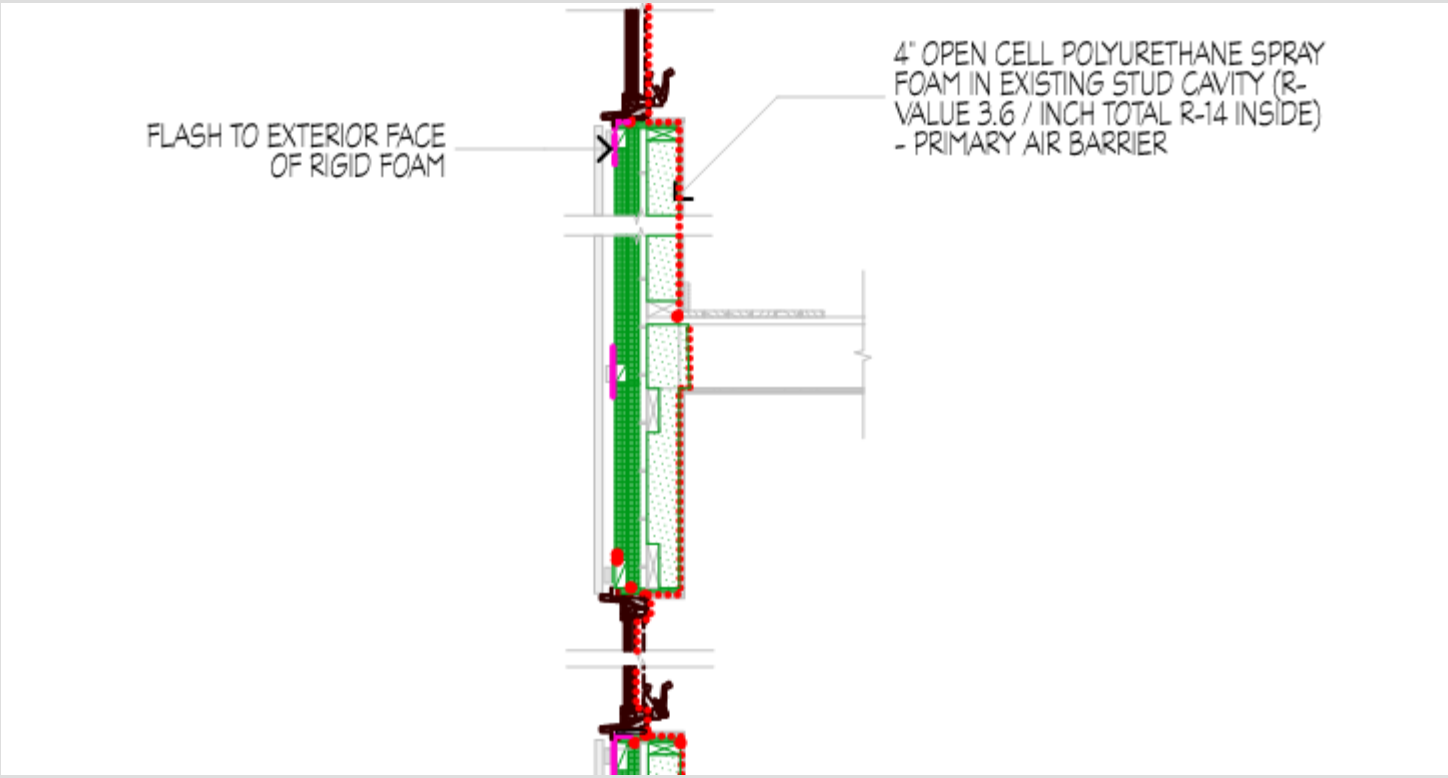
Walls:	**U = 0.17**	**W/m^2-K**
Roof:	**U = 0.11**	
Windows:	**U = 1.0**	
Earth:	**U = 0.28**	

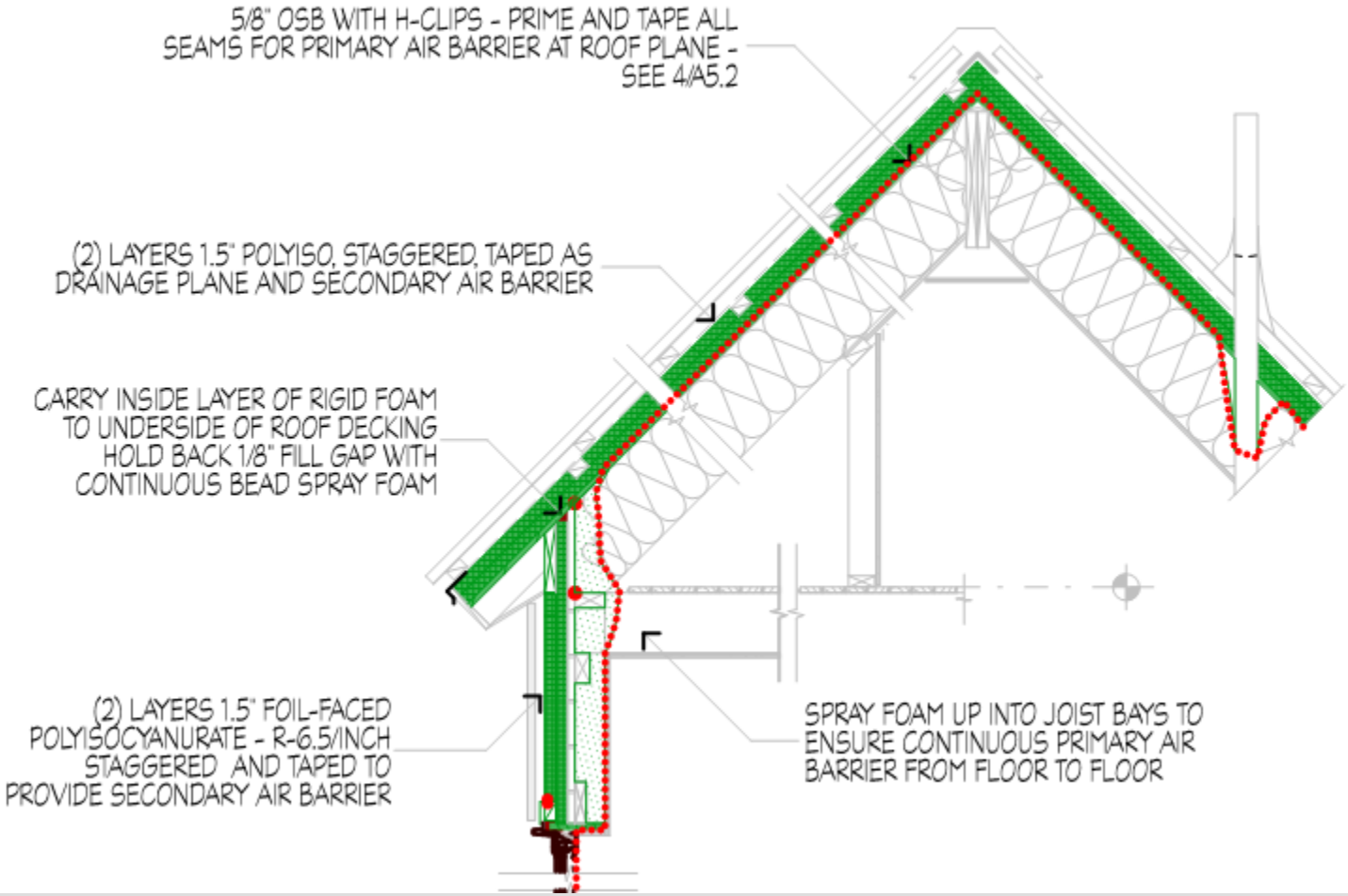
Air leakage rate: 0.3 m^3/sec @ 50 Pa
1.2 air changes @ 50 Pa

Energy use: 41 kWh/m^2-a



1 AIR BARRIER SYSTEM
1/2" = 1'-0"


FLASH TO EXTERIOR FACE OF RIGID FOAM
4" OPEN CELL POLYURETHANE SPRAY FOAM IN EXISTING STUD CAVITY (R-VALUE 3.6 / INCH TOTAL R-14 INSIDE) - PRIMARY AIR BARRIER


5/8" OSB WITH H-CLIPS - PRIME AND TAPE ALL SEAMS FOR PRIMARY AIR BARRIER AT ROOF PLANE - SEE 4/A5.2
(2) LAYERS 1.5" POLYISO, STAGGERED, TAPED AS DRAINAGE PLANE AND SECONDARY AIR BARRIER
CARRY INSIDE LAYER OF RIGID FOAM TO UNDERSIDE OF ROOF DECKING HOLD BACK 1/8" FILL GAP WITH CONTINUOUS BEAD SPRAY FOAM
(2) LAYERS 1.5" FOIL-FACED POLYISOCYANURATE - R-6.5/INCH STAGGERED AND TAPED TO PROVIDE SECONDARY AIR BARRIER
SPRAY FOAM UP INTO JOIST BAYS TO ENSURE CONTINUOUS PRIMARY AIR BARRIER FROM FLOOR TO FLOOR

Open cell urethane spray foam in stud wall cavities

First layer of foil-faced isocyanurate exterior foam

12.4 kW PV system

Daikin VRV heat Pump system

Steibel Eltron heat pump water heater

Venmar Eko EC Motor heat recovery ventilation


© Ethan Drinker Photography

Other Vermont Projects

Pill House – net zero with wind power, First NESEA Net Zero Award

Putney School Field House – Net Zero with PV

State of Vermont Courthouse & Offices, Deep Energy Retrofit