

TOOLBOX of a

CERTIFIED
PASSIVE HOUSE
CONSULTANT

PHPP, Solar Pathfinder, WUFI, THERM

1) Energy Model, The Passive House Planning Package



© Passive House Institute

Energy balance and Passive House Design Tool
for quality approved Passive Houses and EnerPHit retrofits

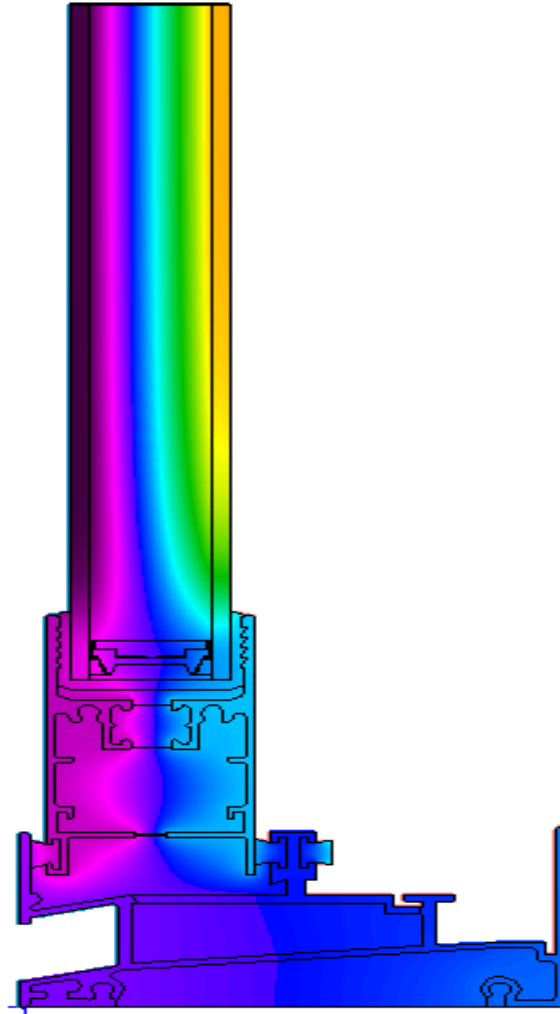
2) Shading Analysis, the Solar Pathfinder



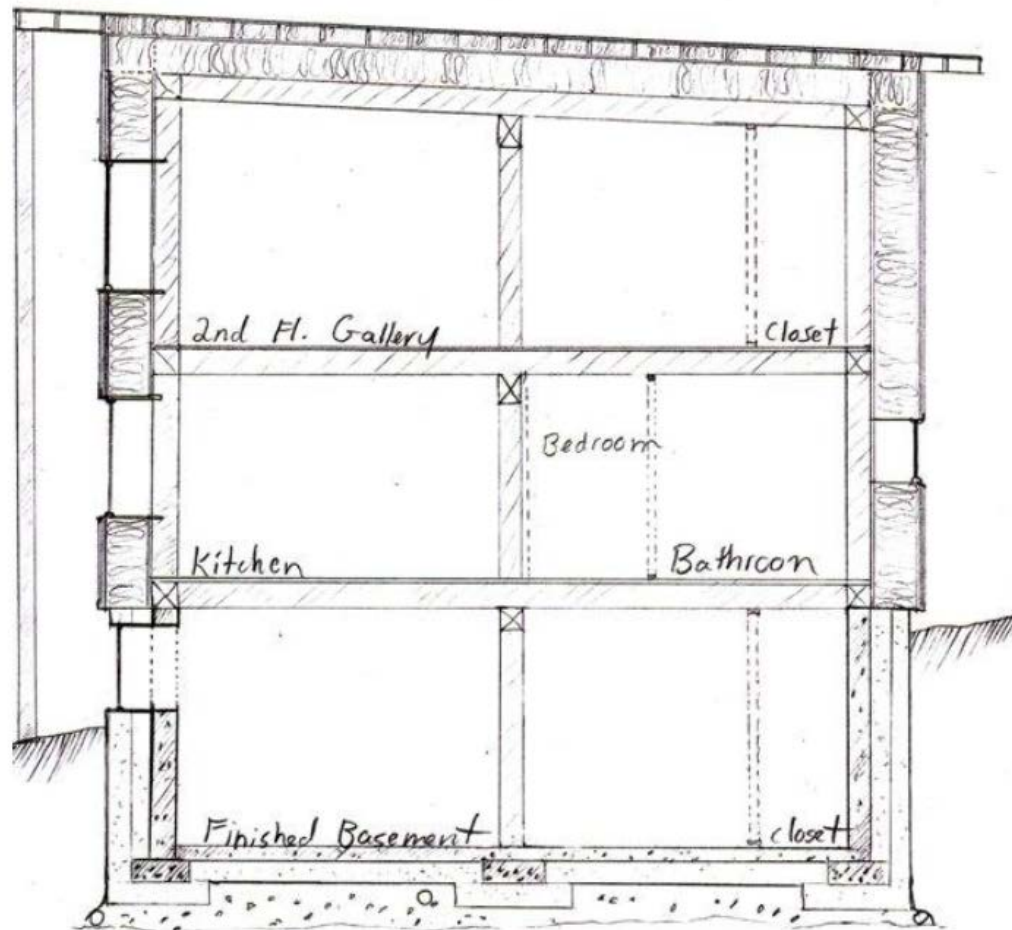
3) Moisture/Mold Risk, WUFI-ORNL



4) Thermal Bridge Analysis, THERM



OUR PROJECT



A Passive House =
4.75
kBTU/ft.²/yr

1) The Whitchurch PH Cottage, 4.35 kBTU/ft.2/yr

Passive House Verification

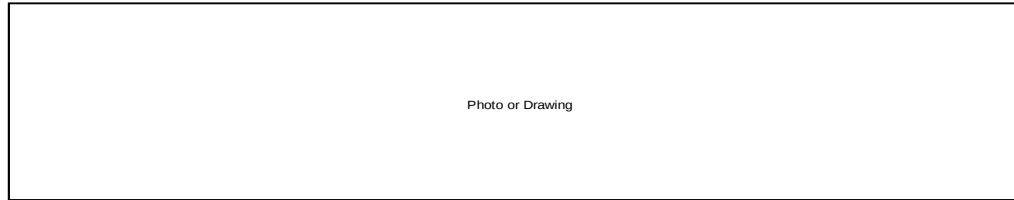


Photo or Drawing

Building:	Lil' House in the Big Woods
Location and Climate:	Montpelier, VT
Street Address:	Brook Rd
City, State, Zip:	Middlesex
Country:	USA
Building Type:	Timber Frame
Home Owner(s) / Client(s):	Greg and Barb Whitchurch
Street Address:	Brook Rd
City, State, Zip:	Middlesex, VT
Architect:	Greg Whitchurch, Chris Miksic, Indigo Ruth-Davis
Street:	405 Camp Rd. PO box 32
City, State, Zip:	Calais, Vermont 05648
Mechanical System:	CERV, by Build Equinox
Street Address:	
City, State, Zip:	
Year of Construction:	2013
Number of Dwelling Units:	1
Gross Enclosed Volume V _e :	21130 ft ³
Number of Occupants:	3.7
Interior Temperature:	68.0 °F
Internal Heat Gains:	0.7 BTU/hr.ft ²

No Standard Climate

Calculation Electricity / Internal Heat G

Building Type: Residential

Internal Heat Gains

Utilization Pattern: Dwelling

Type of Values Used: Standard

Planned Number of Occupants:

2

Verification

Verification:

Monthly Method

Specific Space Heat Dem

Specific Space Heat Dem

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	1400	ft ²		
Applied:	Monthly Method	PH Certificate:		Fulfilled?
Specific Space Heat Demand:	4.35 kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)		Yes
Pressurization Test Result:	0.60 ACH ₅₀	0.6 ACH ₅₀		Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	29.1 kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)		Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.5 kBTU/(ft ² ·yr)			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0 kBTU/(ft ² ·yr)			
Heating Load:	3.64 BTU/(ft ² ·hr)			
Frequency of Overheating:	%	over 77.0 °F		
Specific Useful Cooling Energy Demand:	0.82 kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)		Yes
Cooling Load:	2.43 BTU/(ft ² ·hr)			

We confirm that the values given herein have been

Issued on:

Conventional Build, same design

90.94kBTU/ft.2/yr

Passive House Verification

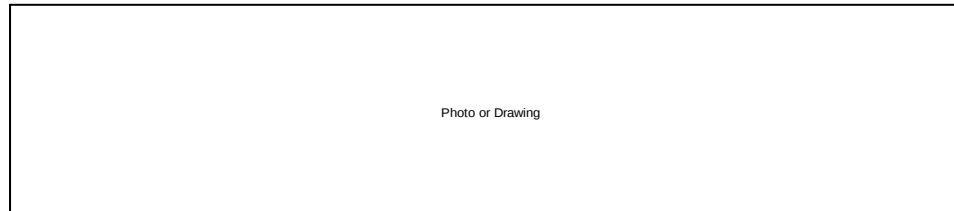


Photo or Drawing

Building:	Lil' House in the Big Woods	
Location and Climate:	Montpelier, VT	
Street Address:	Brook Rd	
City, State, Zip:	Middlesex	
Country:	USA	
Building Type:	Timber Frame	
Home Owner(s) / Client(s):	Greg and Barb Whitchurch	
Street Address:		
City, State, Zip:		
Architect:	Greg Whitchurch and Chris Miksic	
Street:		
City, State, Zip:		
Mechanical System:		
Street Address:		
City, State, Zip:		
Year of Construction:	2013	
Number of Dwelling Units:	1	
Gross Enclosed Volume V_e :	21130	ft ³
Number of Occupants:	3.7	
Interior Temperature:	68.0	°F
Internal Heat Gains:	0.7	BTU/hr.ft ²

No Standard Climate

Calculation Electricity / Internal Heat G

Building Type: Residential

Internal Heat Gains

Utilization Pattern: Dwelling

Type of Values Used: Standard

Planned Number of Occupants:

2 Verification

Verification: Monthly Method
Specific Space Heat Dem
Specific Space Heat Dem

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	1493	ft ²		
Applied:	Monthly Method	PH Certificate:	Fulfilled?	
Specific Space Heat Demand:	90.94 kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	No	
Pressurization Test Result:	3.00 ACH ₅₀	0.6 ACH ₅₀	No	
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	40.0 kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	No	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	20.8 kBTU/(ft ² ·yr)			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0 kBTU/(ft ² ·yr)			
Heating Load:	26.01 BTU/(ft ² ·hr)			
Frequency of Overheating:	0 %	over 77.0 °F		
Specific Useful Cooling Energy Demand:	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)		
Cooling Load:	0.00 BTU/(ft ² ·hr)			

We confirm that the values given herein have been

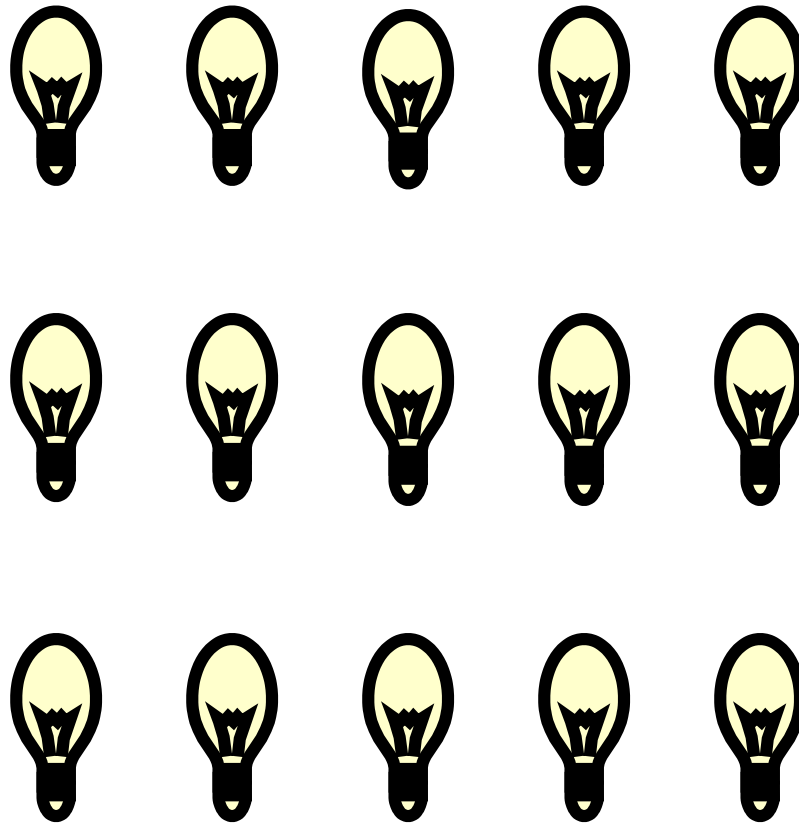
Issued on:

Heating load on coldest days=

5,096BTU/hr=

1494 Watts=

Heating system equivalent to 15, 100W
light bulbs



THE CERV





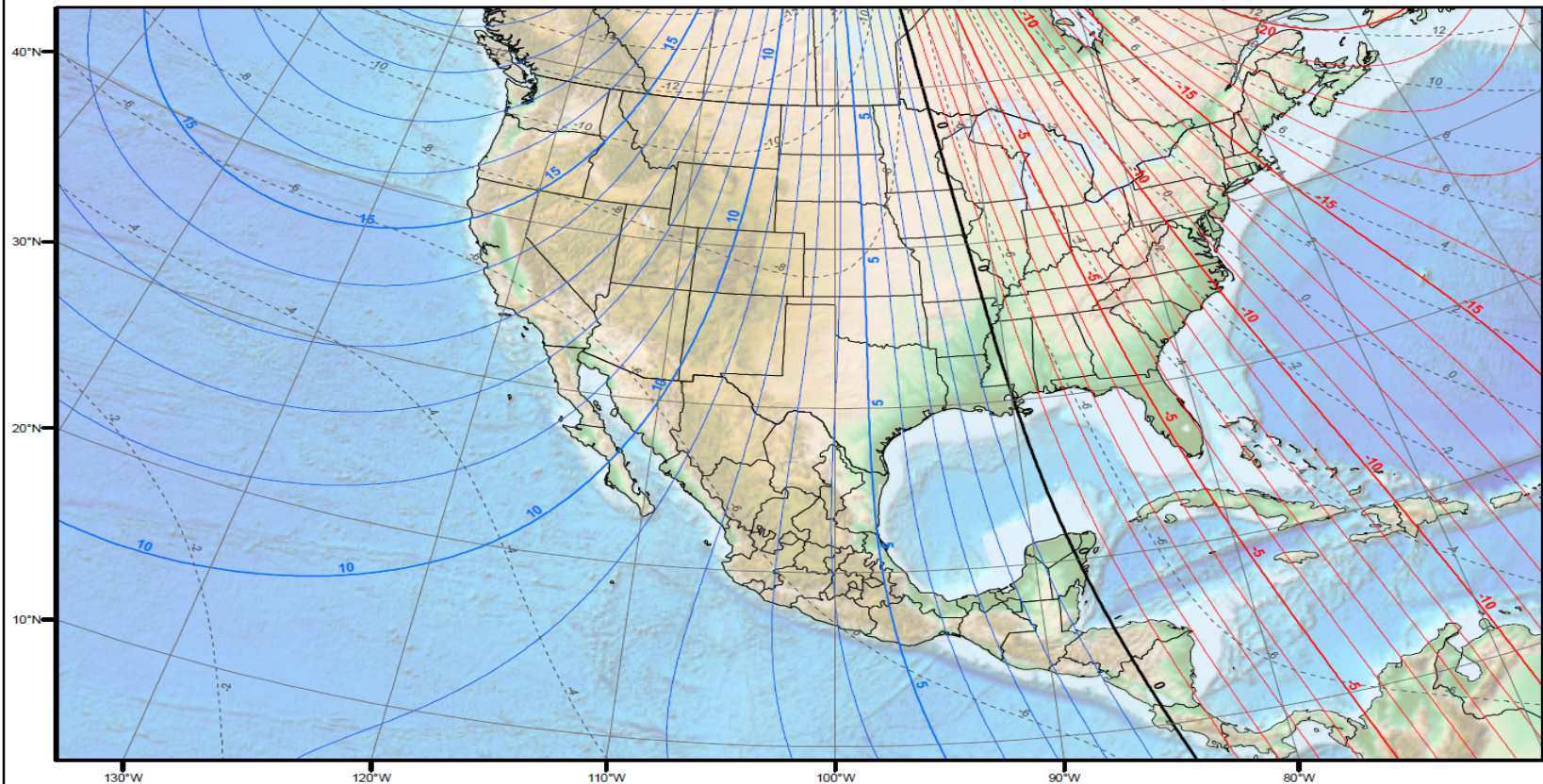
2) Use the solar pathfinder to determine shading conditions at future location of windows

Proper Orientation



-16 Degrees from magnetic north

Magnetic Declination Map of North America for the year 2010



The term magnetic declination (also known as magnetic variation) refers to the angle between the magnetic north (MN - compass north) and true north (TN - true north) at any given latitude / longitude. The black contour line shows the imaginary line along which the declination is zero (MN and TN converges). The magnetic declination increases as one moves east or west from this line. The red line shows the **negative (west)** declination contours and the blue line shows the **positive (east)** declination contours. The degrees of declination required in order to orient the compass with the map is **added east** of this line and **subtracted west** of this line. (e.g., 10 degrees east would indicate that MN lies 10 degrees clockwise from the TN). Magnetic declination gradually changes with time and location. The dotted grey lines show the expected annual change in the magnetic declination in arc minutes. The above map is produced from the World Magnetic Model (WMM 2010) for the year 2010.

3) WUFI Hygrothermal Analysis

WUFI® ORNL 5.2 NonCommercial C:\Users\indigo\Whitchurch vented roof.W5P

Project Inputs Run Outputs Options Database Result Analysis ?

Project

- Case: 1 #1 (Act. Case)
 - Component
 - Assembly/Monitor Positions
 - Orientation
 - Surface Transfer Coeff.
 - Initial Conditions
 - Control
 - Climate
 - Quick Graph

Project/Case: Whitchurch Roof/#1

Assembly/Monitor Positions Orientation/Inclination/Height Surface Transfer Coeff. Initial Conditions

Layer Name Thickn. [in]

Cellulose Fibre Insulation 22

Exterior (Left Side) Interior (Right Side)

0393°3,9370°0,4921.5 22 0,0;0,75

Material Data

Sources, Sinks

New Layer

Duplicate

Delete

Edit Assembly by:

☒ Graph

☐ Table

Assign from

Material Database

Example Cases

Grid

Automatic (II)

100 Fine

Copy Auto. Grid Def. for Manual Editing

Total Thickness

Thickness: 28,76 in

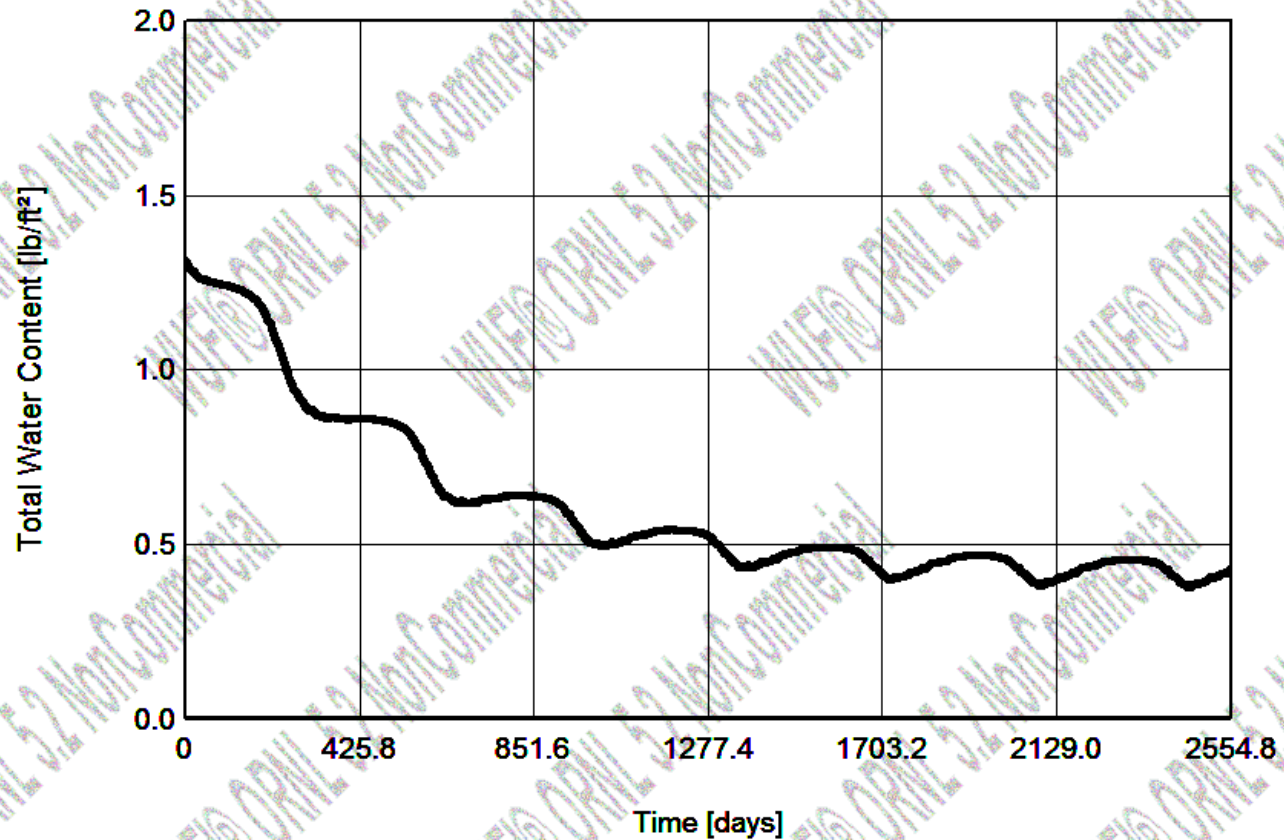
Total Thermal Performance

R-Value: 93,54 h ft² °F/Btu

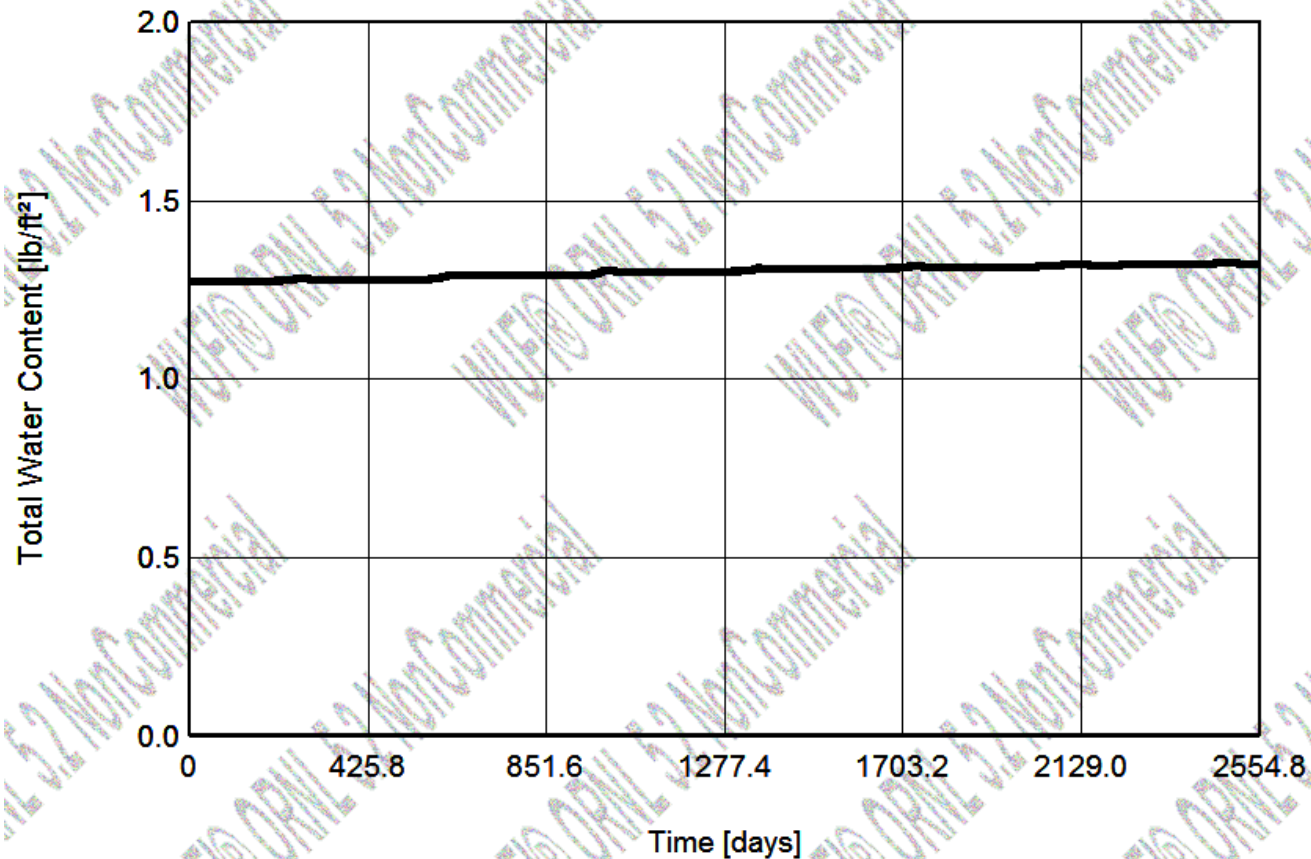
U-Value: 0,011 Btu/h ft² °F

Units: IP Last Calculation: 12/24/2013

WUFI-ORNL, vented roof 7 yr.



WUFI-ORNL, unvented 7 yr.



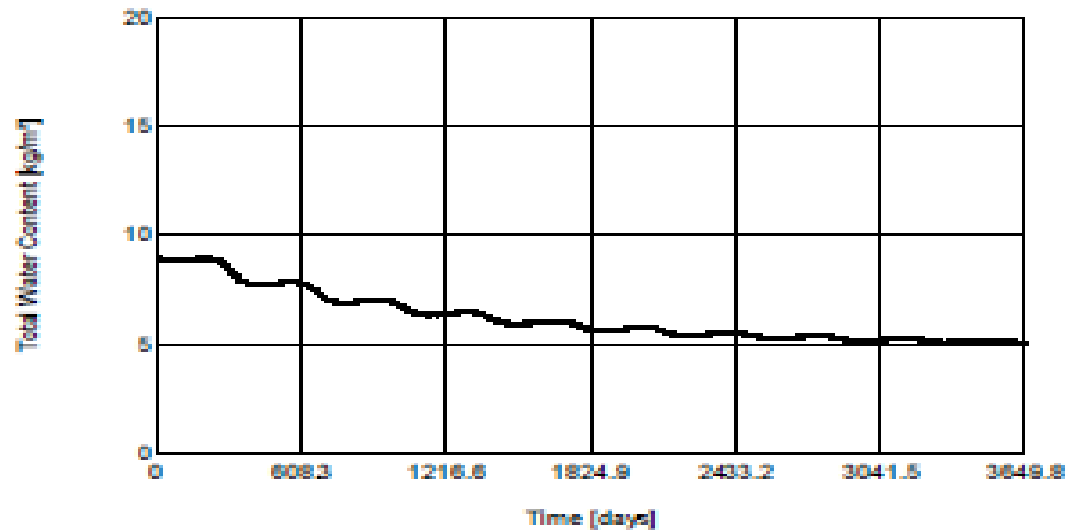
WUFI Pro

10-Year Initial Dry-out

WUFI® Pro 5.2



Total Water Content in Construction

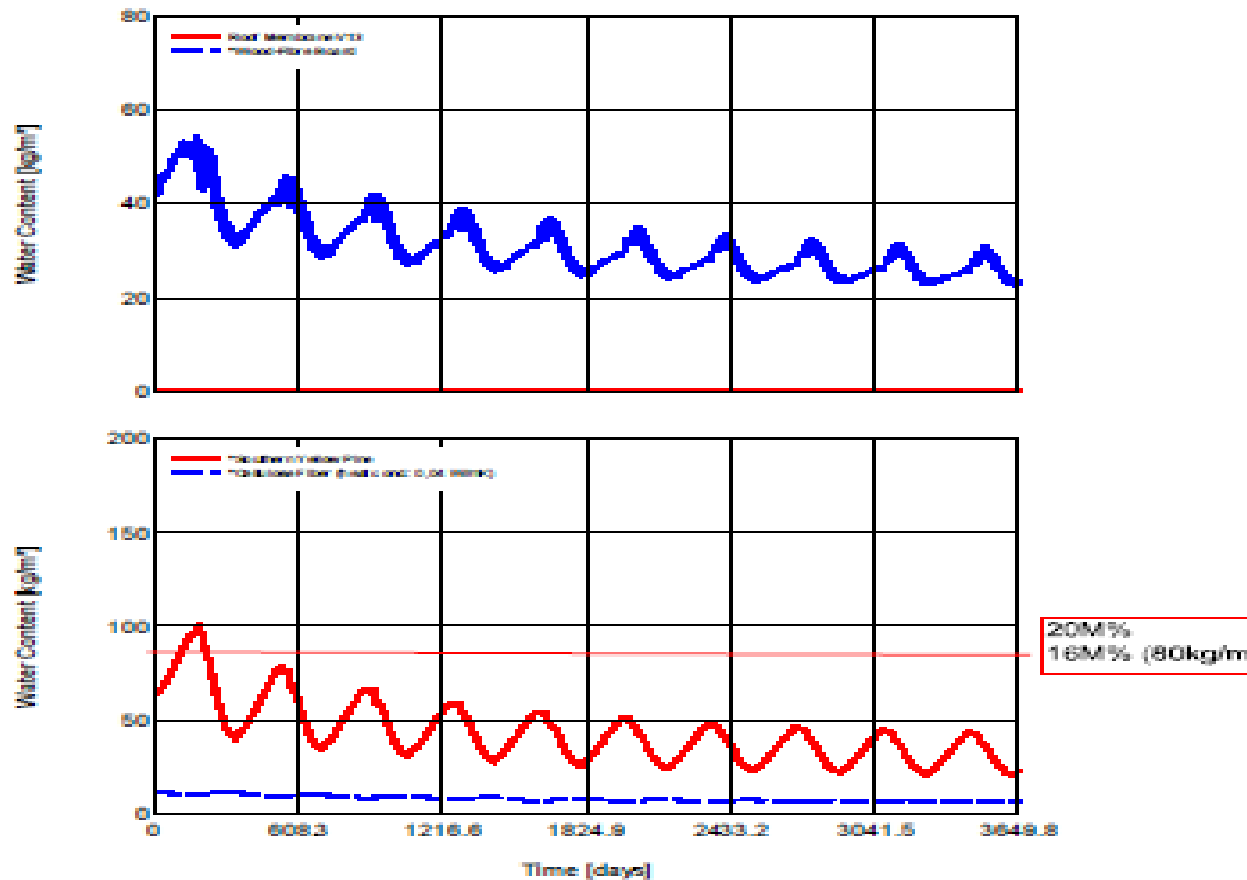


Shows Over 20% Moisture Content In Winter Of 1st Year

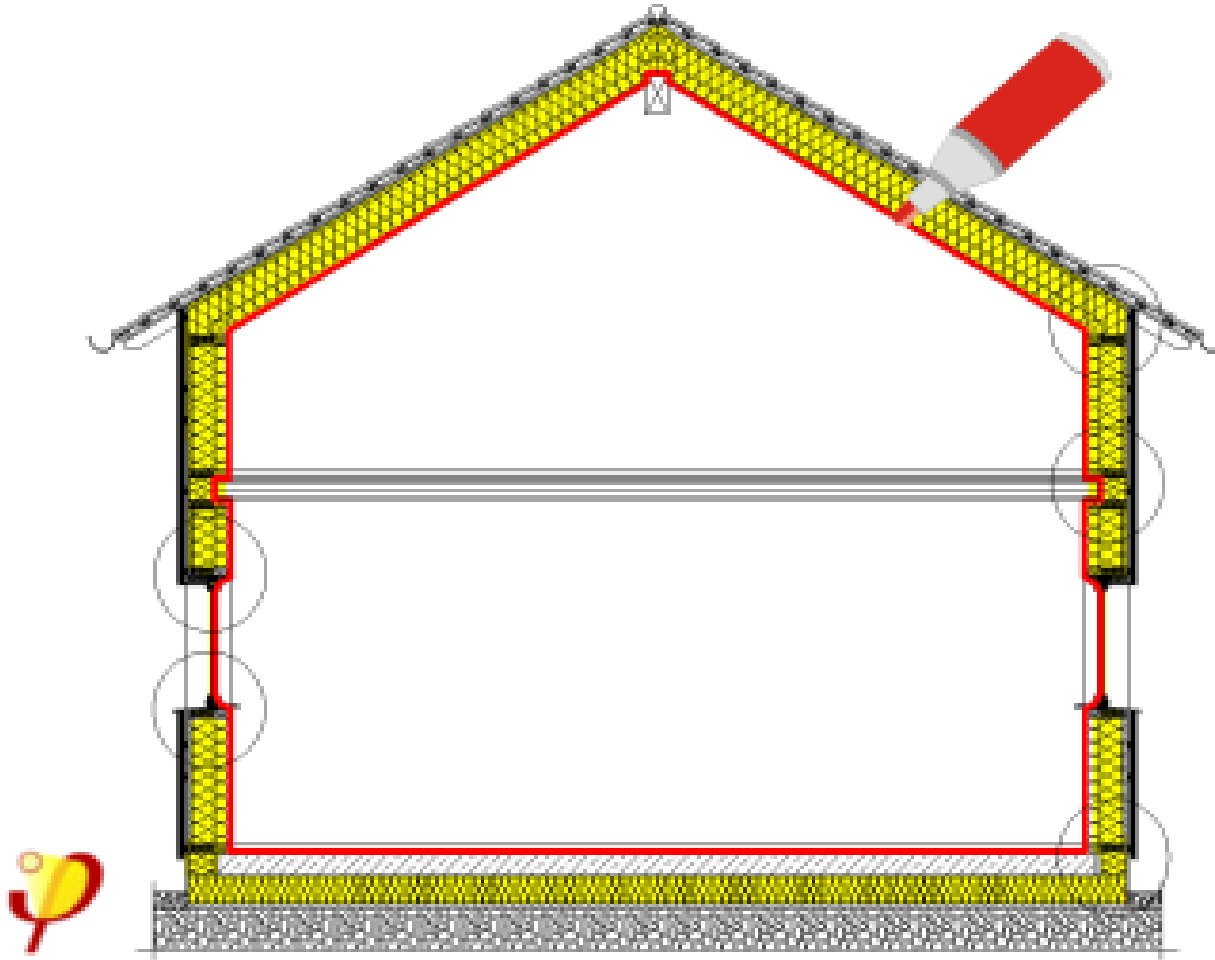
WUFI® Pro 5.2

Fraunhofer
IBP

Water Content of Individual Materials



Thermal Bridge Free=
 $<.006 \text{ BTU/hr.ft.F}$



Continuous thermal envelope

4) Thermal Bridge=

2D Thermal transmittance
modeled in THERM

minus

1D Thermal Transmittance as
modeled in PHPP

Foundation Foam=TB?



Foundation Foam in THERM

Reduction Factor

0.60

Internal Temperature

68.0

External Temperature

35.6

Lowest Surface Temp

65.4

Ψ_e (for PHPP)

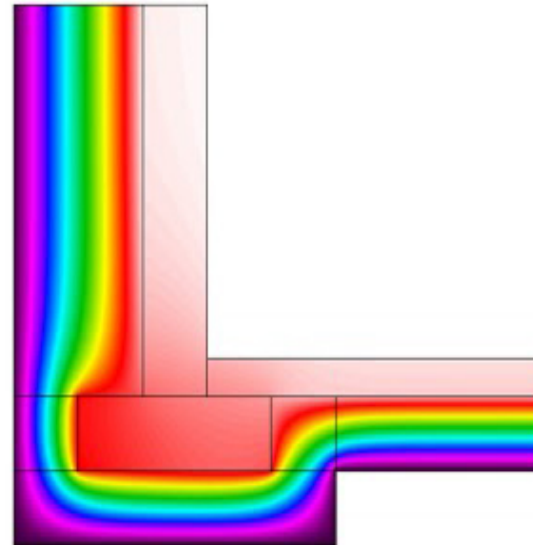
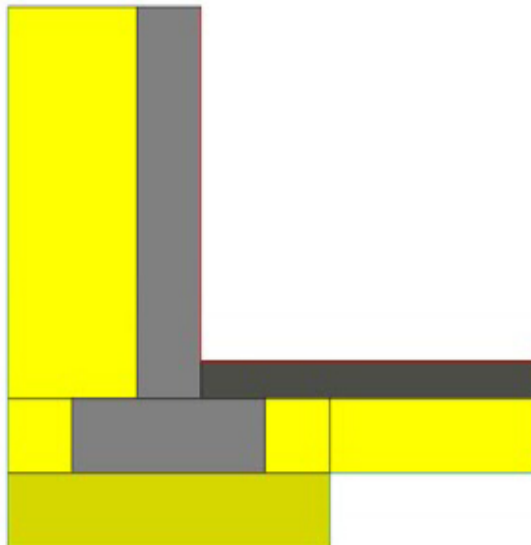
-0.003

Btu/hr*F

f_{RSI} at 68 °F/ 23 °C

0.92

Images Of Detail

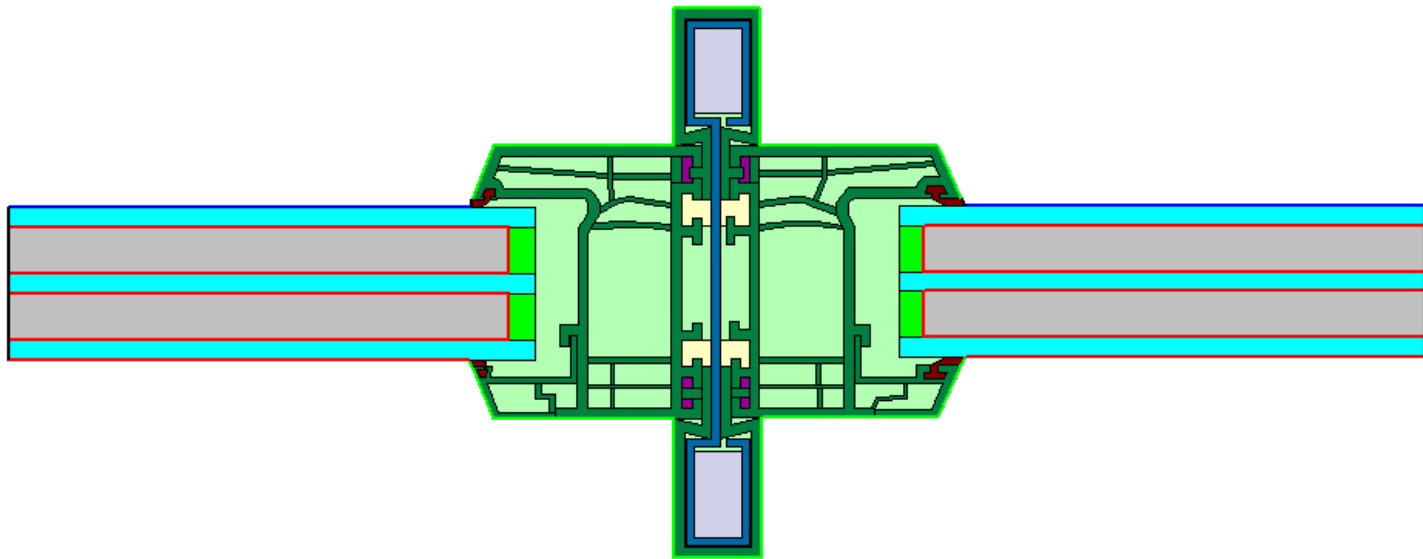


By Chris West, Eco Houses of Vermont

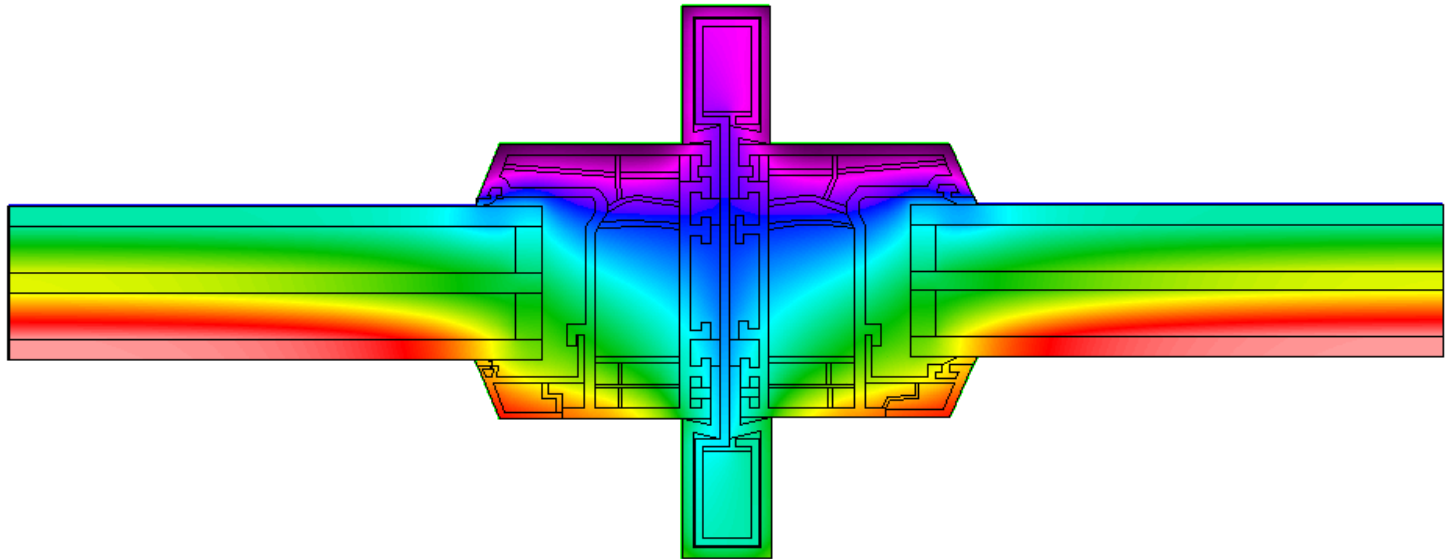
Window connection Mullion=
Giant piece of metal=
Giant thermal bridge



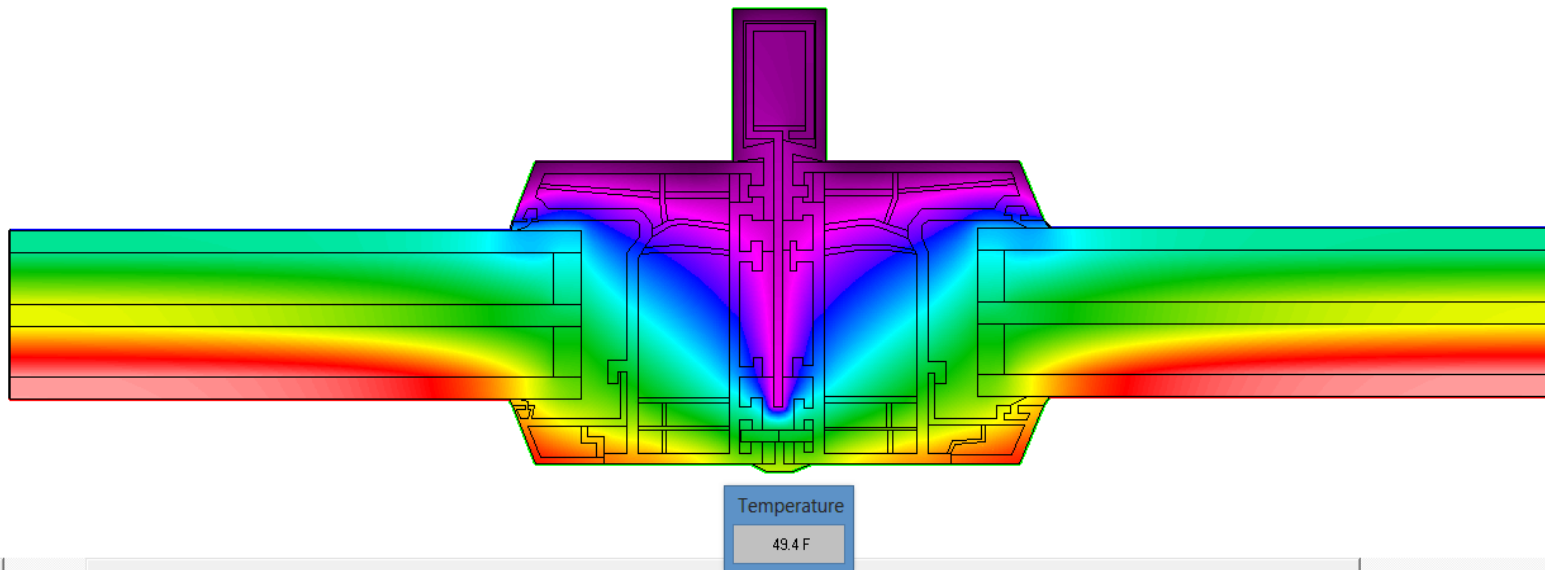
Plan View of Window Jointing Mullion In THERM



Thermal Bridge=0.16 BTU/hr.ft.F
Temperature=42.6 F

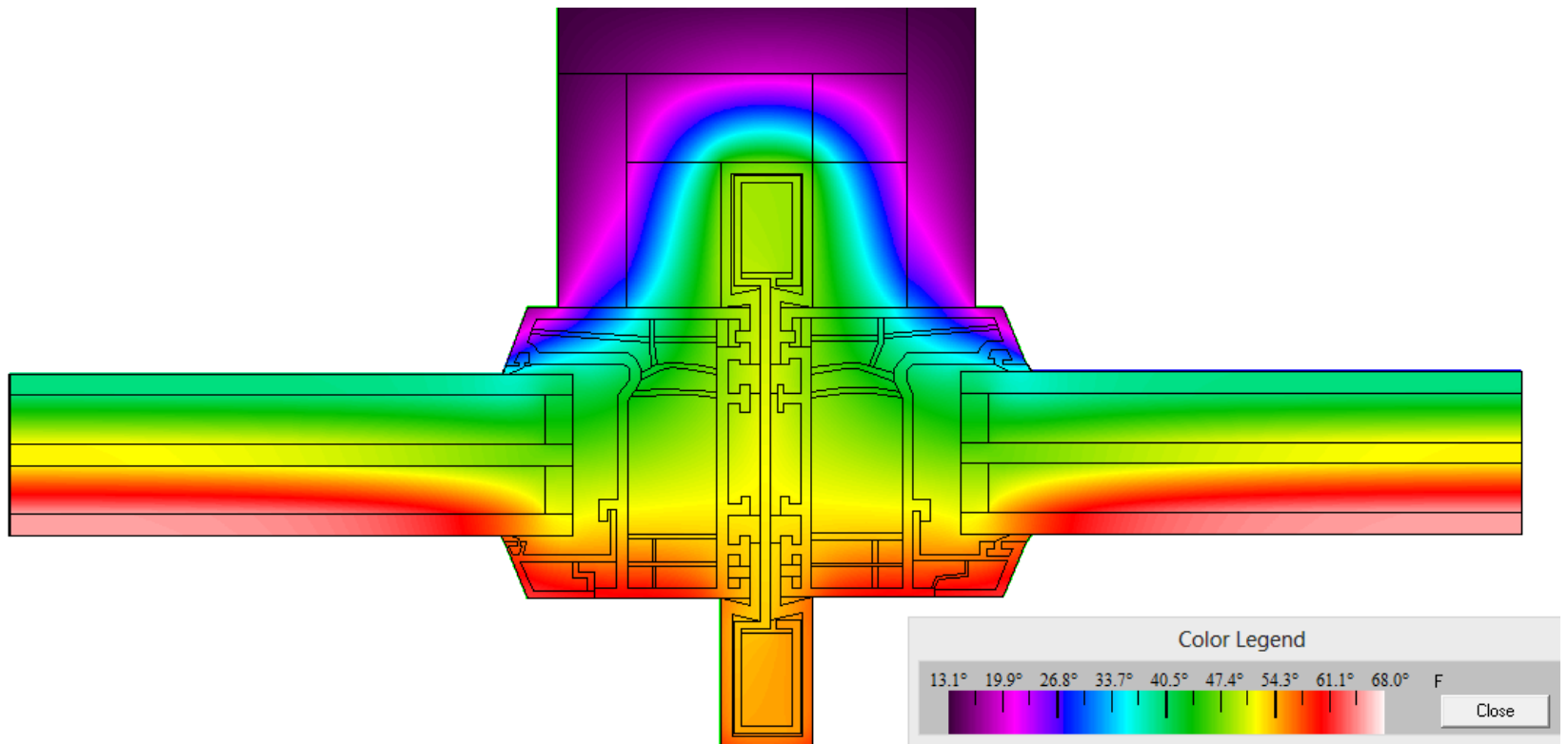


Thermal Bridge=.043 BTU/hr.ft.F
Temperature=49.4 F



Exterior Trim w/ EPS

Thermal Bridge=.039 BTU/hr.ft.F



Performance based design

