

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

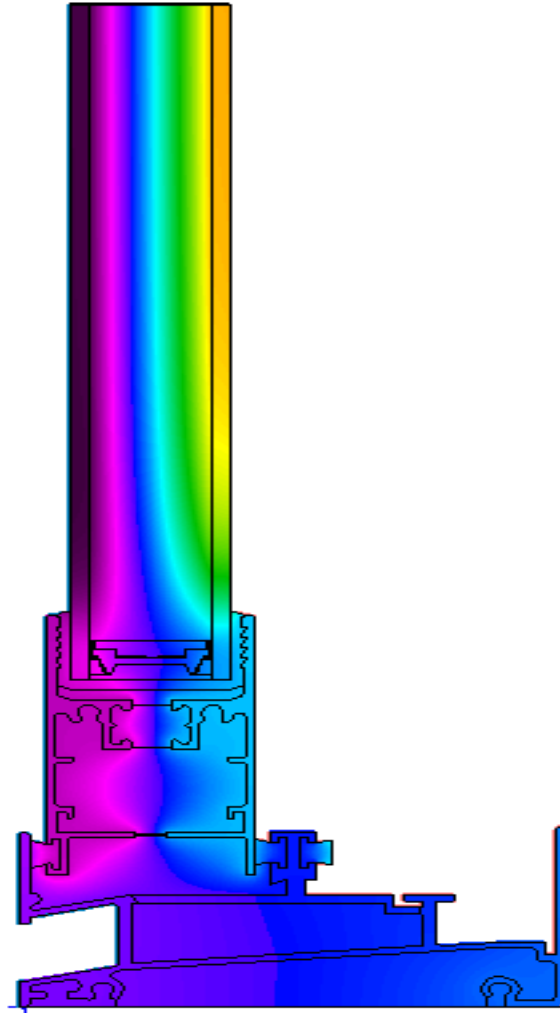
2) Shading Analysis, the Solar Pathfinder



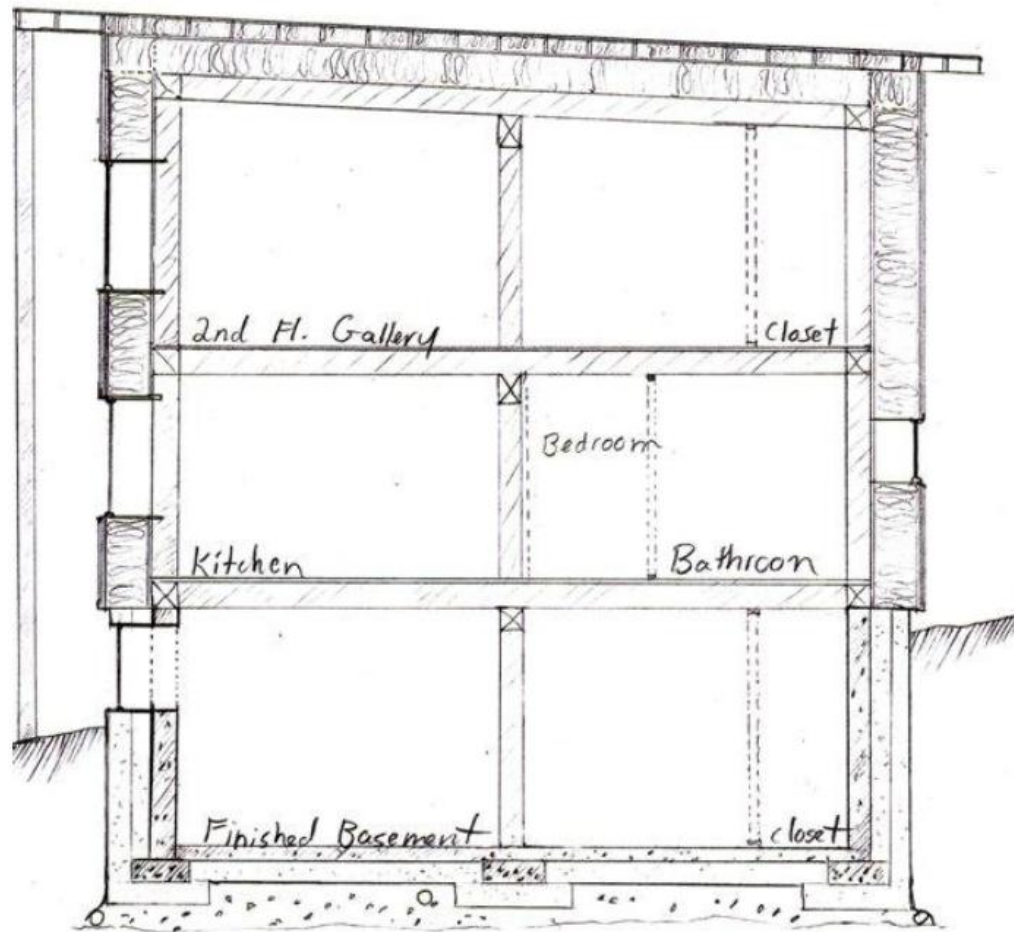
3) Moisture/Mold Risk, WUFI-ORNL



4) Thermal Bridge Analysis, THERM



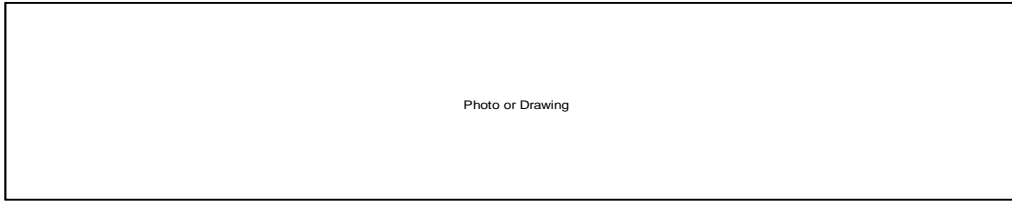
OUR PROJECT



A Passive House =
4.75
kBTU / ft.2 / yr

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

Passive House Verification



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 Mksic, 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 Ge

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

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	4.75 kBTU/(ft²yr)	Yes
Pressurization Test Result:	0.60	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	29.1	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.5		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0		
Heating Load:	3.64		
Frequency of Overheating:		over 77.0 °F	
Specific Useful Cooling Energy Demand:	0.82	4.75 kBTU/(ft ² yr)	Yes
Cooling Load:	2.43		

We confirm that the values given herein have been

Issued on:

Conventional Build, same design

90.94kBTU/ft.2/yr

Passive House Verification

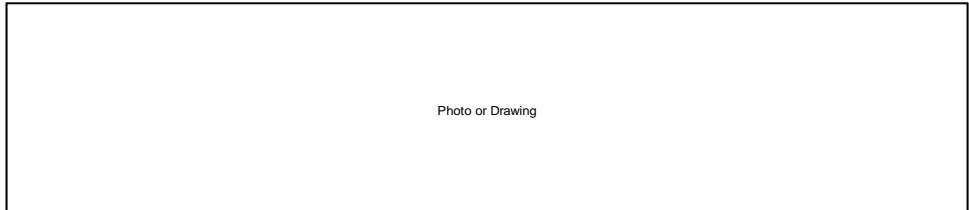


Photo or Drawing

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 Witchurch**

Street Address:

City, State, Zip:

Architect: **Greg Witchurch 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_g : **21130** ft³

Number of Occupants: **3.7**

Interior Temperature: **68.0** °F

Internal Heat Gains: **0.7** BTU/hr.ft²

No Standard Climate

Calculation Electricity / Internal Heat Ga

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 Demand

Specific Space Heat Demand

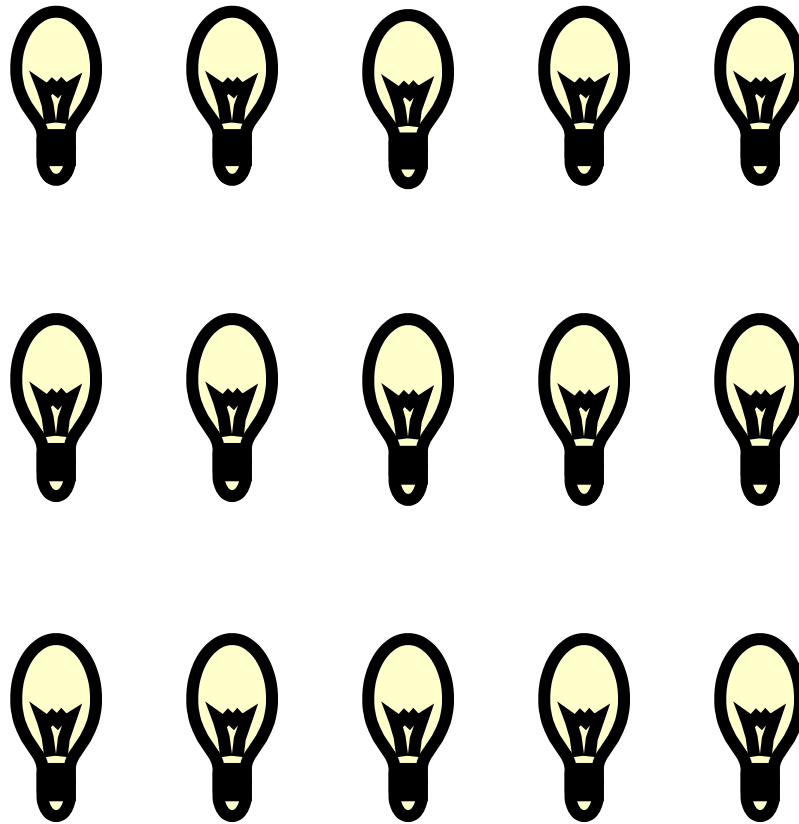
Energy Demands with Reference to the Treated Floor Area			
Treated Floor Area:	1403 ft ²		
	Applied:	Monthly Method	PH Certificate:
			Fulfilled?
Specific Space Heat Demand:	90.94	kBTU/(ft²yr)	4.75 kBTU/(ft²yr) No
Pressurization Test Result:	3.00	ACH₅₀	0.6 ACH₅₀ No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	40.0	kBTU/(ft²yr)	38.0 kBTU/(ft²yr) No
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	20.8	kBTU/(ft²yr)	
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft²yr)	
Heating Load:	26.01	BTU/(ft²hr)	
Frequency of Overheating:	0	%	over 77.0 °F
Specific Useful Cooling Energy Demand:		kBTU/(ft²yr)	4.75 kBTU/(ft²yr)
Cooling Load:	0.00	BTU/(ft²hr)	

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





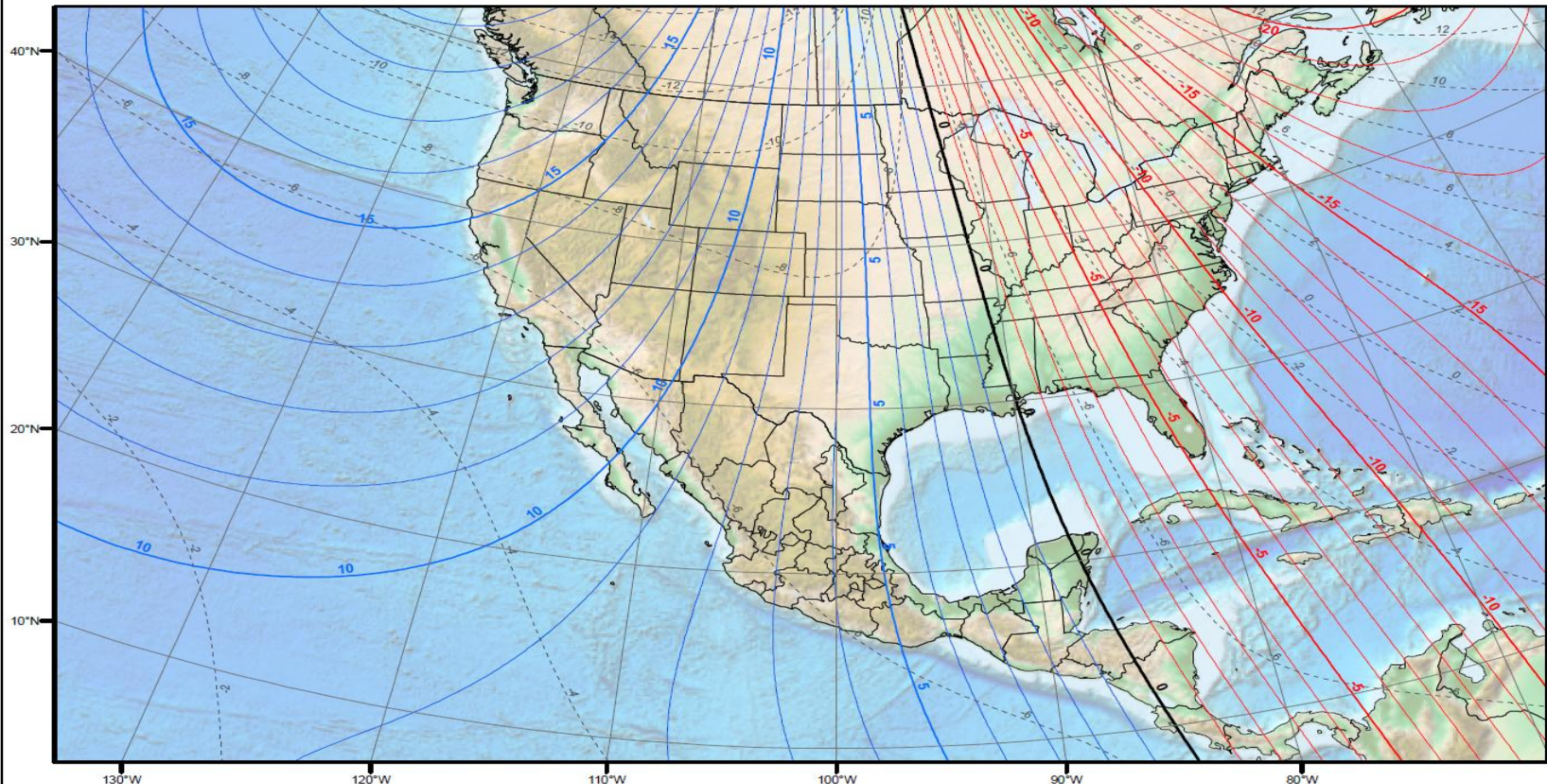
2) Use the solar pathfinder to determine shading conditions at future location of windows

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

The screenshot displays the WUFI ORNL 5.2 NonCommercial software interface. The title bar shows the project path: C:\Users\indigo\Whitchurch vented roof.W5P. The main window is titled "Project/Case: Whitchurch Roof/#1".

Project Tree (Left):

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

Main Assembly Editor (Center):

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

Layer Name	Thickn. [in]
Cellulose Fibre Insulation	22

Exterior (Left Side): 0.39933, 9.93700, 4.92115
Interior (Right Side): 0.0, 0.75

Right Panel:

- Material Data
- Sources, Sinks
- New Layer
- Duplicate
- Delete
- Edit Assembly by:
 - Graph
 - Table

Bottom Section:

Assign from: Material Database, Example Cases

Grid: Automatic (II), 100, Fine

Copy Auto. Grid Def. for Manual Editing

Total Thickness: Thickness: 28.76 in

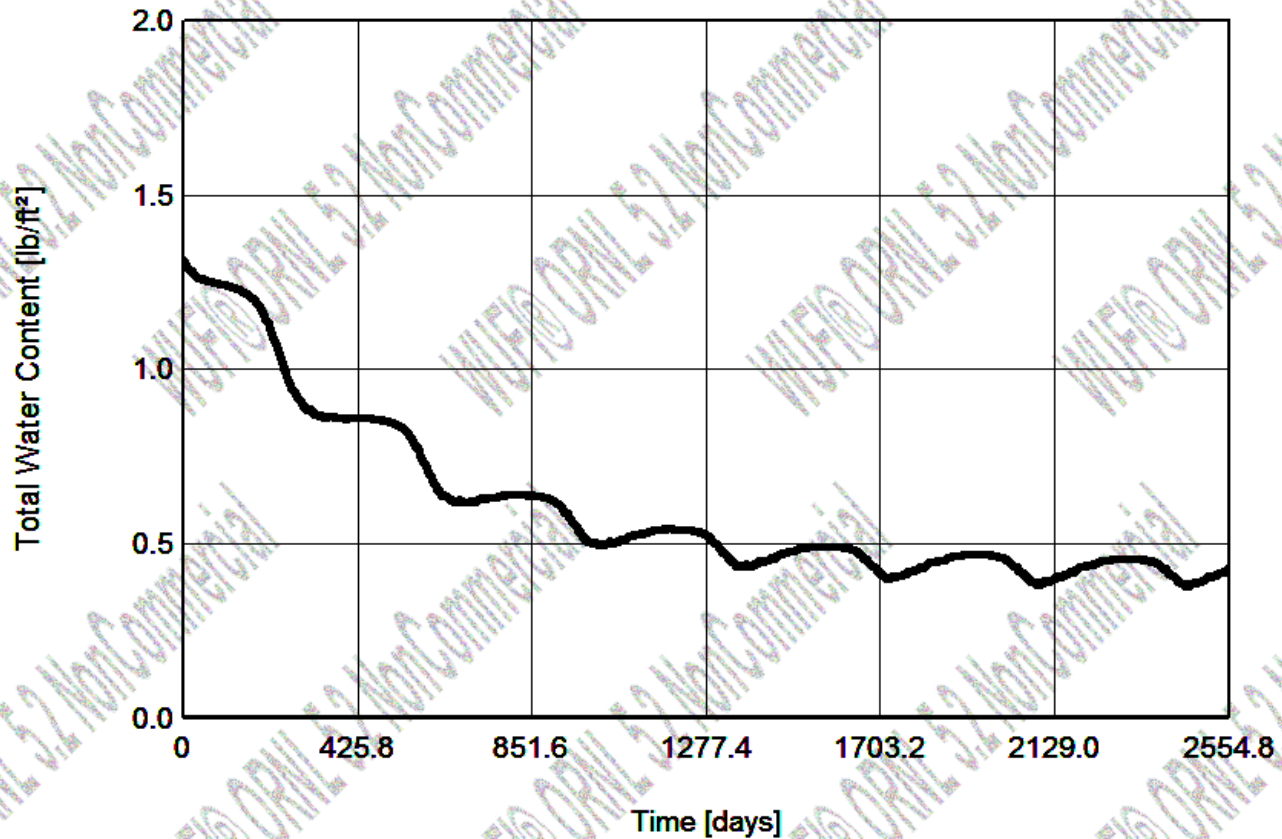
Total Thermal Performance: R-Value: 93.54 h ft² °F/Btu

U-Value: 0.011 Btu/h ft² °F

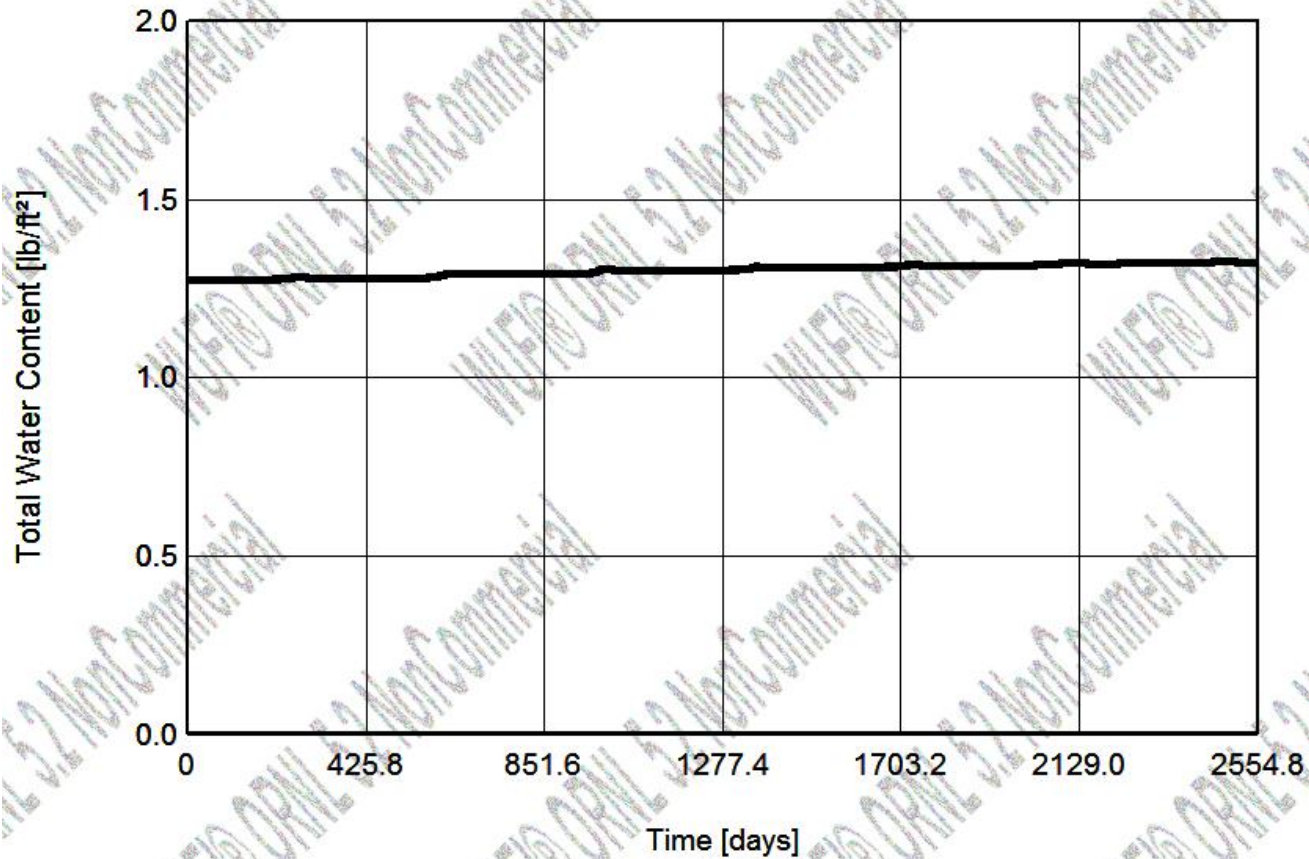
Units: IP | Last Calculation: 12/24/2013

The taskbar at the bottom shows various application icons including Internet Explorer, File Explorer, Google Chrome, and WUFI.

WUFI-ORNL, vented roof 7 yr.



WUFI-ORNL, unvented 7 yr.



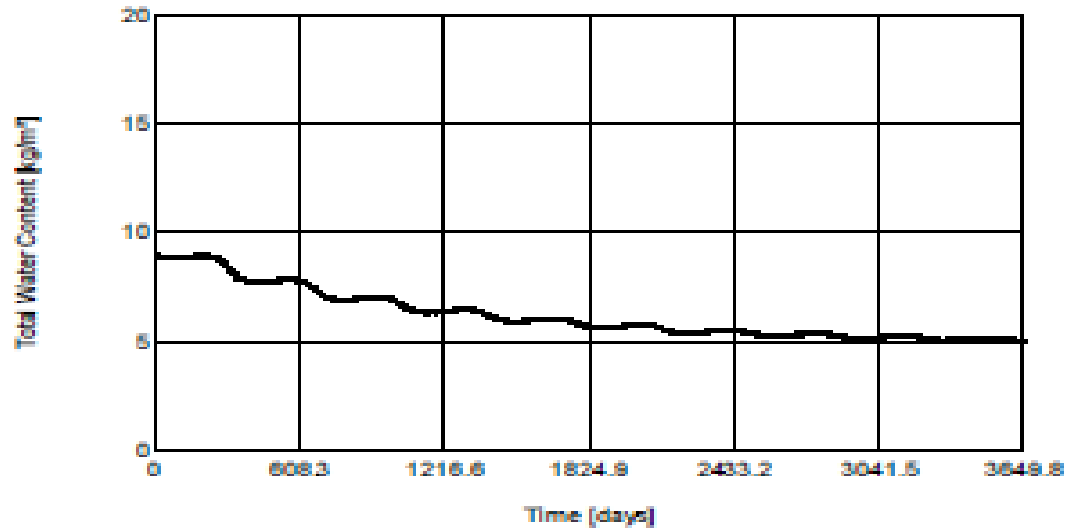
WUFI Pro

10-Year Initial Dry-out

WUFI® Pro 5.2



Total Water Content in Construction

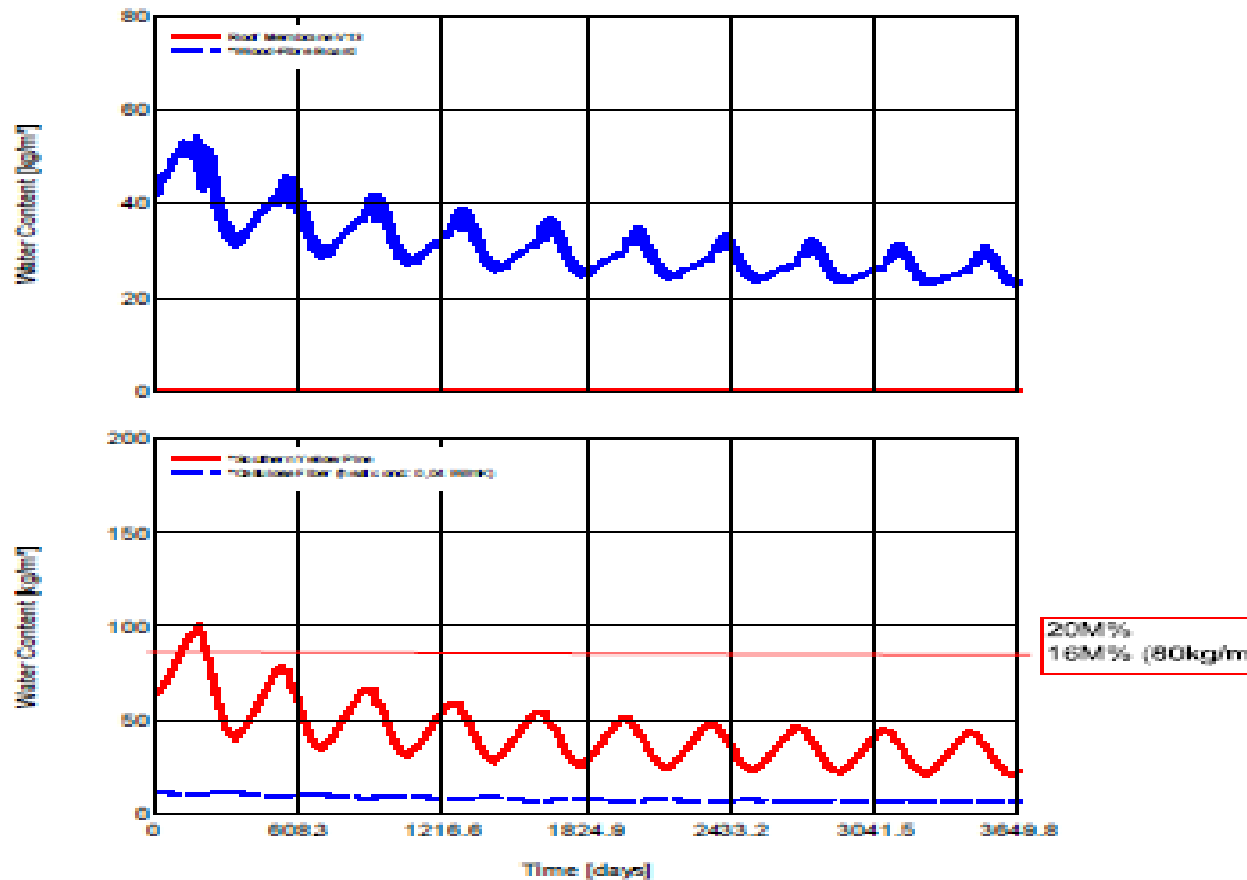


Shows Over 20% Moisture Content In Winter Of 1st Year

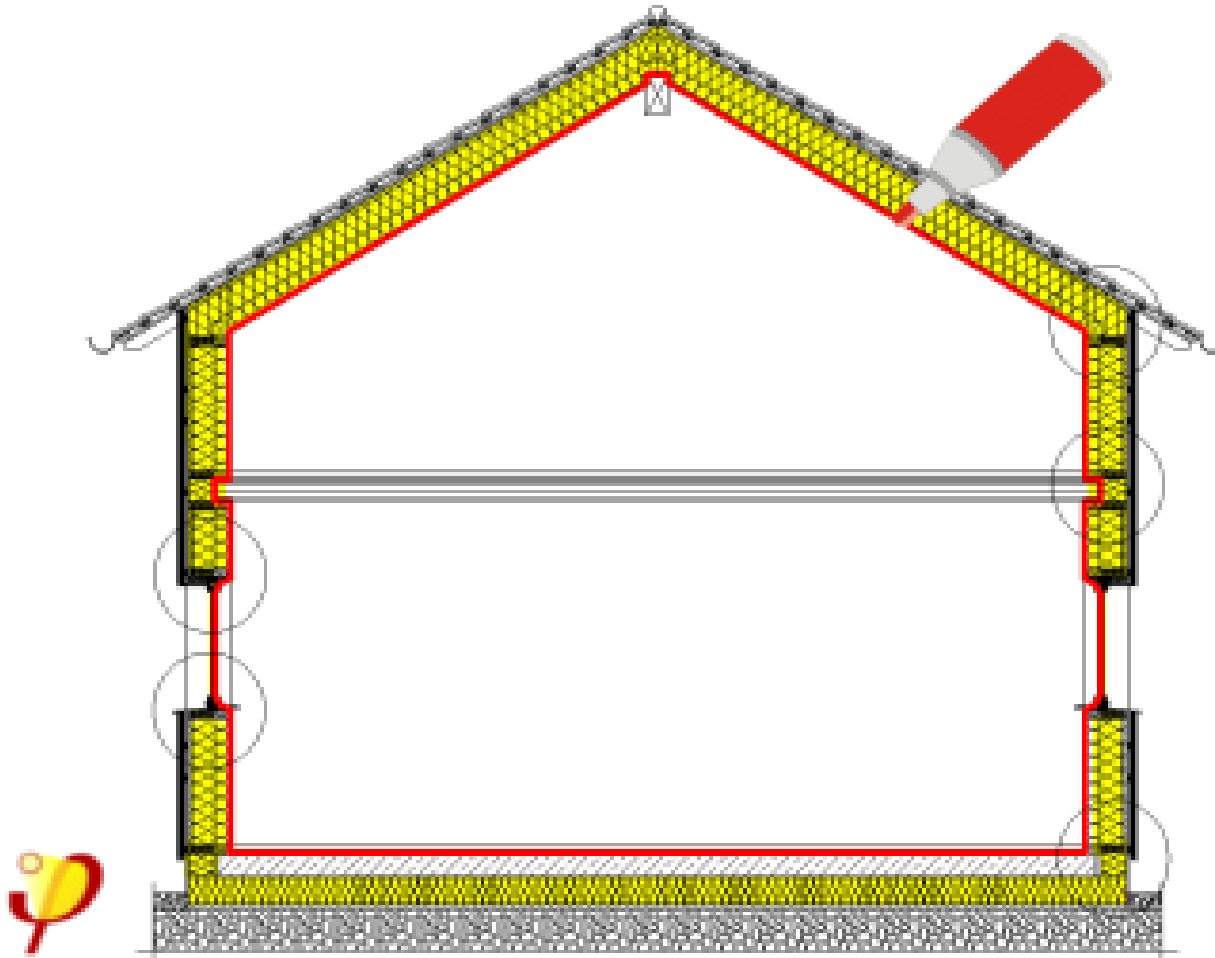
WUFI® Pro 5.2

Fraunhofer
IBP

Water Content of Individual Materials



Thermal Bridge Free=
<.006 BTU/hr.ft.F



Continuous thermal envelope

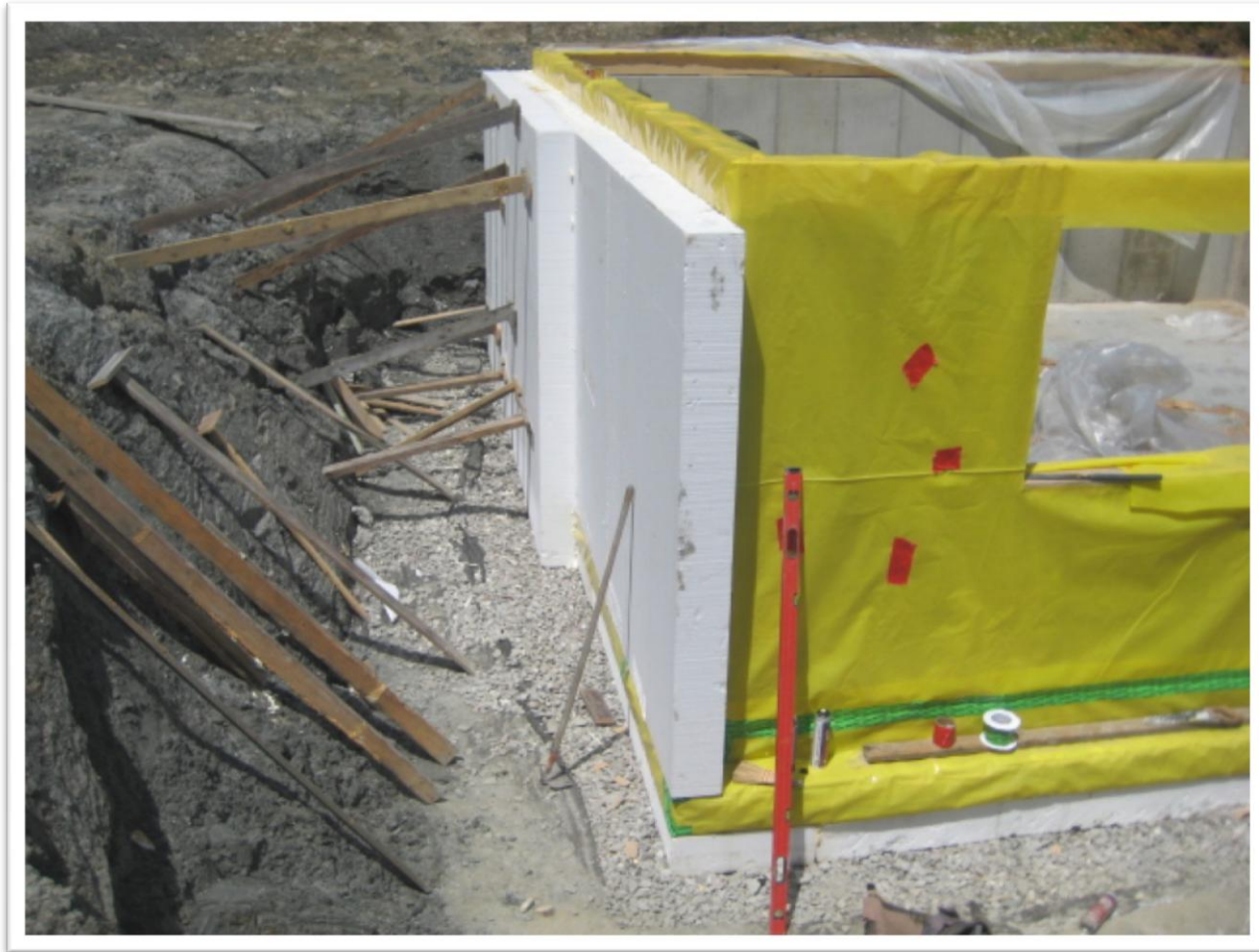
4) Thermal Bridge=

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

Ψ_e (for PHPP) **-0.003** Btu/hr*°F

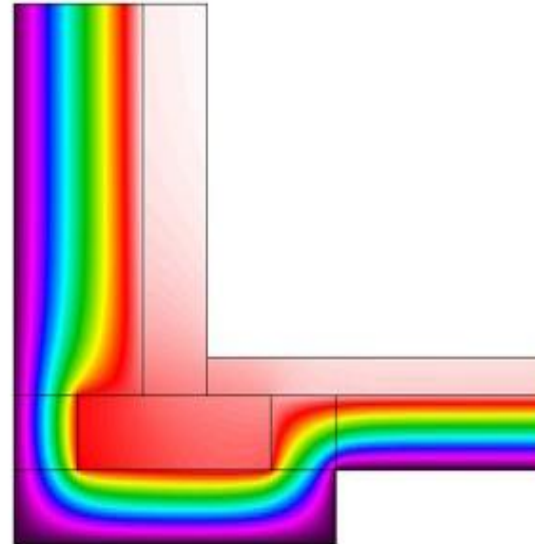
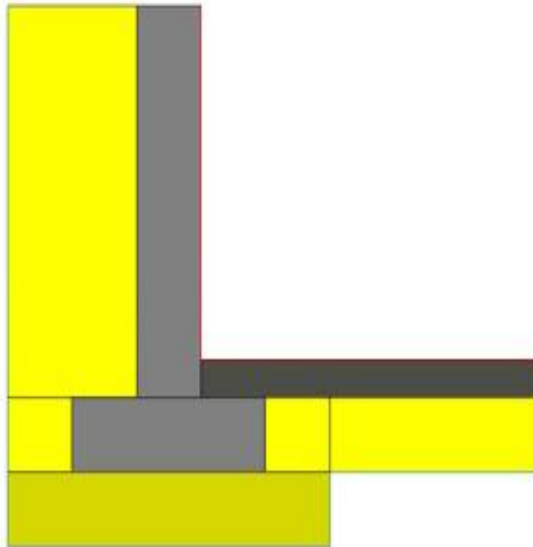
Internal Temperature 68.0

External Temperature 35.6

Lowest Surface Temp 65.4

f_{RSI} at 68 °F/ 23 °C **0.92**

Images Of Detail

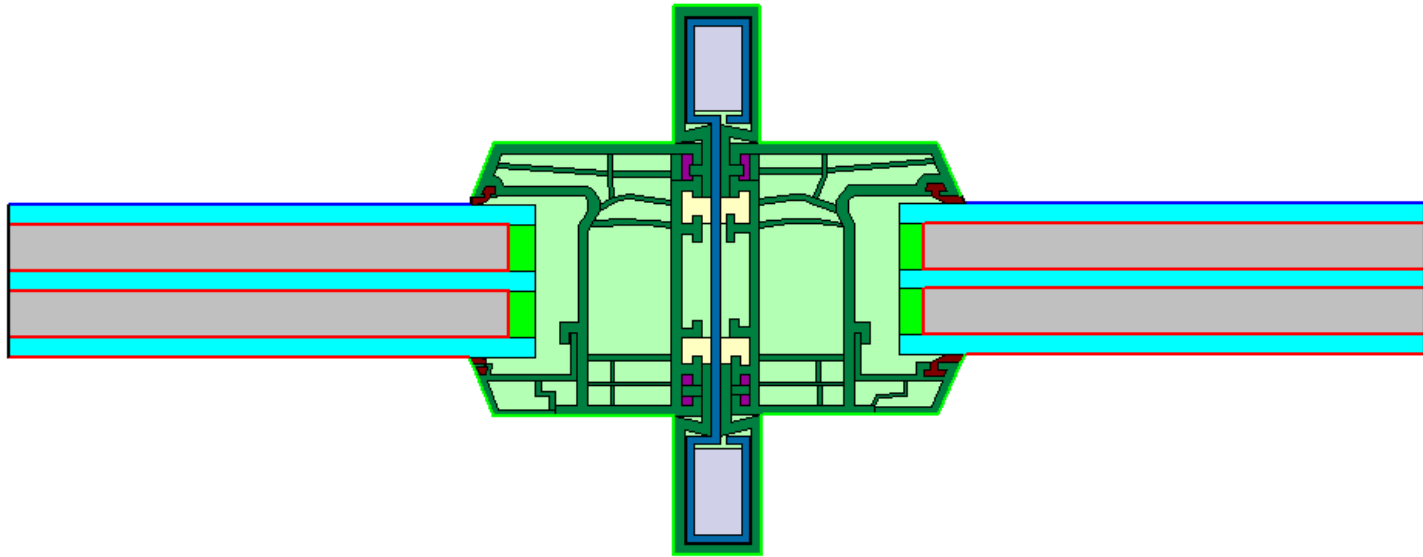


By Chris West, Eco Houses of Vermont

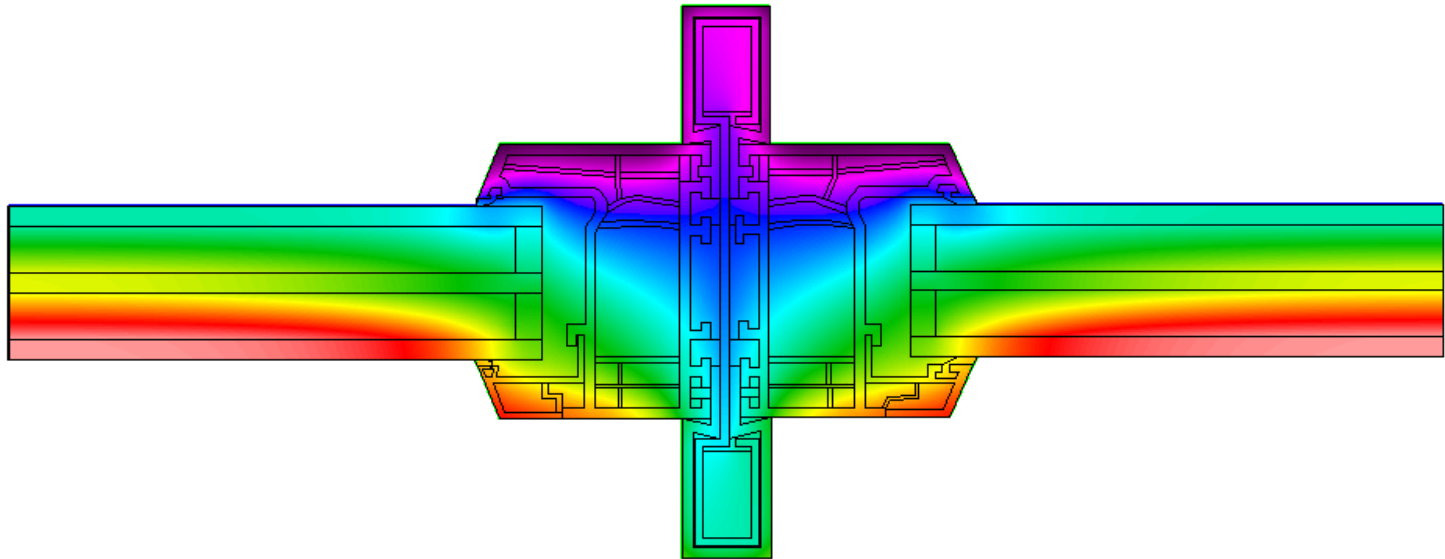
Window connection Mullion=
Giant piece of metal=
Giant thermal bridge



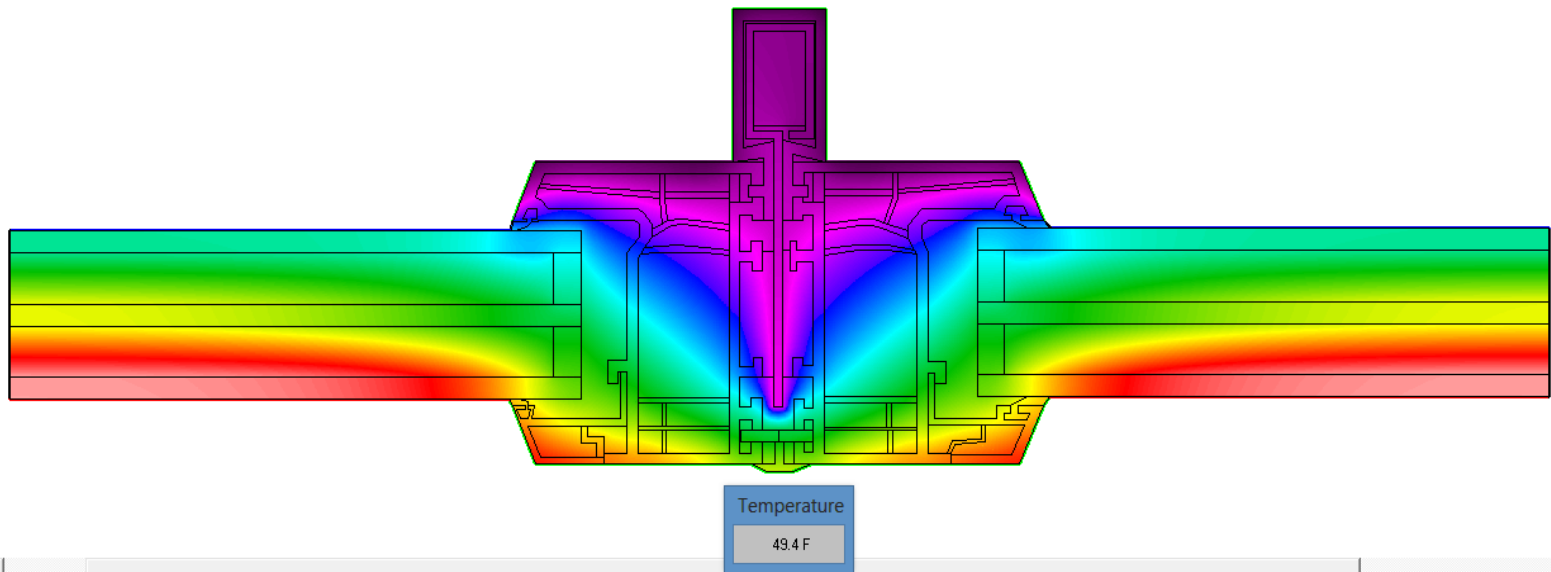
Plan View of Window Jointing Mullion In THERM



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

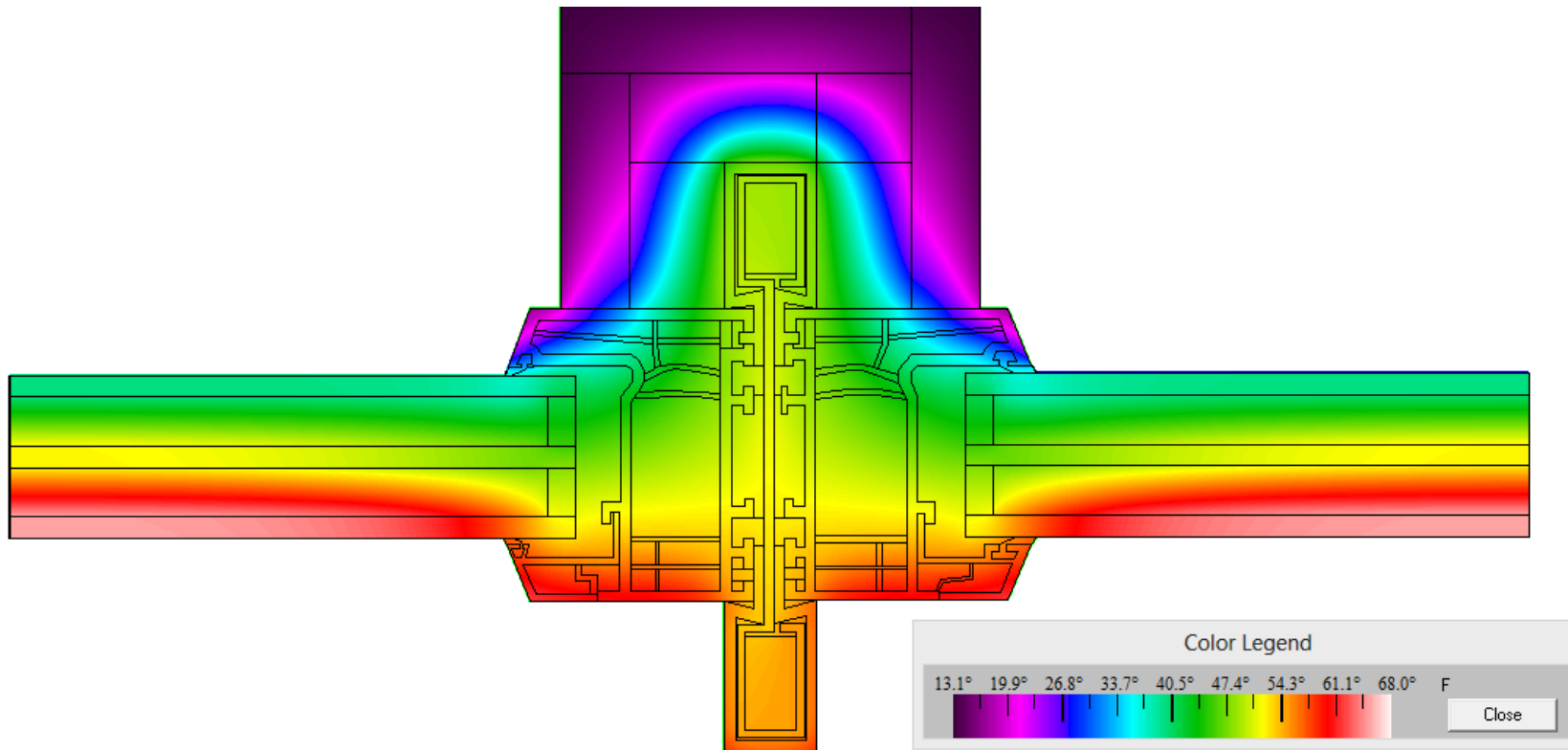


Thermal Bridge=.043 BTU/hr.ft.F
Temperature=49.4 F



Exterior Trim w/ EPS

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



Performance based design

