“What is the use of a house if you haven't got a tolerable planet to put it on?”

- Henry David Thoreau


HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

Presenter - Oliver Klein

- Registered Architect (MA)
- Certified Passive House Consultant (CPHC)
- M.S. Materials Science (1993)
  Thayer School of Engineering, Dartmouth College
- M.Arch (2008)
  Boston Architectural College
- Father of 14-year-old

Our **Mission**

To **transform** the construction market towards **high performance construction** by providing high-quality **knowledge resources** and the best **products and systems** available on the market.

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

- You're seeking to **understand building science** & high-performance construction
- You're seeking **less toxic and more sustainable** solutions.
- You're in need of **resources to analyze risk**, determine best materials and components.
- You want to be supported in **understanding and implementing** those solutions.
- You need critical components **ordered and delivered to the jobsite** in a straightforward manner.

475 is **here for you** when…

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

AIR+MOISTURE CONTROL

VENTILATION

INSULATION

WINDOWS

ROOF DAYLIGHTING

HOT WATER

QUALITY CONTROL

pro clima®

Lunos energy-efficient

Havelock Wool

GUTEX

BEWISO BEST WINDOW SOLUTION

LAMILUX

FAKRO®

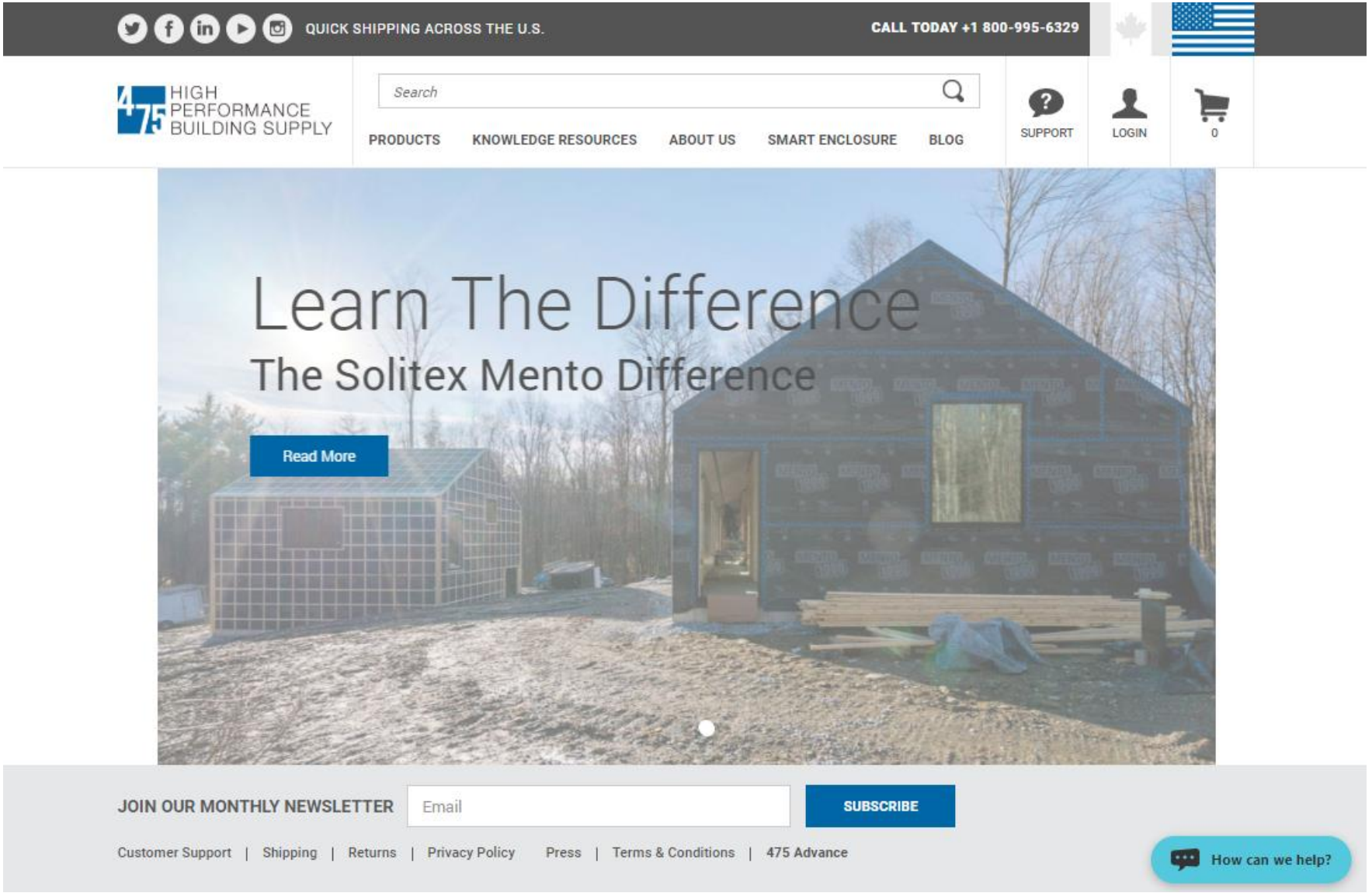
lightway®

SANCO2

designPH

High performance **building components**

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



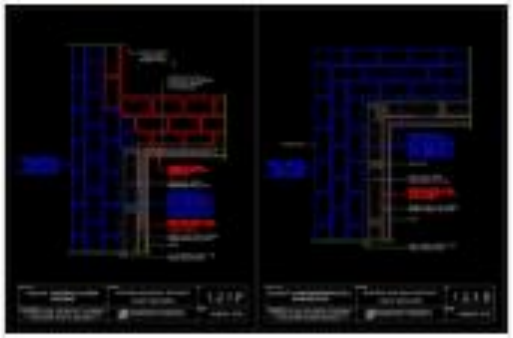
foursevenfive.com | foursevenfive.ca

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

MASONRY RETROFIT SMART ENCLOSURE EBOOK

from **$0.00**

ADD TO CART



MASONRY RETROFIT SMART ENCLOSURE (DWG)

from **$0.00** /book

ADD TO CART

MASONRY RETROFIT HARDCOPY

from **$20.00**

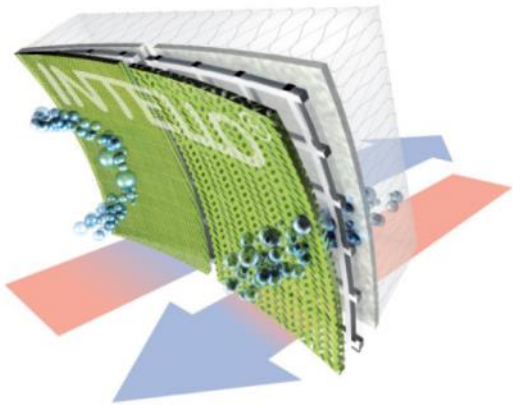
ADD TO CART

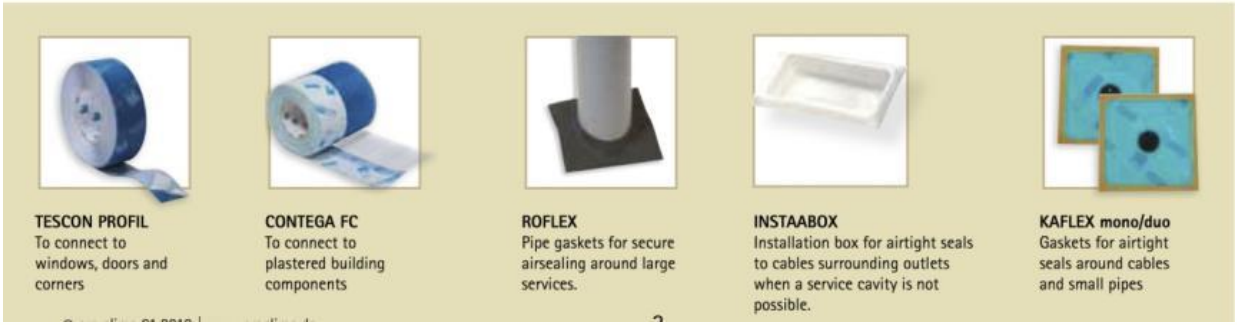
Knowledge Resources

4-75
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Interior air sealing & vapor control

pro clima®





TESCON PROFIL
To connect to windows, doors and corners

CONTEGA FC
To connect to plastered building components

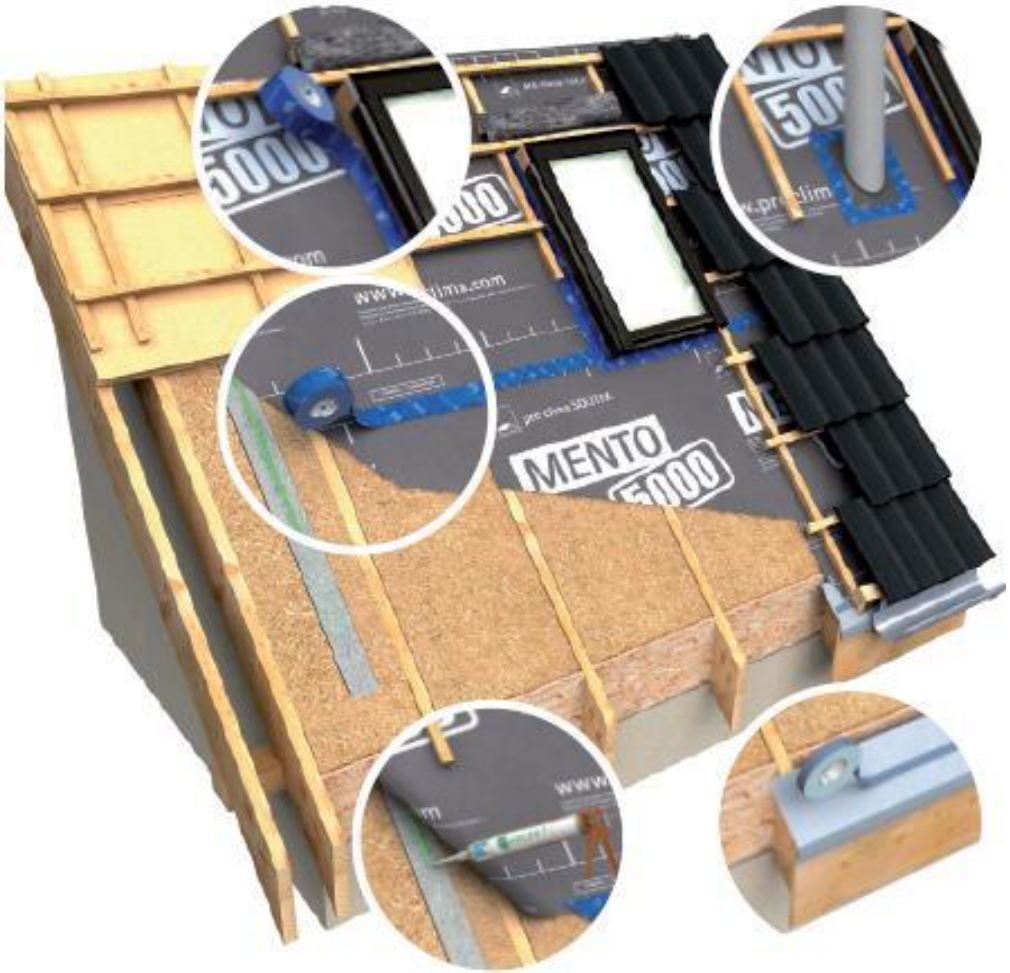
ROFLEX
Pipe gaskets for secure airsealing around large services.

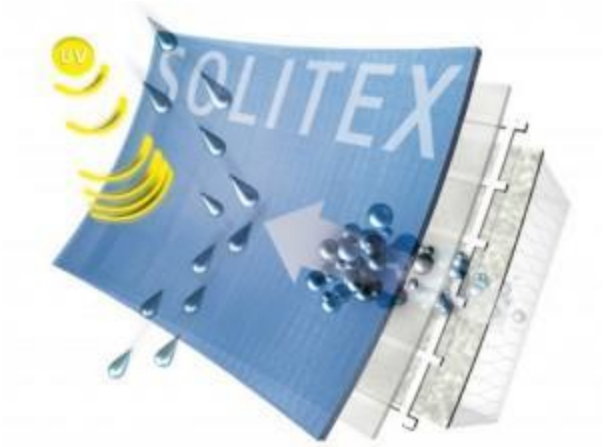
INSTAABOX
Installation box for airtight seals to cables surrounding outlets when a service cavity is not possible.

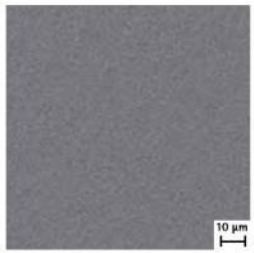
KAFLEX mono/duo
Gaskets for airtight seals around cables and small pipes

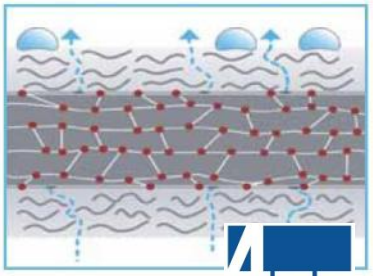
Exterior air sealing & vapor control

pro clima®









ADHERO

Durable, monolithic self-adhered vapor-permeable WRB

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

INTELLO X

Waterproof, UV-rated Smart Vapor Retarder

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

VISCONN

Liquid-applied air barrier for robust connections and details

Application

VISCONN liquid-applied air barrier can be spray applied as a well as brushed. Use on interior or exterior for durable waterproof air seal. For masonry, CMU, wood sheathing, fiberboard, joists or joist bays. It simplifies air sealing of difficult junctions such as windows, roofs, walls, ceilings and floors connections.

- Reliably seals all standard construction surfaces
- Permanent elasticity and high durability (after 12+ hr curing)
- Improves surfaces: bonds/solidifies substrate, subsequent coatings and acts as primer
- Can be plastered / stuccoed over
- Use for interior and exterior areas shielded from UV

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Wood fiber insulation boards/WRB

- Functions as weather resistive barrier
- Very vapor open
- Low embodied energy production
- Carbon sink
- Renewable resource material
- Roofs and walls

GUTEX®

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Gutex MULTITHERM

Product Specifications

Applications

- Floor
- Pitched Roof
- Flat Roof
- Wall

Properties

- Doubles as WRB: meets ASTM
- Tongue & groove
- R-Value: 3.7/in
- Thickness: $1^{9}/_{16}$” - $7\ ^{7}/_{8}$” (40mm - 200mm)
- Perm rating: 44/in

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Gutex ULTRATHERM

Product Specifications

Applications

- Roofs

Properties

- Doubles as WRB
- No additional roof underlay necessary
- Tongue & groove
- R-Value: 3.4/in
- Thickness: 2” - 6 5/16” (40mm - 160mm)
- Perm rating: 44/in

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Product Specifications

Applications

- Floor
- Pitched Roof
- Flat Roof
- Wall

Properties

- No paraffin= cheaper, can be used as an R-value booster
- R-Value: 3.6/in
- Thickness: $1\ ^{9}/_{16}$" - $4\ ^{3}/_{4}$" (40mm - 120mm)
- Perm rating: 44/in

Gutex THERMOSAFE WD

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Gutex THERMOFIBER

Product Specifications

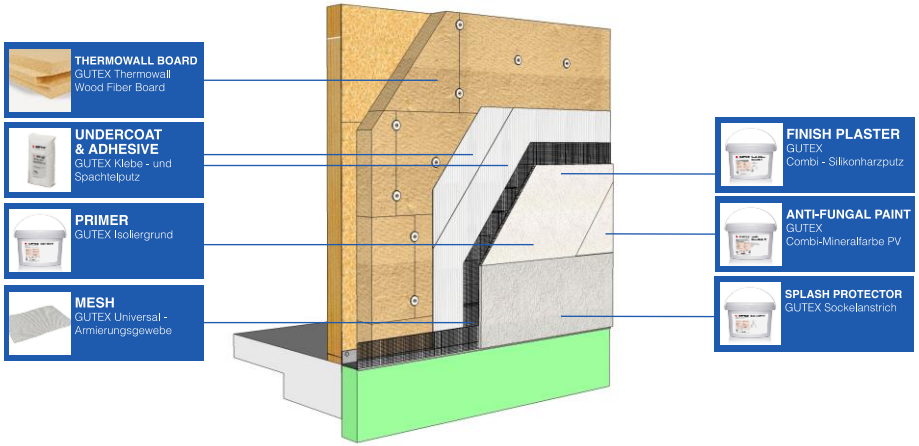
Applications

- Dense pack/loose fill

Properties

- Self supporting from 1.8 lbs/cf when dense packed
- R-value: 3.8/in
- Airflow resistivity (kPa*s/m2) >5
- Perm rating: >100/inch

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Gutex THERMOWALL

Product Specifications

Applications

- Exterior Insulation Finish System (EIFS)

Properties

- Can come in different size boards, thicknesses and board edges
- R-value: 3.6/in
- We supply the stucco system
  - Adhesive, plaster, paint, fasteners, drip beads, etc.
- Thickness: $1\,^{9}/_{16}$" - $7\,^{7}/_{8}$" (40mm - 200mm)
- Perm rating: 44/in

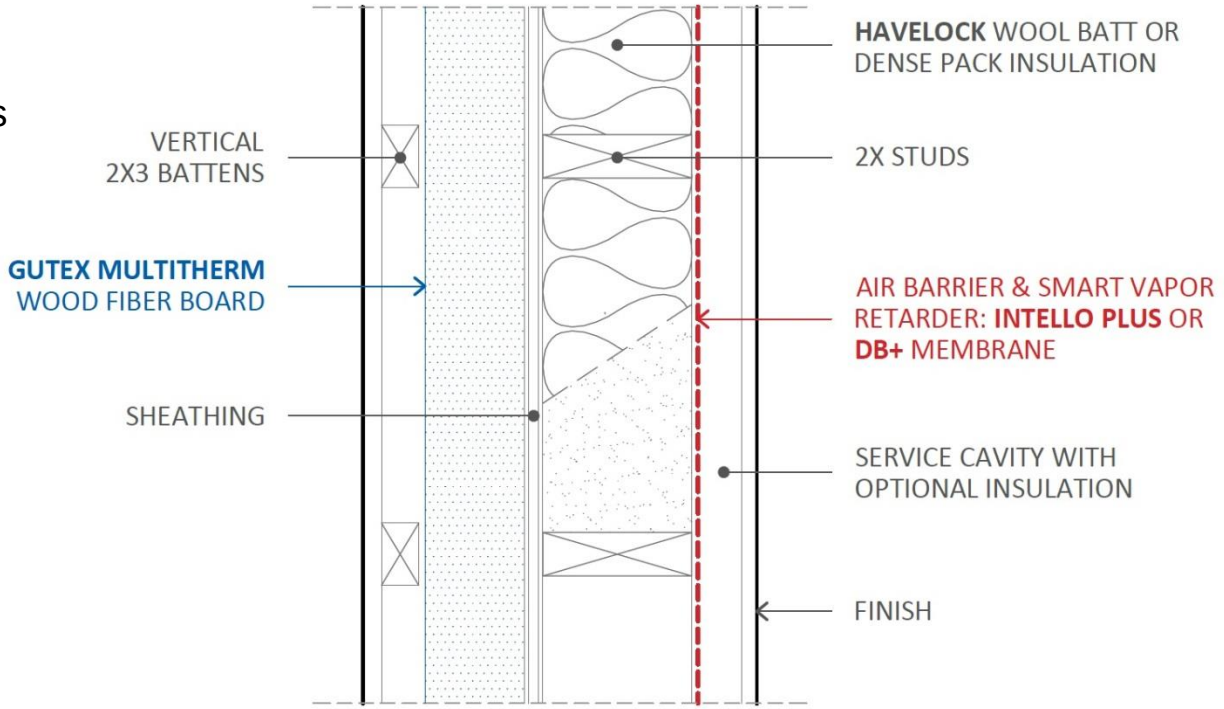
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Sheep’s Wool Insulation

The Smart Wall (& Roof)

Inside to outside:

- Interior finish
- Service cavity (with optional additional sheeps' wool insulation) – for wiring, outlets and other services.
- Interior air barrier and vapor-intelligent membrane
- Framing with Sheep's Wool insulation
- Structural sheathing (from boards to exterior grade gypsum board)
- Continuous GUTEX wood fiberboard exterior insulation and WRB
- Furring strips for back-vented rainscreen.
- Exterior siding rainscreen



PLAN

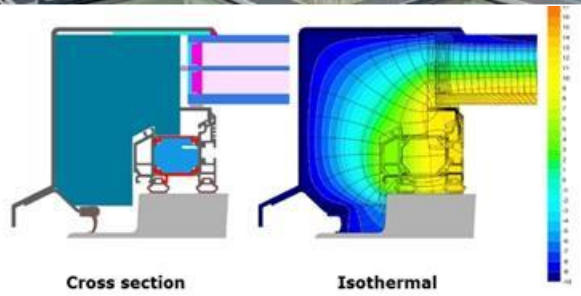
BEWISO

Best
Window
Solution

cool, temperate climate
phA
CERTIFIED COMPONENT
Passive House Institute

THERMAL TRANSMITTANCE	Uw max 0.11 btu/h ft^{2}F
NOISE PROTECTION	35 dB
TRIPLE-GLAZING	Ug max 0.09 btu/h ft^{2}F
ISO-GLASS THICKNESS	Up to 79mm

Roof Daylighting



LAMILUX

Heat Recovery Ventilation

PLUS X AWARD®
honored as:
BEST PRODUCT OF THE YEAR 2012

PLUS X AWARD®
achieved for:
Functionality
Ecology

LUNOS
energy-efficient

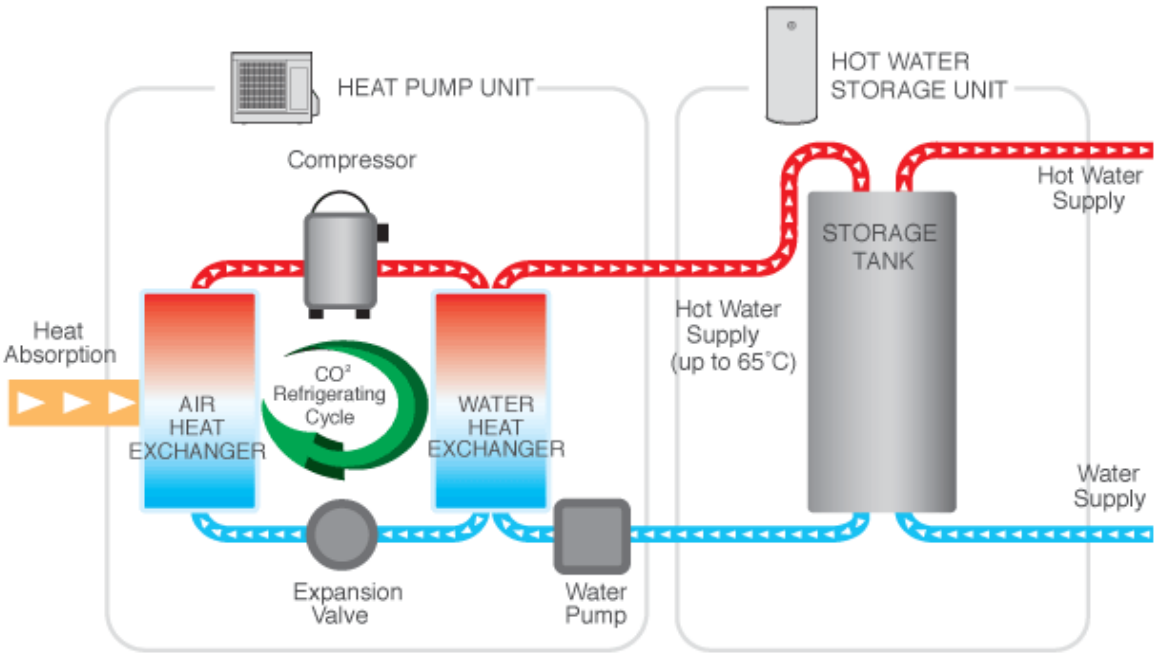
e2

- 90.6% efficient
- Very quiet
- Through wall, ductless HRV

SANDEN
Delivering Excellence

SAN CO_2

Heat Pump Water Heater



- 2 part system, 43 or 83 gallon tank coupled with a 4.5 kW (15,400 Btu/h) capacity inverter compressor outdoor unit
- Refrigerant Type: CO_2 (R744)

High Performance Gets Real

475

HIGH PERFORMANCE
BUILDING SUPPLY

FOURSEVENFIVE.COM

475 High Performance Building Supply

40107374

High Performance Gets Real

AIACES475002

Oliver Klein

January 8, 2020

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.

This course is registered with AIA CES

for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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

Copyright Materials

Course Description

Truly high performance or Passive House certified projects have gone from being an idealistic aspiration to a tangible reality in less than a decade. Enough time has passed to have examples, stories, and data to reflect on the first generation of these buildings and learn from their example. This presentation is a series of case studies about the methods, materials, and successes.

Learning Objectives

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

1. Describe attributes of high performance building enclosures and mechanical systems, and how they contribute to the long term health and comfort of building occupants.
2. Outline known challenges in use of materials and components in making high performance buildings.
3. Describe what is meant to have a systems approach and how it differs from conventional approaches in making more predictable and cost-effective high performance buildings.
4. Outline critical criteria in how data collection informs the improvement of building performance and the protection of occupant health and comfort.

Firmitas, *Utilitas*, and *Venustas*

(Firmness, Commodity, and Delight)

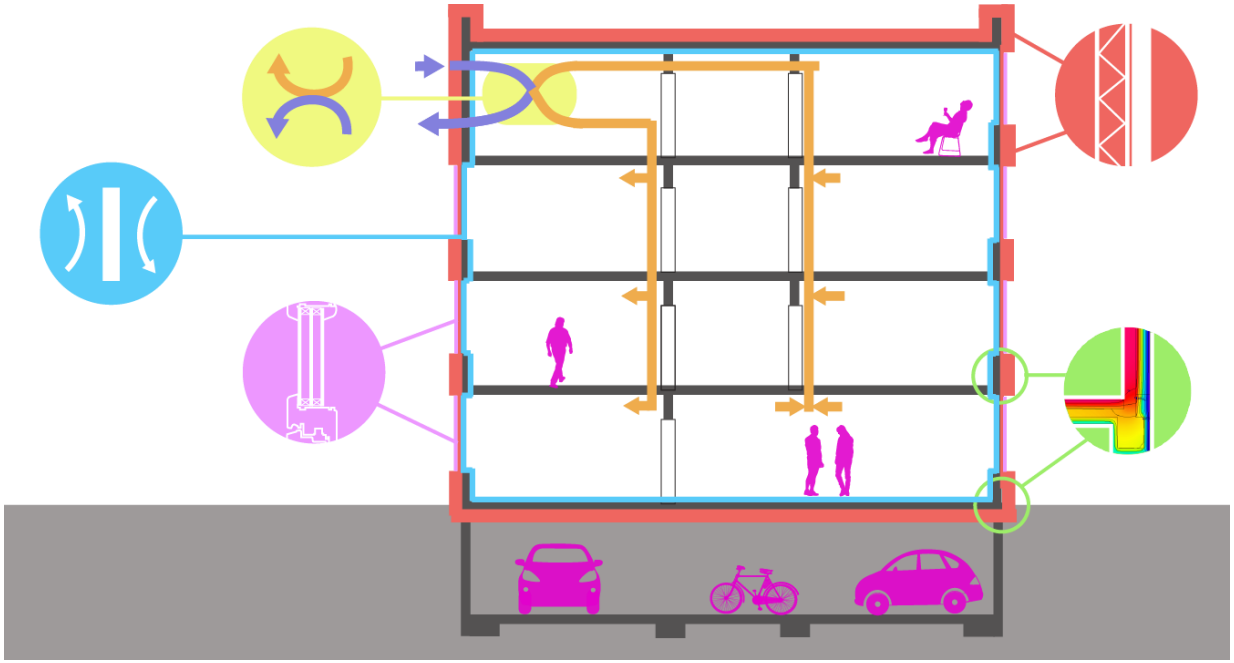
- Comfortable
- Healthy
- Energy Efficient
- Resilient
- Affordable
- Aesthetically pleasing

High Performance Goals

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Win-win

A **very low energy building** via **optimized methods** produces:



- Comfort
- Health
- Affordability
- Efficiency
- Predictability
- Security
- Resiliency
- Climate Mitigation
- Renewables Transition

Passive House: Aiming Higher

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

What makes Passive House different?

Integrated Goals & Methodology:

1. Focus on Passive Elements:

- **Orientation**
- **Massing**
- **Insulation**
- **Airtightness**
- **Windows**
- **Doors**
- **Passive Heat Gains**

2. Fixed Performance Goals:

- **Heating**: 4.75Kbtu/sf2*yr demand or 3.17 btu/hr*sf **peak load**
- **Cooling & Dehumidification:** 4.75Kbtu/sf2*yr + climate specific dehumidification
- **Primary Energy:** ~38Kbtu/ft2*yr
- **Airtightness: T**ested limit 0.6 ACH50

3. Calculated Energy Balance:

- **Passive House Planning Package** (PHPP)

"Peak Load Equivalent"
For 1,000 sq ft house

Peak load is the original "Source EUI" metric. The calculation now is for Primary Energy Renewable (PER) and is no longer directly comparable to EUI but still roughly corresponds to this original number for Passive House Classic certification.

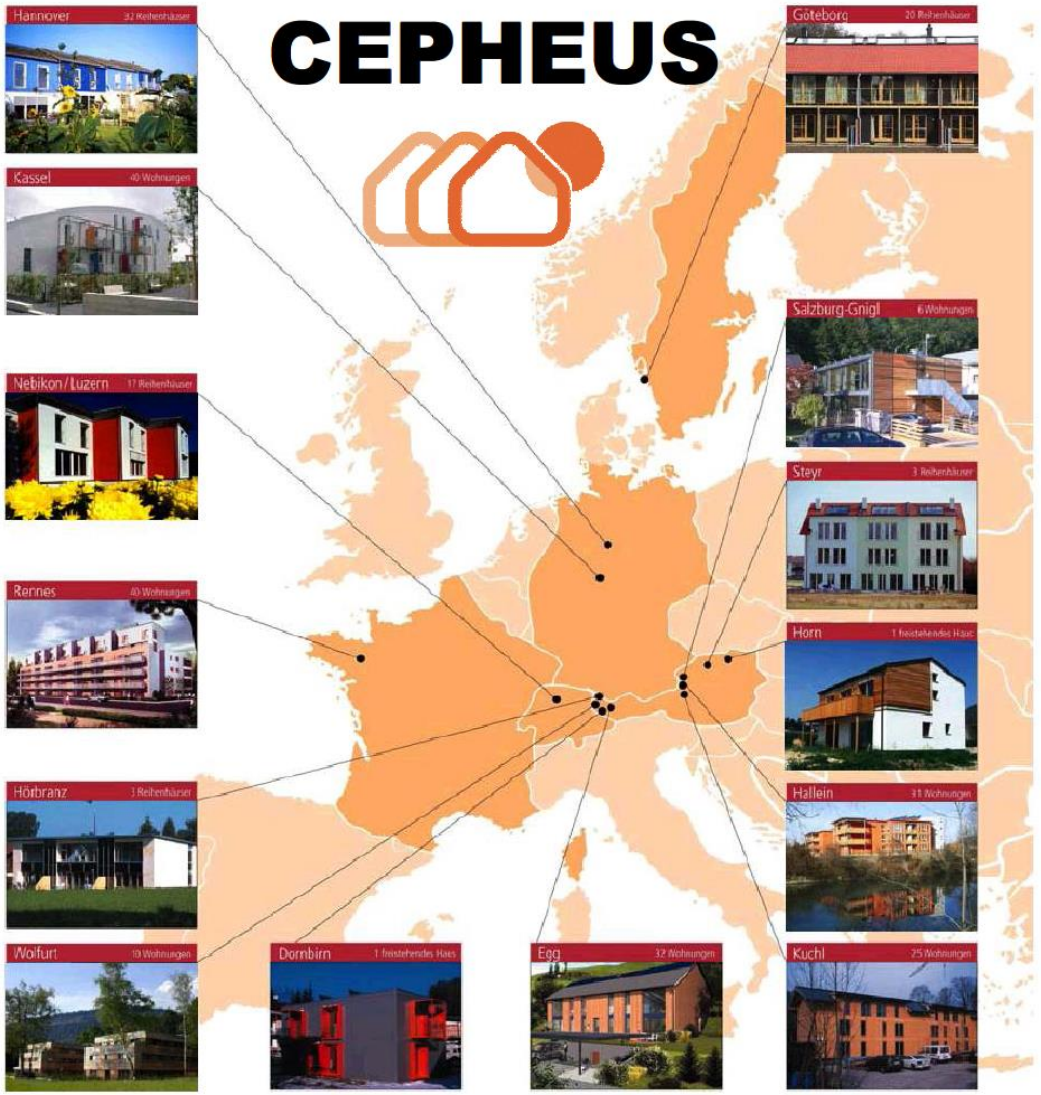
PHIUS+ Separate set of targets and uses WUFI Passive

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Verification of the Methodology

2000:

250 dwelling units in 14 different building projects as Passive House Buildings



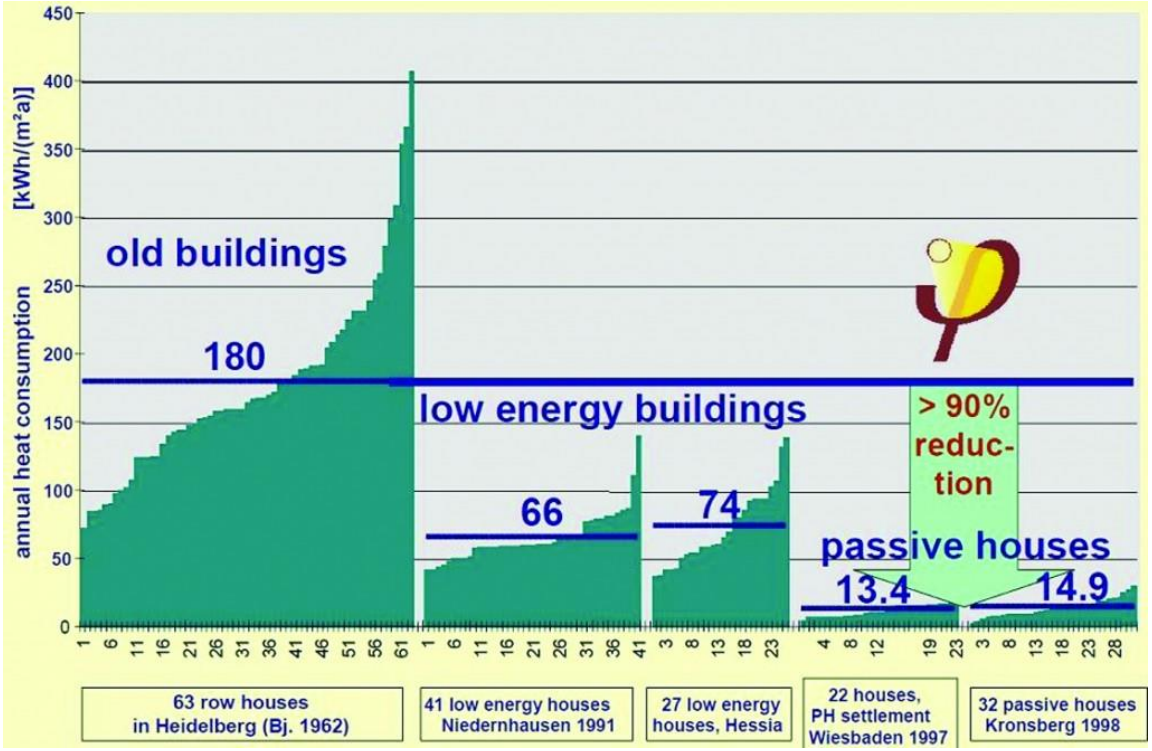
Delivers comfort with dramatic energy savings:

Approx **90%**

reduction in heating & cooling

Up to **75%**

reduction in total energy usage.



Supports renewables transition:

- **Path to Net-Zero Buildings & more.**
- Allows switching to all electric buildings.
- More even utility demand profile.
- Primary Energy Renewable (PER) Calculation optimizes building energy use for 100% renewable grid.

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Bold Implementation

BRUSSELS, 2015: All buildings, private, public, new and retrofitted **mandated** Passive House performance.

EUROPE, 2020:

Nearly zero-energy buildings.

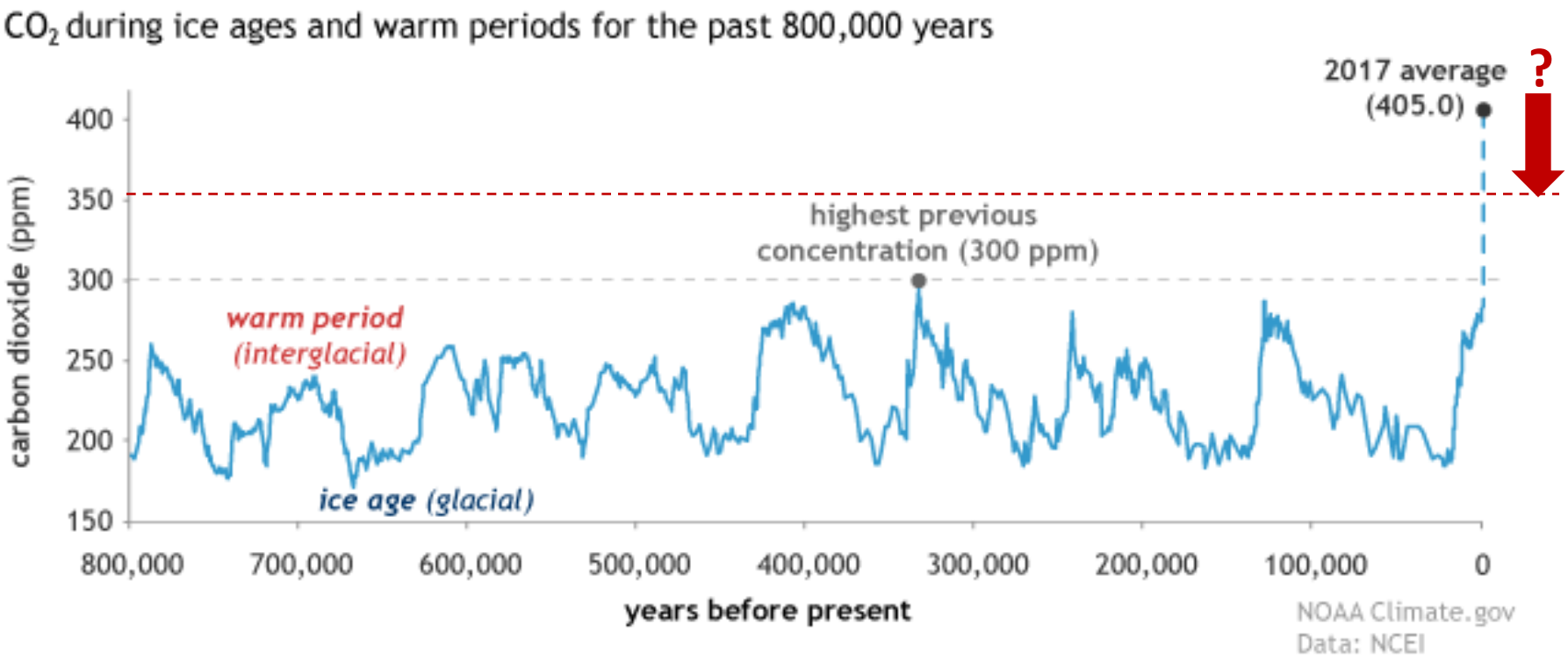
NYC (& Vancouver…)

Not Typical “Cost-Plus” Paradigm

PHFA Multifamily Housing Around Philadelphia Region = 17 Buildings

$206/sf vs. $208/sf average

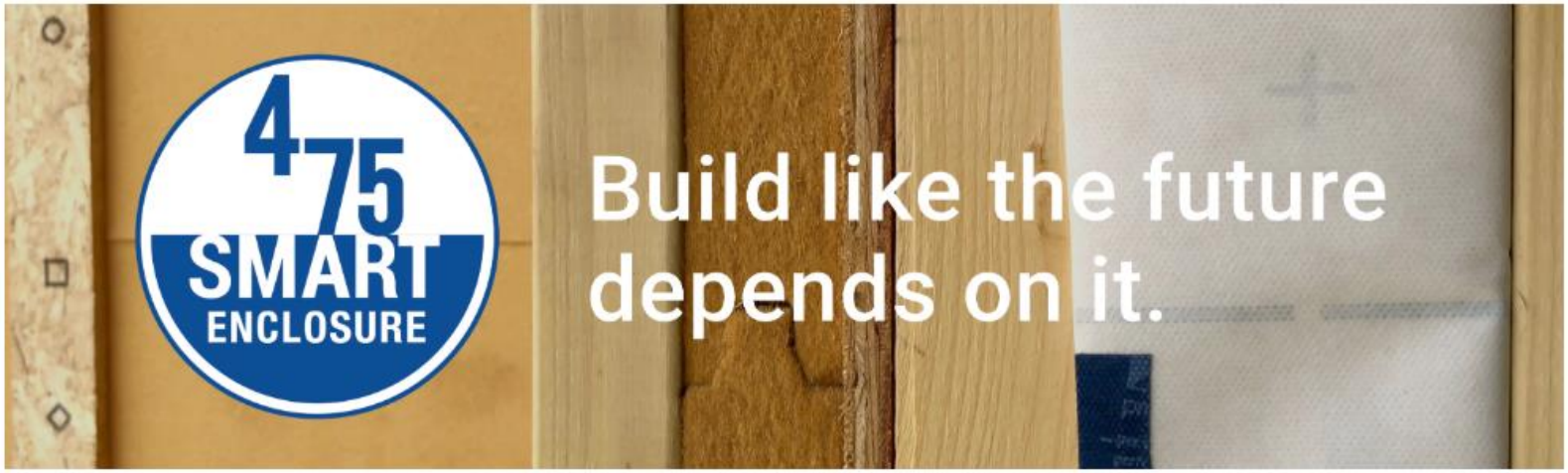
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



1. The world turned upside down
2. Climate Change!
3. Buildings Huge Problem
4. Dramatic Answers Needed

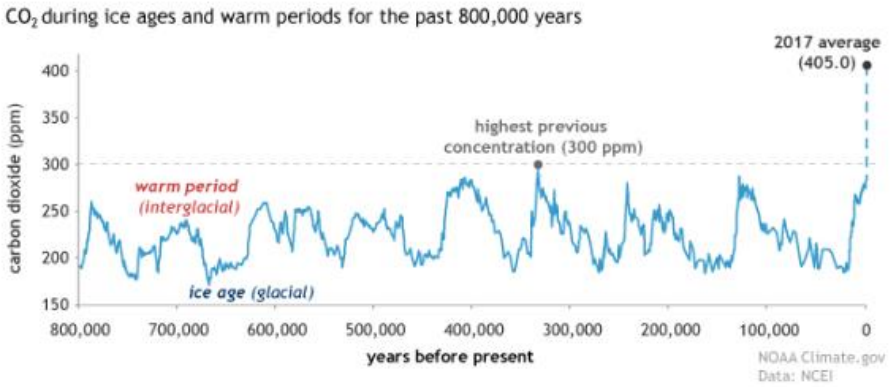
What's **the Problem**?

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Smart Enclosure Introduction

In the 20th century, builders used giant energy resources and chemical-based materials to conquer the vagaries of nature. Our buildings now contribute approximately 45% of total US greenhouse gas emissions (Architecture 2030, 2013). And while scientists tell us a stable climate is assured at atmospheric CO2 concentrations of 350 parts per million (Hansen et al., 2008), today concentrations are rising past 410 parts per million.



Smart Enclosure: Higher Still

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

No Time is Left, **Let's Act**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

BUILD SUSTAINABLY

- Lower Embodied Carbon
- Greater Carbon Sequestration
- Lower Toxicity
- More Natural Materials

BUILD HIGH PERFORMANCE

- Smart Vapor, Air & Thermal Control
- 100+ Year Durability
- Fully Integrated Performance

Seven Principles of a Smart Enclosure

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Lincoln Cathedral

Smarts **embedded** in the **architecture**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Tree of Life

Knowledge Ecosystem

1. Principles
2. Tiers
3. Assemblies
4. Resources
    1. eBooks
    2. DWG files
    3. Picture libraries
    4. Video libraries

Smart Enclosure **Ecosystem**

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

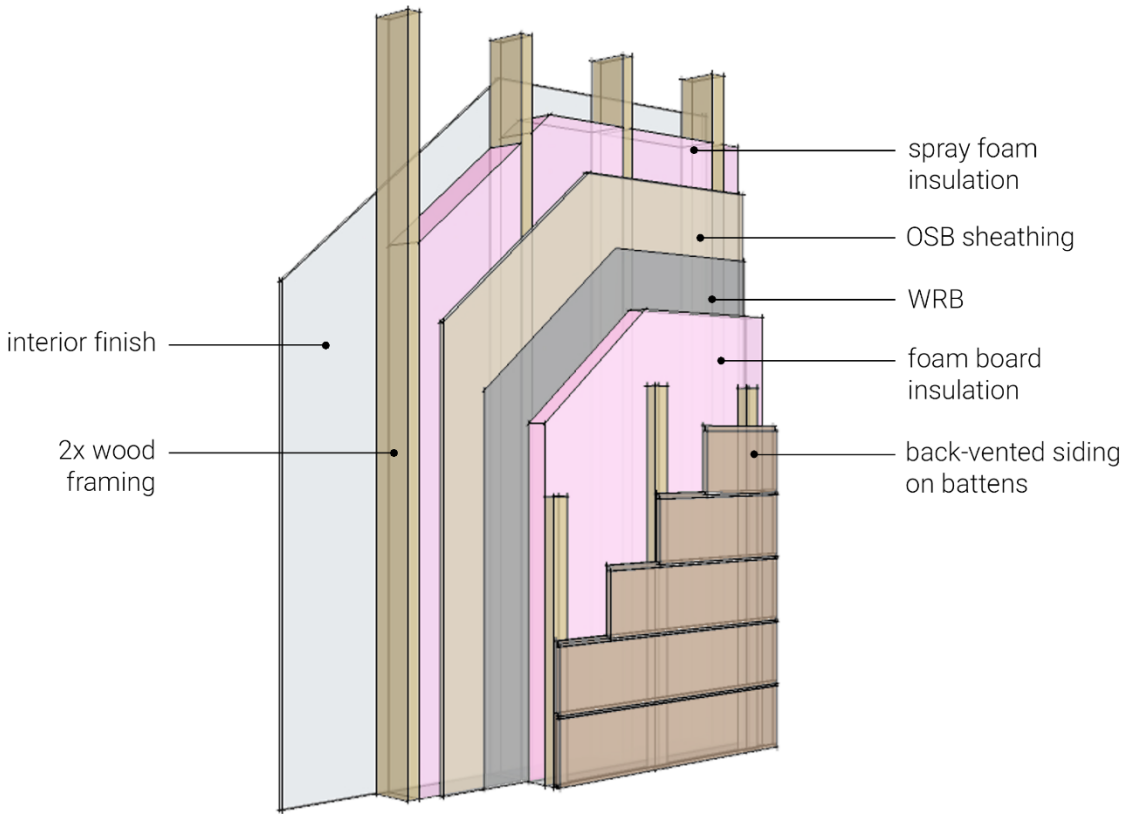
INDUSTRY DEFAULT
Unhelpful Habit

TIER 1
Modified Default

TIER 2
Simplified and Improved

TIER 3
Optimized Performance

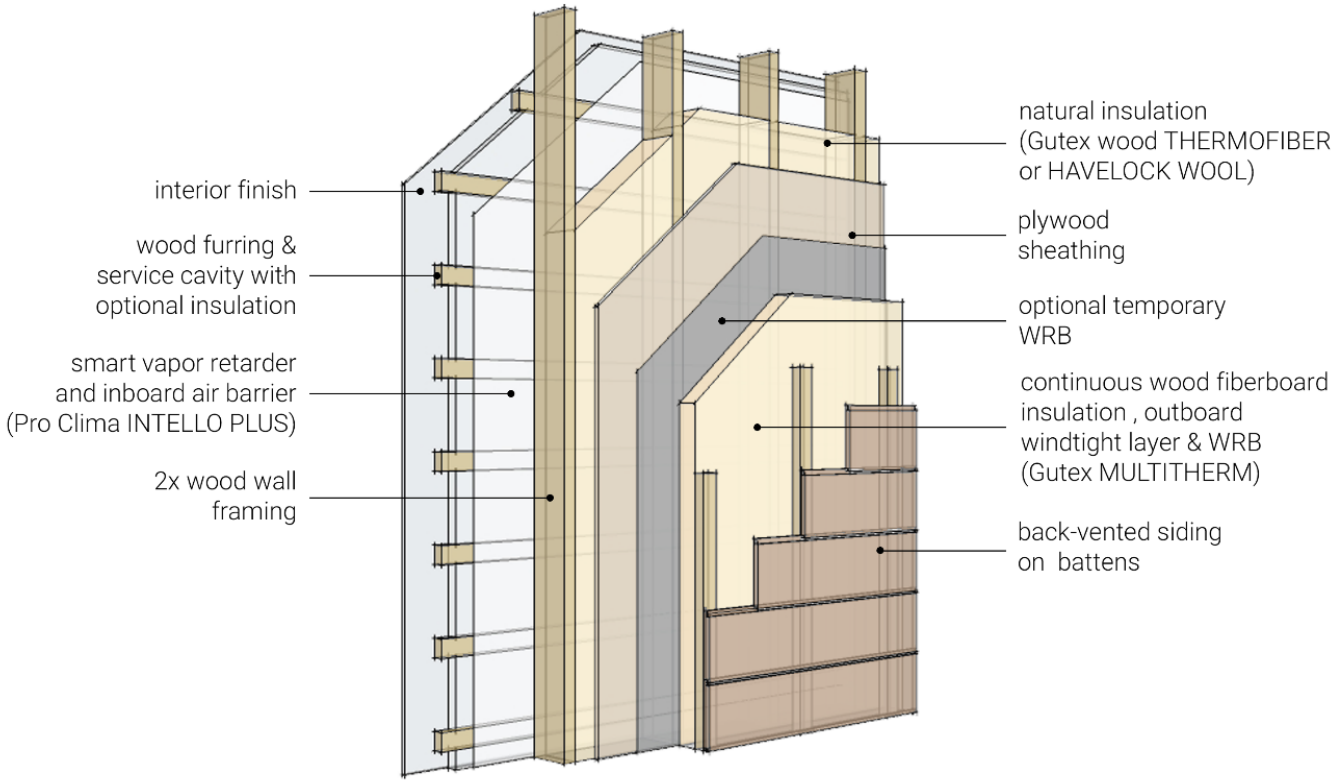
Three Tiers



- High embodied carbon, low sequestration, greater toxicity and less resilience.

Industry High-Performance **Default**

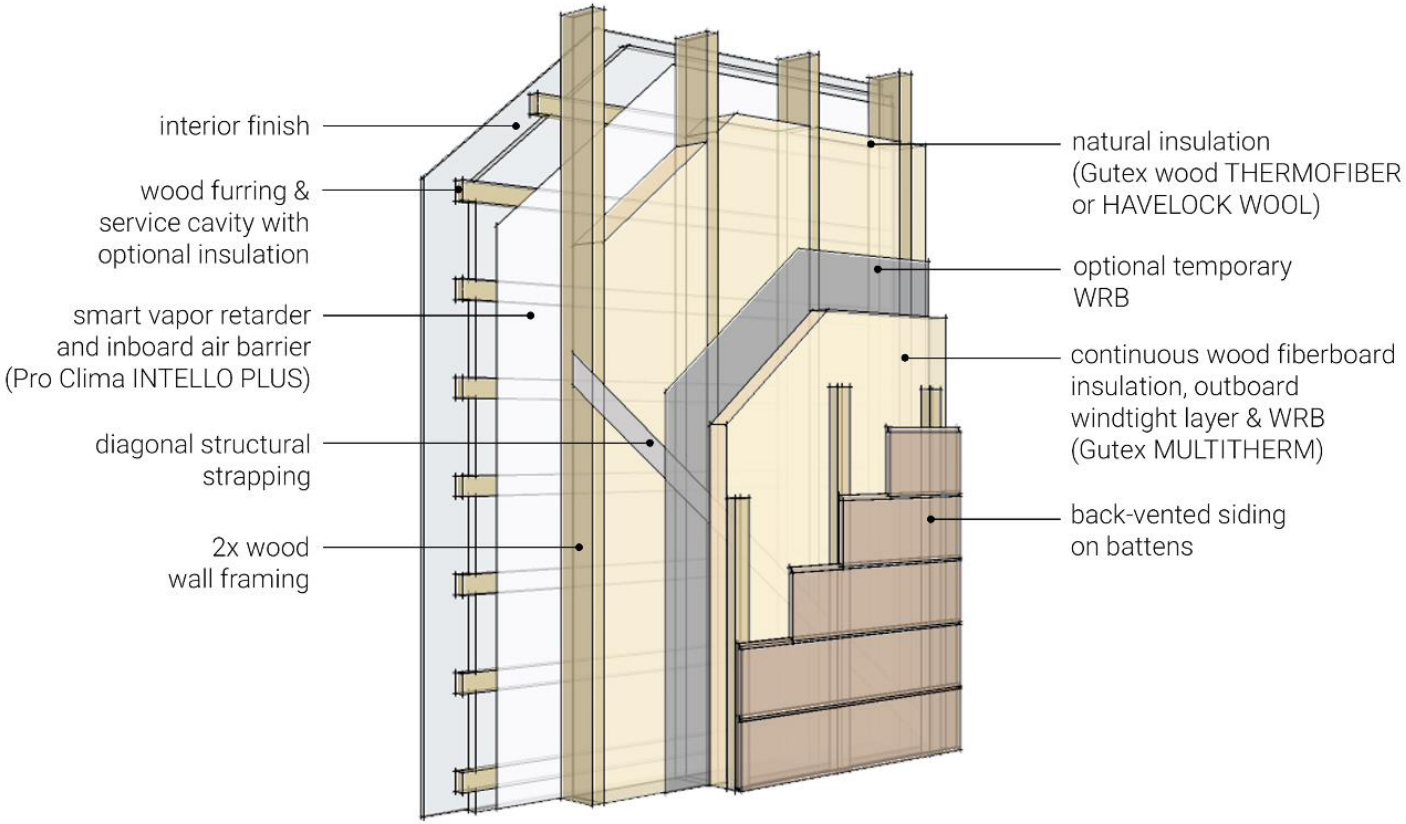
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



- Tier 1 modifies common construction practice at a superficial level, but fundamentally transforms its capabilities

Tier 1: Modified Default

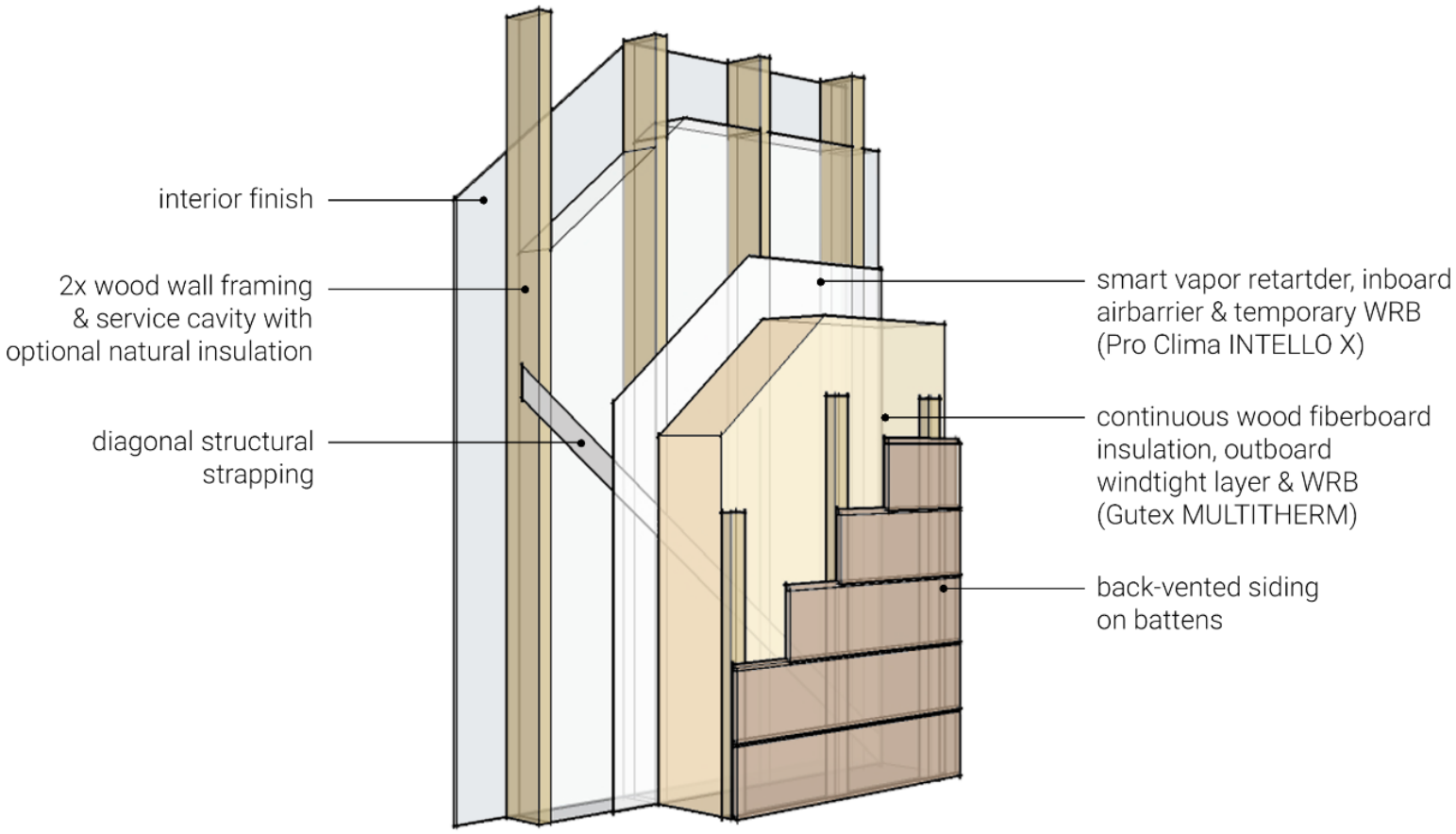
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



- Tier 2 reduces the amount of materials and simplifies the design.

Tier 2: Simplified & Improved

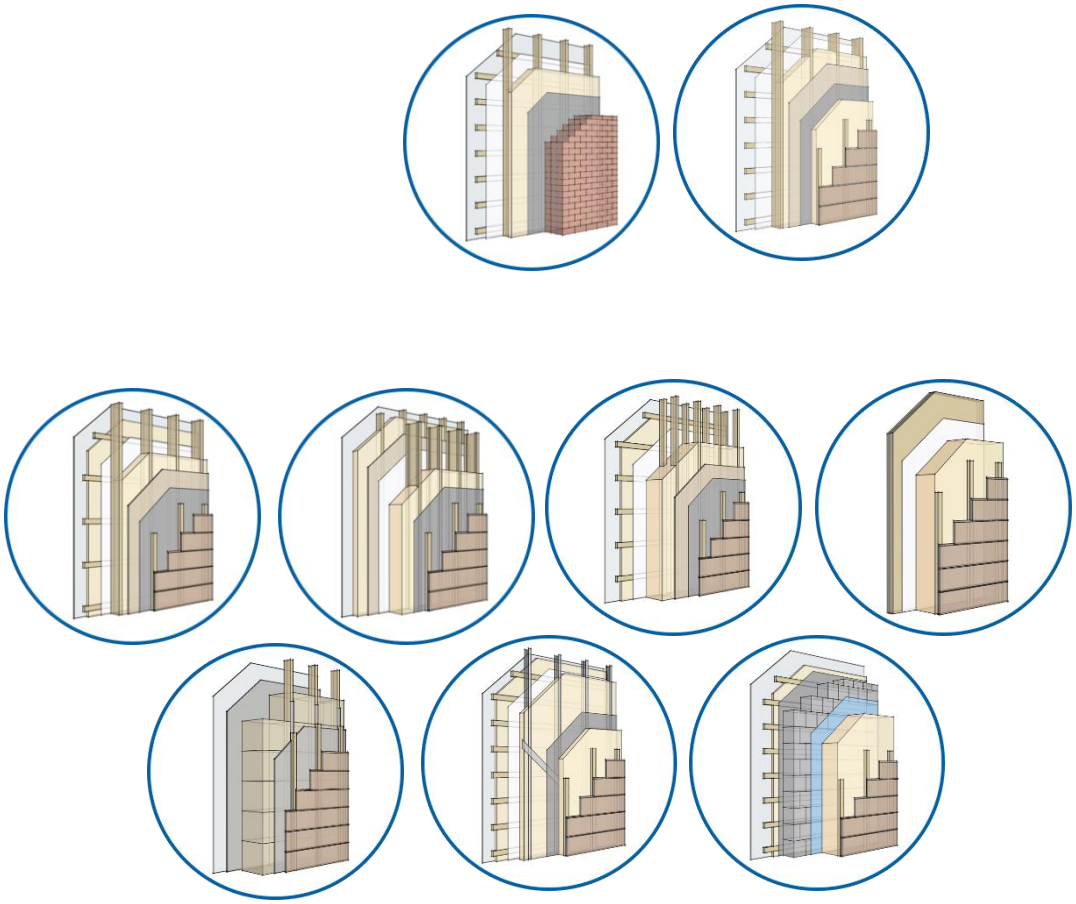
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



- Tier 3 further reduces the layers and complexity, while providing greater future flexibility and robustness.

Tier 3: Optimized Performance

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Retrofits

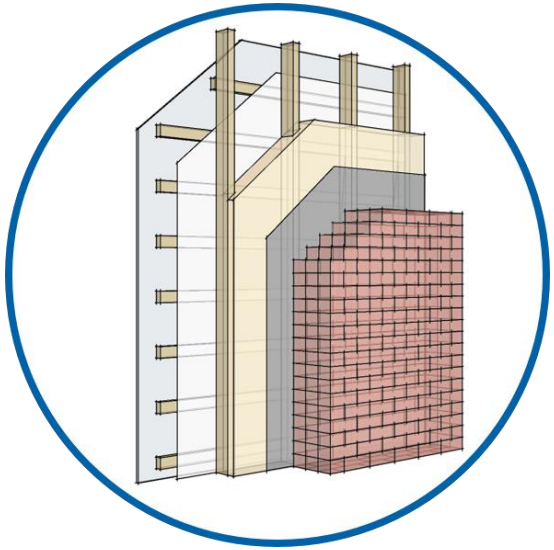
- Masonry Retrofit
- Wood Frame Retrofit

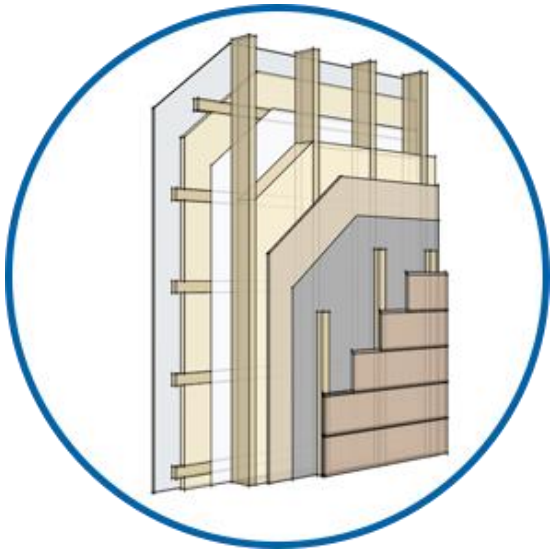
New Build

- 2x Wood Framing
- I-Joist Outrigger
- Double Stud
- Mass Timber
- Straw Bale
- Metal Frame
- Concrete

The Assemblies

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM





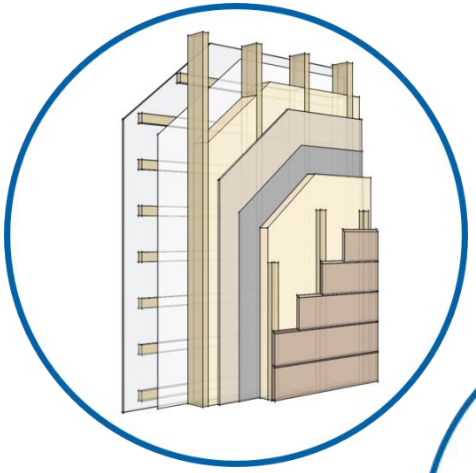
The Retrofits

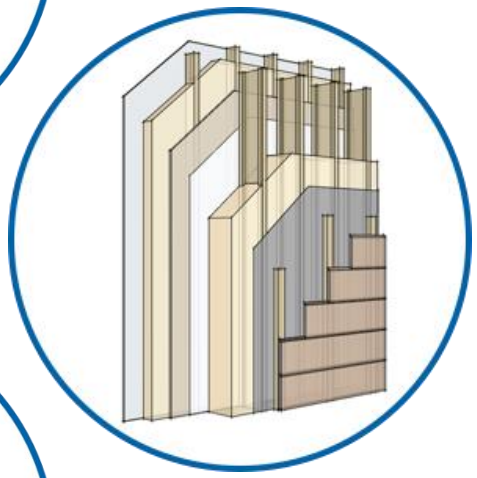
- Masonry Retrofit
- Wood Frame Retrofit

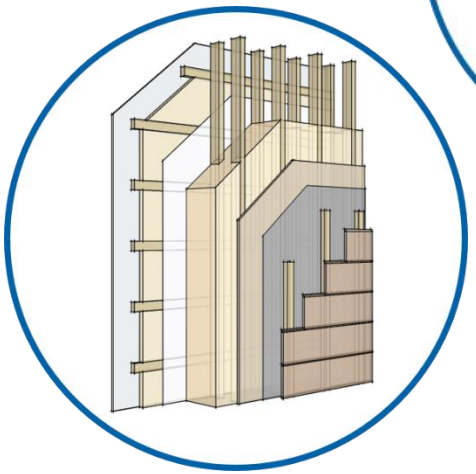
If possible, **chose renovation** before new build, because it's the smartest form of construction. Renovating and reoccupying old buildings is rightly considered, itself, an act of sustainability.

Using the existing structure can mean **50% to 75% less embodied carbon**, on day one of occupancy, than a new building would generate.

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM





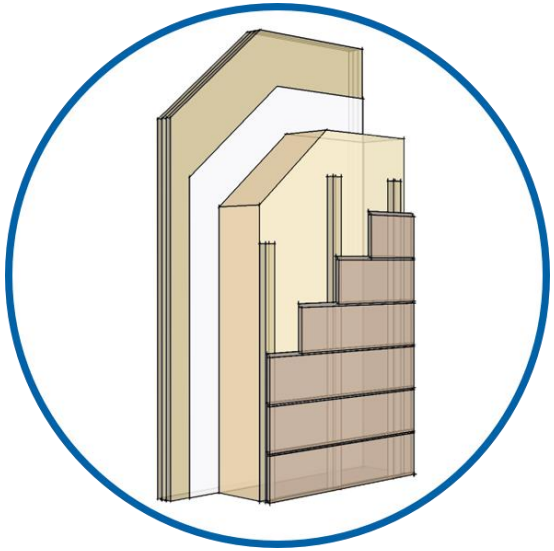


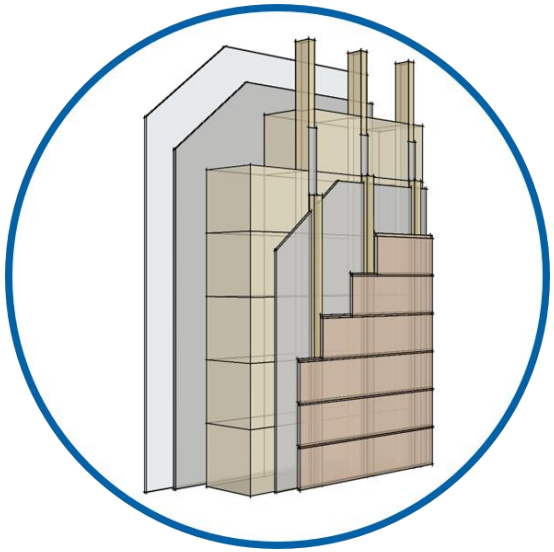
- 2x Wood Framing
- I-Joist Outrigger
- Double Stud

New construction, while bringing with it more embodied energy than a retrofit does, provides **ample opportunities** to provide a low embodied carbon solution with large amounts of carbon sequestration, at the highest level of performance.

Wood Frame **New Build**

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



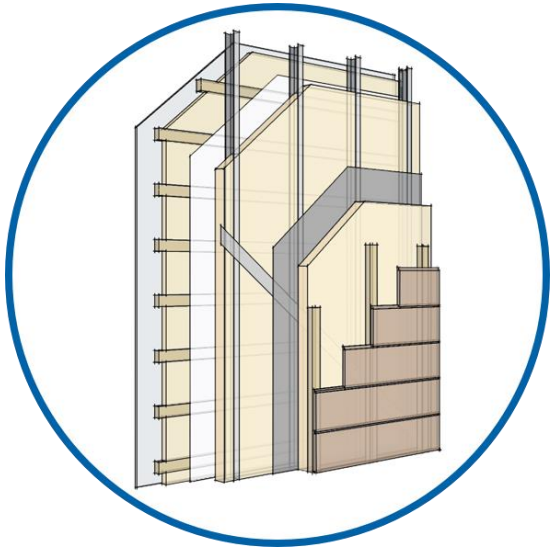


- **Mass Timber**: Mass timber has many performance benefits, including fire resistance, acoustic performance, material stability, and construction efficiency.

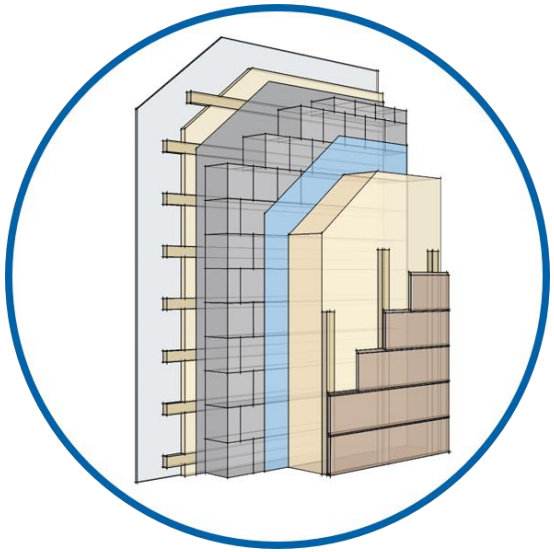
- **Straw Bale**: Straw is a rapidly renewable resource that is full of carbon drawn from the atmosphere, so it can be more effective than wood in our climate mitigation efforts.

New Build – **High (good) Impact**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



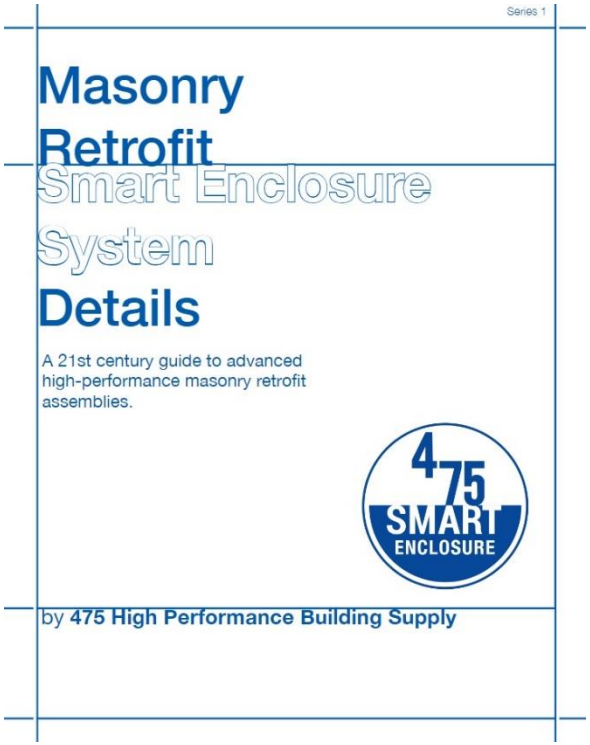
- **Metal Frame**: High levels of recycled content. Limit high embodied energy materials: foam plastic insulation; make more durable and operationally efficient for 100+ years; maximize wood and other natural material use.

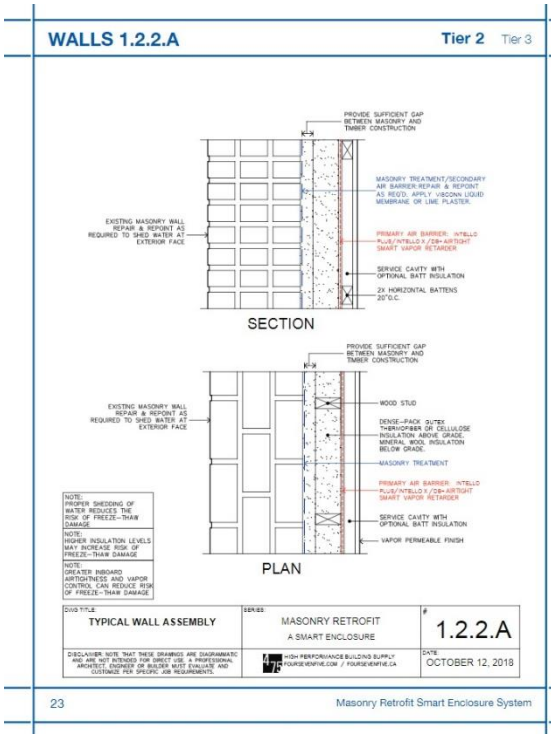


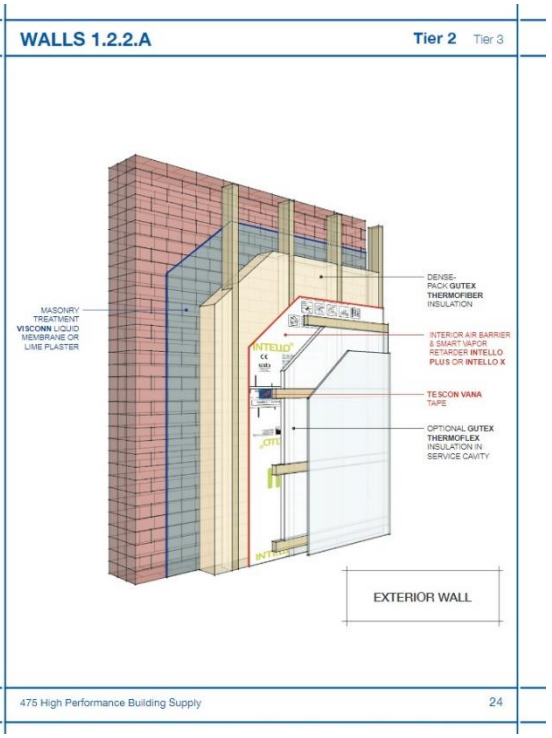
- **Concrete**: Often worse than metal because the embodied carbon of concrete, and particularly Portland Cement, is just so damn high. Like metal, it's not going away, and there are things we can do to make it a smarter option.

New Build – **Minimize Impact**

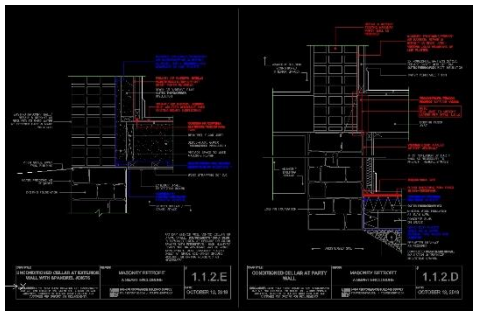
475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM





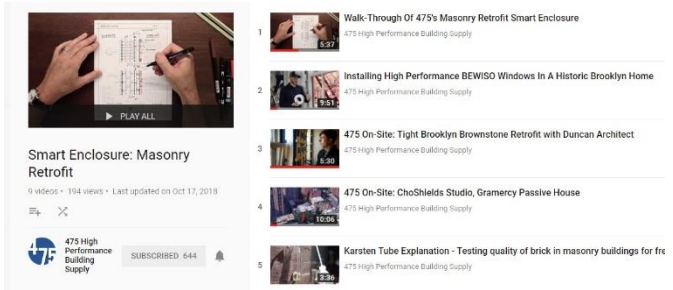


eBook



DWGs

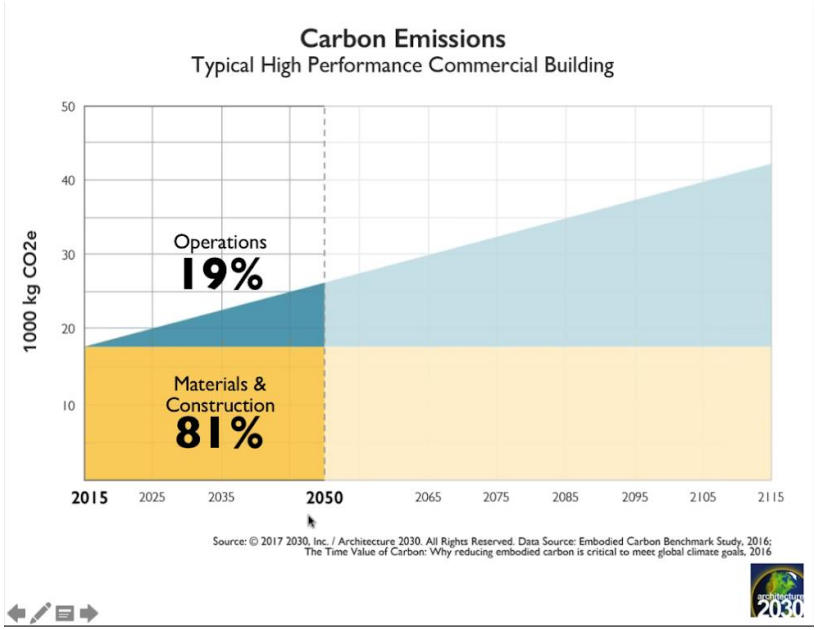
Photo Gallery



Videos

Growing Resources

4 75 HIGH PERFORMANCE BUILDING SUPPLY FOURSEVENFIVE.COM

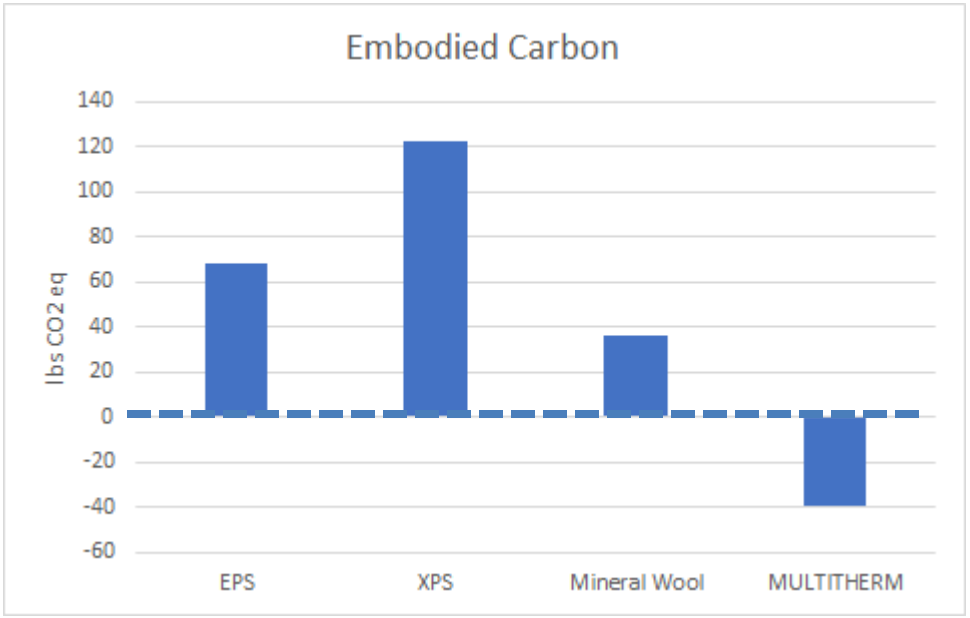


Use fewer construction materials and ensure that the materials used have low embodied energy to significantly reduce short-term emissions.

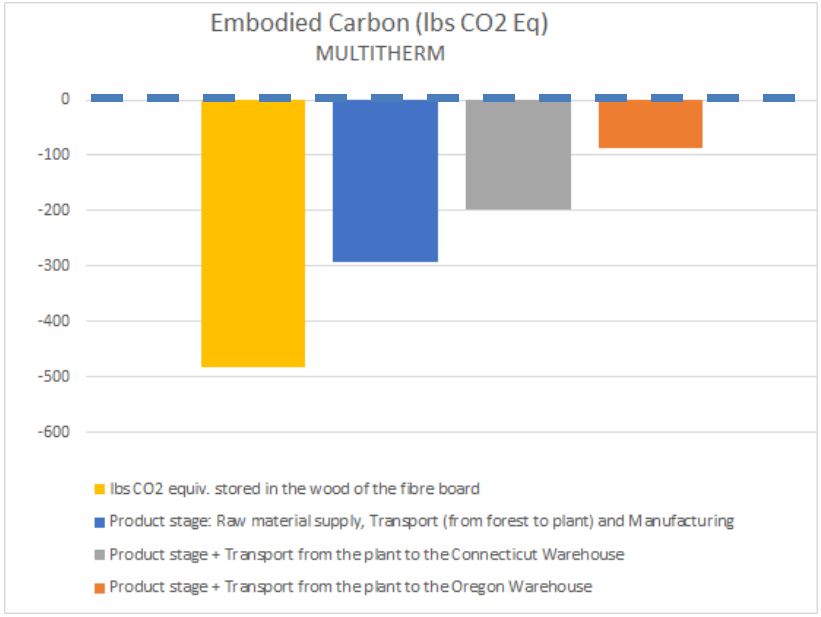
- Reuse and renovate existing structures
- Minimize waste
- Use less new materials
- Source new materials that are produced with less energy intensive processes and have higher recycled content
- Use plant-based materials that have a negative embodied carbon value

1. **Lower** Embodied **Carbon**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



(based on m2 of board material with R29 equivalent thermal resistance)

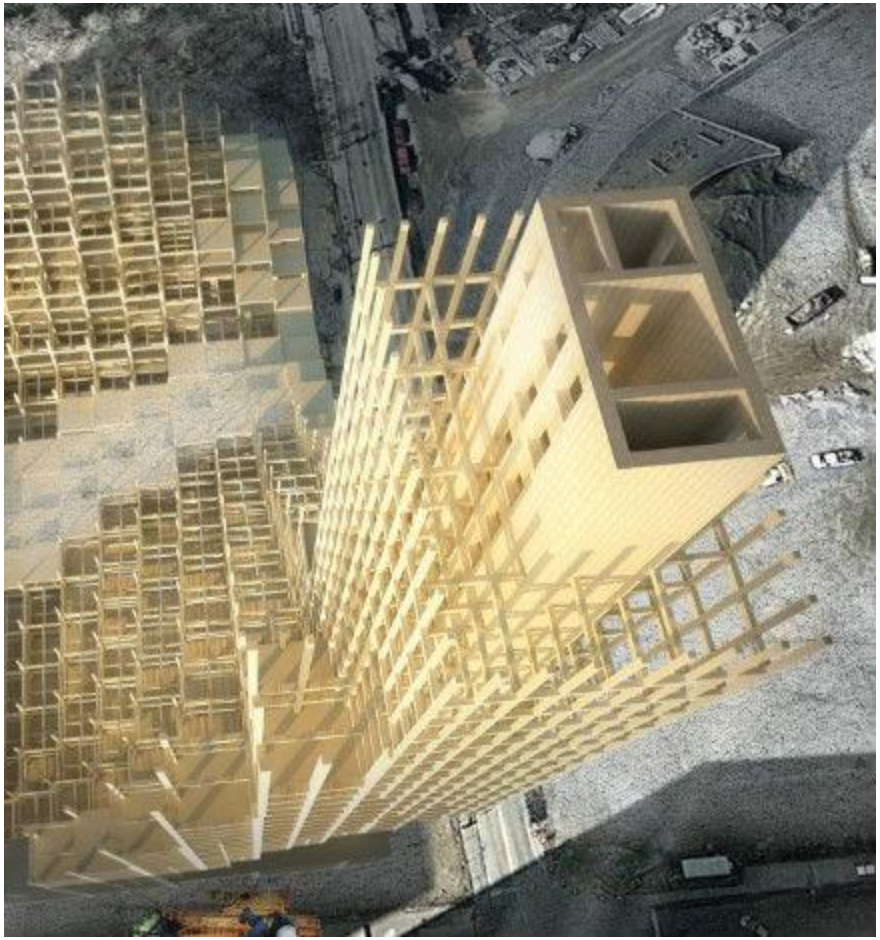


(value for a cubic meter of MULTITHERM)

High level of sequestered carbon is basis for negative embodied carbon product.

Embodied Carbon: **Board Insulations**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

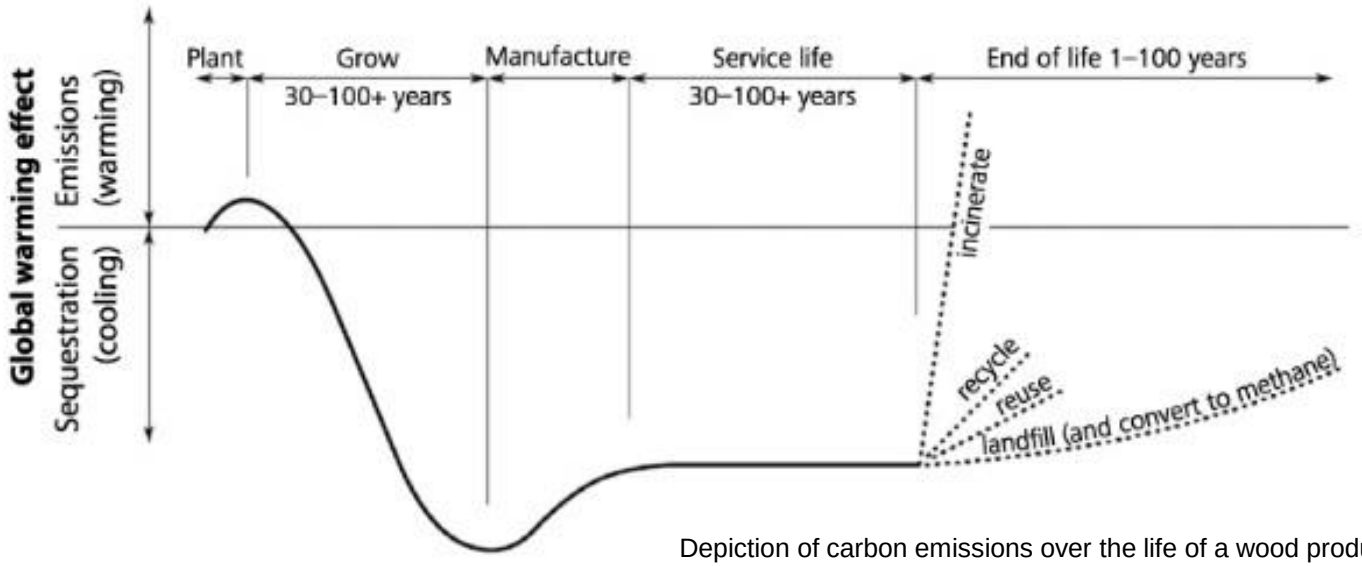


Michael Charters

Lock as much **carbon storage** into the structure as possible and provide long-term emissions security.

2. **Greater** Carbon **Sequestration**

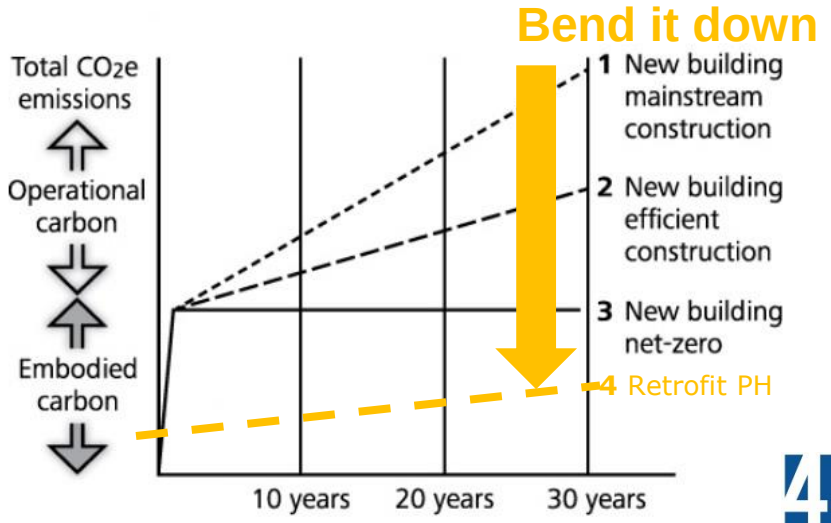
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Depiction of carbon emissions over the life of a wood product.
Arup/Bruce King, The New Carbon Architecture

Maximum Potential Impact:

- Wood based Passive House Retrofit



Bruce King, The New Carbon Architecture

Carbon Curve

Protect workers, occupants, and the biosphere by choosing products that have lower toxicity in manufacturing, construction, and disposal.

3. **Lower** Toxicity

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Foam Insulation… Less is Best

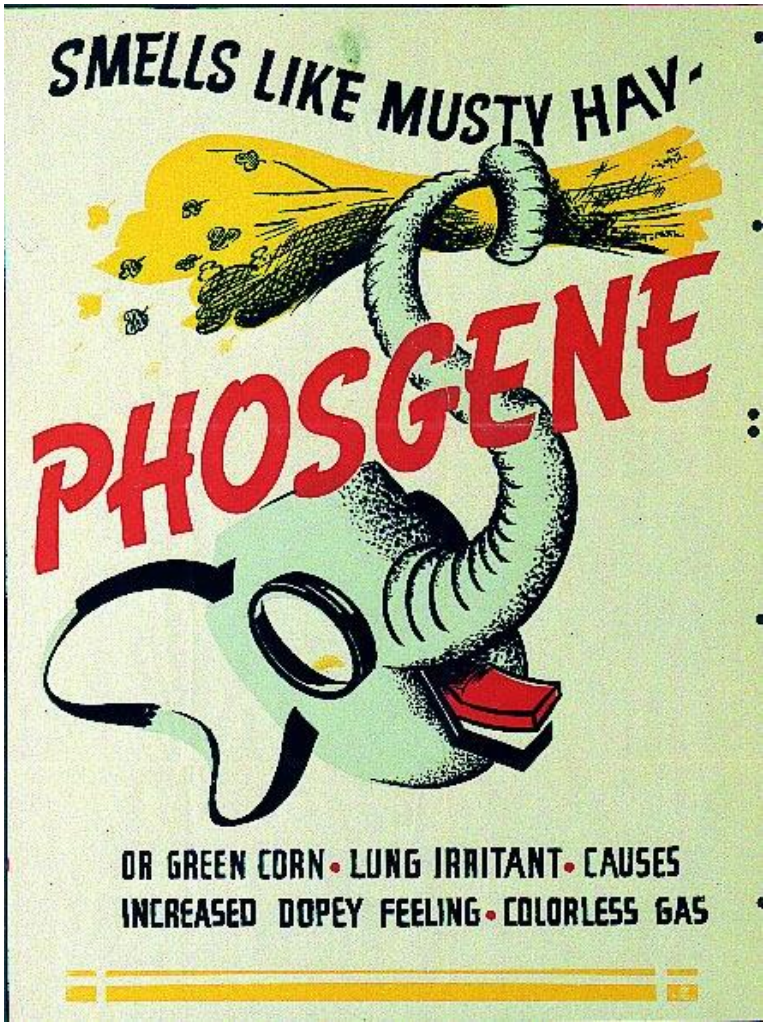
Spray Foam

Part A:

- MDI (methylene diphenyl diisocyanate), aniline, formaldehyde, hydrochloric acid and **phosgene**

Part B:

- Flame retardants:
  - halogenated organic compounds (chlorine or bromine bonded to carbon)
- Catalysts:
  - Amine Compounds
- Blowing Agent:
  - closed cell - **hydrofluorocarbon blowing agent** (EXCEPT AT OPEN CELL/EPS)



3. Lower Toxicity

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

A world of more sustainable materials…

- International Living Future Institute: Red List
- USGBC LEED
- BuildingGreen: Greenspec
- Healthy Building Network: Pharos Project
- Declaration EPD: ISO 14025
- California EPA Air Resources Board
- Perkins & Will's Precautionary List

3. Lower Toxicity

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

CONFIRMED BY TESTS

100 years

Permanent airtightness with pro clima!
Tested for the entire usage period

- ✔ Reliable functioning tested for 100 years
- ✔ Independently confirmed
- ✔ Minimum requirements significantly exceeded

Thermal insulation and airtightness should perform for more than 50 years

Adhesive tapes which are applied to attain airtightness in accordance with DIN 4108-7, SIA 180 or OENORM B 8110-2 should have a durability of 50 to 100 years – after all, this is the expected service life of thermal insulation layers, to ensure that they protect against damage due to convection and moisture vapour ingress.
This period corresponds with reality as airtightness is currently being optimised and thermal insulation is being replaced or adapted for today's legal requirements on structures dating from the 1950s, 1960s and 1970s.

As little as 17 years can be regarded as permanent

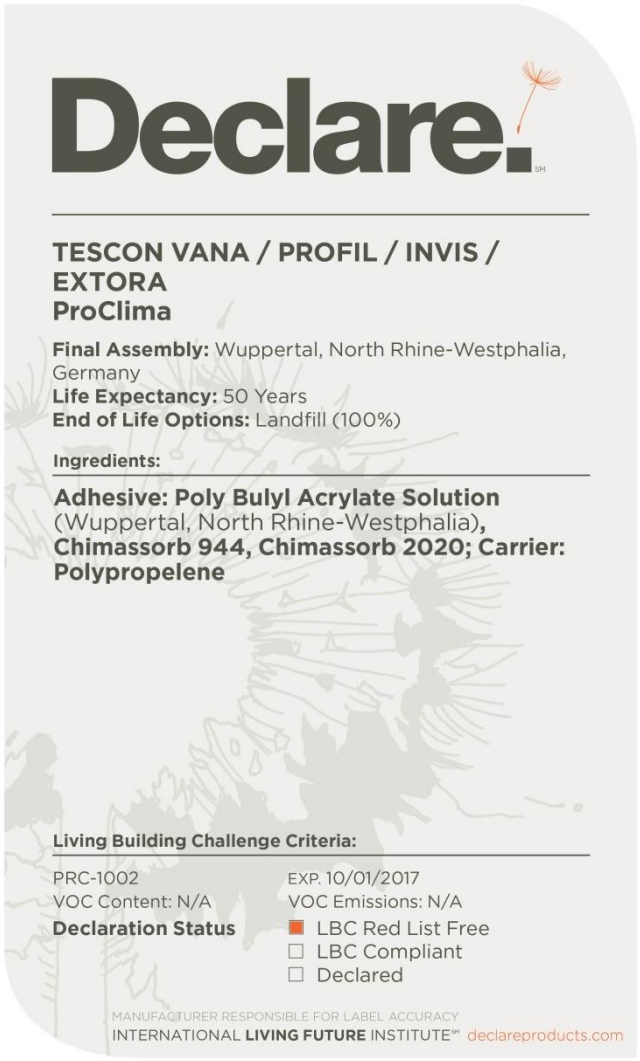
A process for accelerated aging of adhesive tape joints has been developed at the University of Kassel as part of a research project on "Quality assurance for adhesive-based joint technology in airtightness layers". With this process, adhesive tapes have to demonstrate certain specified minimum tensile strengths after being stored at increased air temperature and humidity (65 °C and 80% relative humidity) for a period of 120 days (this corresponds to around 17 years in reality). On successful completion of this test an adhesive tape can be regarded as permanent.

pro clima adhesive tapes have been successfully tested for 100 years

As part of tests to ascertain the durability of airtight joints, pro clima's TESCON VANA adhesive tape has also been subjected to accelerated aging at the University of Kassel under the conditions described above. At the request of pro clima, the test period was increased from 120 days to 700 days. Accelerated aging for 700 days corresponds to 100 years in reality. The test results for the three adhesive tapes from pro clima were also positive for this increased period of accelerated aging.

You are on the safe side with pro clima!

These demanding tests with increased test periods have confirmed the suitability of TESCON VANA adhesive tape for the creation of permanent airtightness which surpass the requirements of DIN 4108-7, SIA 180 and OENORM B 8110-2. This confirms that vapour check and airtightness membranes and airtight wood-based panels can be reliably bonded using pro clima products!



Declare.

TESCON VANA / PROFIL / INVIS / EXTORA
ProClima

Final Assembly: Wuppertal, North Rhine-Westphalia, Germany
Life Expectancy: 50 Years
End of Life Options: Landfill (100%)

Ingredients:

Adhesive: Poly Bulyl Acrylate Solution (Wuppertal, North Rhine-Westphalia), **Chimassorb 944, Chimassorb 2020; Carrier: Polypropelene**

Living Building Challenge Criteria:

PRC-1002 — EXP. 10/01/2017
VOC Content: N/A — VOC Emissions: N/A
Declaration Status
- ■ LBC Red List Free
- ☐ LBC Compliant
- ☐ Declared

MANUFACTURER RESPONSIBLE FOR LABEL ACCURACY
INTERNATIONAL **LIVING FUTURE** INSTITUTE℠ declareproducts.com

Age-tested, VOC-free performance

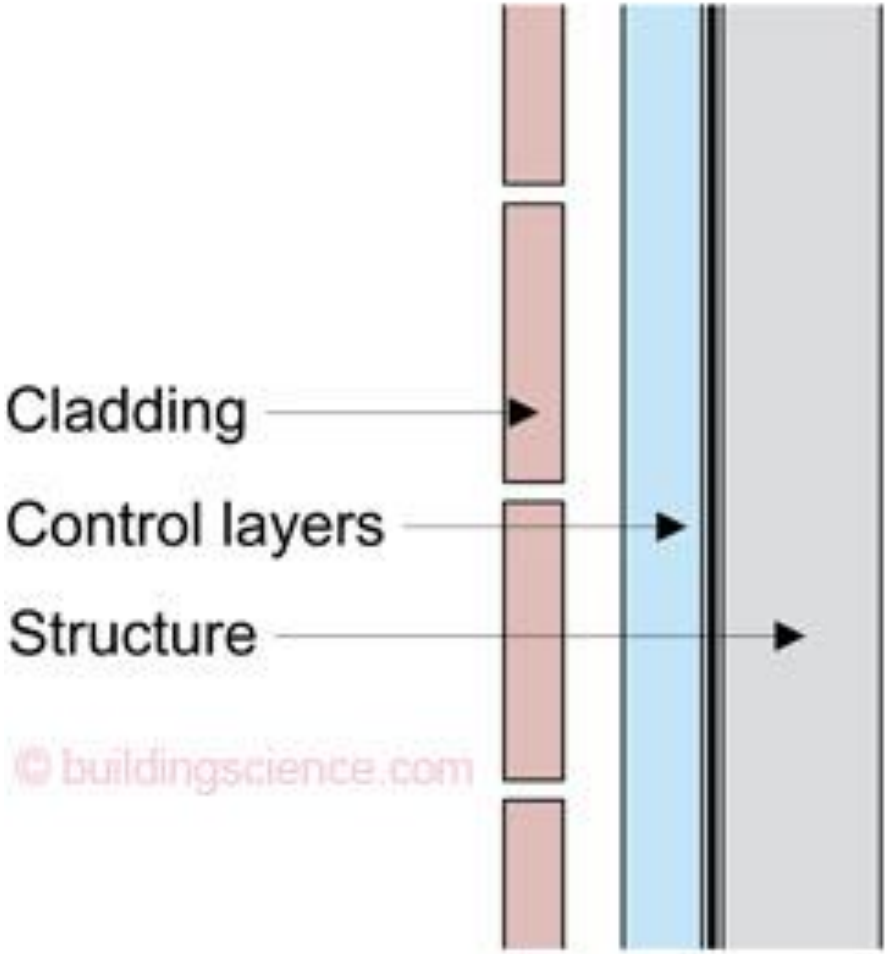
475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

New Frameworks Construction

Source more natural materials such as wood fiber, wool and cellulose insulations, timber structures, and lime plaster finishes.

4. More **Natural** Materials

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Building Science Corporation

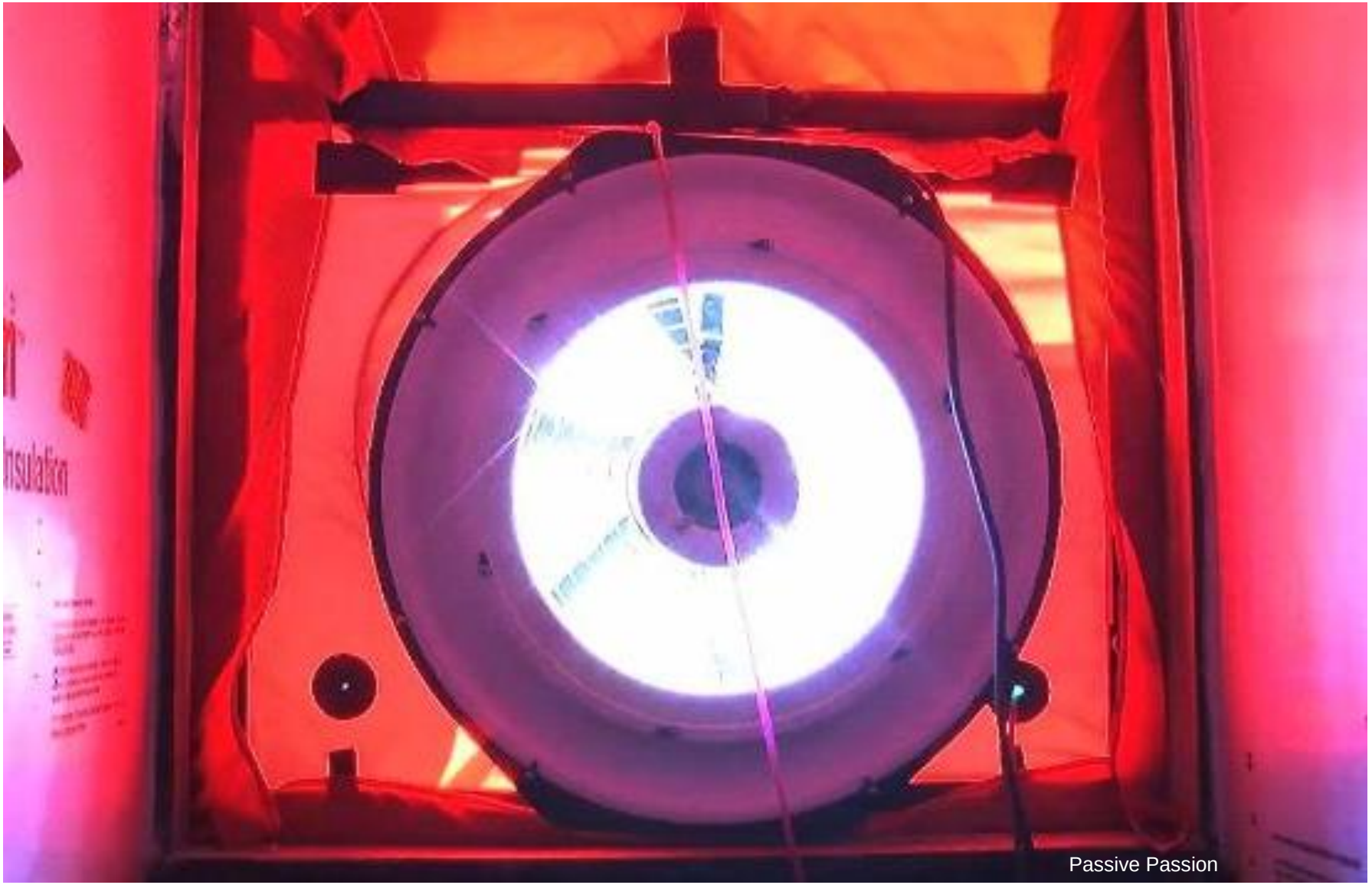
Include air, vapor, and thermal control layers to provide Passive House levels of energy efficiency, comfort, and durability.

Order of Importance:

1. Bulk Water
2. Airtightness
3. Vapor Control
4. Insulation

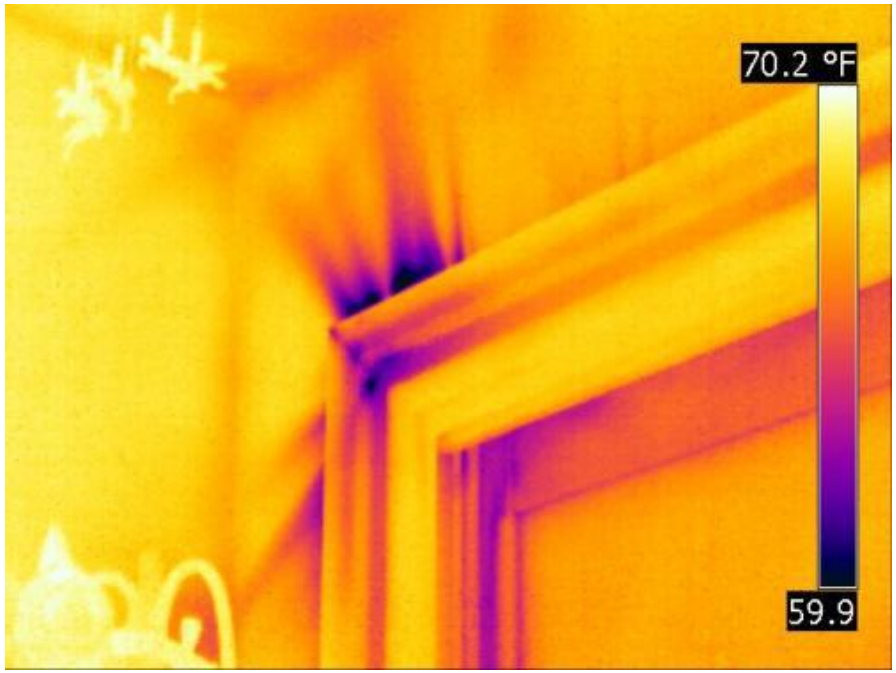
5-6-7. **Smart** Vapor, Air & Thermal **Control**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



Where the **Blower Door is King**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

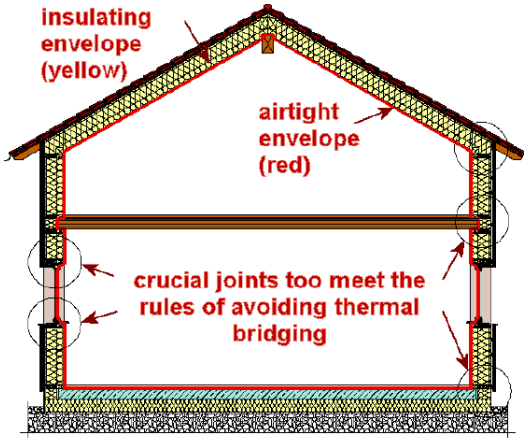


Fundamentally Effective:

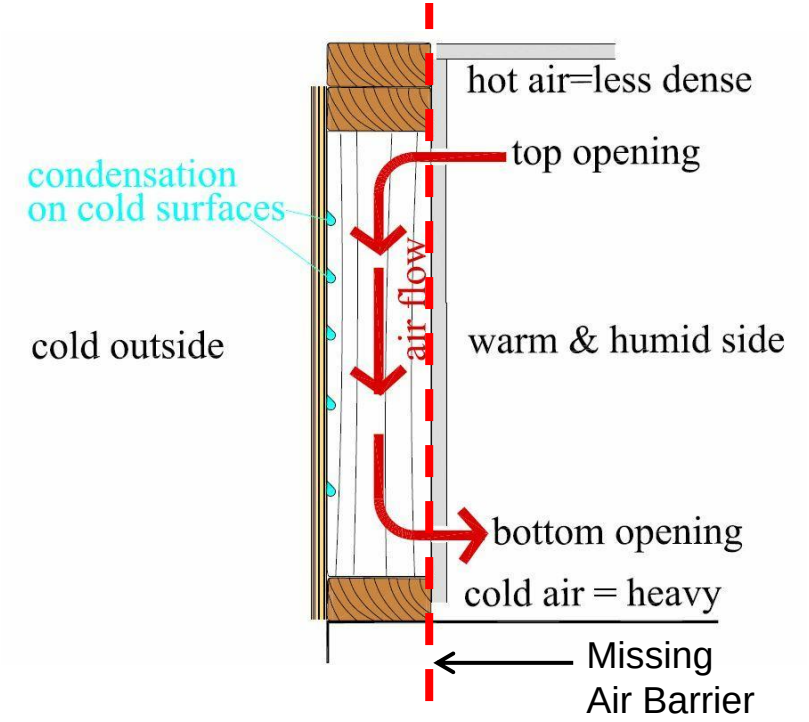
- Indoor Air Quality
- Comfort
- Air Transported Wetting
- Heat Loss & Energy Efficiency

Air control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



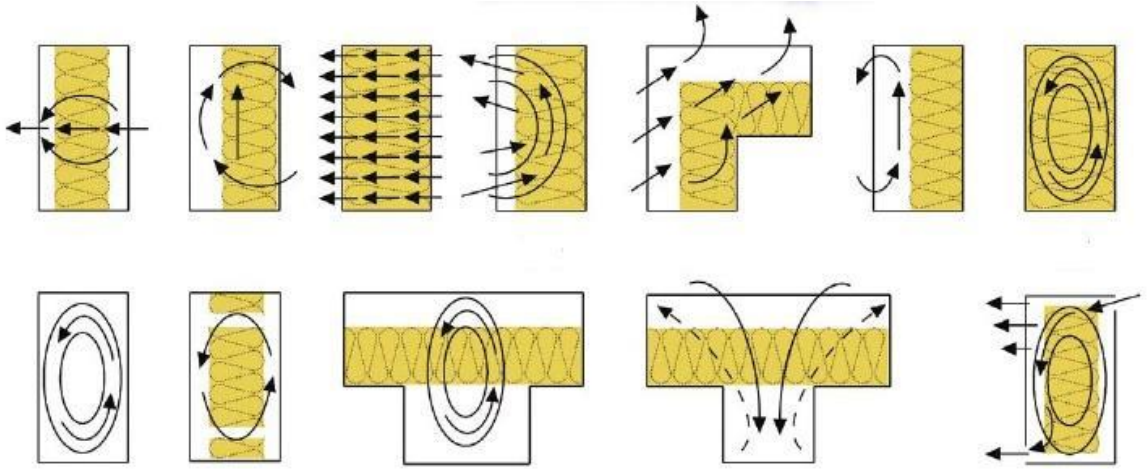
Ref http://passipedia.passiv.de/passipedia_en/

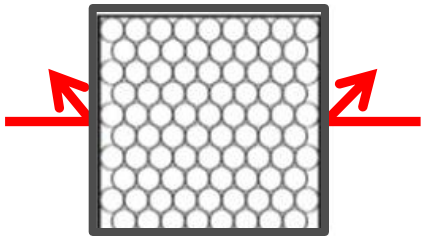


The Primary Air Barrier should be inboard of the insulation

Air Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

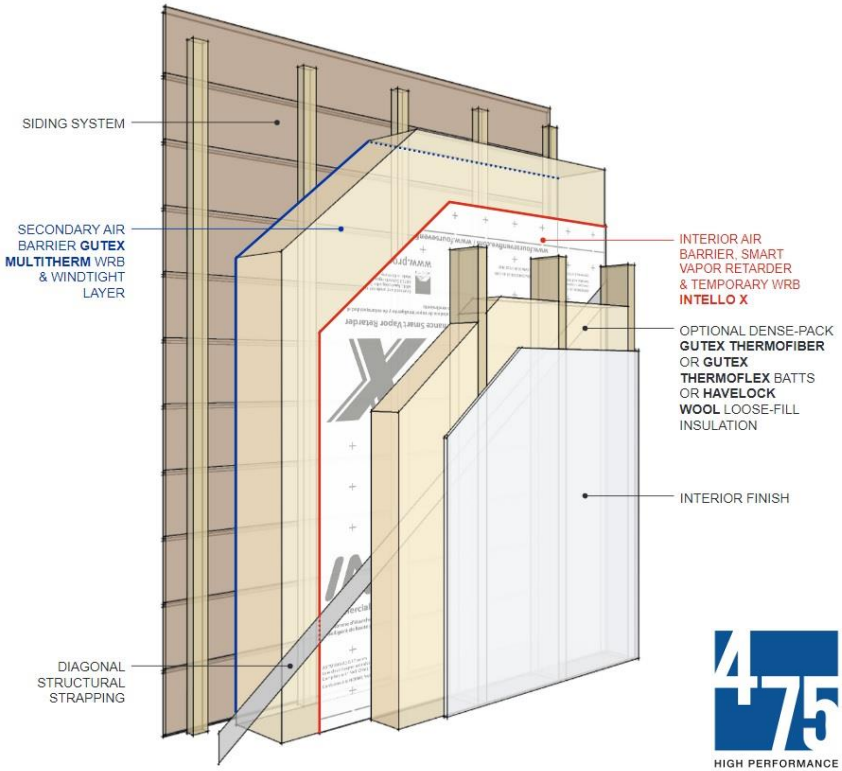




Mark Siddall

To optimize insulation
surround it with airtightness.

- Primary Inboard
- Secondary Outboard (windtight)



Air Control

ASTM E2357 Testing

ASTM E2357 Testing

Inboard:

- Primary Air Barrier
- Tightest PHI Certified Membrane System
- Vapor Control Layer

Outboard:

- Secondary Air Barrier
- Vapor Open
- WRB
- E2357 at edge of lab equipment capabilities

Air Control

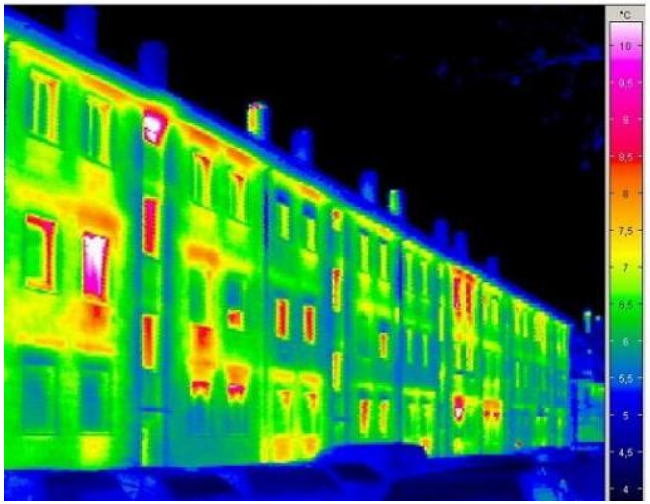
VISCONN

Service Cavity

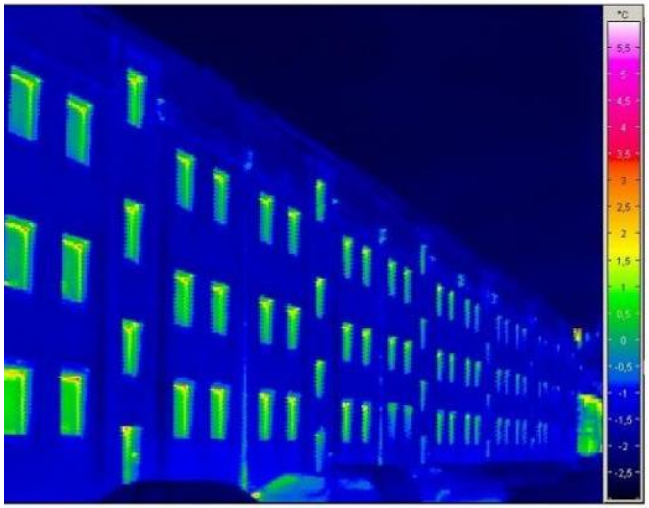
Continuity:

- Between components
- At penetrations
- At junctures of enclosure sides

Air Control



Passive House Institute



Passive House Institute

- Poorly insulated buildings heat themselves dry.
- **Well built assemblies dry through vapor diffusion.**
- “Stuff happens so build a moisture tolerant design”

Smart Vapor Control

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

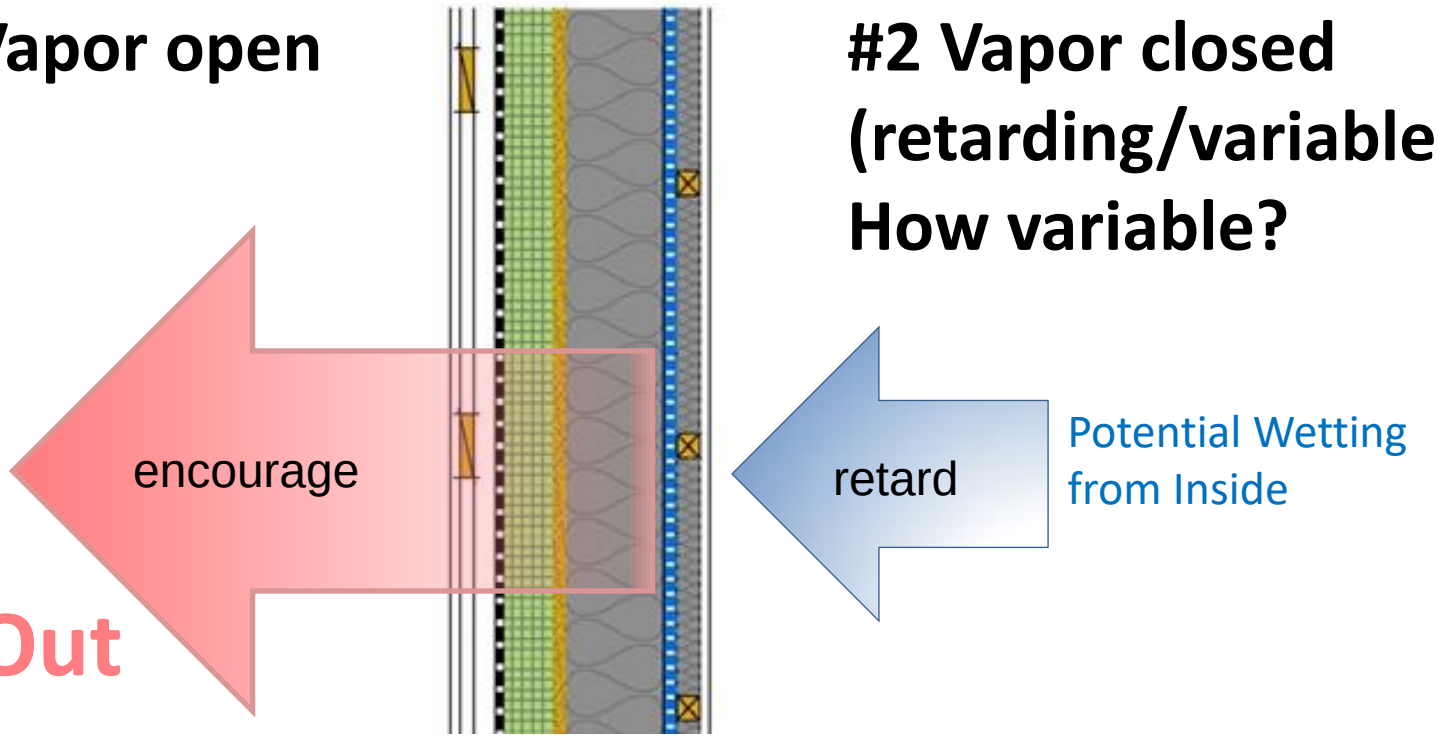
Mixed Climate

more heating than cooling

Outside **Winter** Inside

#1 Vapor open

#2 Vapor closed (retarding/variable) How variable?



Smart Vapor Control

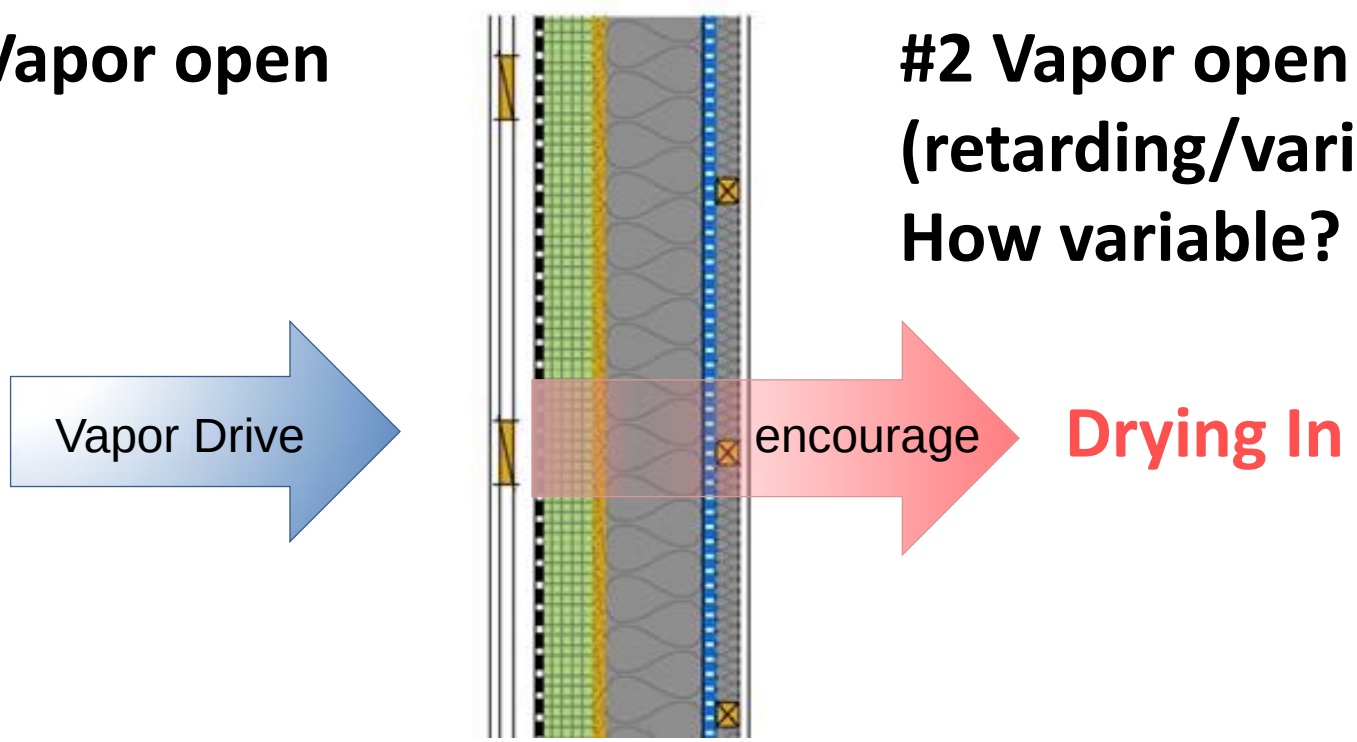
Mixed Climate

more heating than cooling

Outside **Summer** Inside

#1 Vapor open

#2 Vapor open (retarding/variable) How variable?



Smart Vapor Control

Vapor open sheathing at **Exterior**

Credit: Ed May, http://bldgtypblog.blogspot.com/

Smart Vapor Control

Three Tree

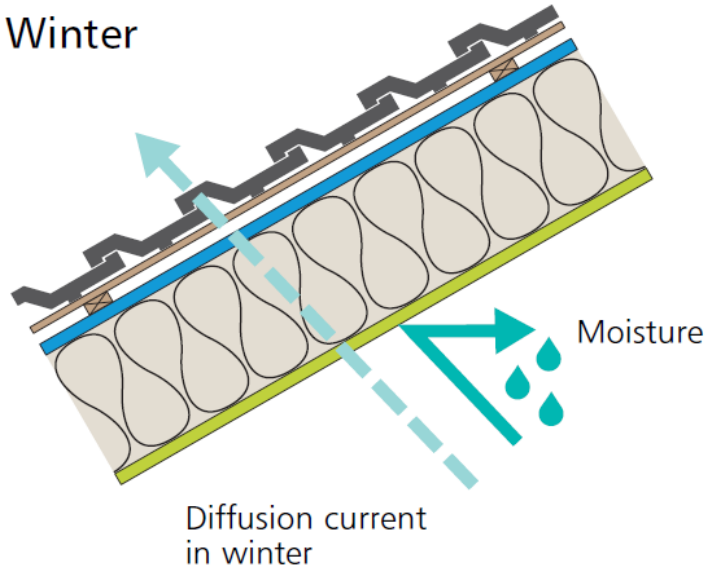
- Vapor open outboard to promote drying

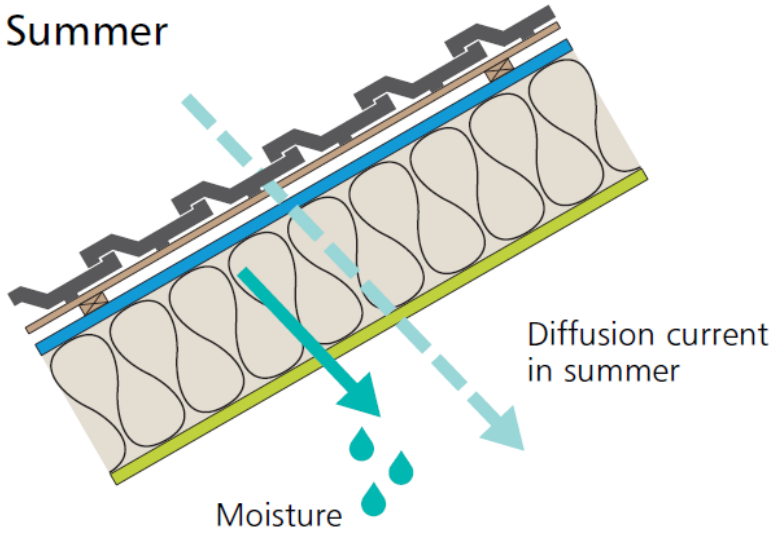
Smart Vapor Control

475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Intelligent vapor retarders:

prevent wetting and **promote drying** for **maximum protection**





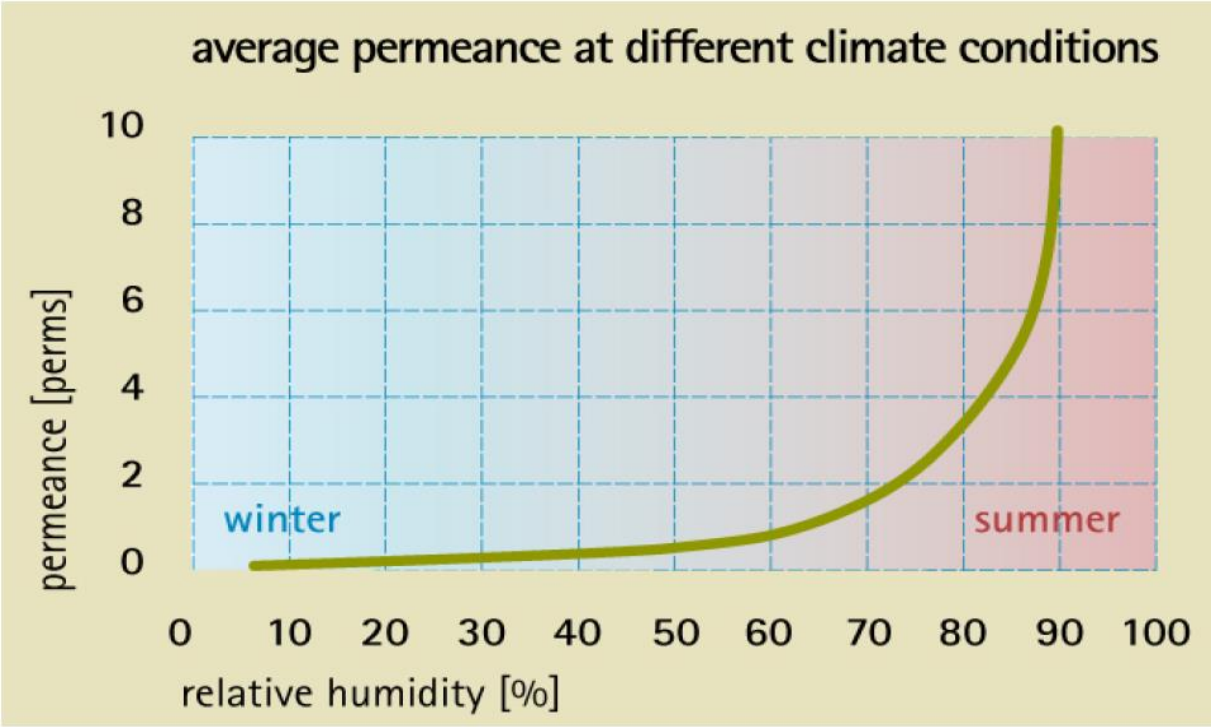
0.17 perms

13.2 perms

Smart Vapor Control

475
HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

Vapor **Intelligent Membrane**



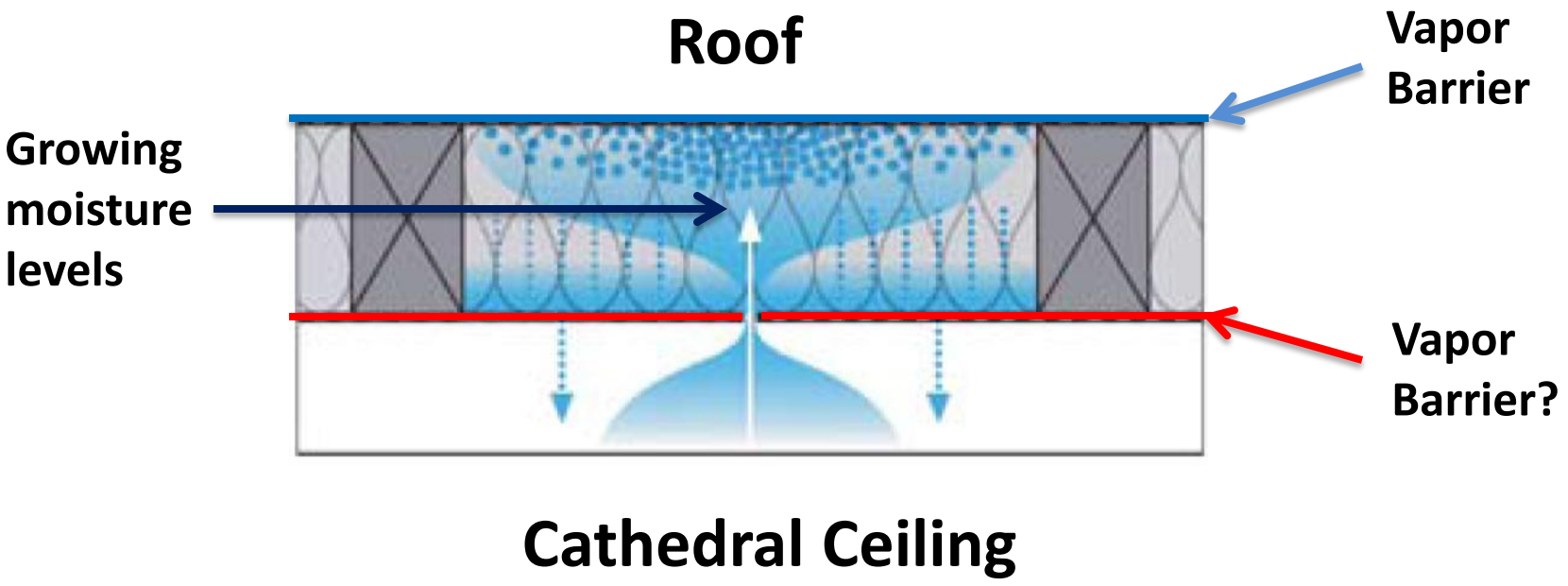
From vapor closed in winter to vapor open in summer.

Smart Vapor Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Often roofs are vapor barriers,

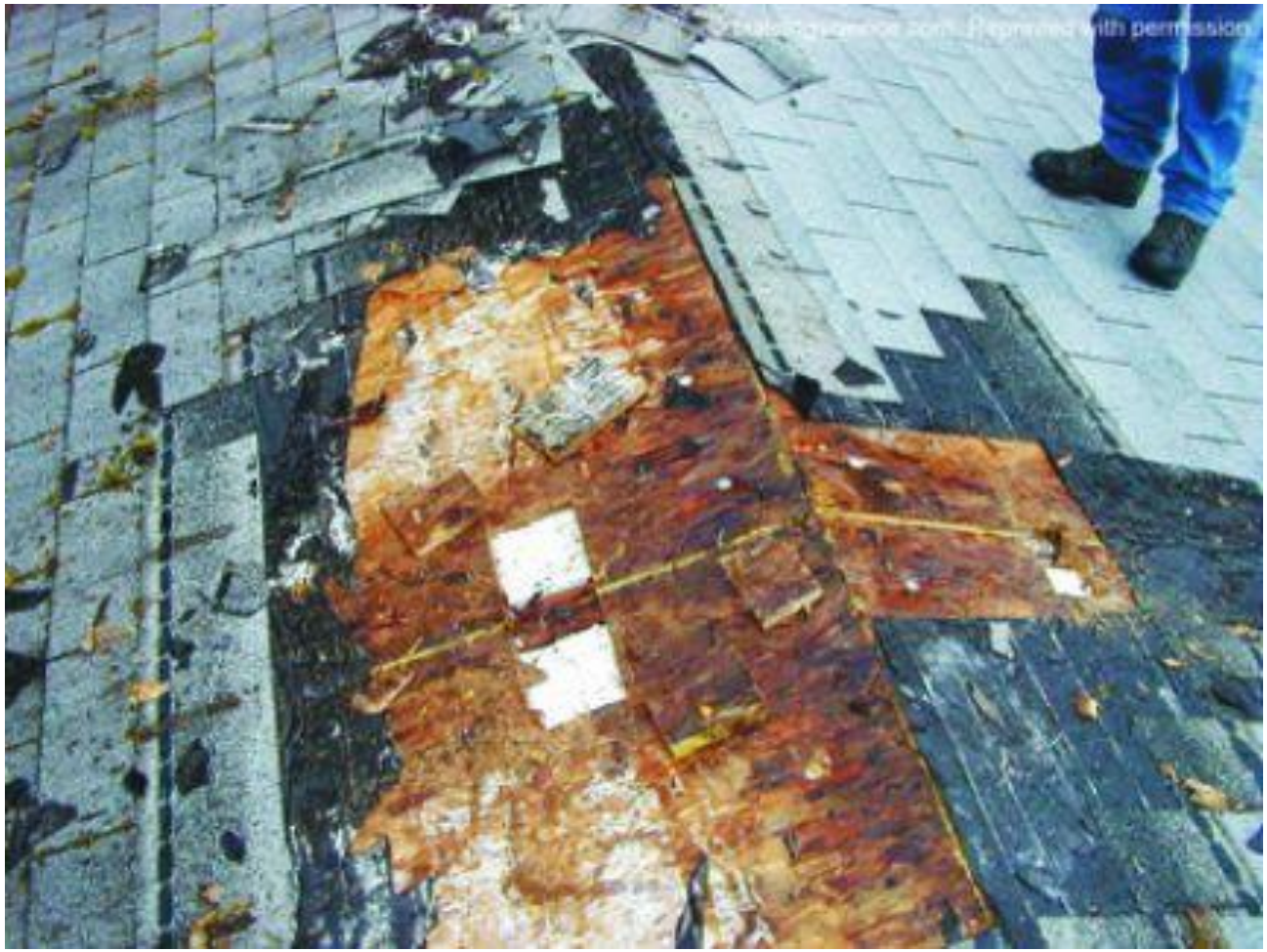
so don't make it **worse** (even in California, watch out for radiant cooling)



Smart Vapor Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Worse



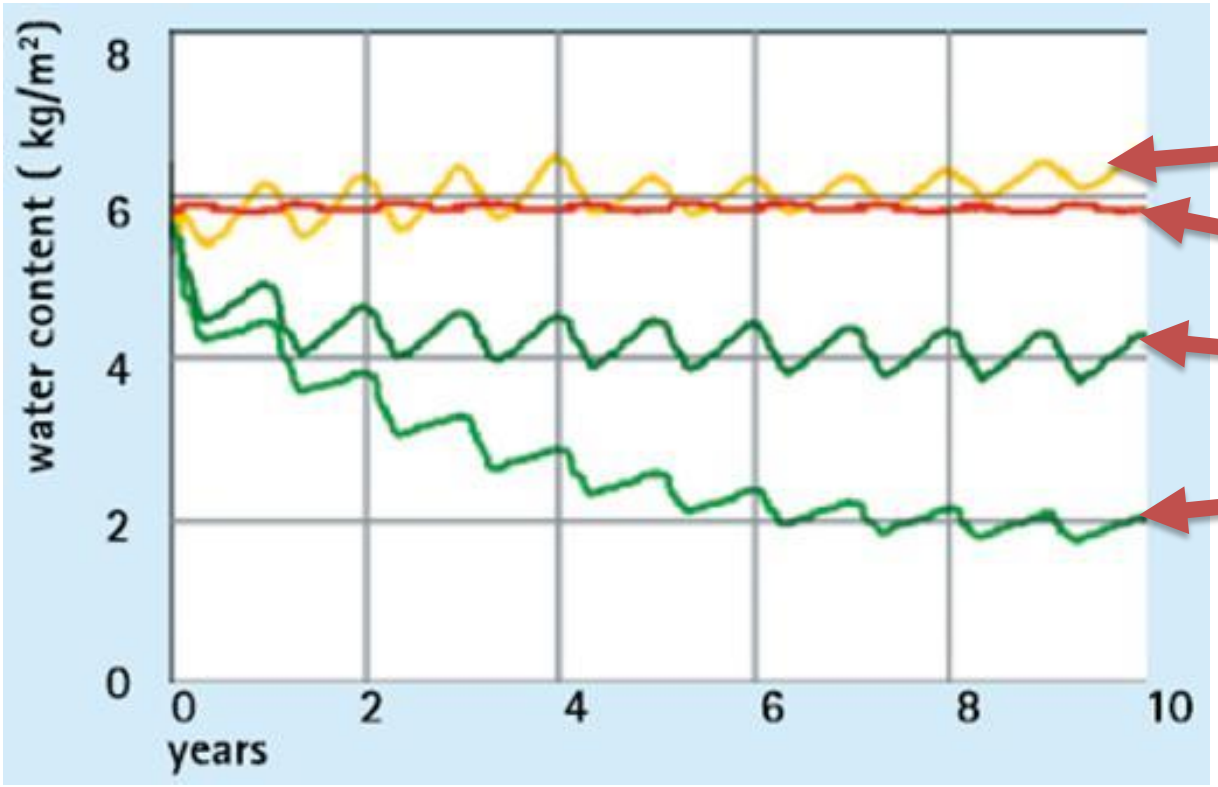
Credit: FineHomebuilding

Smart Vapor Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Maximize drying potential

Study: Steep pitched, north facing roof at high altitude (a worst case scenario).

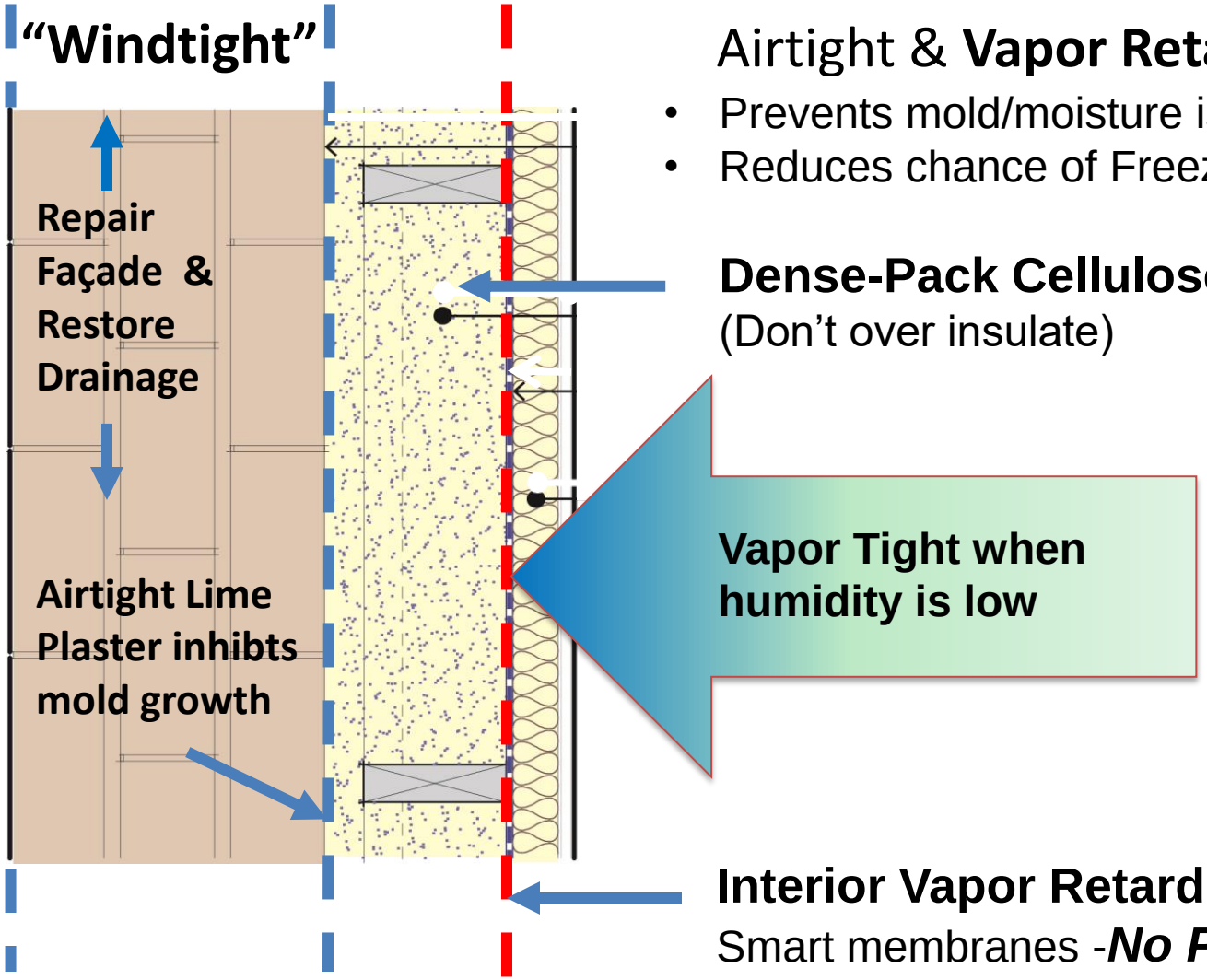


Credit: Pro Clima

Smart Vapor Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Historic Masonry retrofit



Airtight & **Vapor Retarding**

- Prevents mold/moisture issues
- Reduces chance of Freezing

Dense-Pack Cellulose
(Don't over insulate)

Interior Vapor Retarders
Smart membranes -***No Poly***

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Maximize Masonry Drying Potential

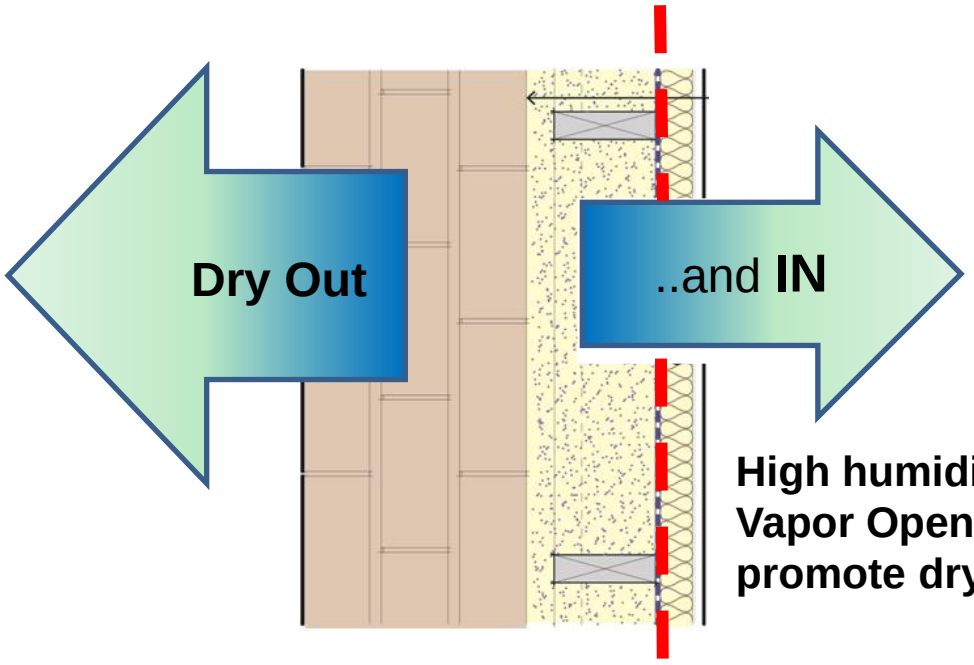
Material Selection

Vapor Open
Brick
Cellulose
Mineral Wool
Fiberglass
Gyp Board
Latex Paint

Vapor Variable
Smart Membranes
Plywood

Vapor Retarding
Foam - >1.5” CC
OSB
Poly – ***vapor closed***

1. **Vapor Open Construction to Exterior**
2. ***Variable* Vapor Retarding at Interior**



Interior Vapor Retarders
Smart membranes ***-No Poly***

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Vapor Intelligent Membrane

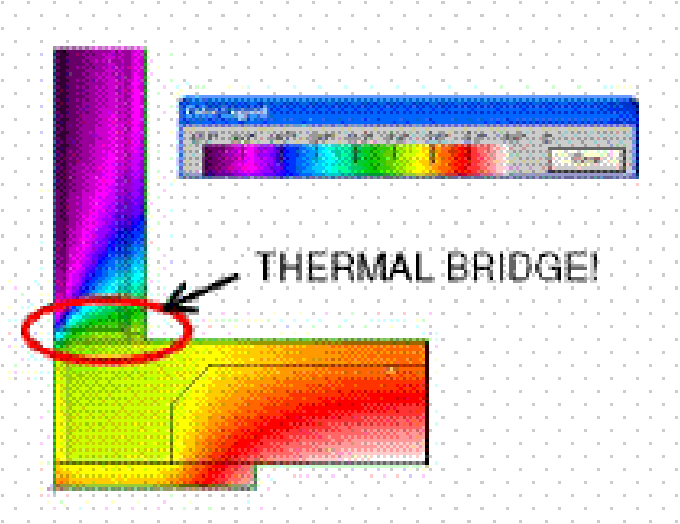
Ideally suited for:

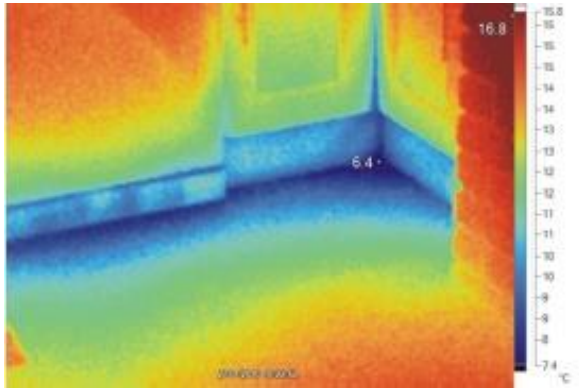
1. Meeting Code for Class II vapor retarders.
2. Assemblies with significant vapor retarding or vapor closed outboard layers.
3. Historic Masonry Retrofits
4. Cellulous and fibrous insulation
5. Highly insulated assemblies
6. Where increased drying reserves are desired

Smart Vapor Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

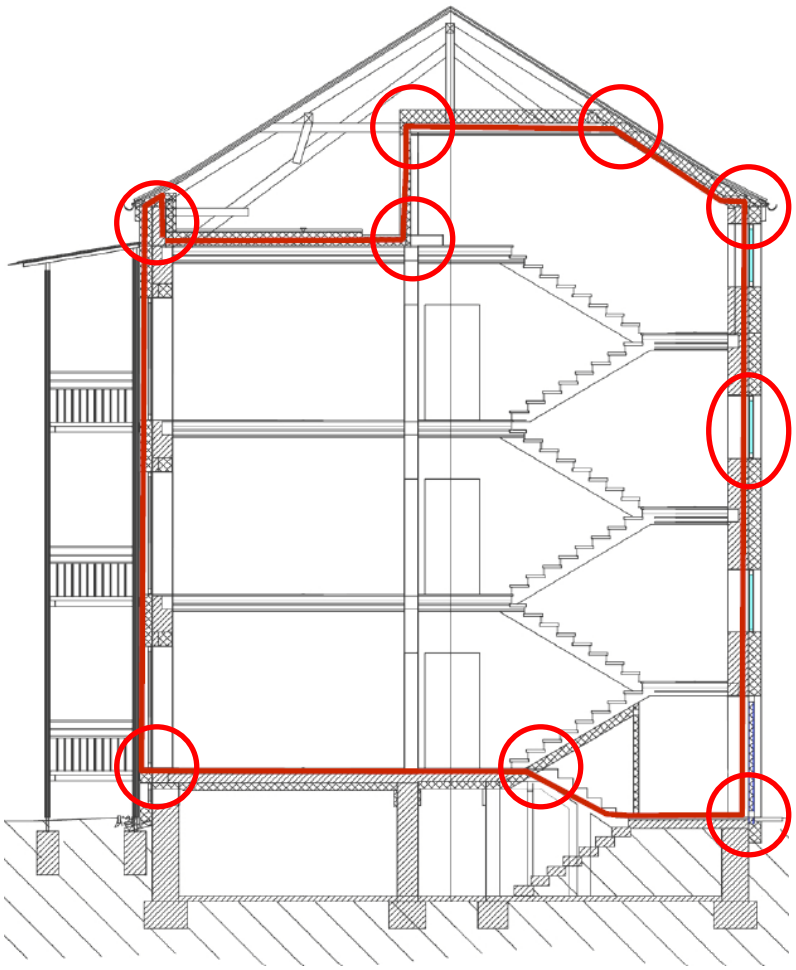
- Continuous Insulation
- Warm Surface Temperatures
- Safety from Condensation
- Climate-Specific Insulation levels
- THINK THERMOS

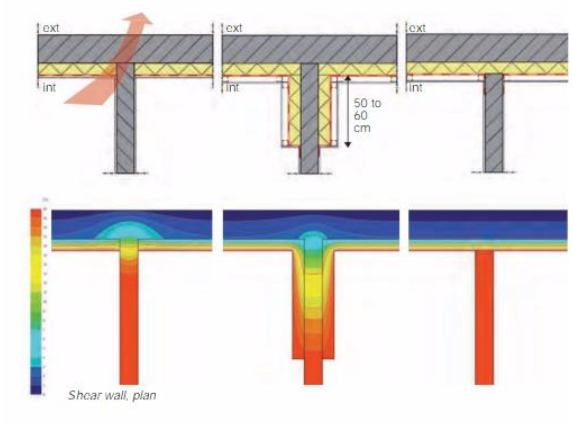


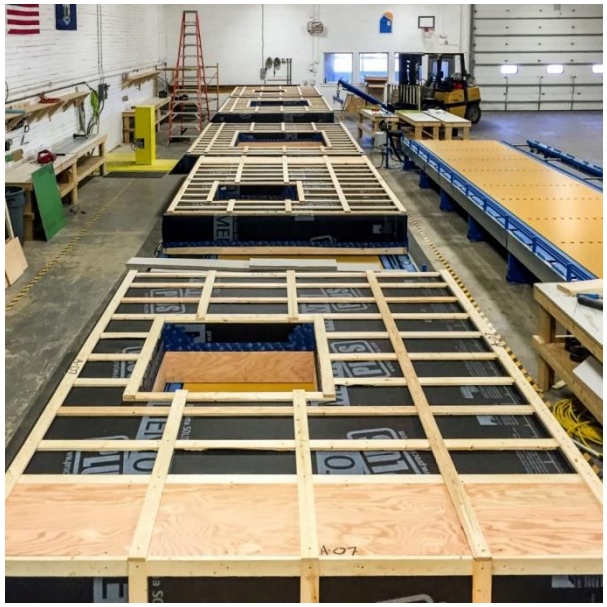


Thermal Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



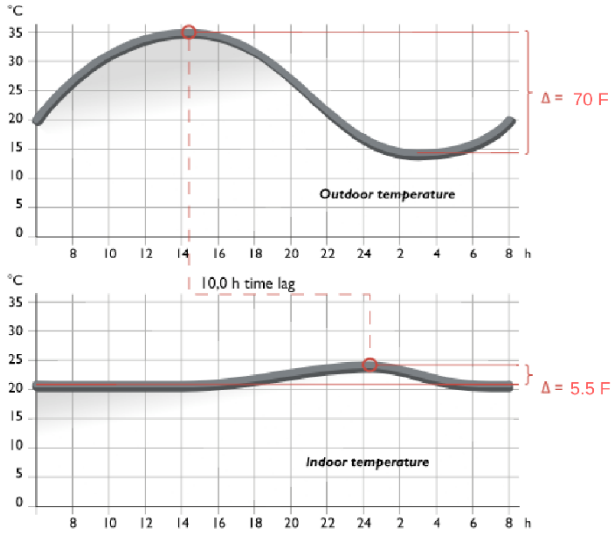




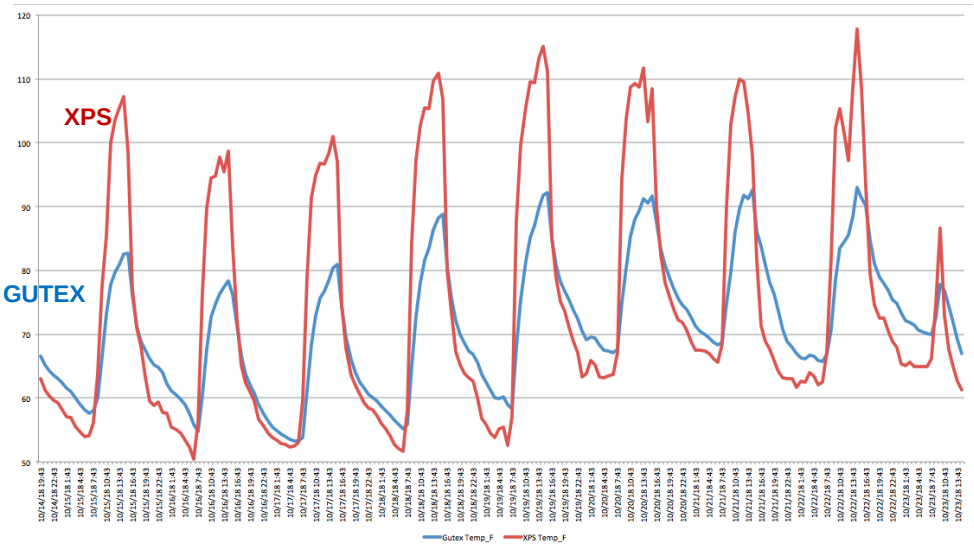
A2M

Thermal Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

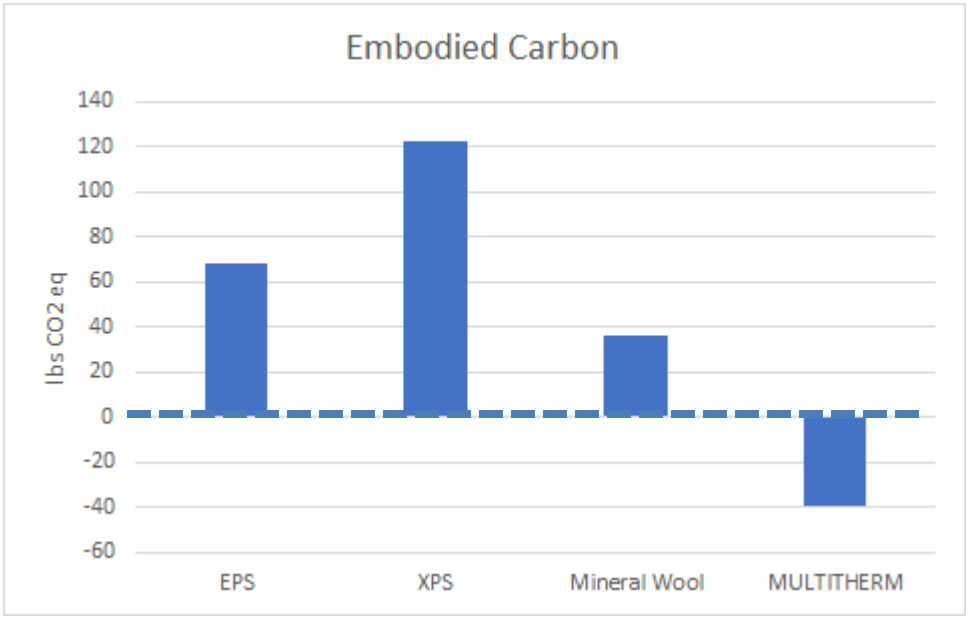


- Thermal Buffering
- Humidity Buffering
- Sound Insulation

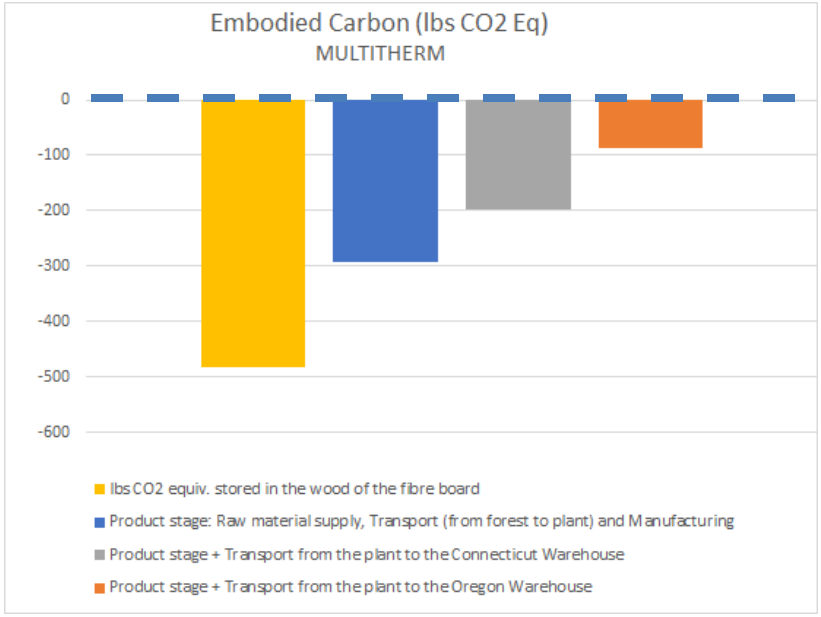


Thermal Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



(based on m2 of board material with R29 equivalent thermal resistance)



(value for a cubic meter of MULTITHERM)

High level of sequestered carbon is basis for negative embodied carbon product.

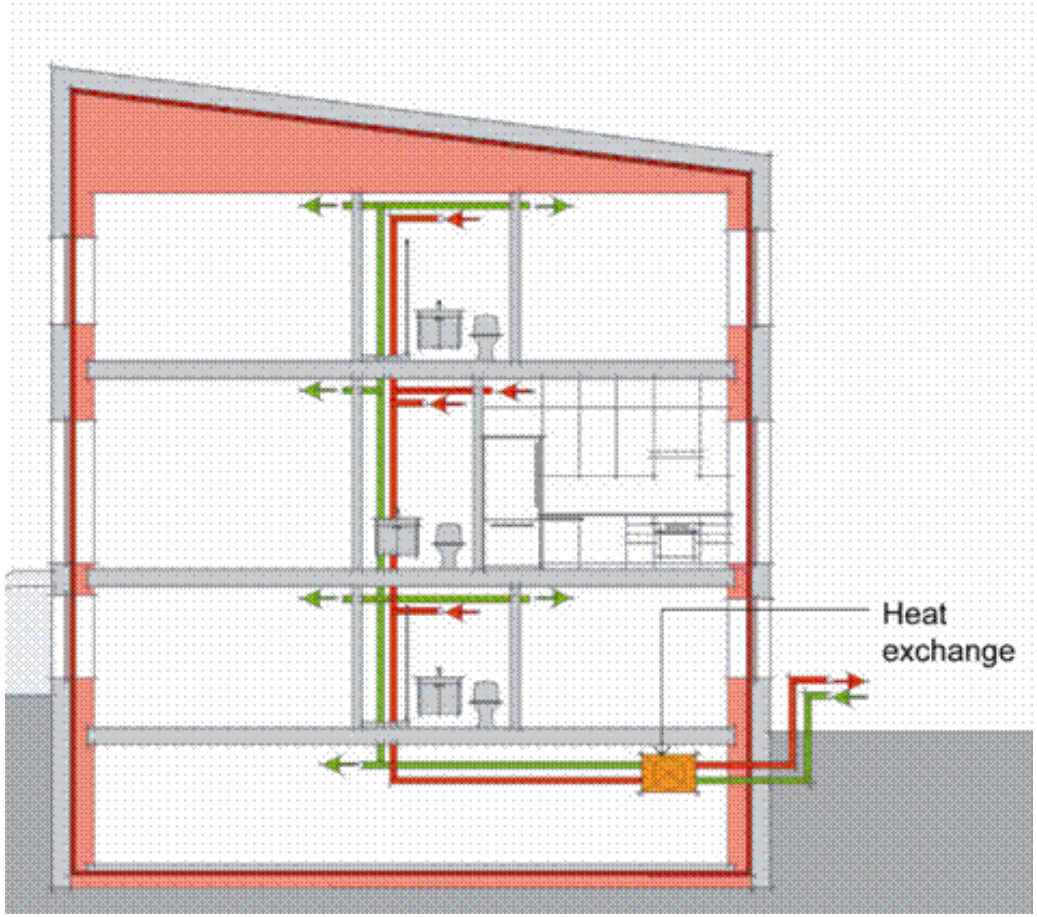
Thermal Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Thermal Control

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Centralized HRV/ERV

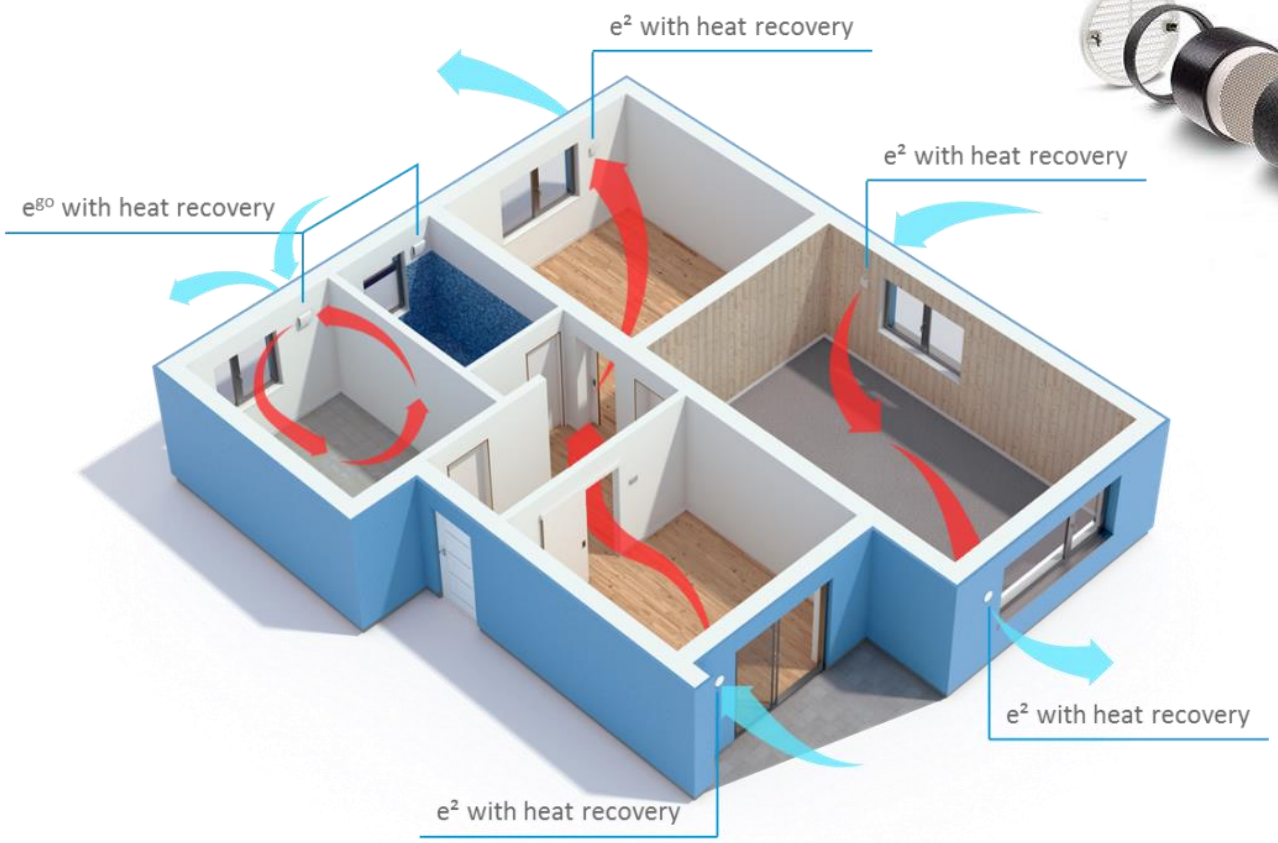


- >75% efficient w/counterflow heat exchange
- Continuous
- Distributed
- Balanced

6. **Fully Integrated** Performance

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Decentralized HRV/ERV



6. **Fully Integrated** Performance

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Daylighting

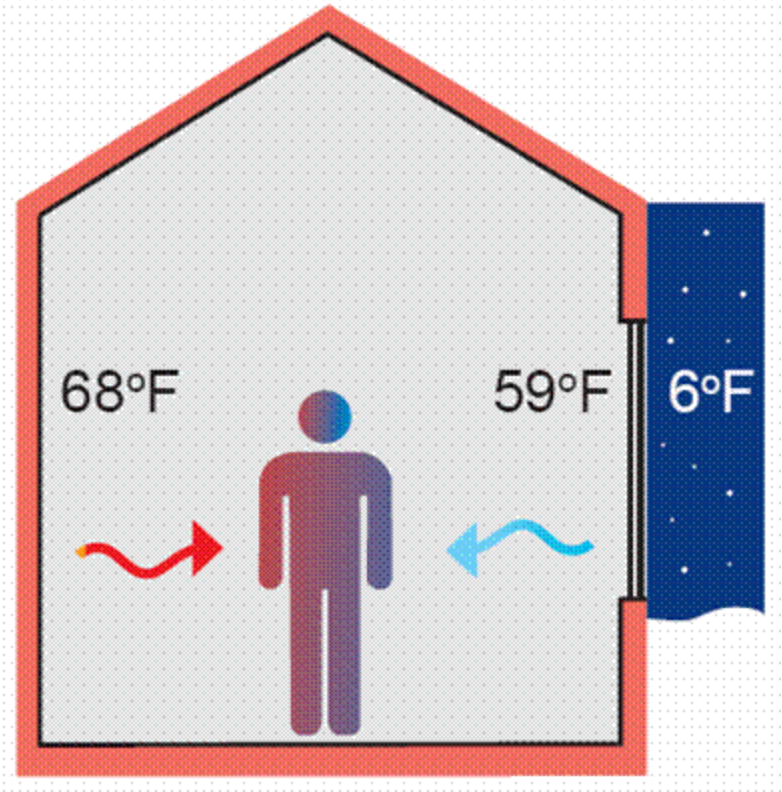
- Balanced Glazing
  - Walls & Roofs
  - The enclosure's weak link
- Utilize free light
- Avoid over-glazing & glare
- Many user benefits

6. **Fully Integrated** Performance

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

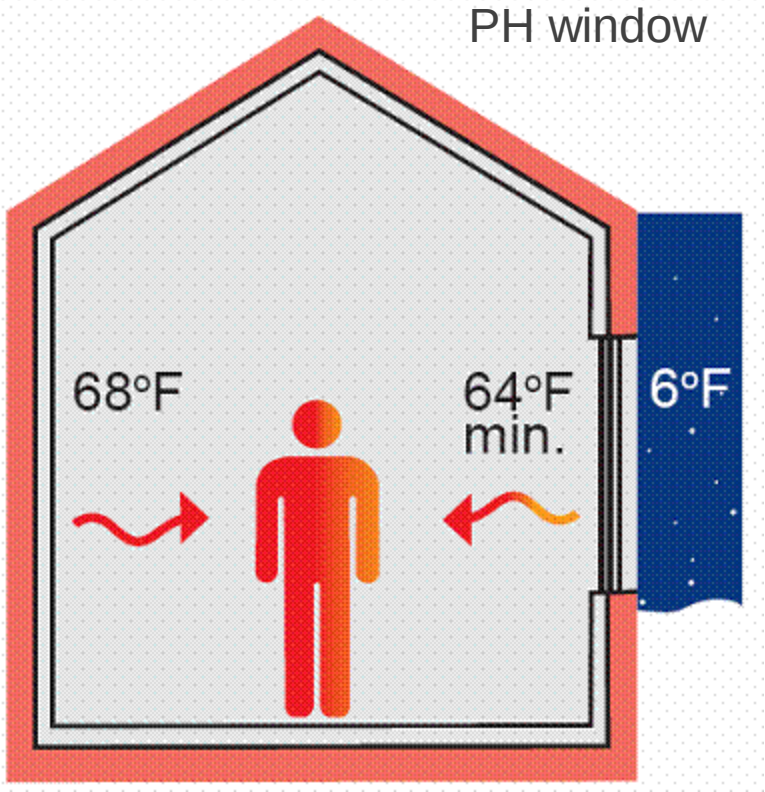
Uglass matters….

Typical Double Glazing



discomfort

Triple glazed
PH window

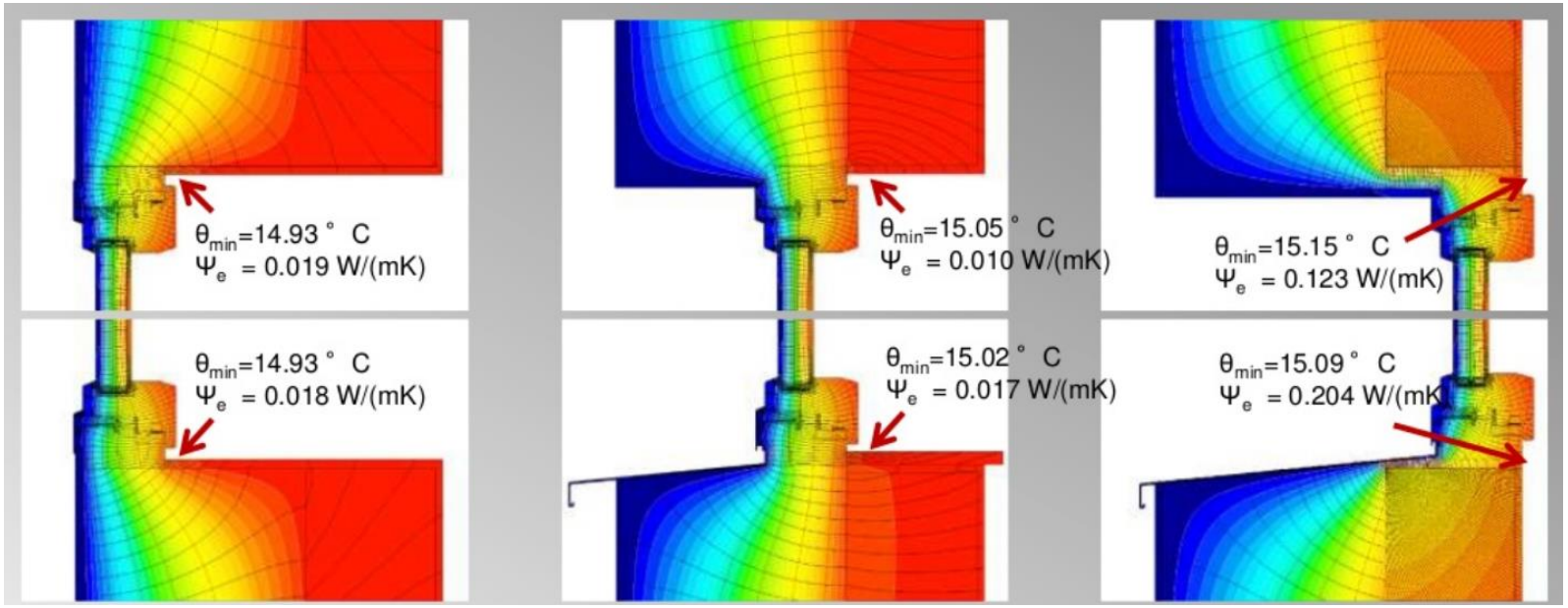


comfort

6. **Fully Integrated** Performance

475
HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

Window Integration….



Uw installed = 0.151 BTU/h sf *F

Uw, installed=0.148 BTU/h sf *F

Uw, installed = 0.215 BTU/h sf *F

Passive House Institute

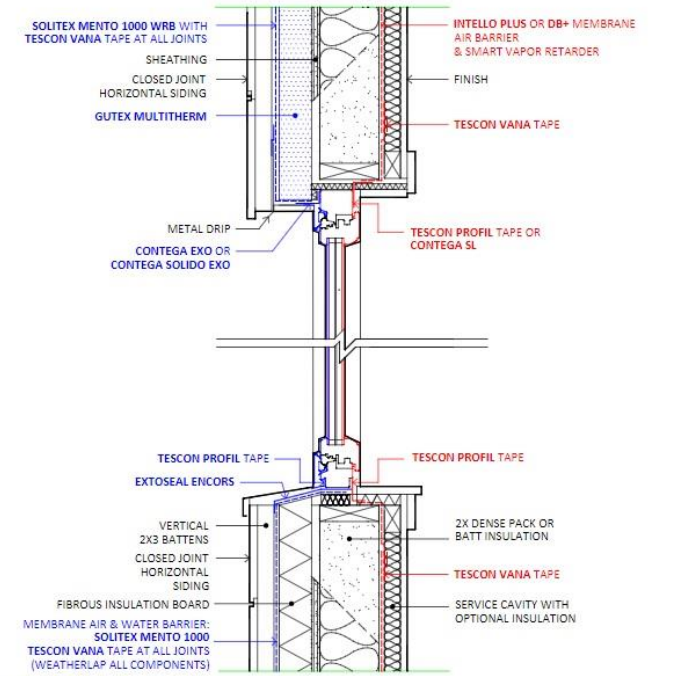
6. **Fully Integrated** Performance

475 HIGH PERFORMANCE BUILDING SUPPLY FOURSEVENFIVE.COM

Window Integration….

3a WINDOW PENETRATION

HEAD/JAMB SIM.

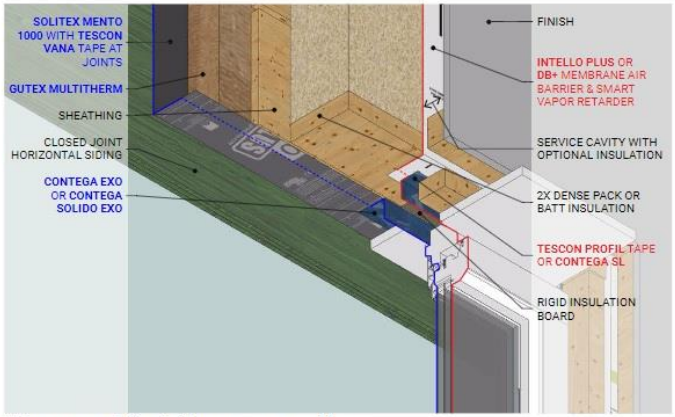


NOTE: FOR OPEN JOINT SIDING USE SOLITEX FRONTA QUATTRO WITH BATT INSULATION

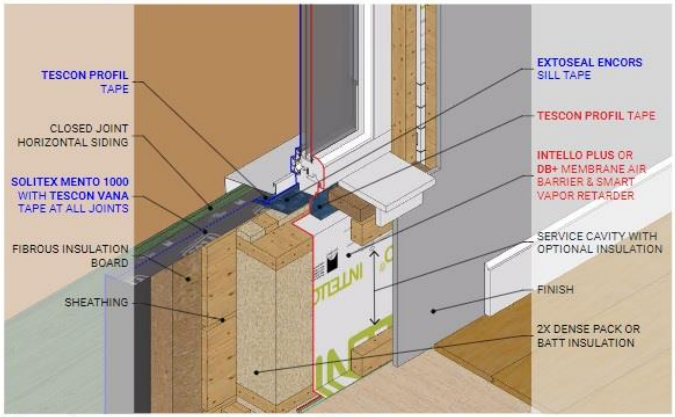
SILL

SECTION DETAIL

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



View up at first floor connection



View down at ground connection

6. **Fully Integrated** Performance

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Horyuji Temple, Nara, Japan: 1,300+ years old

- Holistically integrate the enclosure system into the building design.
- Maximize the building's climate mitigation effectiveness by making it functional for generations.
- Beautiful buildings will be better cared for, last longer
- Interrupt the carbon cycle

7. 100+ Year **Durability**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

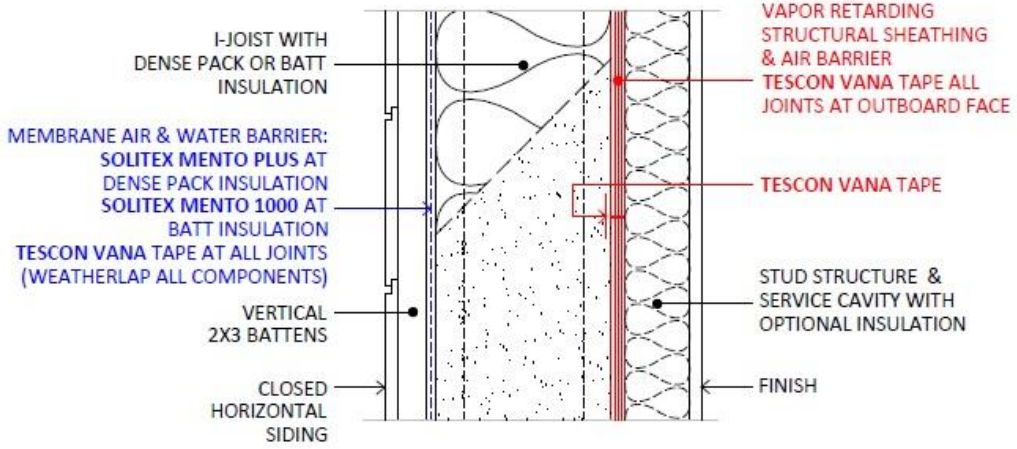
Real World Examples

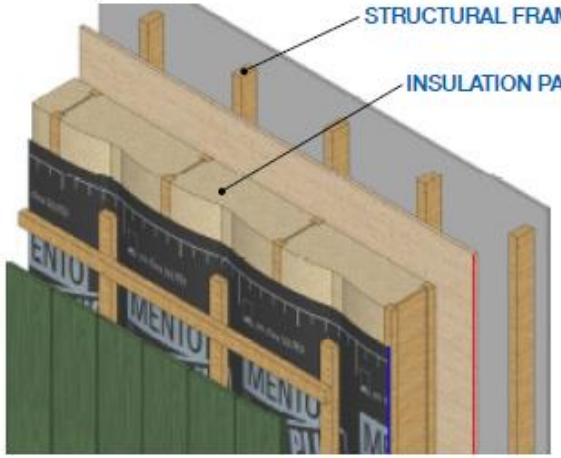
1. **Enclosure**: Home in **Maine**
2. **Daylighting**: Townhouses in **New York City**
3. **Air quality**: Affordable Housing on **Cape Cod**
4. **Less toxic** and more sustainable: **Dartmouth College** Retrofit
5. **Thermal Comfort**: Timber Frame house in **Vermont**

Enclosure – Maine House

- Water Shedding
- Airtightness
- Vapor Control
- Thermal Control

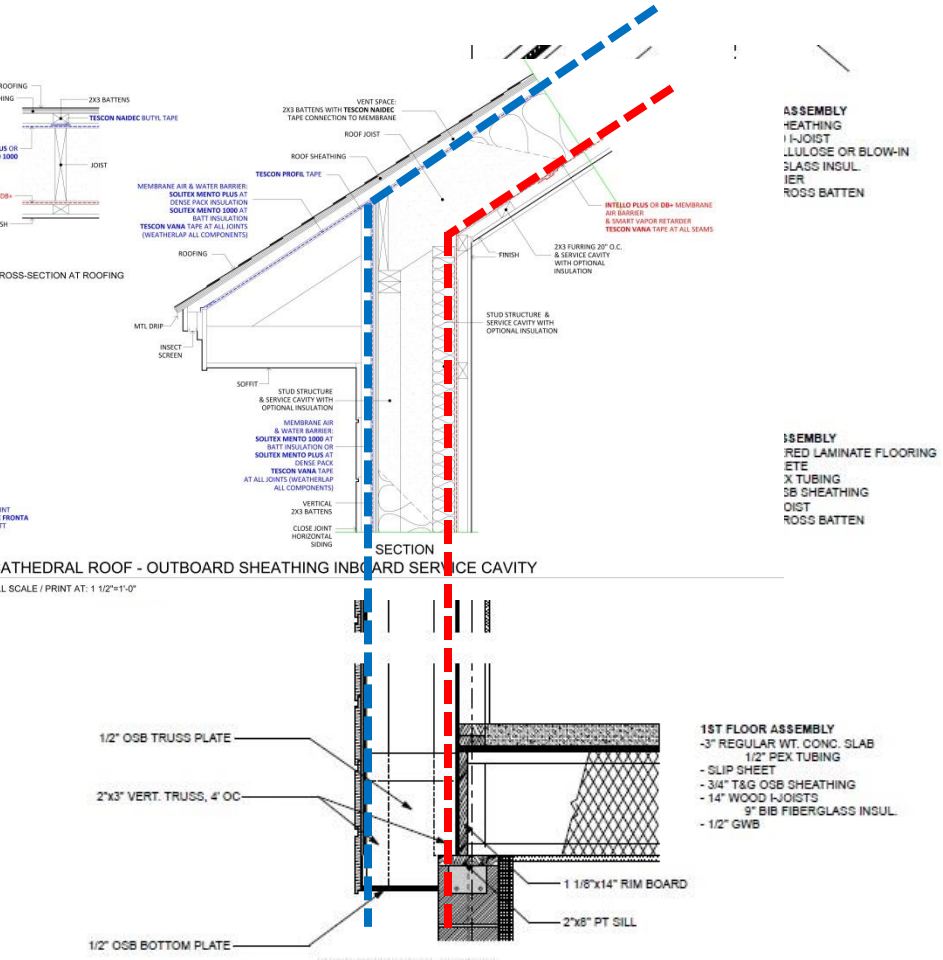
Ecocor.us



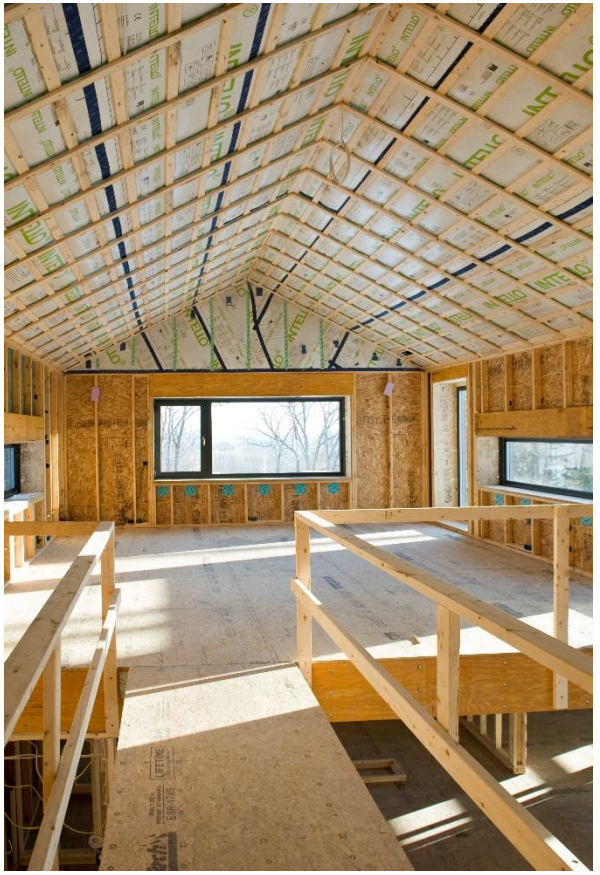


HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Enclosure….



Ecocor.us

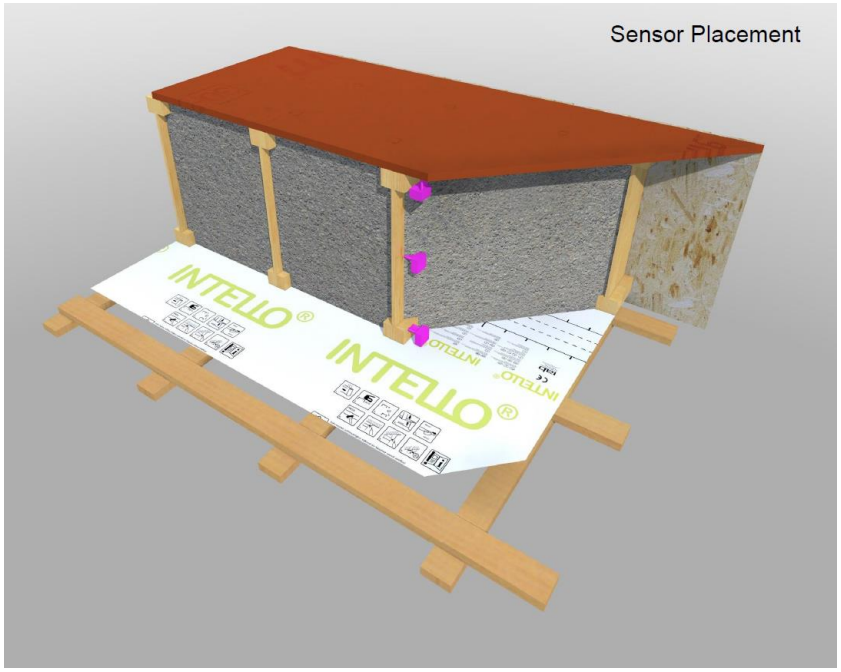


Naomi Beal Photography

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Unvented Flat Roof…

Naomi Beal Photography



Ecocor.us

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Vapor Closed Roof Data…

The trajectory is down and increased reserves.

10 Golden Rules…

10 Golden Rules for Foam-Free Flat Roofs

- Minimum flat roof pitch 3% (3/8”:12”)
- Roof Membrane Should be Dark (in climate zone 5 and higher).
- No shading of roof membrane
- Check wood moisture content before insulation and installation of vapor control & airsealing.
- Use an intelligent vapor retarder inboard: INTELLO
- Do not install humid insulation.
- No cavities/air spaces in the insulation.
- Verified airtight w/ blower door
- Don’t vent the roof (generally speaking it doesn’t work)
- Breaking one or more rules can be done, but requires thought/WUFI.

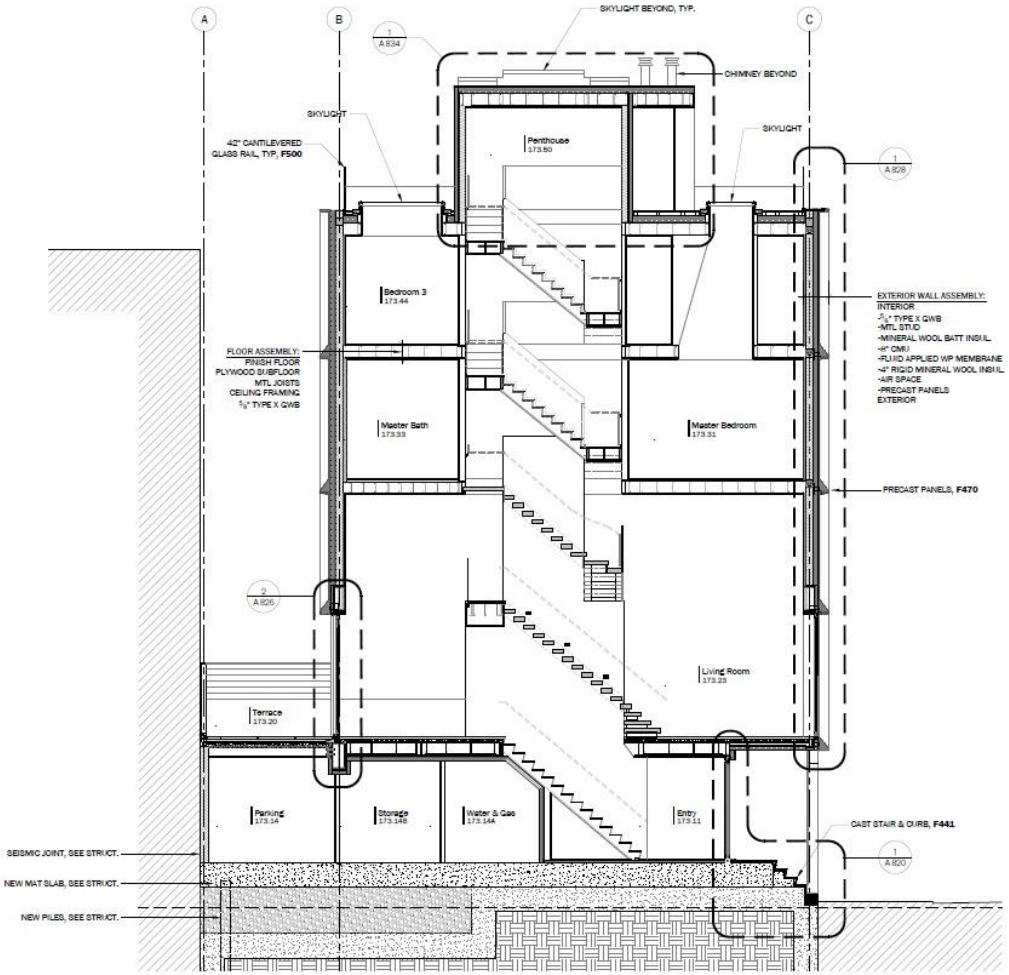
475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Daylighting – NYC Rowhouses

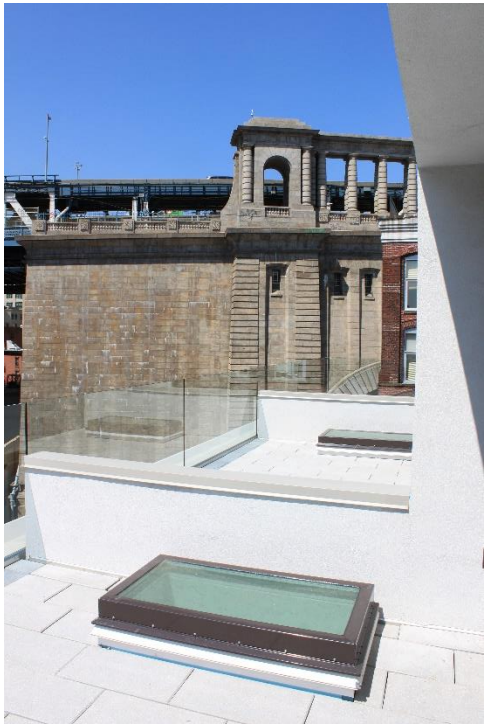
Alloy Design LLP

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Integrated daylighting…

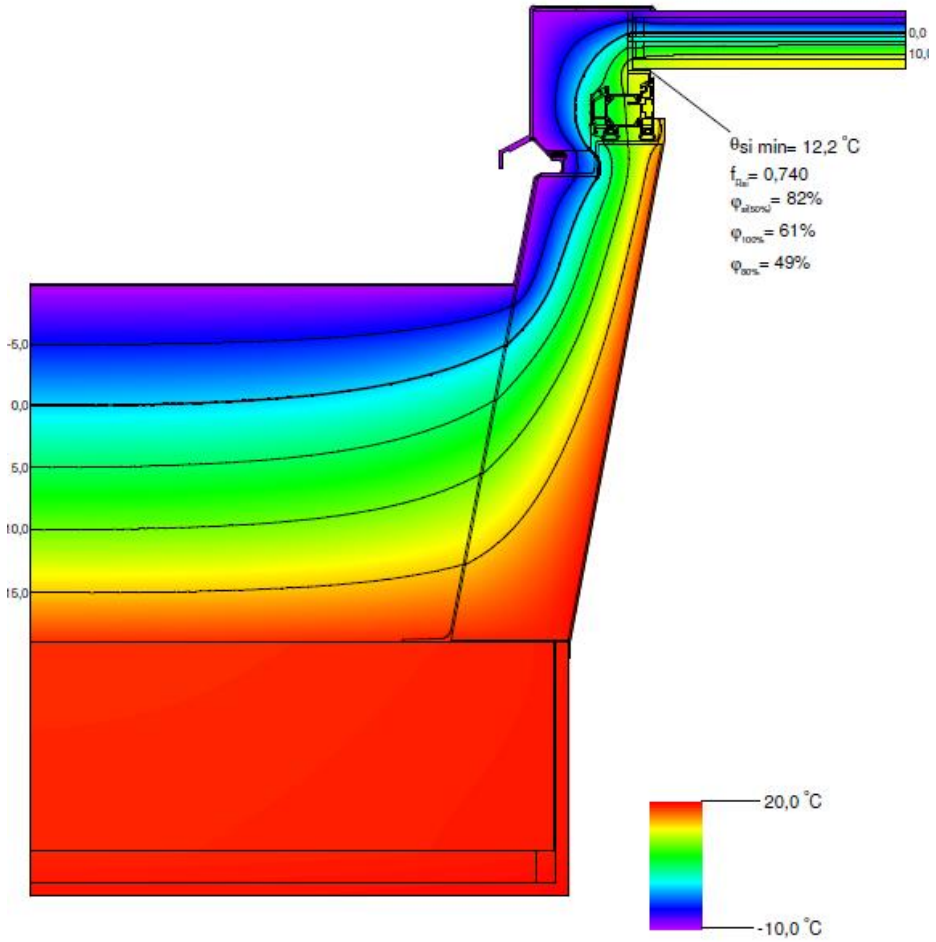


1 Building Section - 02
3/16" = 1'-0"

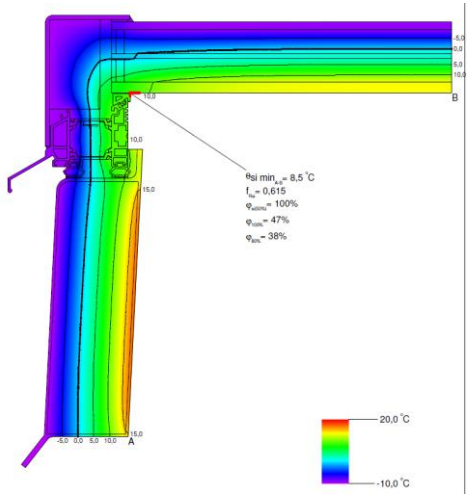


Integrated daylighting…

- PHI Certified: FE Energysave



- PH Compatible: FE



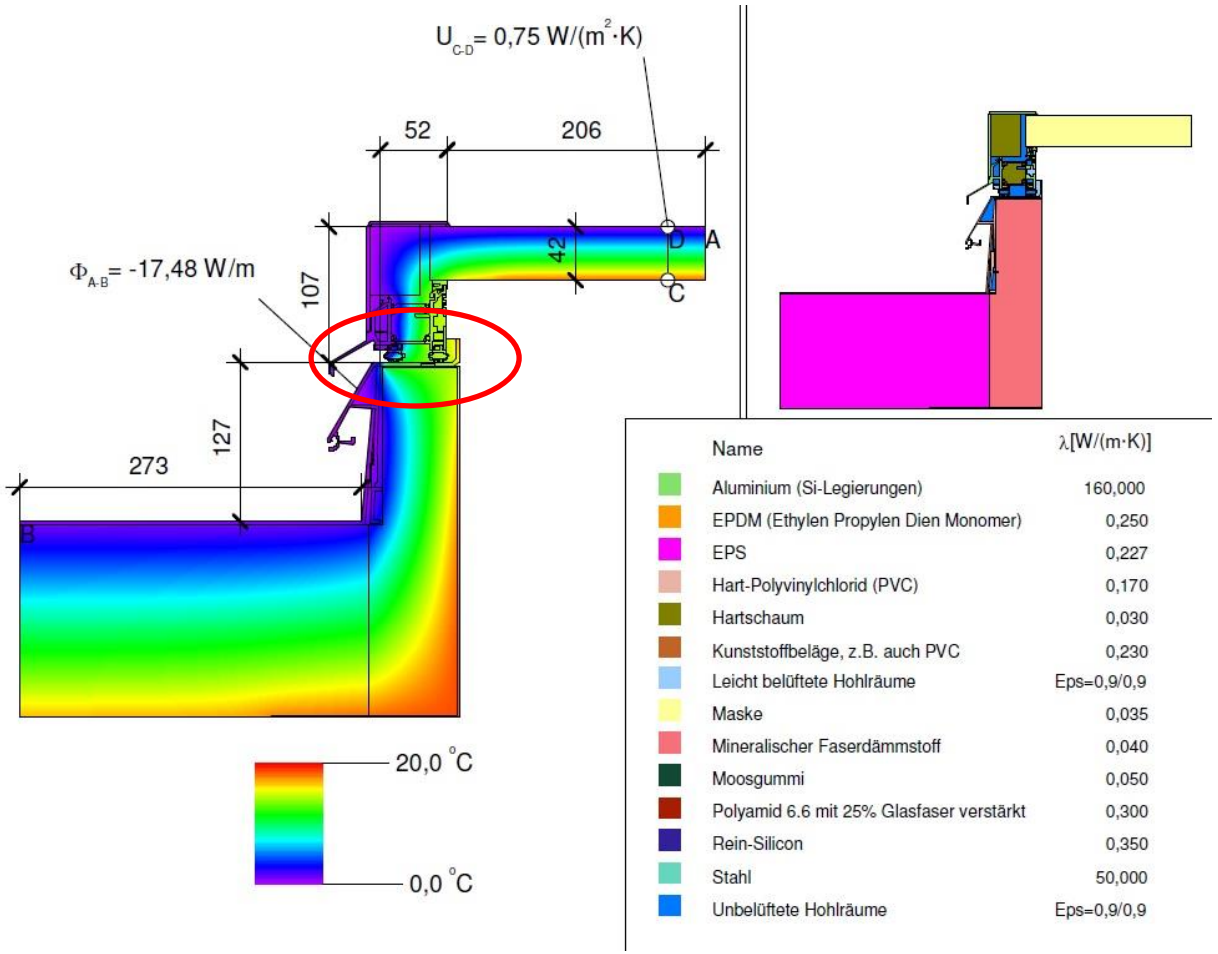
LAMILUX

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Custom…

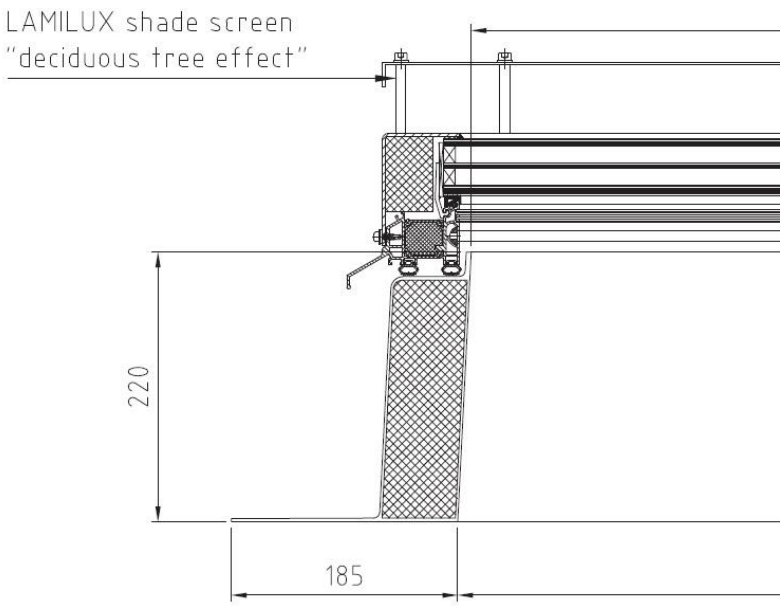
HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

Integrated daylighting…



HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Think about shading…



HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Think about shading…

HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

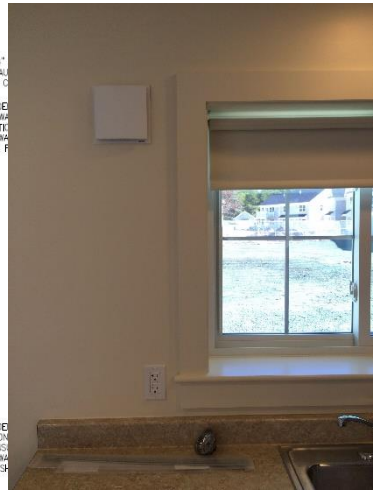
IAQ – Cape Cod Multi-Family

- 27 Units
- Affordable Housing
- 1 ACH50
- Cost Savings:
  - No cellars or attics
  - Decentralized Ventilation
  - Hybrid Ventilation Solution

475 HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

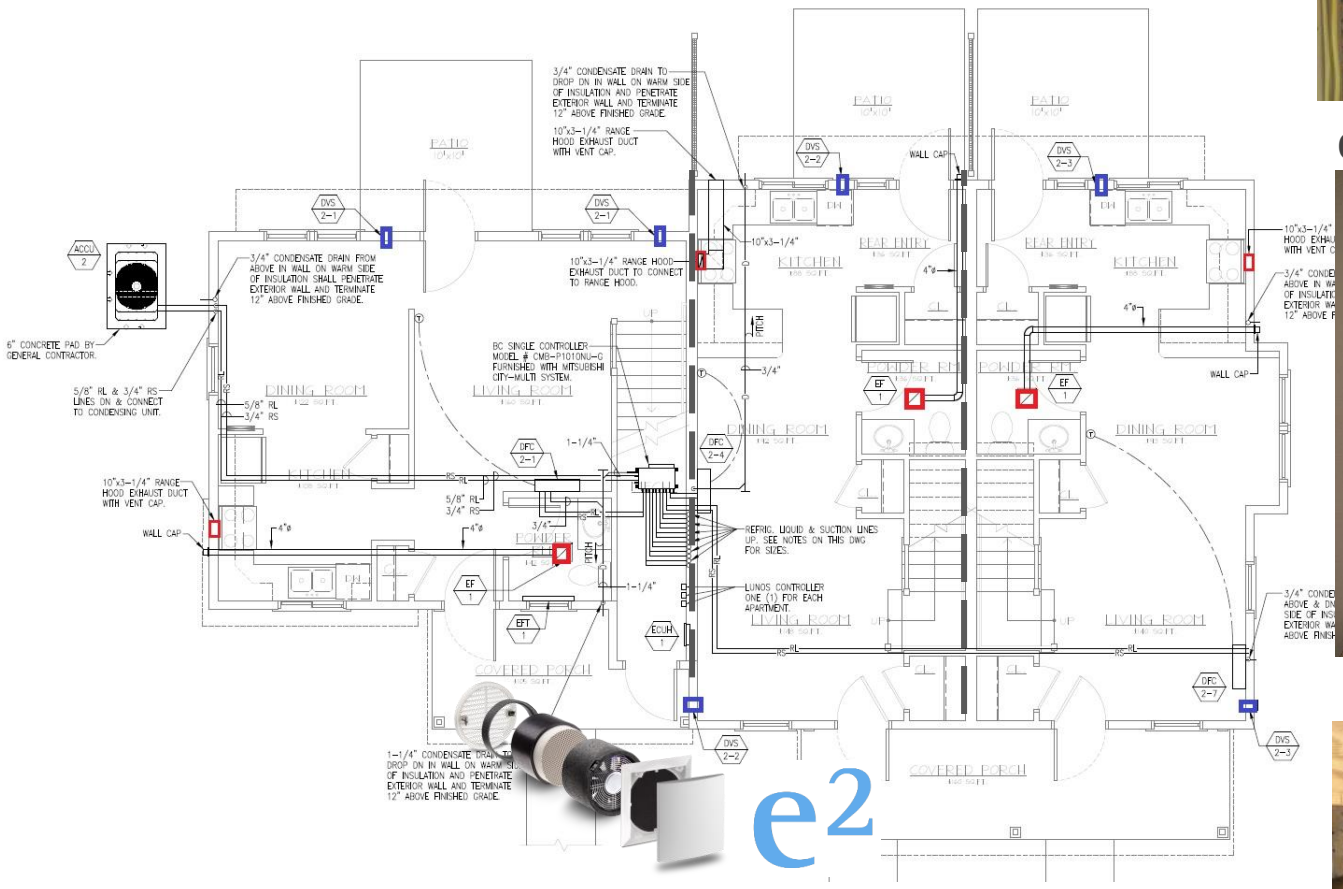
Plans…

e2 installation tube



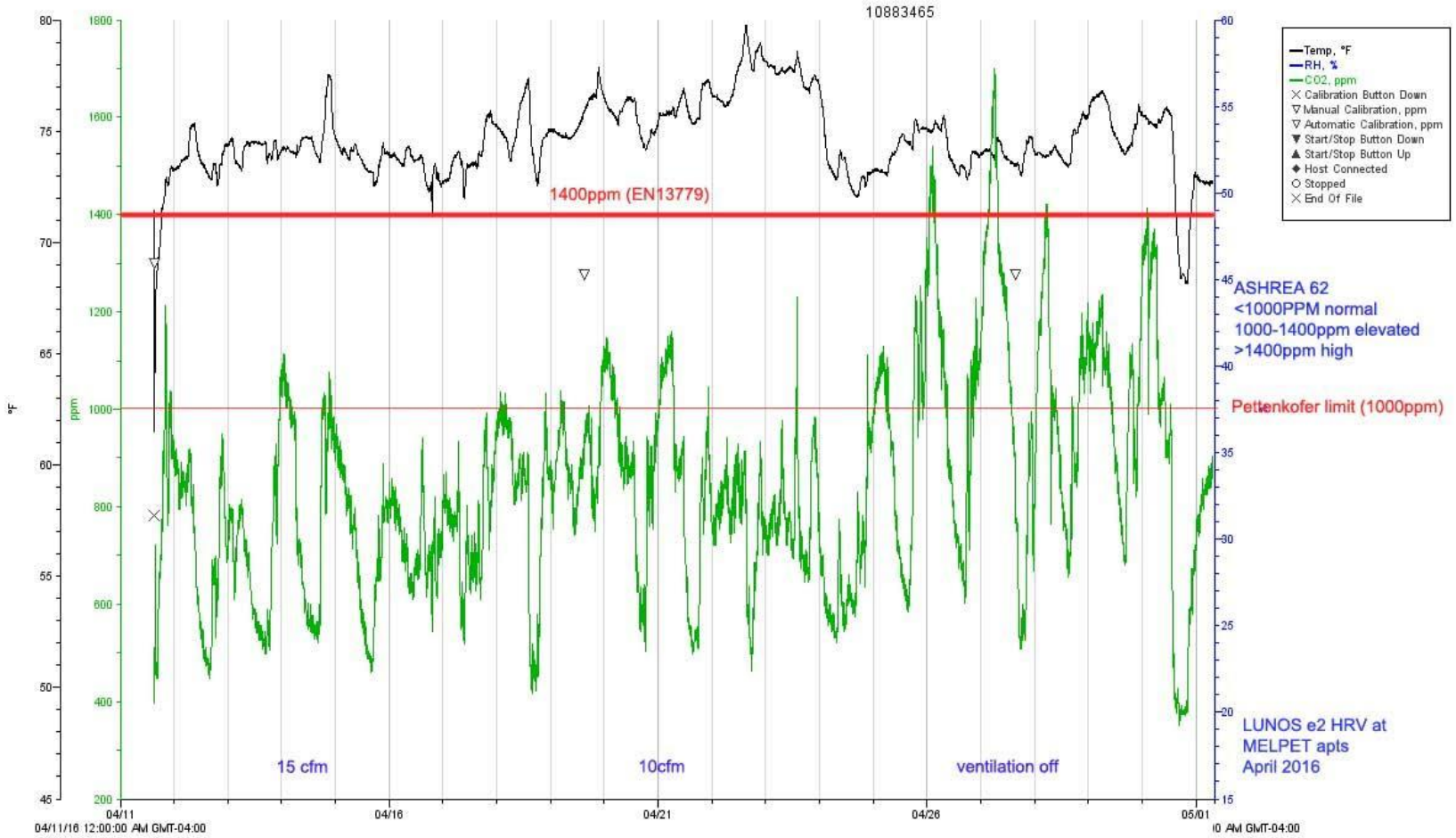
Interior Cover

Controls outside of units



Ground Plan of Three Units

Data...



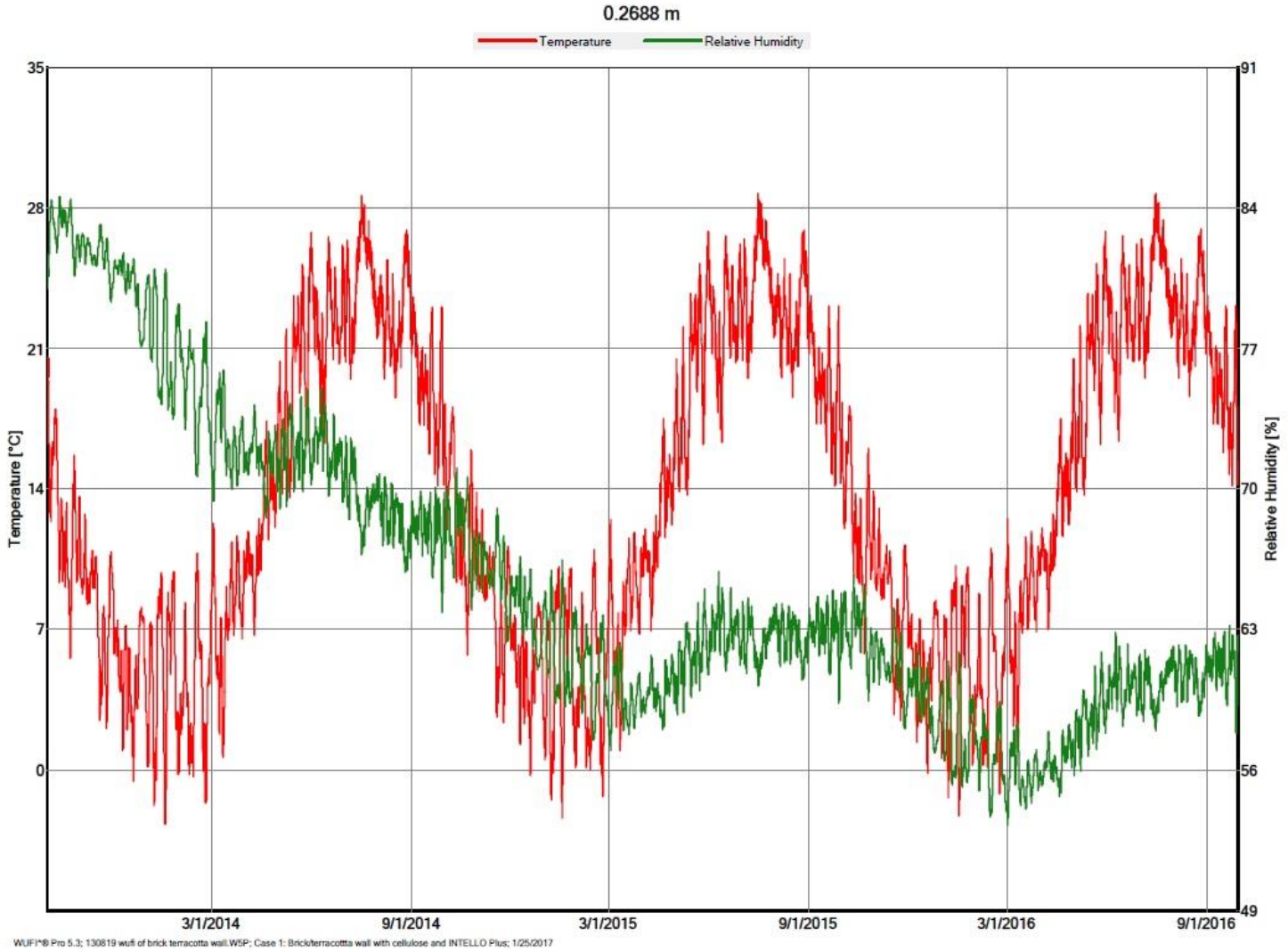
HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

Less Toxic – Dartmouth College Housing

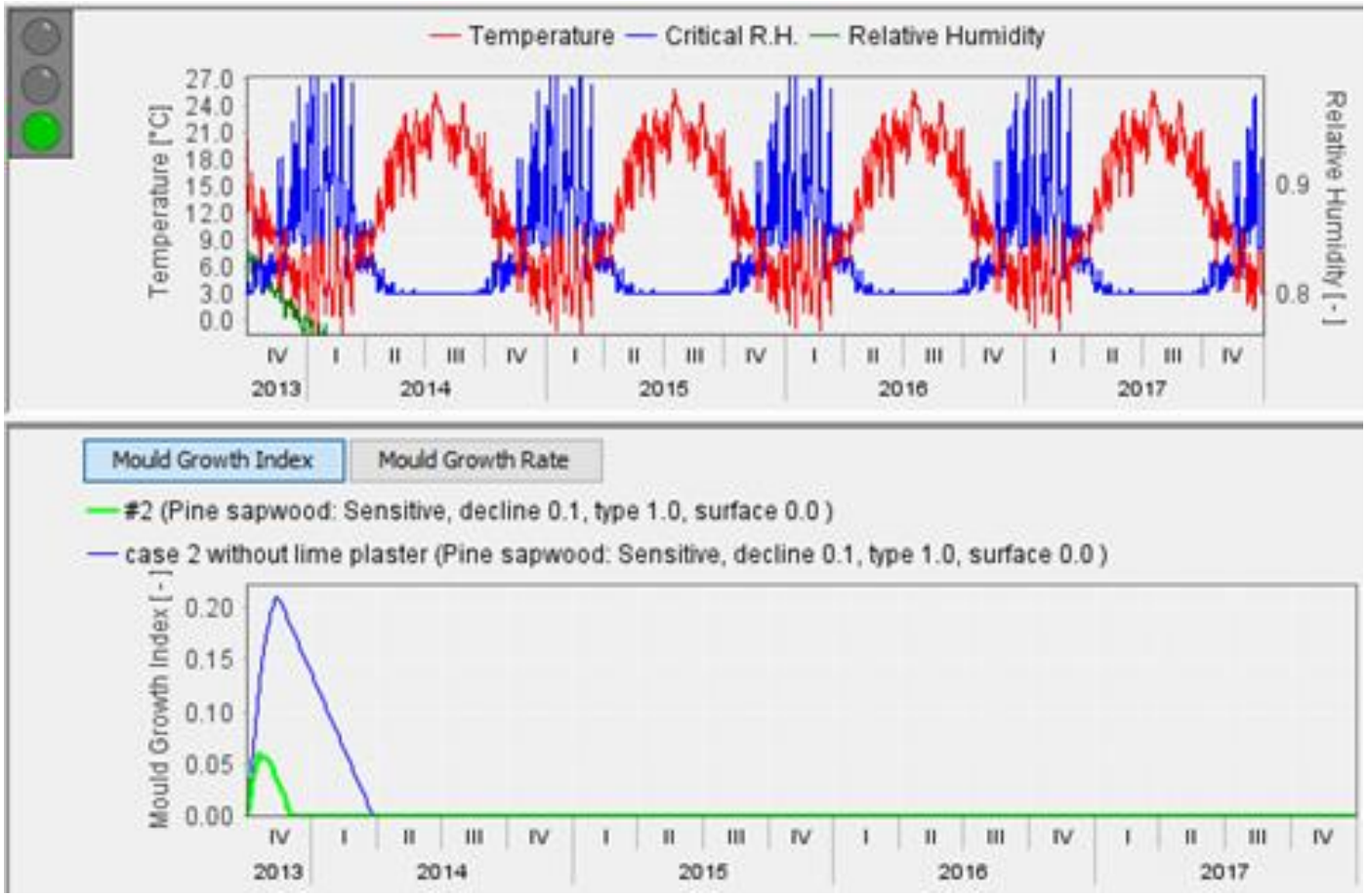
- Historic Building
- Interior Insulation
- WUFI Study

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

WUFI...



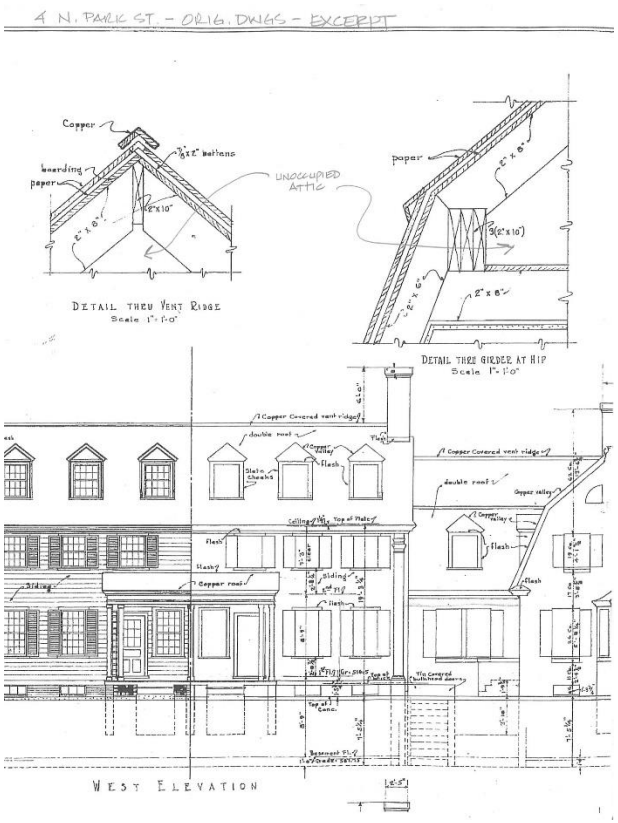
475
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM



WUFI: Mold Index

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Buildings leaning green…



Last bastion of spray foam?…

Rim Joists
Spray Foam

Not Dartmouth

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Services…

Not Dartmouth

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Credit: Smith & Vansant Architects

Dartmouth College “Triangle House”

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Thermal comfort – VT Timber Frame

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

HIGH PERFORMANCE
BUILDING SUPPLY
FOURSEVENFIVE.COM

No Time is Left, **Let's Act**

HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Smart Enclosure System

4 75
HIGH PERFORMANCE BUILDING SUPPLY
FOURSEVENFIVE.COM

Any Questions?

foursevenfive.com I foursevenfive.ca

HIGH PERFORMANCE
BUILDING SUPPLY

FOURSEVENFIVE.COM

Thank you.