NYPH

NEW YORK
PASSIVE HOUSE

A DEVELOPER'S GUIDE TO

Certified Multifamily Passive House Buildings

An outline of certification protocols for the international Passive House Standard.

Image courtesy of Passive House Institute

Presented by New York Passive House, an industry resource for Passive House building across the Empire State, in cooperation with the Passive House Academy.

CONTENTS:

1.	**Welcome to Passive House**	**Page 4**
2.	**8 steps toward your success**	**Page 5**
3.	**7 reasons for international Passive House Standard certification**	**Page 6**
4.	**Multifamily international Passive House Certification Protocols**	**Page 8**
5.	**Appendix**	**Page 15**
a.	certification standards and metrics	Page 15
b.	floor area calculation	Page 17
c.	PHPP	Page 18
d.	airtightness and blower-door	Page 18
e.	windows and doors	Page 20
f.	ventilation	Page 20
g.	multi-use buildings	Page 21

Image: NY Passive House

WELCOME TO **PASSIVE HOUSE**

Passive House is a predictable way to deliver affordable high-performance buildings. When you develop a Passive House multifamily apartment building the residents will get many direct benefits:

- **A healthy home,** with great indoor air quality.
- **A quiet home,** with acoustic separation from the street and neighbors.
- **A comfortable home,** with unprecedented thermal balance.
- **A well functioning home,** with simplicity of operation.
- **An affordable home,** with significantly reduced energy bills.
- **A safe home,** with the ability to shelter-in-place in a power outage in the dead of winter or a summer heat wave.

Passive House gives residents a better life. Passive House also provides our planet dramatically reduced carbon emissions.

Through its integrated and optimized methodology, Passive House can accurately predict results. The predictability allows development with controlled costs resulting in a modest upcharge of approximately 5% from typical construction - making economic sense to lenders, developers and occupants alike.

Due to these features, New York State Housing and Community Renewal (HCR) has incentivized Passive House certification for affordable housing funding, the Community Preservation Corporation (CPC) is encouraging Passive House certification for its SPARC redevelopment program, and New York City

Image courtesy of Passive House Institute

is looking to Passive House to meet its goals of 80% carbon emissions reductions by 2050.

Passive House reliably provides up to a 90% reduction in energy required to heat and air-condition, and up to a 75% reduction in overall energy use from our existing buildings. It focuses on passive measures and components like, insulation, airtightness, heat recovery, solar heat gains and incidental internal heat gains. It is an international building standard developed in 1991 by the Passive House Institute (PHI), located in Darmstadt, Germany.

New York Passive House (NYPH) is an independent nonprofit organization, affiliated with PHI, that promotes the Passive House building energy standard in New York State and the New York City metropolitan area. An important focus of NYPH and Passive House building in New York is affordable housing.

The Passive House Academy (PHA) is the leading provider of professional Passive House training and building certifications in the US. It also consults directly on specialized projects.

We hope this booklet helps you become a successful Passive House developer. As you move forward, please contact us at info@nypassivehouse.org. We are happy to help you.

8 STEPS TOWARD YOUR SUCCESS

Developers can ensure Passive House performance goals are met with these simple steps:

1. **Make Passive House a clear programmatic goal at the very start of the process.** It should be as basic to the definition of success as gross sq ft, number of units, etc... Consequently, the earliest design and budget choices will be fully informed by Passive House criteria, allowing for the best cost optimization and control.

2. **Commit to certifying your project and stick to it.** Be sure to get the final certification. Outside of the certification process, the accumulation of compromises can result in discomfort, poorly working systems, moisture damage, tenant dissatisfaction, a loss of predictability and failure to achieve the project goals.

3. **Hire professionals who "get it".** The architect, MEP engineer, structural engineer and contractor must all see the value and understand the consequences of being hired to design and build a Passive House. Such a team can be more unified than might be expected on a traditional project - seeking common and measurable goals, for profound results.

4. **Demand professionals be Passive House trained.** Architects, engineers and enclosure consultants should be Certified Passive House Designers. Contractors should have a Certified Passive House Tradesperson on staff assigned to the lead the project. Find local certified professionals at www.nypassivehouse.org/directories

5. **Use Certified Passive House products and components when possible.** These certified components provide unparalleled assurance your performance goals will be met. And while some may cost more initially, the optimized performance achievable can make them affordable, in installation and operation.

6. **Deliver on the promise of predictability.** If your team puts the design details into the PHPP energy model and the contractor builds what is shown in the PHPP - and not something else - then you can achieve a highly predictable result.

7. **Introduce your construction team to the reality of airtightness at the construction start.** Have a meeting of key personnel to clarify all questions regarding the air barrier: its components, its installation, protection, testing and repair. Run a blower-door test and have the carpenters, plumbers, electricians and duct installers feel air leaks. Air leaks are easily understood and can unify the many trades in common cause to build high quality.

8. **Provide residents a clear orientation.** In your building, they now live somewhere very special. If they understand a few key attributes and how they can improve or hurt performance, with a simple orientation, high rates of resident satisfaction can be assured.

With this framework embedded into your traditional development process you can deliver a Passive House while providing the highest satisfaction for all team members.

7 REASONS FOR INTERNATIONAL PASSIVE HOUSE STANDARD CERTIFICATION

New York has a strong history of working with the international Passive House Institute (PHI), www.passivehouse.com, and the international Passive House Standard. We want developers to know about the many important advantages it provides.

1. **It has a proven track record of quality:** The PHI certification process is rigorous, resulting in projects that perform as predicted. Over the course of 25 years and thousands of projects, the energy model inputs and certification protocols have evolved resulting in unsurpassed quality today. In New York, in addition to a number of certified single family homes, a Multifamily NYSERDA net-zero Certified Passive House was just completed in Brooklyn and a 27 story residential building for Cornell University is under construction to become a Certified Passive House project.

2. **It empowers the development team:** The international Passive House certification process supports additional certification approaches but doesn't mandate them. The development team may want to incorporate NYSERDA, Energy Star, Zero Energy Ready Home, or Enterprise Green Communities certifications, and can. A HERS Rater is welcome to the process, if desired by the team. But these options are at the team's discretion. The professional responsibilities rest with the project architects & engineers. This flexibility means that teams can have a flatter and simpler structure that can help control soft costs.

3. **Multiple Certifier Options avoid sole source bottlenecks:** There are currently five certifier organizations operating in the US – CertiPHiers Cooperative, Herz-Lang, Passive House Academy, Passive House Institute and Peel Passive House Consulting. For more information and an up-to-date list see www.nypassivehouse.org.

4. **Certifiers have a deep bench of technical resources:** The certifying organization you choose has a deep bench of technical support in the unparalleled expertise of the Passive House Institute. The Passive House Institute's 25 years of scientific research of low-energy buildings around the globe forms an unmatched foundation of knowledge. The Passive House Institute has a staff of over 60 including many physicists working on research to make the standard ever more robust.

5. **Software tools are powerful, relatively simple, affordable, and flexible:** The Passive House Planning Package (PHPP) energy model, forms the basis of a successful Passive House building. The latest release, Version 9 (PHPP 9), of 2015 is a highly evolved yet relatively simple tool with proven ability. It can be purchased from multiple resellers in the US for a few hundred dollars. The PHPP has embedded in it not only powerful algorithms to determine the energy balance of heating, cooling, dehumidification and primary energy, but it can provide analysis of multiple assembly approaches regarding their energy effectiveness and their financial feasibility.

Photos by Timothy Bell

This core program can then be supplemented as individual projects may require and/or as team members desire, with other software such as:

- **Design PH** - a SketchUp based interface that allows designers to quickly determine design variants' suitability to hit Passive House metrics in 3D. Design PH is available from multiple resellers. (http://www.designph.org/)
- **THERM** - a thermal bridge calculator, available for free from Lawrence Berkeley National Laboratory (https://windows.lbl.gov/software/therm/therm.html)
- **WUFI** - a dynamic hygrothermal model to analyze envelope moisture levels when envelope assemblies are deemed risky by the team. (https://wufi.de/en/)
- **Other dynamic models** of interior environmental conditions may be deemed necessary for complicated or unusual building configurations. They are typically not needed.

6. **Certification Levels are not one size fits all. Instead, five certification levels are possible depending on the goals of your project:**

- **Passive House Classic** is for the standard criteria of a high-performance Passive House building.
- **Low-Energy Buildings** for those projects that experience "near misses" when going for Passive House, but are otherwise of high quality.
- **Passive House Plus & Premium:** includes criteria and recognition for integrated renewables as a move in the direction of net zero and positive energy buildings.
- **EnerPHit:** a renovation standard for existing buildings with a growing track-record of proven quality across a broad range of project types.

7. **Global support network: Anchored by the efforts of the Passive House Institute, resources and information networks abound.**

- **Trainings:** The Certified Passive House Consultant/Designer and Tradesperson trainings are the most comprehensive and in-depth trainings available - regularly provided in New York, in state of the art facilities, including the nation's first dedicated hands-on training lab for contractors located in the Bronx.
- **Component research and certifications:** A growing body of research and certified components for key components such as windows and ventilation units helps guide selections.
- **Passipedia:** An online Passive House encyclopedia. www.passipedia.org
- **iPHA, NAPHN and NYPH:** these Passive House associations aligned with the international standard provide unrivaled opportunity to share knowledge and grow capacity with contacts across the state, the continent and the globe.

For these reasons developers should use the international Passive House Certification Protocols.

MULTIFAMILY INTERNATIONAL PASSIVE HOUSE **CERTIFICATION PROTOCOLS**

While building buildings is an inherently complicated endeavor, making them a Passive House doesn't need to make it more so. In fact, well deployed optimization and certification can clarify and simplify construction, potentially reduce costs, unify the team and ensure that what is meant to be built is actually built. Counterintuitively, if embraced and executed, the clear focus on priorities can be liberating.

OUTLINE OF PROCESS:

1. Passive House Standard Selection
2. Selection of optional additional certifications (if applicable)
3. Selection of Passive House certification organization
4. Pre-Construction Certification
5. Construction process
6. Final Certification

1. PASSIVE HOUSE STANDARD SELECTION

Your performance goal may vary from project to project. The performance goals are defined by specific energy usage and airtightness limits. Detailed metrics are provided in the Appendix. Here is a brief outline of those options:

Passive House Classic limits:

- Annual heating energy: ≤ 4.75 kBtu/(ft2·yr) or a peak heating load of ≤ 3.17 Btu/(hr·ft2).
- Cooling is limited to ≤ 4.75 kBtu/(ft2·yr) + allowance for dehumidification requirements.
- Primary Energy Demand: ≤ 38.0 kBtu/(ft2·yr) or Primary Energy Renewable demand (PER) ≤ 19.0 kBtu/(ft2·yr)
- Building Airtightnesss: ≤ 0.6 ACH@50
- Excess Temperature Frequency: (>770F) ≤ 10%

Passive House Plus limits:

- Has the same basic limits of Classic but that it tightens the Primary Energy Renewable limit and adds a rewable energy generation requirement.

Passive House Premium:

- Has the same basic limits of Passive House Plus but tightens further the Primary Energy limit and increases the renewable energy generation requirement.

EnerPHit: (The Passive House Renovation Standard)

- Annual heating energy (demand) ≤ 7.92 kBtu/(ft2·yr)
- Yearly Cooling Demand ≤ 7.92 kBtu/(ft2·yr) + allowance for climate specific latent cooling
- Primary Energy ≤ 38.0 kBtu/(ft2·yr) + allowance for additional energy required for heating and cooling or Primary Energy Renewable demand (PER) for EnerPHit 'Classic' is ≤ 19.0 kBtu/(ft2·yr), EnerPHit 'Plus' is ≤ 14.26 kBtu/(ft2·yr) and EnerPHit 'Premium' is ≤ 9.50 kBtu/(ft2·yr) (supplemental allowance in each case for additional energy required for heating and cooling).
- Building Airtightness ≤ 1.0 ACH@50

Low-Energy Building:

- This certification is meant for "near-misses" of the Passive House Classic Standard.
- Annual heating energy: ≤ 9.50 kBtu/(ft2·yr)
- Annual cooling energy: ≤ 9.50 kBtu/(ft2·yr)
- Building Airtightness: ≤ 1.0 ACH@50
- Primary Energy Demand: ≤ 38.0 kBtu/(ft2·yr) or Primary Energy Renewable demand (PER) ≤ 23.77 kBtu/(ft2·yr)

Photos by Timothy Bell

Primary Energy or Primary Energy Renewable?

In 2015 the Passive House standard is transitioning towards a location-specific accounting of the raw carbon-equivalent used for all energy uses in the building (heating, cooling, ventilation, domestic hot water, plug loads - all of it). In the past, the same 'Primary Energy' multiplier was used for electricity all over the world, irrespective of how 'brown' or 'green' that energy might be at a local level. In 2015, a location-specific 'Primary Energy Renewable' factor will be used which reflects the extent of renewable energy available on the regional grid. Consequently in the standards listed above, the two options of Primary Energy or Primary Energy Renewable are listed.

Select the performance goal and certification standard that make the most sense for your project.

2. SELECTION OF OPTIONAL ADDITIONAL CERTIFICATIONS (IF APPLICABLE)

Your development may be coming out of a NYSERDA program and/or seeking the DOE Zero Energy Ready Home certification, the Enterprise Green Communities certification or perhaps a LEED certification or others. Identify these additional requirements at the start. They are not requirements for Passive House certification but the Passive House certification process can support them.

The optional certifications may require a HERS Rater or another specialized consultant. Identify such consultants at the start and integrate them into the Passive House certification process.

Image by: think! architecture and design pllc

3. SELECTION OF PASSIVE HOUSE CERTIFICATION ORGANIZATION

There are over 30 accredited Passive House certification organizations around the world with five actively operating in the US, including PHI, and three that have operations based in the US, and one with its US office in New York. They are:

- **CertiPHiers Cooperative,** www.certiphiers.com
- **Herz-Lang,** www.herz-lang.de
- **Passive House Academy,** www.passivehouseacademy.com
- **Passive House Institute,** www.passivehouse.com
- **Peel Passive House Consulting,** www.peelpassivehouse.ca

Make the team that works best for you.

4. PRE-CONSTRUCTION CERTIFICATION

Pre-Construction Certification is a process where you work with a certification organization to formulate the optimal energy strategy required to meet the standard.

It is highly recommended to have your project 'Pre-Certified' in order to ensure you avoid any unforeseen constraints that may arise during the full-certification process. And if Passive House certification is part of a government incentive or mandate, it may be required. A nine point outline of the key submissions required for pre-certification is provided here:

1. **Project drawings** including site layout plan as well as plans, sections and elevations of the building. Included here also must be a drawing which documents the calculation of the treated floor area (TFA). Drawings must be clearly labelled to illustrate from where key areas in PHPP have been derived, including exterior limits of the conditioned envelope, window sizes and volume calculations for both the sizing of the ventilation system as well as the blower-door test.
2. **Completed Passive House Planning Package (PHPP)** for the project.
3. **Shading overview** - photographs in all directions from the building site (360 cover) with accompanying site plan referring to photo reference numbers.
4. **Construction details including proposed insulation materials.** If specific materials have not been finalized at the time of pre-certification, the certifier will accept generic insulation products with conservative insulating values than can be reliably matched or exceeded in the full certification phase. The location of thermal bridges must be highlighted, as well as the position of the continuous and uninterrupted air-tight layer for the project.
5. **All window and door specifications and test certificates,** including U-value of both frame and glass, solar heat gain coefficient (SHGC), Psi-value of both the glazing spacer bar as well as the install detail and the width of the frame for top, side and bottom. If the Client has not yet chosen the specific window / door type for the project, the certifier will accept generic specifications that can typically be met with a wide range of products available on the market in North America.
6. **Ventilation system and strategy,** including whether centralized (one system for entire scheme), decentralized (separate system for each living unit) or semi-centralized (zoned system, with a number of ventilators each serving multiple living units). The system efficiency, flow rates, and planned air change rates must also be specified. The certifier can provide guidance to the project design team in all these aspects should they be unsure at the time of pre-certification on the specifics listed above. See Appendix for further details.
7. **Heating and cooling system strategy** appropriate to the climatic challenges of the project location. Generation and distribution of heating, cooling and dehumidification (where needed) must be outlined in the project pre-certification pack, including credible system efficiencies. These systems may be integrated into the fresh air ventilation system or completely separate.
8. **Primary Energy, renewable energy systems and domestic hot water production** including mechanicals schematic. Schematics of renewable energy systems and proposed domestic hot water generation and distribution systems must be provided to enable the certifier to determine whether the project meets the 'Classic', 'Plus' or 'Premium' standard.
9. **Documentation List:** All Passive House projects must be thoroughly documented as described above. Much of the work involved for both the Passive House consultant, as well as the project certifier, entails the logical and systematic collation of the documents required to process the project. A full documentation list will help both parties through the process and highlight information gaps should they arise.

5. CONSTRUCTION PROCESS

There are three key requirements to follow during the construction process:

- **Document construction materials used on-site;**
- **Photo-document build-up of all assemblies and insulation coverings; and**
- **Commissioning of the H/ERV system**

And if there are additional construction checklists required by other certifications specific to your project they can be integrated with the Passive House certification requirements.

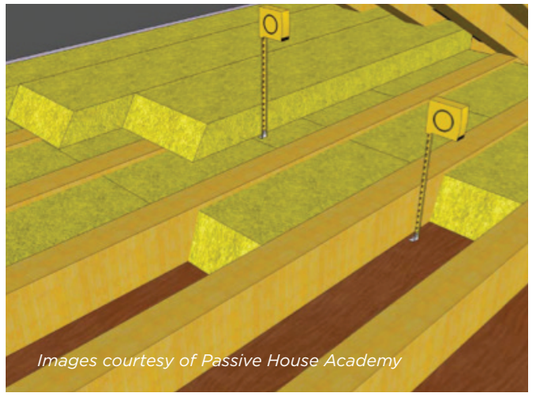
5.1 Document Construction Materials Used

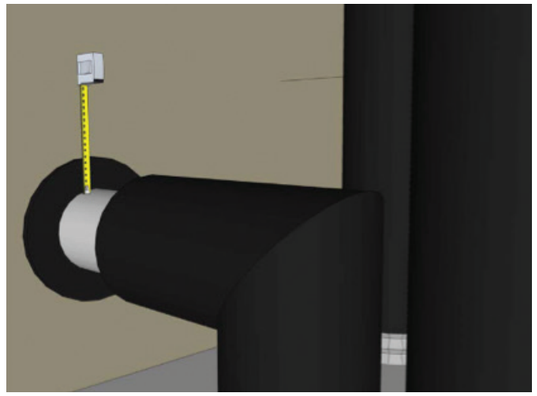
Photographs must be taken of the labels from all materials used on-site relevant to achieving the Passive House standard. This is especially important regarding the specific properties of insulation materials (including the R-per-inch for all products, for example) as well as glass and frames values and airtightness products.

5.2 Photo-Document Build-Up of all Assemblies

During the construction process it is critically important to take legible photographs at key stages of the build-up of the thermal envelope for the project. Included in the photographs must be a measuring tape placed adjacent to the construction detail such that thicknesses can be readily discerned. This recommendation pertains not just to assemblies but also to insulation used on ducting as well as devices and materials used to reduce thermal bridge effects.

An example of the kind of photo-documentation is provided below for the purposes of illustration.





Images courtesy of Passive House Academy

5.3 H/ERV Commissioning Report

At minimum, the H/ERV commissioning report must include the following:

- Description of the property, address of the building, name and address of the tester and time of adjustment;
- Ventilation system manufacturer and type of device, adjusted volume flow rates for standard operation, mass flow / volumetric flow balance for outdoor air and exhaust air (maximum disbalance of 10%).
- A report should be provided regarding the adjustment of all supply air and extract air valves (documenting the realization of the designed air flow rates at all points). If this is not possible in individual non-residential buildings for technical reasons, then at least the volume flow rates in the ventilation unit (outdoor air/exhaust air) and in the principal ducts of the ventilation system should be measured.
- We recommend using the “Final Protocol Worksheet for Ventilation Systems” which can be sourced from your building certifier.

6. FINAL CERTIFICATION

The quantitative and qualitative criteria listed below must be satisfied in order to achieve full certification on completion of the project. Building certifiers will be happy to provide you with a customized list of requirements for your specific project. which will include at the very least the fundamentals listed below.

1. **Completed PHPP model for the as-built completed project,** with the front ‘Verification’ page duly signed by the assigned construction supervisor. This declaration by the construction supervisor must confirm full and complete implementation of the specifications modelled in the PHPP. Any variations to the PHPP model must be noted in writing and documentation provided to enable to certifier to ascertain the impact, if any, on the overall energy balance of the project.
2. **Blower door test result.** The test is to be performed by someone independent of the contractor and the design team. See Appendix for more information.
3. **Technical certifications for all insulation materials,** providing credible thermal values materials used.
4. **Test certificates for window and door frames and glazing systems.** See Appendix for certificate data requirements.
5. **Detailed photographs of the window and door install situation must be provided.**
6. **H/ERV test certificates** (whether from PHI or HVI / AHRI) including heat recovery efficiency (calculated according to the PHI formula, less heat from the fans) and electrical efficiency (further details in Appendix). Details for frost-protection must also be provided to ensure that the system continues to operate effectively in very cold weather. If a sub-soil heat exchanger has been used, details critical to its performance must be included.
7. **Ventilation system commissioning**, report with detailed flow-rate measurements carried out at the ‘standard’ flow rate. The commissioning report must record less than 10% imbalance between supply and exhaust at normal (77%) flow rates. The measured flow rates recorded at each register (both supply and extract) must also be documented. See description above as well as the Appendix for more information.

Picture courtesy of Passive House Institute

8. **H/ERV installation photographs,** clearly depicting complete vapor tight insulation cover on the cold air ducts.

9. **Domestic hot water system, specification and details,** including pipe layout and lengths as well as insulation type and thickness.

10. **Lighting layout including wattage schedule of fixtures.**

11. **Household appliance schedule with the efficiencies.**

12. **Equipment schedule for other items** such as elevators, trash compactors and office equipment where applicable.

13. **Usage type and patterns** (mostly relevant to non-domestic projects) including operational hours and holiday shut-down periods, activity levels of occupants, staff and visit numbers, age of occupants and typical type of clothing.

14. **Construction details photographic catalog** of all key junctions and construction details from commencement to finish (see examples above).

15. **Final and complete as-built detail and architectural drawings** pertaining to the energy efficiency of the project.

Certification requirements comprise a modest list, and yet a comprehensive list. These items reinforce each other and ensure that the intent is met and the promise of predictability fulfilled. We hope these quality control processes will be incorporated into your business, and as an industry leader, together, we can make Passive House high-performance normal.

We look forward to working with you in building our future.
Please contact us at info@nypassivehouse.org.

Picture courtesy of Passive House Institute

Photos by Timothy Bell

APPENDIX

a. certification standards and metrics
b. floor area calculation
c. PHPP
d. airtightness and blower-door
e. windows and doors
f. ventilation
g. multi-use buildings

a. CERTIFICATION STANDARDS AND METRICS

Here are a series of charts that outline the five certification standards available to you, and the metrics each requires. For a complete description refer to PHI's certification Building Criteria document online here: http://passiv.de/downloads/03_building_criteria_en.pdf

PASSIVE HOUSE CLASSIC, PASSIVE HOUSE PLUS & PASSIVE HOUSE PREMIUM:

Common Criteria: Heating - Cooling - Airtightness			Criteria			Alternative Criteria
Heating						
heating demand	kBtu/sf·yr	≤	4.75 (4.91)			-
heating load	Btu/h·sf	≤	-			10
Cooling						
cooling + dehumidification demand	kBtu/sf·yr	≤	4.75 (4.91) + dehum.			variable limit value
cooling load	Btu/h·sf	≤	-			3.17
Airtightness						
pressurization test result n_{50}	ACH50	≤	0.6			
RenewablePrimary Energy (PER)			**CLASSIC**	**PLUS**	**PREMIUM**	
PER demand	kBtu/sf·yr	≤	19	14.3	9.5	4.75 kBtu/sf·yr deviation from criteria...
renewable energy generation (with reference to ground area)	kBtu/sf·yr	≤	-	19	38	...with compensation of the above deviation by different amount of generation

As you can see in the chart above, the heating and cooling demand/load requirements as well as the airtightness requirement is the same for all three standards. Then for Passive House Plus and Passive House Premium there are additional requirements for lower Primary Energy demand and renewable energy generation.

ENERPHIT:

EnerPHit is the Passive House standard for substantial renovations of existing buildings. There are two methods of compliance to the EnerPHit standard: performance method or component method.

In the performance method

General EnerPHit criteria (always applicable, irrespective of the chosen method)

			Criteria			Alternative Criteria
Airtightness						
pressurization test result n_{50}	[1/h]	≤	0.6			
Renewable Primary Energy (PER)			**Classic**	**Plus**	**Premium**	
PER demand	kBtu/sf·yr	≤	$19+(Q_H-Q_{H'PH}) \cdot f_{ØPER,\,H}+(Q_C-Q_{C,PH}) \cdot 1/2$	$14.3+(Q_H-Q_{H'PH})+(Q_C-Q_{C,PH}) \cdot 1/2$	$9.5+(Q_H-Q_{H'PH})+(Q_C-Q_{C,PH}) \cdot 1/2$	4.75 kBtu/sf*yr
Renewable energy generation (with reference to ground area)	kBtu/sf·yr	≥	-	19	38	...with compensation of the above deviation by different amount of generation

Then there is a breakdown of component compliance based on climate zone.

General EnerPHit criteria for building component method

Climate Zone according to PHPP	Opaque envelope against...				Windows (including exterior doors)					Ventilation	
	...ground	..ambient air			Overall			Glazing	Solar load		
	Insulation	Exterior Insulation	Interior Insulation	Exterior paint	Max. heat transfer coefficient $U_{D/W,\,installed)}$			Solar heat gain coefficient (g-value), only if active haeting present	Max. specific solar load during cooling period	Min heat recovery rate	Min. humidity recovery rate
	Max heat transfer coefficient (U-value)			Cool colours							
	Btu/h·sf·F			-	Btu/h·sf·F			-	[W/(m^2Ka)]	%	
Artic	Determine in PHPP from project specific heating and cooling degree days against ground.	0.016	0.044	-	0.079	0.088	0.60	U_G-g*0.7≤0	32	80%	-
Cold		0.021	0.053	-	0.114	0.123	0,80	U_G-g*1.0≤0		80%	-
Cool-temperature		0.026	0.062	-	0.150	0.176	0.194	U_G-g*1.6≤0		70%	-
Warm-temperature		0.053	0.088	-	0.185	0.194	0.211	U_G-g*2.8≤0		75%	-
Warm		0.088	0.132	-	0.220	0.229		-		-	-
Hot		0.088	0.132	Yes	0.220	0.229		-		-	60%
Very hot		0.044	0.079	Yes	0.185	0.194	0.211	-		-	60%

EnerPHit criteria for the energy demand method

Climate Zone according to PHPP	Heating	Cooling
	Max. heating demand	Max. cooling + dehumidification demand
	kBtu/sf·yr	kBtu/sf·yr
Artic	**11.1**	equal to Passive House requirement
Cold	**9.5**	
Cool-temperature	**7.93**	
Warm-temperature	**6.34**	
Warm	**4.75/4.92**	
Hot	**-**	
Very hot	**-**	


Picture courtesy of Passive House Institute

LOW ENERGY BUILDING:

Low Energy Building certification is for "near misses."

Low Energy Building Criteria

			Criteria	Alternative Criteria
Heating				
heating demand	kBtu/sf·yr	≤	9.5	-
Cooling				
cooling + dehumidification demand	kBtu/sf·yr	≤	Passive House requirements +15	
Airtightness				
pressurization test result n_{50}	ACH50	≤	1,0	
Renewable Primary Energy (PER)				
PER demand	kBtu/sf·yr	≤	23.8	Exceeding the criteria up to + 4.75 kBtu/sf*yr is permitted...
renewable energy generation (with reference to ground area)	kBtu/sf·yr	≥	-	...with compensation of the above deviation by additional generation

b. FLOOR AREA CALCULATION

In Passive House, there are some very specific rules governing the calculation of what is referred to as the 'treated floor area (TFA), which corresponds to the idea of usable space or "carpetable floor area". It is relative to the floor space actually used that Passive House measures efficiency. These rules are familiar to all Certified Passive House Consultants and Designers and are part of their normal Passive House modelling work. The impact of using these protocols to determining the TFA is that the demand and load thresholds for both heating and cooling are on the conservative side for the project.

c. PASSIVE HOUSE PLANNING PACKAGE (PHPP)

The current version of PHPP available in the US is Version 9, which includes new tools to enable the designer to simultaneously evaluate different Passive House strategies. This tool also includes an economic modelling tool to determine the feasibility of individual or collective measures being evaluated by the designer.

PHPP Resellers: The following organizations are accredited resellers of the PHPP software in North America:

- Passive House Institute **(www.passivehouse.com)**
- Passive House Academy **(www.passivehouseacademy.com)**
- 475 High Performance Building Supply **(www.foursevenfive.com)**
- Small Planet Workshop **(www.smallplanetworkshop.com)**
- Canadian Passive House Institute West **(www.canphi.ca)**

d. AIRTIGHTNESS

The following is an overview of the airtightness protocols and reporting requirements for Passive House projects. The checklist below can be given to your air-tightness tester to highlight the important items. We recommend that a series of blower door tests be first carried out during the construction phase to detect leaks but it is only the final blower door test on completion of the project that is used in the Passive House certification model.

Checklist

1. Zero flow readings recorded before and after the test series and average pressure reading over a 30 second interval for theses readings should be less than 5 Pa.

2. Internal and External air temperature readings recorded both before and after the testing. The delta T between inside and outside both before and after the test should be less than or equal to 180F.

3. Wind speed recorded before and after the test series and should be less than or equal to 20 ft/s for both. Reading to be taken at center of fan height on the side of the building where the fan is to be installed.

4. Height from ground level externally to highest point on building envelope multiplied by the delta T from (2) above should be less than or equal to 2952 ft.°F.

5. Two series of test readings recorded for the building: 1 for positive pressure and 1 for negative pressure.

6. At least 5 readings of flow and pressure recorded for each series. Recommended to take 7 or more readings, with at least 1 reading in each series above 50 Pa.

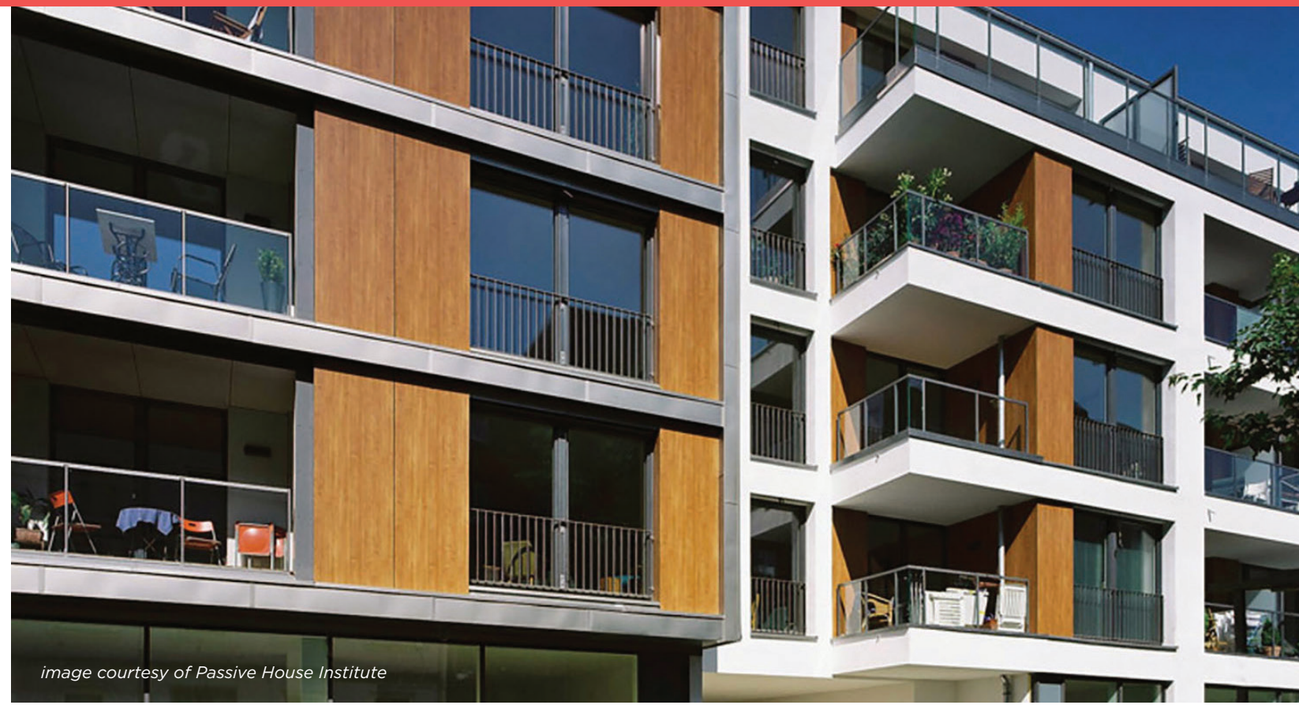


image courtesy of Passive House Institute

7. First reading in each series should be greater than 10 Pa and also should be greater than 5 times the zero flow reading recorded in (1) above.

8. There should be no more than a 10 Pa delta pressure of between any two readings in any series.

9. Plotted logarithmic graphs for both multipoint test reading series of flow (ft3/h) versus pressure (Pa). Should be 'Best Fit' straight line graphs.

10. Graph correlation coefficient must be greater than 0.98 and the airflow component must be between 0.5 and 1.0. Ideally should be as close as possible to 1.0, indicating much better level of airtightness and laminar air flow as opposed to closer to 0.5 which shows leakier buildings and turbulent flows.

11. Flow at 50Pa recorded from the Best Fit straight line graph for both positive and negative pressure test (V50+ and V50-).

12. Certification V50 value taken from the summation of the V50+ and V50- divided by 2 (average of the two results).

13. Correctly entered values for the internal volume (ft3), internal envelope area (ft2) and TFA (ft2) from separate calculations using the Passive House methodologies.

14. n50 = V50 / Vol (ACH @ 50 Pa)

15. q50 = V50 / EA (ft3/h.ft2 exterior surface area @ 50 Pa)

16. w50 = V50 / TFA (ft3/h.ft2 of floor area @ 50 Pa)

17. n50 less than or equal to 0.6ACH when rounded to one decimal place.

18. Can also show the A50 if wished to tell the client the equivalent size of hole that exists in their building envelope.

Further information is available on airtightness testing from your cetifier.

e. WINDOWS AND DOORS

Comfort is central to the Passive House standard, including avoidance of radiant temperature asymmetry. Passive House windows are specified to provide high thermal comfort even during the most severe weather events without the need for compensatory radiators underneath. Using certified Passive House windows designed for your climate will ensure that surface temperatures of the window will not drop more than 7 F compared to the indoor room air temperature. Furthermore, such windows will avoid the commonplace complaint of homeowners getting 'cold-feet' in winter where the difference in temperature between ankles and head in close proximity to windows is > 3.6 F. In summary, the science behind certified Passive House windows assures high thermal comfort for occupants in all seasons.

Key test data documentation for windows include Ug according to ISO EN 673, Uf and Psi spacer-bar according to ISO EN 10077-2, Psi install according to ISO EN 10211 and solar heat gain coefficient (SHGC) according to ISO EN 410.

f. VENTILATION

Central to Passive House is assurance on providing comfort for building occupants, be they home owners, office workers or school-goers. Comfort in turn is greatly influenced by fluctuations in indoor temperature as well as air quality concerning both CO2 as well as humidity. Essentially the objective is to avoid temperature asymmetry which can result from cold surfaces and un-tempered fresh air and also to maintain CO2 and humidity levels at acceptable limits (< 800ppm above outdoor, often much lower in Passive House, and 35 – 55% respectively).

All Passive House projects have mechanical ventilation system, typically referred to as HRV's or ERV's (H/ERV's). The heat ('H') or enthalpy ('E') recovery efficiency of the H/ERV's has a significant influence on the overall space heating demand and cooling demand. The quality of H/ERV used in the project also has a significant influence on both temperature and air quality (including pollutant levels in supply air stream due to internal leakage in the H/ERV).

The following key recommendations pertain to H/ERV's in projects to be certified as Passive House projects:

- There is currently a limited availability of larger Passive House Institute (PHI) certified H/ERVs in the US.
- Non PHI-certified locally manufactured H/ERVs can be used but at the very least they must have independent HVI or AHRI testing from which the heat recovery efficiency rate can be determined using the PHI calculation protocol (excluding heat from the fans).
- The units must employ a counter flow heat exchanger with decently insulated casing and reasonable internal and external airtightness provided (including achieving <3% leakage according to CSA439 or AHRI[TL2] or at least air tightness category A3 according to EN 13141-7, better A2[k1]).
- For economic reasons alone, it is highly recommended to use ventilation devices with heat recovery rates much better than 75% with low power consumptions of less than ≤ 0.765 W/CFM.
- Please note that lower efficiency machines will not only significantly increase space heating demand but they will also require the use of a pre-heater upstream of the H/ERV in order to ensure that fresh air delivered to living and work spaces is adequately tempered (minimum 62OF at all times).
  Such pre-heating will significantly increase the primary energy demand for the project and might lead to failing Passive House certification. In case of any doubt, we highly recommend the use of H/ERVs with a significantly higher heat recovery rate than 75%.
- In order to ensure occupant acoustic comfort, maximum noise levels in living and sleeping rooms should be < 25 dBA whether PHI certified or not.

Further details pertaining to determining the efficiency of H/ERV's in the North American market can be sourced directly from Passive House Academy, here:
www.passivehouseacademy.com/index.php/news-blogs/hints-tips-blog/334-protocols-for-using-non-phi-certified-ervs-in-the-us

Photo credit: Sam Oberter

Image courtesy of Passive House Institute

h. MULTI-USE BUILDINGS

Generally all building types can be certified as Passive House projects, however for some complex non-residential uses a more detailed design and certification is needed. Dental surgerys, retail stores, swimming pools and many other complex types have been built both as stand-alone Passive House projects as well as integrated into Multifamily buildings. The key issue in designing such complex Passive House projects is that such specifics as opening times, number of occupants and amount of heat generating equipment can make it more challenging to predict the overall energy balance.

NEW YORK PASSIVE HOUSE (NYPH): is an independent nonprofit organization that promotes the Passive House building energy standard in New York State and the New York City metropolitan area through outreach, education, and support of industry professionals.
www.nypassivehouse.org

NORTH AMERICAN PASSIVE HOUSE NETWORK (NAPHN):
a cooperative of North American regional Passive House organizations sharing the common mission of promoting the international Passive House Standard to the general public and building industries of North America.
www.naphnetwork.org

PASSIVE HOUSE INSTITUTE (PHI): an independent research institute that has played an especially crucial role in the development of the Passive House concept.
www.passivehouse.com

INTERNATIONAL PASSIVE HOUSE ASSOCIATION (IPHA):
A global network for Passive House knowledge, promoting the Passive House Standard and connecting stakeholders.
www.passivehouse-international.org

PASSIPEDIA: The ever-expanding knowledge database on energy efficient building and Passive House, comprising over two decades of research.
www.passipedia.org

Image: NY Passive House

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