Passive House Primer

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Certification Manager, Passive House Academy

Program Overview

- Introduction
- Definition of Passive House Standard
- Case Studies
- Insulation and Thermal Bridging
- Airtightness
- Passive House Windows
- Mechanical Ventilation
Passive House ...

... a joyous never ending voyage of discovery

- Built First Passive House 2004
- PH Trainers (500+ graduates in Ireland and US)
- PH Building Certifiers (60+ US projects alone)
- PH Consultants (US Army, Various Other Projects)
- PH Marketers (6 edu-videos, 60,000 views)
- PH Researchers (EuroPHit, ZECOS)
- PH Policy Advisors (Government & State Authorities)
- PH Business Development (Export & innovation)

Where it all started for us...

What exactly is a ‘Passive House’?

- >85% reduction on heating & cooling demand
- Precisely defined (21 years ago)
- 30,000+ projects
- Applies to any building type – ANY!
- Both New-build as well as Retrofit
- Achievable in any climate (some easy, some not)
- Focus is on building envelope
- Major emphasis on comfort and IAQ
- Demands very high quality construction
- Design must be verified with PHPP software

Common Passive House Myths

- It’s only applicable to ‘houses’
- You can’t open the windows
- IAQ in an airtight building must be awful
- Too restrictive on aesthetics
- It’s too expensive
Passive House concept: A great leap forward

85% reduction in heating and cooling energy compared with most building standards for new construction.

- **Practicable:**
- **Verifiable:**
- **Open-concept:**

Source: PHI

Really smart – warm in winter, cool in summer
How does a Passive House work?

If you minimise heat losses and maximise solar gains, you can reduce heating demand very significantly.

What about cooling?

If you minimise heat gains (Insulation, PH windows, SHADING, clever orientation) you can reduce cooling demand very significantly.
Heating Energy balance according to ISO 13790

- Trans. Windows: 9.51
- Trans. Opaque: 6.33
- Ventilation: 3.17

- Solar Gain Windows South: 12.66
- Solar Gain Windows North: 40
- Solar Gain Roof: 0.05
- Solar Gain Exterior Wall: 0
- Solar Gain Ground: 0
- Interior Heat Gains: 25
- Free Heat: 30
- Ground Heat: 10
- Heating: 4.75

0.05 Therms gas/(ft² yr)

2,000ft² house = 100 Therms = $110 / year

... But with Passive House, you know exactly what you’re getting
Passive House criteria – Still valid 21 years on

Heat protection:
- \( R \geq 37.9 \text{ (h ft}^2\text{ F)/Btu} \)
- \( R_g \geq 7.1 \text{ (h ft}^2\text{ F)/Btu} \)

Triple-glazing:
- \( R_w \geq 7.1 \text{ (h ft}^2\text{ F)/Btu} \)

Airtightness:
- \( n_{50} \leq 0.6 \text{ /h} \)

Ventilation with \( \geq 75\% \) heat recovery

Electricity demand max. 0.76 W/CFM

Heating energy demand
- \( \leq 4.75 \text{ kBtu/(ft}^2\text{ yr)} \)
- or Building heating load
- \( \leq 3.17 \text{ Btu/(hr ft}^2\text{)} \)

Primary energy demand
- \( \leq 38.0 \text{ kBtu/(ft}^2\text{ yr)} \)

Building airtightness
- \( \leq 0.6 \text{ ACH}_50 \)

Excess temperature frequency
- \( \leq 10\% \)

Take a 2,000 ft\(^2\) project:

1. Heating energy demand \( \leq 4.75 \text{ kBtu/(ft}^2\text{ yr)} \)
   - 95 Therms of gas = $103 per year
   - Or 800 kWh electricity = $104 per year

2. Cooling energy demand \( \leq 4.75 \text{ kBtu/(ft}^2\text{ yr)} \)
   - 800 kWh electricity = $104 per year

Total heating and cooling cost < $250 yr

Gas prices per Therm June 2011: National = $1.06. Electricity prices per kWh June 2011:
National = $0.13; above scenario assumes heat pump with COP of 3.5
Take a 20,000 ft² project:

1. Heating energy demand \( \leq 4.75 \text{kBtu/(ft}^2 \text{ yr)} \)
   
   950 Therms of gas = \$1,000 per year
   
   Or 8,000 kWh electricity = \$1,000 per year

2. Cooling energy demand \( \leq 4.75 \text{kBtu/(ft}^2 \text{ yr)} \)
   
   8,000 kWh electricity = \$1,000 per year

Total heating and cooling cost \$2,000 yr

Gas prices per Therm June 2011: National = \$1.06. Electricity prices per kWh June 2011: National = \$0.13. Above scenario assumes heat pump with COP of 3.5

Brussels City Mandates Passive from 2015

MDW Architecture

www.detail-online.com

Going Passive but within the EPBD – that’s so clever!
Buildings with heating & cooling < 4.75 kBtu/ft2.yr will almost certainly suffice to be called nearly zero-energy building
No limits on what can be built

Passive House House
Passive House School
Passive House Apartments
Passive House Factory
Passive House Offices
Passive House Church
Passive House Industrial
Passive House Retrofit

Passive Goes Massive!

oehler faigle archkom solar architektur
Size: 62,000 ft²
Completed: 2003
Cost: $185/ft²

Fresh air delivery
Fresh air intake
Geo-thermal cooling
The Building that *(mostly...)* Heats Itself

External Temperature:

If > + 41°F = No heating

If 23 - 41°F = Heated by ‘waste’ heat from kitchen & server room

If < 23°F = District heating

Cost of heating and cooling:

- Conventional offices = $1.60 / ft² / year
- Energon PH offices = $0.30 / ft² / year
- Saving of 80% ($80,000 / year)
- **Built at no additional cost – yes, none**
- Payback from Day 1
- Fully occupied
- Happy, healthy productive tenants
World’s First Passive House Prison

Passive House School - Frankfurt
The Sky’s the Limit

This Passivhaus ain’t no house, it’s a 20 storey office building

Chief Res.
Director: House Architecture
Oct 22, 2013

Actual energy use 6% less than predicted in 1st year

Center for Energy Efficient design
CEED

Design and images by:
www.structuresdb.com
First New Construction PH NYC by Loadingdock5

- Cost efficient
- Conventional NYC construction methods – tweaked to PH
Thermal Bridge free, AAC

Conventional detail: Severe thermal bridge

Passive House detail: Thermal bridge free

Big Double Height Space
Super-tight PH retrofit in Brooklyn

Terraced Brownstone Passive House

Project Description:

This is a comprehensive overview project for the Garden PH retrofit project that consists of a commercial and residential building. The project is located in Brooklyn, New York City, and involves the transformation of an existing building into a Passive House. The building is designed to meet the high-performance standards of Passive House, including airtightness, energy efficiency, and comfortable living conditions.

Project Details:

- Location: Brooklyn, New York City
- Total Area: 2,400 sq ft
- Heating Source: Heat Pump
- Cooling Source: Heat Pump
- Energy Usage: Less than 100 kWh/year
- Water Usage: Less than 150 gallons/year

Materials:

- Insulation: R-50 in walls, R-60 in ceilings
- Windows: Triple-pane, low-E, argon-filled
- Walls: 2x6 stud framing

Design Team:

- Architect: Green Building Design
- Contractor: Green Building Construction
- Engineer: Green Building Consulting

First PH Project on Long Island

First Passive House Artist’s Studio

Project Description:

The project is a unique Passive House featuring an artist’s studio in New York City. The building meets the rigorous Passive House standards, including airtightness, energy efficiency, and comfortable living conditions. The studio is designed to be a retreat for artists, providing a tranquil and inspiring environment.

Project Details:

- Location: Long Island, New York
- Total Area: 600 sq ft
- Heating Source: Electric Heat Pump
- Cooling Source: Electric Heat Pump
- Energy Usage: Less than 100 kWh/year
- Water Usage: Less than 150 gallons/year

Materials:

- Insulation: R-40 in walls, R-50 in ceilings
- Windows: Triple-pane, low-E, argon-filled
- Walls: 2x4 stud framing

Design Team:

- Architect: Passive House Design
- Contractor: Passive House Construction
- Engineer: Passive House Consulting
Passive House Wins Syracuse Housing Competition

From the Ground Up Passive House
Project Overview:
Located in Syracuse, New York, the被动式 housing area is designed to meet the Passive House standard.

Building Products:
- Roof: Passivhaus Roof, 16" thickness
- Walls: Insulated Concrete Forms (ICF), 10"
- Windows: Marvin Ultimate, 1.5" thickness
- Doors: Marvin Ultimate, 1.5" thickness

Glazing Solution:
- Low-e, triple-pane windows

Project Team:
Architect: John M. Van Hoff Architects
Contractor: United Homes

Affordable Passive Housing in Philly

Bellwether Passive TownHouses
Project Overview:
Located in Philadelphia, the Passive TownHouses project was designed to meet the Passive House standard.

Building Products:
- Roof: Low-slope, stainless steel
- Walls: Insulated Concrete Forms (ICF), 10"
- Windows: Marvin Ultimate, 1.5" thickness

Glazing Solution:
- Low-e, triple-pane windows

Project Team:
Architect: John M. Van Hoff Architects
Contractor: United Homes

Passive House Academy
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Onion Flats, Philly, Commence Largest Project in the US

146 Apartments in 8 Blocks
Stunning Spaces, Kit-Build, Renewable Energy...

How it all works

• Superbly insulated envelope
• High performance windows
• Thermal bridge free detailing
• Complete Airtightness
• Mechanical Ventilation
Superbly Insulated Envelope

Increased insulation means thicker envelope - simple

Typical R-values (hr*ft²*˚F)/Btu:

- ROOF = R20
- WINDOW = R3
- WALL = R20
- FLOOR SLAB = R10

Source: [PHS 1.0] Author: JM

Source: Passive House Academy
Examples of Passive House-external wall constructions:

R ≥ 35 (hr.ft².˚F)/Btu

a) Masonry with EIFS (thickness 250mm (10in))

b) Formwork element made of rigid polystyrene 240+120+60mm - (9½+4¾+2½in)

c) Lightweight: plywood I-beam, fully insulated 300-400mm (12-15¾in)

d) Formwork element on expanded clay basis 375mm (14 ¾in)

e) Prefabricated porous concrete element

f) Thick timber board wall

g) Prefabricated polyurethane sandwich elements 200mm (8in)

h) Hightech: VIP* 25mm (1in)

Top- and bottom sheet (steel)

IR

j) Porous concrete blocks with mineral foam insulation

Insulation Reduces Transmission Losses

Calculating Transmission Losses:

\[ Q_T = A \times \left( \frac{1}{R} \right) \times f_t \times (G_t) \]

\[ ft^2 \times Btu/(hr \ ft^2 \ ˚F) \times 1 \times (k\˚F \ hr)/yr \]

\[ = kBtu/yr \]
Modelling Transmission Losses in Passive House Planning Package

**Things to Remember about Insulation**

- It’s **cheap** as chips!
- Low-tech and **easy to apply** – no gaps
- Do it once and **do it well**
- Absolutely **no excuse** for getting this wrong
Thermal Bridge Free Construction

Effects of Poor Thermal Bridge Detailing
**Definition of a Thermal Bridge**

**EN 10211 definition**

Part of the building envelope where the otherwise uniform thermal resistance is significantly changed by:

- full or partial penetration of the building envelope by materials with a different thermal conductivity

and/or

- a change in thickness of the fabric

and/or

- a difference between internal and external areas, such as occur at wall/floor/ceiling junctions.
Construction thermal bridges

Heat losses in winter and heat gains in summer

At any location where a thermal bridge occurs there is a risk of the following:

- **Extra Heat Flow** – Higher Space Heat Demand and / or Cooling depending on climate
- **Discomfort** due to temperature asymmetry
- **Condensation** and possible structural damage
- **Mold** and Fungus Growth, with possible Health problems

Thermal-Bridge-Free construction avoids these problems.
Thermal Bridges are Potentially Everywhere!

Thermal-bridge-free designing

$\Psi < 0.006 \text{ Btu/(hr.ft.}^\circ\text{F)}$

Source: PHI
Author: JS

Passive House Certification of Student Residential Facility - Dublin
Transmission Losses through Thermal Bridges

Length of thermal bridges (excl. windows) = 12,000 feet

2.25 miles!

Passive House detailing = 51,000 kBtu/year
15% of total

‘Normal’ detailing = 142,000 kBtu/year
32% of total

Passive House Detailing cuts Losses by 50% minimum

Products Used to Reduce Thermal Bridges

Foamglas Perinsul – “the insulation that thinks it’s a brick”
Solutions for Separating Balconies

Lenton Thermo Balcony System

Schock Isokorb Separator

Continuity of Levels but Thermally Separated

Separate The Structural Layer From The Insulation Layer?

Internal Structural Layer Can Function as service Cavity

Typical wall to floor junction detail
Psi value of Existing Detail

Huge Loss, Cold Surface Temperatures, Possible Saturation

Ψ (for PHPP) = 0.334

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Psi value of Alternative Detail

Separate the Insulation Layer from the Structural Layer

Make use of Structural Layer by Adding Services

Add a Structural Thermal Break

Add Insulation to the Floor
Psi value of Alternative Detail

Things to Remember about Thermal Bridging

- Thermal bridges have profound effects
- Think comfort, health, mold, heat flow
- Large projects have miles of junctions
- It's easy to get it right
- Lots of new products available to help
Complete Airtightness

Build Tight – Ventilate Right

Passive House Requirement: 0.6 ACH @ 50 Pascal

Infiltration and exfiltration due to leakages in the building envelope

Source: Zeller/Biasin Author: JS

Copyright Passive House Academy
Airtightness is a **planning task**

\[ n_{50} \text{ max. } 0.60 \, \text{h}^{-1} \]

design ONE airtight layer all around the building

Source: Passivhaus Institut Saris Author: SP

"**The PH airtightness level is too difficult**"

**Saskatchewan Conservation House**
1977: \[ n_{50} = 0.8 \, \text{h}^{-1} \]

**Darmstadt Passive House**
1991: \[ n_{50} = 0.22 \, \text{h}^{-1} \]
Hudson Passive House Project

Tight, really tight, perhaps even a record

0.16 ACH @ 50 Pascal

120 Year old Brooklyn Brownstone EnerPHit

2012

n50 = 0.38 h⁻¹

Thermographic image - Sam McAfee, SG.Build
Sample calculation

In a Passive House with a net air volume of 17,000 ft³, an air flow rate of 250 CFM was determined with a differential pressure measurement at 50 Pa.

Was the requirement for Passive Houses of $n_{50} < 0.6$ 1/h met?

$$n_{50} = \frac{V_{50}}{V_{Air}}$$

measured air flow rate

net interior air volume

250 CFM

0.0147 per min x 60 = 0.88 1/h ($n_{50}$)

(> 0.6 1/h, requirement not met)
Airtightness: Details, Materials, Trades

The Blowedoor Test – Day of Reckoning!
Weapons of Mass Destruction

Passive House training for ‘thinking’ fingers

Passive House Learning + the Wild West

The era of the cowboy-builder is over
How durable is airtightness?

Airtightness in Passive House Darmstadt Kranichstein

Things to Remember about Airtightness

- All junctions and penetrations have to be thought about in advance
- The simpler the details, the easier to achieve
- Use tried and tested materials (not spray foam!)
- Hugely dependent on quality workmanship
- There is no hiding from the blower-door test
- You can do it

Source: PHI
Author: SP
Passive House Windows and Doors

- High Spec Windows
  - Take in more energy per year than they let out
  - 4 times better than standard double glazing
  - Improved sound proofing
Evolution of glazing performance

<table>
<thead>
<tr>
<th>Glazing</th>
<th>Single</th>
<th>Double</th>
<th>Double, low-e</th>
<th>Triple, low-e</th>
<th>Future: vacuum/multi-foil</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-value</td>
<td>1.01</td>
<td>2.03</td>
<td>4.73</td>
<td>11.36</td>
<td>16.22</td>
</tr>
</tbody>
</table>

Source: PHI
Author: PHI/F. Freundorfer
Window profiles – 129 Certified systems now available

\[ R_{w,\text{installed}} \geq 6.5 \ (\text{hr}.\text{ft}^2.\text{°F})/\text{Btu} \]

My home (2004) – floor to ceiling glass
**High quality double pane, Uₜ= 0.28 Btu/hr.ft².F**

R=3.55 (hr*ft²°F)/BTU

The radiant temperature asymmetry of 9.9°F is far too high. (max 7.2°F) A compensating heating surface near the window is thus required

Source: PHI / Sariri, Author: PHI/F. Freundorfer

**Certified Passive House window, Uₜ= 0.14 Btu/hr.ft².F**

R=7.1 (hr*ft²°F)/BTU

Radiant temperature asymmetry of just 4°F Radiator no longer required under the window

Source: PHI / Sariri, Author: PHI/F. Freundorfer
Ice on the Glass? What’s going on here?

Certified Passive House Windows

\[ R_w = 9.8 \text{ hr. ft}^2/\text{F/BTU} \]
Impact of poor quality glazing spacers

For a living room of 325 ft², 0.5 pints of condensate are produced easily.

Source: F. Freundorfer
Author: F. Freundorfer

Window Fitting Detail – Wood Frame

According to PHI, ‘thermal bridge free’ is 0.006 Btu/hr.ft.F

\( \Psi_e \) (for PHPP) 0.013 Btu/hr.ft.F

Copyright Passive House Academy
Detail 03 – Wood Frame

Improved Wood Frame Fitting Detail

Congratulations!
Steel Frame Multi-Residential

Not thermal bridge free- but acceptable, Ψ1, (for PHPP) 0.0849

Have the Window Supplier Do the Work for You...
How is the $U_w$-value for window determined?

Four aspects determine overall $U$-value:

1. U-value of the glass = $U_g$
2. U-value of the frame = $U_f$
3. Thermal bridge of the spacer = $\Psi_{\text{spacer}}$
4. Thermal Bridge of fitting detail = $\Psi_{\text{installed}}$

Performance of the glass is typically better than the frame.

Calculation of the installed $U_w$-value for windows

$$(U_g \times A_{\text{glass}}) + (U_f \times A_{\text{frame}}) + (\Psi_{\text{spacer}} \times L_{\text{spacer}}) + (\Psi_{\text{installed}} \times L_{\text{installed}})$$

<table>
<thead>
<tr>
<th>Component</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_g$</td>
<td>0.10 Btu/(hr Ft² F)</td>
<td>0.10 Btu/(hr Ft² F)</td>
</tr>
<tr>
<td>$A_{\text{glass}}$</td>
<td>15 ft²</td>
<td>15 ft²</td>
</tr>
<tr>
<td>$U_f$</td>
<td>0.15 Btu/(hr Ft² F)</td>
<td>0.80 Btu/(hr Ft² F)</td>
</tr>
<tr>
<td>$A_{\text{frame}}$</td>
<td>5 ft²</td>
<td>5 ft²</td>
</tr>
<tr>
<td>$\Psi_{\text{spacer}}$</td>
<td>0.02 Btu/(hr Ft)</td>
<td>0.03 Btu/(hr Ft)</td>
</tr>
<tr>
<td>$L_{\text{spacer}}$</td>
<td>16 ft</td>
<td>16 ft</td>
</tr>
<tr>
<td>$\Psi_{\text{installed}}$</td>
<td>0.006 Btu/(hr Ft F)</td>
<td>0.100 Btu/(hr Ft F)</td>
</tr>
<tr>
<td>$L_{\text{installed}}$</td>
<td>18 ft</td>
<td>18 ft</td>
</tr>
<tr>
<td>$A_{\text{window}}$</td>
<td>20 ft²</td>
<td>20 ft²</td>
</tr>
</tbody>
</table>

On the people on the left: All the people on the right:

$A_{\text{Window}}$
Which of these windows has the best U-value?

What is the reason for your answer?

Size and Design Matters

Which of these windows has the best U-value?

What is the reason for your answer?
Size and Design Matters

Which of these windows is the cheapest?

What is the reason for your answer?

What is the proportion of frames in these Windows?

20%? 25%? 30%?
Empire State Building in numbers (estimations)

- 0.0867 BTU/hr.ft°F Heat Loss due to fitting detail
- 25 miles of window frames!
- 1.7 million KBTUs heat loss each winter
- 0.5 million kWh heat loss each winter
- 100% energy saving with special low-cost fitting details

Don’t forget the Shading

Overheating @ 77°F: Max allowed is 10% of year
Things to Remember about Passive House Windows

- Think **comfort**, not just energy
- **Fitting** Details are crucial
- Remember **thermal bridges** & airtightness
- Minimize % of **frame**
- **Low SHGC** in hot climates – plus shading
- When **retrofitting**, put in the very best

Mechanical Fresh Air Ventilation
Whole-house ventilation system

Continuous fresh air supply – not recirculated

Typical layout in multi-family units

- Decentralised ventilation system in each apartment
- Outside and exhaust air through the façade or the roof

Source: PHI  Author: PHI / PHD

Copyright Passive House Academy
Ventilation of schools – high achievers!

Typical Ventilation Unit

Training Module
High Indoor Air Quality – Appropriate flow rates

<table>
<thead>
<tr>
<th>Dimensioning the air quantity according to air quality</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>required person-related fresh air flow (CFM)</td>
<td></td>
</tr>
<tr>
<td>classified according to ISO 13770</td>
<td>12</td>
</tr>
<tr>
<td>max. allowed diff. CO2</td>
<td>19</td>
</tr>
<tr>
<td>asleep</td>
<td>23</td>
</tr>
<tr>
<td>typical</td>
<td></td>
</tr>
<tr>
<td>working</td>
<td></td>
</tr>
<tr>
<td>for excellent air quality IDA 1</td>
<td>400</td>
</tr>
<tr>
<td>for good air quality IDA 2</td>
<td>600</td>
</tr>
<tr>
<td>for satisfactory air quality IDA 3</td>
<td>1000</td>
</tr>
<tr>
<td>moderate air quality IDA 4</td>
<td>1200</td>
</tr>
</tbody>
</table>

CFM/p (cubic foot per minute per person)

Source: [PHI/Feist] Author: WF / PH

Measured Air Quality in bedrooms

CO₂ Levels in PPM

CO₂ in Conventional House

CO₂ in Passive House

Copyright Passive House Academy
Things to Remember about Ventilation

- Airtight buildings must be ventilated somehow
- Mechanical systems give you control
- Air-quality in PHs proven to be high
- Waste heat in winter is efficiently recovered
- High quality units use little power & are very quiet
- Design a simple ducting layout

Heating and Cooling of Passive House Projects
Heating and Cooling loads

Existing Building Stock: Heating and cooling load more than 31.7 Btu/hr.ft² Heating load only 31.7 Btu/hr ft²

Passive House: Heating and cooling load Reduced by 90% to 3.17 Btu/hr.ft²

Heat pumps can be used for both heating and cooling

Design and Image by loadingdock5
Cooling of Passive House Projects

1. Cooling Demand (Sensible & Latent)
2. Cooling Load (Sensible & Latent)

“Sensible” = temperature comfort
“Latent” = moisture comfort (humidity)

Ideally all demand and loads could be served by one tried and tested system – simple & cost effective to install.

Select climate data for your project location

Data required for all energy calculations included.
Get the specifications for ‘Energy’ recovery efficiency (ERV = humidity (latent load) reduction)
Multi-Family in Philly

Cooling Energy Demand (1 kWh = 3.4 kbtu)

Specific dehumidification Demand (1 kWh/m² = 0.32 kBtu/ft²)
Equates to 61% humidity at 77°F

Frequency of overheating if no cooling = almost 50%!
Frequency of exceeding humidity if no dehumidification = 17%!

Active cooling and dehumidification needed – forget night cooling with windows in Philly climate...

1. Cooling coil
2. Mini-split
3. Surface cooling

PHPP provides multiple options for specifying active sensible and latent cooling

- 27 kBTU/hour or 2.25 tons of cooling
- 17 kBTU/hour or 1.4 tons of cooling
Which device can do heating, cooling and dehumidification?

- Boiler
  - Gas Condensing boiler
  - Oil Condensing boiler
  - Biomass Pellets Logwood
- District Heat
  - Combine Heat & Power
    - Hard coal CHP
    - Gas CHP
    - Oil CHP
    - Hard coal Gas Oil
- Heat pump
- Compact unit
  - Soil / Water
    - Terrestrial sensor
    - Terrestrial collector
  - Air / Water
  - Water / Water
  - Heat pump
  - Exhaust air
  - Soil
  - Natural gas

Source: PHD

Ductless Mini-Split

Lower cost than ducted system, but aesthetically intrusive?
Aesthetically more integrated, however more expensive and slightly less efficient

http://www.energyvanguard.com

http://homeenergypros.lbl.gov
Summary Recommendations for Sensible and Latent Loads

1. In winter looking for > 30% RH and in summer c. 60% RH
2. Use an ERV and not a HRV in NYC
3. ERV will convert 90°F + 90% RH to approx 78°F + 70% RH – almost there...
4. ERV will reduce cooling loads by 25 to 30% and reduces frost protection demand
5. Mini-split can heat, cool and dehumidify – perfect!
6. Separate the (1) ventilation system from the (2) heating and cooling system – different to the classic European approach
7. Single point-source thought to be risky for ‘whole house’ comfort
8. In 2 storey house, one on each floor ideal – for example in sitting room and landing of stairs
9. More preferable again to have ducted system to ensure even distribution – this costs more than a ductless mini-split
10. So, 2 separate and ducted systems – one for fresh air ventilation, the other for heating, cooling and dehumidification
11. Potential to do all-in-one with the Compact system?
All-in-1 Compact Unit?

Retrofitting to the Passive House Standard

RenerPHit
Quality Approved Energy Retrofit with Passive House Components
Dr. Wolfgang Feist
EnerPHit – Recently Launched Retrofit Standard for PH

- Currently only applies to residential.
- Heating Demand < 7.92 kBTU/ft²/yr (4.75 normally)
- Airtightness of 1.0 ACH @ 50 PA (0.6 normally)
- Proof of moisture protection
- Comfortable windows
- Performance cert also possible if SHD > 7.92 kBTU/ft²/yr
- Projects underway in Brooklyn and Boston
Refurbishment with Passive House components

Before refurb
- basement thermally insulated
- thermally insulated walls

after refurbishment
- Passive House windows
- ventilation with high efficient heat recovery

85% reduction

8.24 kBtu/ft²yr

Building refurbishment, Nürnberg, Jean-Paul-Platz
Architect: Burkhard Schulze-Darup

A New Concept ...

...Air-loose-ness
Retrofitting School to Passive House Standard – Without Closing it down!! (Schwananstadt, Austria)

EuroPHit Project Looking for US Participation
What can be certified?

Products
Projects
People

The safest route to having your project Certified is to use Certified Products and People

Sample Certified PH Windows - Klearwall

Triple Glazing/Triple Pane
Excellent Spacer
Tri Seal Super Spacer (0.014 BTU/hr.ft.F)
Styrofoam Filling
PVC Frame
Timber Cladding

Rw = 9.8 hr.ft².F./BTU
Uw = 0.102 BTU/hr.ft².F.
Certified PH Tradesperson – learning by doing

Certified buildings

- Quality Assurance
- Indisputable
- Fantastic learning experience
Extra Over Costs of Passive House Standard

CEPHEUS – Additional costs

Additional investment costs on average: 8%

That was 10 years ago – extra cost in EU now 0% to 5%

Source: PHI  Author: PHI/AB
Another perspective on extra over costs:

- Residential 8% to 10%
- Commercial 4% to 7%

Adam Cohen, CPHC, Structures DB
February 19th 2012

Cost of renovating to PH standard

- Gut renovation of 4 storey brownstone = $720,000
- Same gut renovation to PH standard = $735,000

Jeremy Shannon, Prospect Architecture?
February 23rd 2013
Affordable / Social Housing Cost

- Fully certified PH social housing project in Philly = $125 per square foot

Tim McDonald, Onion Flats
October 2012
Training Models

For demonstration

For practice

Demonstration Models
Stick frame and board cladding
WORKSHOP pro-demo

Airtightness

Practice Models

Hands-on building envelope training
Passive House Tradesperson Lab in NYC (AEA & PHA)

Certified Passive House Tradesperson

- building envelope
- building services

• Global Accreditation
• Theory based training and exam
• Exams set by the PassivHaus Institut x 4 per year
Specify PH Tradespersons On Your Bid Documents

HANDwerker with 'thinking fingers'

How it all works

- Superbly insulated envelope
- High performance windows
- Thermal bridge free detailing
- Complete Airtightness
- Mechanical Ventilation
On-Line Training Now Available – AIA Accredited

Certified Passive House Consultant Course in Philly
### Pop-Quiz – what have you learned?

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### Thank You!

**Robert Ryan**  
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