NEW YORK PASSIVE HOUSE 2015

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Editor and Writer: Mary James
Marketing Director and Editing: Tad Everhart
Art Director: Leanne Maxwell

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Cover: R-951 Passive House; Photo by Timothy Bell Photography

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Foreword

2015 MARKS NEW YORK PASSIVE HOUSE'S *fifth year of participation in international Passive House Days, a three-day global event, held in early November each year and organized by the* **INTERNATIONAL PASSIVE HOUSE ASSOCIATION**.

Around the world, owners open their doors so that the public can experience the benefits of Passive House. Visitors be aware. Once you have experienced the thermal and acoustic comfort of a Passive House building, settling for standard construction may no longer be an option.

Ken Levenson

In New York, each year has brought more projects for newcomers to visit. Today, we are excited to see a new generation of multifamily and commercial buildings either completed, under construction, or in design.

Starting with single-family homes upstate and row house retrofits in Brooklyn, Passive House has taken root in New York. New York Passive House has grown by sharing knowledge between professionals and owners. In this spirit, *New York Passive House 2015* brings you a showcase of Passive House projects from around the region.

Not all of the projects that will be opening their doors for the international Passive House Days made it into the book, and not all of the buildings in this book will be participating in the event this year. (For the event listings go to **WWW.NYPASSIVEHOUSE.ORG**.) Whether you are viewing projects in the book or experiencing them in person, we hope you will come away with a fuller understanding of Passive House activity across the New York State region.

We hope you enjoy both!

Ken Levenson
President

WELCOME TO NEW YORK PASSIVE HOUSE (NYPH), *the organization that has propelled Passive House to its current heights in New York.*

And, what heights those are.

NYPH broke ground in 2010 as an education and advocacy organization. Every year since, its membership has grown, its conferences have expanded, and its powers of persuasion have extended, reaching even the mayor's office. In 2014 New York's Mayor Bill de Blasio issued *One City: Built to Last*, a ten-year plan aimed at cutting greenhouse gas emissions by 80% by 2050, which suggests Passive House as a model for a building performance standard.

Today NYPH has 185 professional members. It hosted close to 90 educational Meetups in the last year. And, this year's conference, *Built to Last: Passive House*, had more than 450 attendees including representatives from the New York Mayor's office, the New York City School Construction Authority, and the New York State Energy Research and Development Authority (NYSERDA).

For the NYPH community 2015 has been a remarkable year in many other ways. While construction hummed along on a 40-unit Passive House apartment building in northern Manhattan designed by architect Chris Benedict, on Roosevelt Island site preparation began for the world's tallest Passive House building, a residential tower designed by Handel Architects for Cornell Tech. Many other stellar Passive House projects opened their doors as well, pushing the total number of New York Passive House projects well past 50. Particular congratulations go out to a special Passive House project—the Stevens Institute of Technology's Su+Re House—which brought home the gold in the U.S. Department of Energy's Solar Decathlon 2015.

Passive House even rated a mention in a White House press release last August. The New York State Homes and Community Renewal (HCR), representing the State's major housing agencies, established a new, optional Passive House track for funding applicants to encourage much greater energy efficiency in New York's affordable housing stock. In the wake of this announcement, several affordable housing developers have been knocking on NYPH's doors, soliciting help to boost their Passive House projects' success.

With all of these outstanding achievements, it is difficult to believe that 2016 could get any better—but it will. Stay tuned for NYPH's conference in June, which will double as the annual conference for the North American Passive House Network (NAPHN). Be sure to get in on the action early. Volunteer opportunities abound for conference organizing and other activities of NYPH.

The NYPH's 2015-2016 Board of Directors are Ken Levenson, Lois Arena, Andreas Benzing, Kevin Brennan, Greg Duncan, Floris Keverling Buisman, Ben Igoe, Emily Jones, Buck Moorhead, Roxanne Ryce-Paul, Jeremy Shannon, Shawn Torbert, and Stas Zakrzewski.

NYPH thanks the board members and all the NYPH member volunteers for their countless volunteer hours and invaluable expertise in helping launch NYPH to its current heights.

PASSIVE HOUSE

Changing Classes, Consistent Standards

PASSIVE HOUSE IS BOTH A METHOD USED *to create high-performance buildings and a building energy standard.*

The Passive House approach captures a thorough understanding of building science, delivering buildings with year-round comfort and superior indoor air quality—while using 50-80% less energy than a conventional building. With buildings contributing the overwhelming share of greenhouse gas emissions in New York City—nearly 75%—it is essential to cut building energy consumption to reduce the worst effects of climate change.

Around the world thousands of Passive House buildings—and even whole Passive House neighborhoods—testify to the success of this approach. The Passive House district of Bahnstadt in Heidelberg, Germany is one such neighborhood, with close to 300,000 m² (3.2 million ft²) of Passive House buildings either completed or under construction in the 116-hectare (287-acre) redevelopment district. The buildings there include residences, dormitories, a kindergarten, retail stores, offices, and laboratories. Monitoring of 1,260 housing units with a total living area of more than 75,000 m² (807,000 ft²) in 2014 shows that the average consumption for heating was 14.9 kWh/(m²a)—just below the standard's heating energy target of 15 kWh/(m²a) (4.75 kBtu/ft²).

The Passive House Standard was developed by the Passive House Institute (PHI) in Darmstadt, Germany almost 20 years ago. The standard's criteria have been adapted over the years, and a new category for Passive House retrofits, the EnerPHit standard, was added in 2010. In 2015 PHI updated the Passive House Standard and added several new classes of Passive House certification.

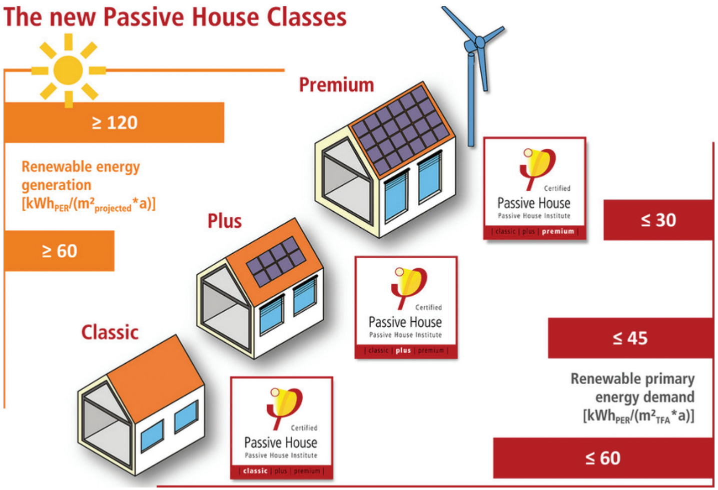


Figure courtesy of PHI

To achieve the classic Passive House certification a building has had to meet three criteria: annual heating and cooling energy demand or load as calculated using the Passive House Planning Package (PHPP) energy modeling software; total annual primary or source energy—the energy used at the power plant to supply all the energy demand in a building—also calculated with the PHPP; and airtightness as tested using a blower door. A building's air leakage must not exceed 0.6 air changes per hour (ACH_{50}) for new construction or 1.0 ACH_{50} for a retrofit.

Looking to the future, and assuming that the energy supply would come from only renewable sources—as will be needed sooner rather than later to cut carbon emissions from the electricity-generating sector—PHI developed a new renewable primary energy (PER) demand criterion. The PER demand assesses the

energy demand of such applications as heating, dehumidification, water heating, and household appliances as supplied by the potential renewable energy generation at the project location while including an accounting of short term and seasonal storage losses. PHI has developed PER factors for all of the climate data sets in the PHPP; these PER factors and the ability to calculate PER demand are available in the newly released PHPP 9.

Depending on the PER demand and the amount of on-site renewable energy being generated, a new building or a retrofitted one may meet the requirements for either the Classic, Plus, or Premium label. The required renewable energy generation is calculated based on the building's footprint, not the treated floor area, eliminating a potential bias against multi-story buildings. For all of these new classes, the heating and cooling demand criteria remain unchanged. Similarly, the airtightness requirement is still 0.6 ACH_{50} for all new buildings and 1.0 ACH_{50} for retrofits.

Another innovation that appears in the PHPP 9 is the ability to model what is known as a step-by-step retrofit. Often, for budgetary or other reasons, a complete renovation of a building is not possible. Yet, without an overarching plan, partial retrofits probably won't achieve the desired energy savings. In order to achieve the highest efficiency for building retrofits, and CO_2 emission reductions of 80% or higher, every single retrofit measure along the path of a step-by-step retrofit has to be carried out using a sound retrofit approach and the highest quality, most suitable components. The PHPP 9 will help with determining the appropriate components and steps.

Finally, a new class known as the PHI Low Energy Building has been created. This certification applies to buildings whose designers used the PHPP but weren't quite able to meet the criteria for Passive House. Examples of situations where this new class might be well suited include a particularly difficult site, such

WHAT MAKES A PASSIVE HOUSE?

It's not the style, it's what's not easily visible that counts. Here are the keys to creating a Passive House structure.

- A superinsulated building façade, with a continuous insulation layer all the way around the building shell.
- Thermal bridge free construction, which requires careful detailing to minimize the weaknesses in the building envelope where heat can pass from interior to exterior or vice versa.
- An airtight building envelope, with meticulous attention to all connection details and use of the appropriate sealing materials to ensure airtight junctions.
- High-performance windows and doors with well insulated frames.
- Mechanical ventilation with heat recovery or heat and energy recovery to supply a constant stream of fresh air and exhaust the stale air without losing heat in winter or adding heat in summer.
- Use of the Passive House Planning Package (PHPP) software to model a building's energy losses and gains.

as an infill area completely shaded by neighboring buildings, or a building in which problems arose in meeting the airtightness requirement.

Meeting the criteria for any of these classes does not entail using a specific architectural style or construction materials. Indeed, an experienced architect can design a Passive House building in a wide variety of styles, as the projects in this book reveal. What is required is a rigorous attention to detail in both the design and the construction of a building. Whatever the class, a Passive House building is synonymous with high performance and high quality.

THE BUILDING ENERGY EXCHANGE

THE BUILDING ENERGY EXCHANGE (BEEX) LAUNCHED *in 2009 as Greenlight New York, delivering programs designed to educate the building industry about lighting efficiency.*

Its mission has grown to encompass efficiency opportunities throughout the whole building, and it supports the building industry through trainings, exhibits, critical research, and networking opportunities. In 2014 BEEx opened the doors of its new Resource Center in downtown Manhattan, right next to City Hall, expanding its educational offerings, including hosting some New York Passive House (NYPH) programs, as well as presentations given by nearly 50 other organizations.

In a conversation with Richard Yancey, executive director of BEEx, he discussed the synergies between NYPH and BEEx. "We think Passive House is a really well thought-through solution to a lot of challenges," says Yancey. He sees BEEx as playing a role in bringing that awareness to a wider community and in better understanding and solving how to scale up Passive House in New York City.

BEEx was awarded a grant this year to act as an information hub for Mayor de Blasio's Retrofit Accelerator initiative, intended to help building owners, operators, and designers realize cost-saving energy efficiency opportunities. The Accelerator will have a High Performance track for which BEEx will be developing guidance resources for achieving deep retrofit savings.

Another of BEEx's main Accelerator roles is creating an easier-to-understand menu of incentives. "We've been calling it an incentive map," says Yancey. Right now there are a confusing mash-up of incentives from Con Edison, NYSERDA, and National Grid, along with incentives for specific efforts such as retrofits or new construction. "A lot of people give up or leave money on table," he says. Look to BEEx for detailed information on financing pathways for retrofits in the months to come.

Mamaroneck EnerPHit House

Mamaroneck, New York

The owners of what had been a 60s-era split-level bungalow were clear about their goal from the beginning; they wanted a beautiful makeover and the kind of comfort that only a Passive House retrofit, or EnerPHit home, could bring. Carefully planned, every detail in this retrofit contributed to that goal.

Reusing what was still in good shape, the foundation and basement were retained. The roof was removed, and a second story was added. The first floor walls were taken down to the studs, which were then wrapped with OSB sheathing and 5 inches of graphite-infused EPS. The new roof's 2x12 joists are surrounded by dense-pack cellulose with a 1½-inch layer of EPS on the exterior.

The cladding is fiber-cement siding with redwood trim work and custom-built redwood shutters on the west side.

These moveable shutters provide protection from storms. A redwood pergola shades the ground-floor windows on the south side in the summer, while a two-foot roof overhang shades the south-facing upstairs windows.

Heating and cooling are provided by a ductless mini-split heat pump with four wall-hung units, aided by an energy-recovery ventilator. With Superstorm Sandy a too-vivid memory, the owners chose to install a backup natural gas-powered stove, which can put out 18,000 Btu/hr. A 6.7-kW photovoltaic (PV) system mounted on the roof is expected to make the house net-zero in electric energy use on an annual basis.

The rebuilt home has an open, airy feel with multiple decks that face the private dock and the waterfront. It's a showcase of what an EnerPHit can achieve.

Mamaroneck; Photos by Korin Krossber for PlanOmatic

PASSIVE HOUSE METRICS

Heating energy	2 kWh/ft²/yr	6.83 kBtu/ft²/yr
Cooling energy	1.9 kWh/ft²/yr	6.48 kBtu/ft²/yr
Total source energy	10.9 kWh/ft²/yr	37.20 kBtu/ft²/yr
Treated floor area	3,938 ft²	
Air leakage	0.7 ACH_{50}	

PROJECT TEAM

Architect and Passive House Consulting
Andreas Benzing, **A.M. BENZING ARCHITECTS**
Craftsperson Dave Tormina,
NORTH SHORE CONSTRUCTION SERVICES INC.

PASSIVE HOUSE COMPONENTS

Air/Moisture Control **475**
Ventilation **ZEHNDER AMERICA**
Insulation **OPCORE G**
Windows **BIEBER WINDOWS & DOORS**

North Street Passive

Cold Spring, New York

Obsolete and flood-damaged, this single-family house started out with just one saving grace: an outstanding site overlooking the Hudson River and the surrounding Highlands. Believing that the greenest buildings are those that already exist, the owner chose to carry out a Passive House, deep-energy retrofit to usher this drafty residence into the post-carbon century.

The Passive House measures undertaken, such as raising the original 2x4-framed house to thermally break it from its existing foundation, serve a double duty, helping to protect the interiors from future storms. The continuous insulation, high-performance windows, and airtight construction techniques will also help to shield the home from moisture damage. Flood gates add to the home's resiliency.

With the aid of a highly efficient energy-recovery ventilator (ERV) and a mini-split system to meet the minimal heating and cooling loads of the upgraded home, the house went from frequently unbearable to effortlessly comfortable, with no more than $320 in annual heating and cooling bills. The 8-kW solar photovoltaic array rendered the completed house energy neutral.

Along with its energy performance upgrades, the house underwent a significant facelift. The exterior was clad in regionally sourced rough-sawn hemlock preserved by charring—a technique known as sho sugi ban. The striking appearance protects the wood without preservatives and with very little maintenance.

North Street Passive; Photo by Brad Dickson

PASSIVE HOUSE METRICS

Heating energy	1.34 kWh/ft^2/yr	4.57 kBtu/ft^2/yr
Cooling energy	1.01 kWh/ft^2/yr	3.45 kBtu/ft^2/yr
Total source energy	8.35 kWh/ft^2/yr	28.50 kBtu/ft^2/yr
Treated floor area	1,845 ft^2	
Air leakage	0.45 ACH_{50} (preliminary)	

PROJECT TEAM

Architect James Hartford, **RIVER ARCHITECTS**
Builder **NUGENT CONSTRUCTION MANAGEMENT**
Mechanical Engineer **BAUKRAFT ENGINEERING**

PASSIVE HOUSE COMPONENTS

Heating/Cooling **FUJITSU**
Windows **YARO WINDOWS & DOORS**
PV System **LIGHTHOUSE SOLAR**

High Falls Passive House

High Falls, New York

The owners wanted a home where multiple generations could relax, mingle, and appreciate the wonders of the nearby Mohonk Preserve. Looking northwest, the site has beautiful views of the Catskill Mountains, both a boon and a potential complication when designing this Passive House.

As a compact form helps to reduce the heat loss from the building envelope, the two-story house was designed with a rectangular shape. Large windows face northwest, taking in the mountainous views. On the south-facing façade additional large windows supply most of the heat, supplemented by mini-split heat pumps. A separately ducted heat-recovery ventilator (HRV) provides continuous fresh air.

Sliding shutters on the southeast- and southwest-facing windows reduce solar heat gains. The shutters are made from a fiberglass grating that is more commonly used as a floor material in oil rig platforms and sewage treatment facilities. The grating effectively cuts out direct light and heat gain yet doesn't obstruct the views.

Insulated concrete forms (ICFs) join with interior 2x4 stud walls, filled with dense-packed cellulose, to form the exterior walls. The roof has 20 inches of cellulose insulation blown into the truss space. The airtightness membrane spans the interior of the roof trusses and then was draped into the top of the ICF walls before the concrete was poured, creating an uninterrupted air barrier and allowing the home to easily meet the airtightness criterion.

The angle and line of the roof, which faces due south, were designed to maximize solar exposure for the 6.3-kW photovoltaic (PV) system. Monitoring of the home's power generation and usage began last May, and the house has been net positive so far.

The owners report that the house is bright and comfortable and a joy to be in, no matter the season. Spending time there with their extended family is a delight.

High Falls Passive House; Photo by Tommaso Ivagnes

PASSIVE HOUSE METRICS

Heating energy	1.17 kWh/ft²/yr	4.01 kBTU/ft²/yr
Cooling energy	0.49 kWh/ft²/yr	1.68 kBTU/ft²/yr
Heating load	1.44 kWh/ft²/hr	4.94 kBTU/ft²/hr
Total source energy	8.26 kWh/ft²/yr	28.2 kBTU/ft²/yr)
Treated floor area	2,978 ft²	
Air leakage	0.45 ACH_{50}	

PROJECT TEAM

Design WENDY ING
Passive House Consulting ZEROENERGY DESIGN

PASSIVE HOUSE COMPONENTS

Air/Moisture Control 475
Ventilation ZEHNDER AMERICA
Windows SCHUCO BY EAS
PV System LIGHTHOUSE SOLAR

Cabin 3000

Bearsville, New York

Minimal impact on this special setting and in terms of environmental footprint were the client's twin goals from the beginning. Sourcing materials with the lowest embodied energy and global warming potential was a top priority. Building a Passive House using prefabricated roof and wall assemblies helped meet all of these goals.

The framing timber that was used to assemble the wall and roof components are all Forest Stewardship Council (FSC)-certified, and the components are completely foam free. All of the exterior cladding and the interior flooring was cut and milled locally, no more than 20 miles from the site. The interior finishes were all low or zero volatile organic compounds (VOCs).

An integrated team of the architect, builder, and manufacturer was crucial to ensuring the construction met the homeowner's expectations. The builder is a certified Passive House designer and the manufacturer's wall system is the only Passive House Institute-certified opaque component in North America.

By using panelized Passive House components, the construction time was reduced, the quality of the build and airtightness were assured, and the impacts on this remote site were minimized.

Cabin 3000; Photos by Chris Kendall

PASSIVE HOUSE METRICS

Heating energy	1.30 kWh/ft²/yr	4.44 kBtu/ft²/yr
Cooling energy	1.21 kWh/ft²/yr	4.12 kBtu/ft²/yr
Total source energy	10.03 kWh/ft²/yr	34.24 kBtu/ft²/yr
Treated floor area	2,486 ft²	
Air leakage	0.28 ACH_{50}	

PROJECT TEAM

Architect BARRY PRICE

Builder and Passive House Consultant HARMONY BUILDERS

Wall and Roof Assemblies and Passive House Consultant ECOCOR HIGH PERFORMANCE BUILDING

PASSIVE HOUSE COMPONENTS

Air/Moisture Control 475
Ventilation ZEHNDER AMERICA
Windows M SORA BY ECOCOR

Hudson Passive Project

Claverack, New York

Set in the heart of the Hudson Valley, the Hudson Passive Project was the first certified passive house in New York State when it was completed in 2011. At the time it also set a national record for airtightness with a blower door test result of 0.149 ACH_{50}.

The three-bedroom home has the easy appearance of an old stone barn. Its design was inspired by historic buildings in the area, and it fits seamlessly in its rural setting. Inside, graceful bow-arch beams of southern pine—25 feet at their apex—frame an open, loft-like plan. A southern-facing wall of glass provides a dramatic focal point and a crucial function: it maximizes solar gain in the winter, while steep overhangs shield the house from the sun's harshest rays in the summer.

The exterior walls were built using 12-inch structural insulated panels (SIPS), as was the roof. Beneath the slab

lies another 12 inches of EPS, and the foundation walls are surrounded by 4 inches of XPS, ensuring a very well insulated building envelope. Heating and cooling are provided by two heat pumps, while a heat-recovery ventilator (HRV) supplies the fresh air.

What began as an experiment for a firm long committed to sustainable architecture ended up as a case study for all of New York to learn from. Monitoring has shown that the house indeed uses very little energy for heating and cooling—about 90% less than what a conventional home would use. The homeowners report that the comfort and indoor air quality is excellent. Furthermore, the house is incredibly quiet; when they drive up to the house, the dogs inside don't even hear them arriving.

Hudson Passive House; Photos by Peter Aaron/OTTO

PASSIVE HOUSE METRICS

Heating energy	1.13 kWh/ft^2/yr	3.84 kBtu/ft^2/yr
Cooling energy	0.32 kWh/ft^2/yr	1.08 kBtu/ft^2/yr
Total source energy	10.11 kWh/ft^2/yr	34.52 kBtu/ft^2/yr
Treated floor area	1,568 ft^2	
Air leakage	0.15 ACH_{50}	

PROJECT TEAM

Architect BarlisWedlick ARCHITECTS
Builder BILL STRATTON CONSTRUCTION CO
Engineer LEVY PARTNERSHIP

PASSIVE HOUSE COMPONENTS

Ventilation ZEHNDER AMERICA
Insulation OPCORE G
Windows ALPEN HPP

Colonial Farmhouse

Honeoye Falls, New York

This two-story Colonial farmhouse being built for a family of four shares a rural aesthetic with its neighbors in this small town just south of Rochester, but it will differ sharply in its efficiency. The open-floor-plan home incorporates a host of energy-saving features and is on target to meet all Passive House criteria.

The first and second floor exterior walls feature a 16-inch double-wall assembly that is being insulated with dense-packed cellulose. The interior load-bearing 2x4 wall, which is being insulated with damp-spray cellulose, will serve as the service cavity.

A carefully sealed OSB layer on the exterior side of the interior wall will be the air barrier layer. A 1.5-inch rain screen gap and a weather resistant barrier layer on the exterior side of the double-wall assembly help protect against moisture intrusion.

The raised-heel truss roof assembly will hold 24 inches of blown-in cellulose, a sorely needed blanket when the icy winds blow in from nearby Lake Ontario. The full basement will be similarly swaddled with an 8-inch layer of EPS under and at the perimeter of the 4-inch slab.

A heat-recovery ventilator will bring in fresh air year-round, tempered by a 200-foot subsoil brine loop. Two 9,000-Btu air-source heat pumps will deliver all the needed additional heating and cooling. A split heat pump water heater with a 4.5 COP will supply plenty of hot water.

The project goal has been to focus on constructing a high-performance, airtight building envelope with a final blower door test result of 0.4 ACH_{50}; it's a practical goal as previous homes built by this construction firm have come in at less than 1.0 ACH_{50}, and one achieved 0.3 ACH_{50}.

The 7-kW photovoltaic (PV) system will be the icing on this Passive House, allowing it to be net zero on an annual basis. The house should be completed by March 2016.

Colonial Farmhouse; Renderings by Grater Architects

PASSIVE HOUSE METRICS

Heating energy	1.21 kWh/ft²/yr	4.13 kBtu/ft²/yr
Cooling energy	0.26 kWh/ft²/yr	0.88 kBtu/ft²/yr
Total source energy	9.12 kWh/ft²/yr	30.8 kBtu/ft²/yr
Treated floor area	2,892 ft²	

PROJECT TEAM

Passive House Consulting and Energy Services
Matthew C. Johnson, Matthew Bowers, Bill Labine, **AIRTIGHT SERVICES INC.**

Construction Tad Garbacik, **GARBACIK CONSTRUCTION INC.**

Architect **GRATER ARCHITECTS, P.C.**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control **475**

Insulation **ADVANCED FIBER**

Windows **ZOLA**

Perch Harlem

Harlem, New York

When completed, this seven-story building in the Hamilton Heights neighborhood of Harlem will be a breakthrough: a commercial-scale, market-rate rental building designed to Passive House standards. The 34-unit property will provide unparalleled views of the George Washington Bridge and midtown Manhattan. It is expected to be ready for occupancy in Spring 2016.

The building's façade, with its playful arrangement of glass squares and rectangular shapes, salutes its liberation from the constraints of conventional masonry construction, where the building loads determine the positioning of the windows. In each apartment large fixed windows will maximize the light and solar gain, while smaller, operable windows will ensure fresh air when desired.

The exterior wall assembly starts with a heavy gauge metal stud frame, surrounded by fiberglass mat gypsum sheathing on the outside and regular fire-code sheetrock on the inside to create a 1-hr fire-rated wall. An exterior insulation and finish system (EIFS) with 7 inches of EPS on the building's rear side and 8 inches on the front side is the outermost layer.

All of this insulation means that the cooling demand can be met with no shading devices on any of the facades. Variable refrigerant flow (VRF) heat pump units will be used to meet the conditioning demand. Each apartment will have its own thermostat and its own energy-recovery ventilator (ERV), so the occupants can adjust the temperature and the fresh air flow rate as needed.

This new Passive House multifamily residence blends the best of low-impact living with a design that fosters community. Community amenities will include a private gym, rooftop terrace, resident storage, and a lounge.

Perch Harlem; Rendering by Chris Benedict

PASSIVE HOUSE METRICS

Heating energy	1.34 kWh/ft^2/yr	4.58 kBtu/ft^2/yr
Cooling energy	1.37 kWh/ft^2/yr	4.67 kBtu/ft^2/yr
Total source energy	9.57 kWh/ft^2/yr	32.66 kBtu/ft^2/yr
Treated floor area	28,717 ft^2	
Air leakage	0.6 ACH_{50} (design)	

PROJECT TEAM

Developer SYNAPSE DEVELOPMENT GROUP
TAURUS INVESTMENT HOLDINGS
Architect Chris Benedict, R.A.

PASSIVE HOUSE COMPONENTS

Ventilation ZEHNDER AMERICA
Air/Moisture Control STO BY S&J SUPPLY
Windows SCHUCO BY EAS

Brooklyn Landmark

Brooklyn, New York

At the start of this retrofit of a Brooklyn row house in a landmark district, the client was not asking for a Passive House. However, the client did ask for such amenities as a quiet house, filtered fresh air, a dry cellar, bug-free and pest-free living—all attributes of a Passive House. The renovation also brought a clean, modern aesthetic to this historic home, with easy access to indoor and outdoor living.

This row house was in such poor shape—with most of its historic details already removed—that it needed to be completely gutted. This is the perfect opportunity to introduce Passive House detailing from roof to slab without adding much to the overall costs. Passive House detailing brings another advantage: reducing the mechanical needs frees the design of typical constraints, avoiding sacrifices to ceiling height and having to build soffits for ducting to the perimeter of the home.

The front and back exterior walls were thoroughly insulated with generally 5 inches of dense-pack cellulose. The existing slab was dug out, and four inches of XPS insulation and waterproofing membrane were added below a new slab. The roof received a similar treatment with 4 inches of XPS above the topmost air barrier. The party walls were air sealed using a slurry mix of lime-based mortar and an elastomeric coating.

A penthouse addition with ample, large triple-pane windows provides what is sometimes called a winter room, because the homeowners can sit there, enjoying an outdoorsy experience without having to feel the cold.

The landmark commission was very accommodating regarding the inclusion of Passive House principles in this renovation. In order to preserve the historic wood–frame doors, the front vestibule was isolated from the air-sealed envelope.

An energy-recovery ventilator (ERV) introduces fresh air, while a 5-ton mini-split heat pump conditions all five floors. The homeowners moved in six months ago and are thrilled with how effortlessly comfortable and quiet their new home is—no tweaking of the thermostat and, yet, even temperatures in every room.

Brooklyn Landmark; Photos by Chris Stein

PASSIVE HOUSE METRICS

Heating energy	2.04 kWh/ft^2/yr	6.98 kBtu/ft^2/yr
Cooling energy	1.11 kWh/ft^2/yr	3.80 kBtu/ft^2/yr
Total source energy	10.96 kWh/ft^2/yr	37.41 kBtu/ft^2/yr
Treated floor area	3,531 ft^2	
Air leakage	0.7 ACH_{50}	

PROJECT TEAM

Architects Michael Ingui, Amy Faila, Will Conner
BAXT INGUI ARCHITECTS, PC
Engineer Bob Divilio, RJD Engineering LLC
Passive House Consultant Sam McAfee, **FENTREND**
Contractors Eoin Kileen and Betim Jusufaj
Passive House Consulting and Certification Kevin Brennan, Tomas O'Leary, Mariana Moreira, Bob Ryan, **PASSIVE HOUSE ACADEMY**
Air sealing Adam Romano, **ASSOCIATION FOR ENERGY AFFORDABILITY**

Columbia Condominiums

Brooklyn, New York

The reasons for the quick sale of the 13 condominiums at 255 Columbia aren't hard to find. While a great location is always an inducement, the built-in Passive House benefits made these two-, three-, and four-bedroom units irresistible. It's rare that a residence includes a constant supply of filtered fresh air, thanks to individual ERVs, barely perceptible street noise, and a pittance of a utility bill for heating and cooling. And, then there are the outdoor spaces—a 2,000 ft^2 common garden and private outdoor spaces for each unit in this 7-story building—generous amenities in a city that defines urbanism.

The front 10-ft by 18-ft terraces, which face south-southwest, serve as green retreats and provide an important Passive House function: each shades the unit below. They were also a classic Passive House challenge, requiring the use of thermally broken connectors to stop the thermal bridging and potential heat loss at the points where the terraces are joined to the main building structure.

The site's poor soil quality added to this development's construction challenges. In order to hit minimum soil-bearing capacity, ground compaction was needed. To lessen the building's weight, the structure started with a medium-gauge, steel framing system that was manufactured off site. The wall panels were sheathed, air sealed, and water

proofed, before being trucked to the site. Exterior walls that abut neighboring buildings are insulated with 2 inches of XPS, and a 6-inch exterior insulation and finishing system (EIFS) was applied to those walls that are exposed to the elements.

A reclaimed wood canopy creates a warm welcome to the small lobby, dominated by a green living wall—a tribute to the building's Passive House design. Each apartment features large triple-pane windows, individually controlled heating and cooling supplied by mini-split heat pumps, and many designer touches. Several residences have dramatic views of Manhattan and the New York Harbor.

Columbia Condominiums; Photos courtesy of JBS Project Management

PASSIVE HOUSE METRICS

Heating energy	0.93 kWh/ft²/yr	3.17 kBtu/ft²/yr
Cooling energy	0.84 kWh/ft²/yr	2.86 kBtu/ft²/yr
Treated floor area	22,755 ft²	

PROJECT TEAM

Project Manager/Owner's Representative Ben Igoe, **JBS PROJECT MANAGEMENT**
Architect **LOADINGDOCK5**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**
Windows **YARO WINDOWS & DOORS**

Bergen Street Row House Retrofit

Brooklyn, New York

This Brooklyn row house, built originally in the 1870s, was visibly distressed before its Passive House retrofit, or certified EnerPHit, makeover. The home's classic brick façade, mahogany stair railings, and marble mantel were preserved, while the interior was completely rebuilt.

All joists were replaced except for the roof framing. Stripping the existing exterior walls down to the interior face of the brick greatly simplified the air sealing process. The air tightness is achieved through a smart vapor retarder on the inside of the exterior walls and a fluid applied air barrier on the party walls.

To make way for sub-slab insulation, the existing slab was dug out. In its place, a gravel layer with perforated pipes was laid down first, topped by a waterproof membrane, 4 inches of a below-grade expanded polystyrene (EPS) insulation, and a new slab.

A variety of insulation products were used in this retrofit. Dense-packed cellulose was used wherever possible, but certain areas, such as the cellar, required different products. There, mineral wool was used for its moisture resistance and sound absorption.

An energy-recovery ventilator (ERV) helps to keep the house comfortable year-round, aided by a separately ducted mini-split heat pump. The ERV can be used in a cooling ventilation mode, bypassing the heat recovery. Most local heating and air conditioning contractors are familiar with using a mini-split as an air conditioner, but most would balk at relying on it to supply heat for a house this size. There was just enough space on the roof for an evacuated tube solar thermal system, which should supply most of the family's annual hot water needs.

The home is incredibly comfortable now and quiet—a desirable, yet elusive, characteristic on a busy New York street.

Bergen Street Row House; Photos courtesy of Build With Prospect

PASSIVE HOUSE METRICS

Heating energy	1.6 kWh/ft^2/yr	5.5 kBtu/ft^2/yr
Cooling energy	1.1 kWh/ft^2/yr	3.8 kBtu/ft^2/yr
Total source energy	10.1 kWh/ft^2/yr	34.5 kBtu/ft^2/yr
Treated floor area	2,338 ft^2	
Air leakage	0.8 ACH_{50}	

PROJECT TEAM

Architect and Passive House Consultant
JANE SANDERS ARCHITECT

Builder Jeremy Shannon, **BUILD WITH PROSPECT**

Mechanical Engineer **CRAMER SILKWORTH, PE**

Structural Engineer **KATHLEEN DUNNE, PE**

PASSIVE HOUSE COMPONENTS

Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**
Windows **MAKROWIN BY EAS**

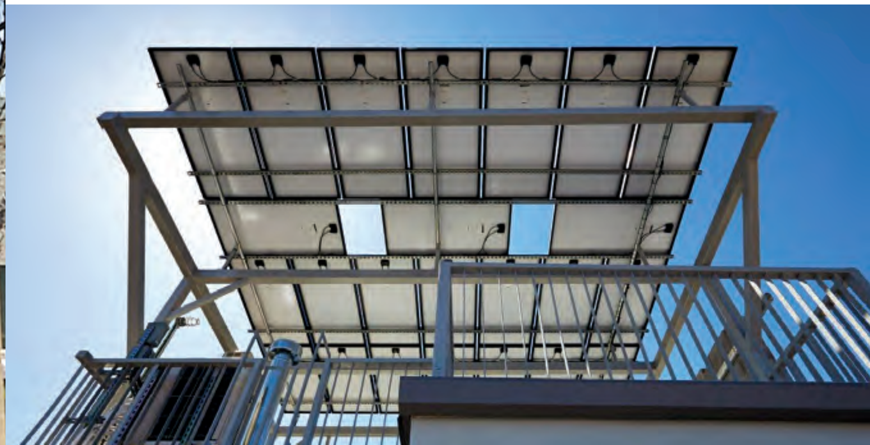
R-951 Passive House

New York, New York

The R-951 Residence, a row house with three 1,500-ft^2 duplex condos, achieved both Passive House and the Net Zero Energy-capable certification set by the New York State Energy Research and Development Authority. In response to this building's contributions to the architectural landscape and its implementation of sustainable energy, Brooklyn's Borough President awarded the team three citations: one for the architect, another for the innovative team that developed the project, and one for the solar firm that helped make this building net zero.

Designed for year-round comfort and resiliency, the thermal bridge-free, high performance building envelope was constructed using an insulated concrete form (ICF) superstructure. A smart, breathable membrane system provides the airtightness layer. The exterior is finished with stucco and zinc.

The apartments have open-loft layouts, high ceilings, and sound-dampening floors to increase privacy. Non-toxic paints are used throughout, and the interiors are illuminated with light-emitting diode (LED) lamps to reduce lighting energy use.



Each all-electric apartment has its own energy-recovery ventilator (ERV) to bring in constant fresh air, a heat pump water heater for hot water, a mini-split heat pump for heating and cooling—and private outdoor space. The building has a 1,200-gallon rainwater collection system, which can be used to irrigate the gardens in the back yard and on the terraces.

A grid-tied 12.5-kW photovoltaic system tops the roof, yielding approximately 4 kW per apartment, which can power all the heating or cooling needed and the appliances. Each apartment has its own inverter that can be switched to supply daytime backup power during a utility outage. This Passive House building has been estimated to reduce carbon emissions by 320,000 metric tons annually, compared to a conventionally built row house, directly addressing Mayor de Blasio's '80 by 2050' goals.

R-951 Passive House; Photos by Timothy Bell Photography

PASSIVE HOUSE METRICS

Heating energy	1.37 kWh/ft^2/yr	4.69 kBtu/ft^2/yr
Cooling energy	1.16 kWh/ft^2/yr	3.96 kBtu/ft^2/yr
Total source energy	10.13 kWh/ft^2/yr	34.56 kBtu/ft^2/yr
Treated floor area	3,735 ft^2	
Air leakage	0.6 ACH_{50}	

PROJECT TEAM

Architect PAUL CASTRUCCI
Developer FURTHER, INC.
Passive House Consulting ZEROENERGY DESIGN
Builder INTEGRAL BUILDING
Solar AEON SOLAR

PASSIVE HOUSE COMPONENTS

Air/Moisture Control 475
Ventilation ZEHNDER AMERICA
Windows YARO WINDOWS & DOORS
Rain Screen Facade Attachment KNIGHT WALL SYSTEM

8th Street EnerPHit Retrofit

Brooklyn, New York

This certified Passive House retrofit in the Park Slope area of Brooklyn has a completely new interior behind its turn-of-the-century brownstone façade. The renovated three-and-a-half story house now includes four bedrooms, four bathrooms, and a below-grade playroom. Exterior decks were installed on the rear façade at the ground and parlor floors, as well as at the two rooftop levels. The primary roof even hosts a green living roof, providing a verdant, outdoorsy experience for the homeowners.

The renovation required an almost complete gut of the interior to accommodate the continuous air barrier and insulation layers, while retaining the house's original staircase. Other historic elements such as wood doors and interior trims were removed, refurbished, and reinstalled.

To create the high-performance thermal enclosure, new walls were framed up on the interior of the front and back walls and filled with dense-packed cellulose, held in place by a vapor-intelligent membrane. The back wall has another four inches of an exterior insulation and finishing system (EIFS) installed over the original brick. The roof has four inches of insulation installed

over the sheathing, with dense-packed cellulose surrounding the framing. The new cellar slab has four inches of rigid insulation below it.

To preserve the look of the historic front façade, the triple-pane windows have wood frames in front; the rear-facing windows have uPVC frames. The party walls were parge-coated with a high lime content mortar and then coated with a vapor-open, airtight layer. The final air tightness of 1.0 ACH_{50} was achieved after extensive testing and sealing of troublesome leaks at various details, especially the joist pockets in the party walls.

Thanks to the high performance envelope, all heating and cooling is provided by one 2-ton multi-zone heat pump with three indoor air handlers. Ventilation is provided by an energy-recovery ventilator (ERV).

8th Street EnerPHit Retrofit; Photos by Andrew Rugge

PASSIVE HOUSE METRICS

Heating energy	1.39 kWh/ft²/yr	4.75 kBtu/ft²/yr
Cooling energy	1.23 kWh/ft²/yr	4.2 kBtu/ft²/yr
Total source energy	11.06 kWh/ft²/yr	37.73 kBtu/ft²/yr
Treated floor area	2,680 ft²	
Air leakage	1.0 ACH_{50}	

PROJECT TEAM

Architect Amy Shakespeare, **REDTOP ARCHITECTS**
Builder Joe Maldonado, J's Custom Contracting
Passive House Consulting and Mechanical Engineering
Cramer Silkworth, **BAUKRAFT ENGINEERING**
Green Roof Professional Inger Staggs Yancey, **BROOKLYN GREEN ROOFS**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**
Windows **ZOLA**

Carroll Gardens Retrofit

Brooklyn, New York

> *We have been very pleased to not have to turn the heat on yet; it's like an amazing miracle since we didn't really understand how that would work (or totally believe that it would). I can see how it may be possible that we will never turn the heat on. AMAZING and THANK YOU!!! I am totally sold on the 'passive house' concept and feel like there should be a law that mandates projects of a certain scope/cost must be done passive.*

That unsolicited comment—not atypical of the feedback that builders of Passive Houses receive—came from the enthusiastic homeowner who moved back into her 1860s townhouse, after it was retrofitted to meet the EnerPHit standard.

During the rehab, 8 inches of dense-pack cellulose insulation were added to the front and back walls, bringing the total thickness of these walls to 21 inches. In order to visually minimize these thick walls the architect and Passive House consultant worked together to angle the interior casings while maintaining a thermal bridge-free wall assembly. The resulting window surrounds let in the direct sunlight much deeper into the house.

The back of the house faces south, enabling the large, triple-pane glass wall at that end of the parlor floor to bring in plenty of solar heat in winter. A dogwood tree shades it in summer.

An energy-recovery ventilator (ERV) brings in tempered fresh air, and a mini-split heat pump is available to condition the air year-round. Even during very cold winter days, it has rarely been needed. It is used during the summer to control humidity and cool down the house.

The row house has four floors plus a playroom in the cellar level, and a separate garden-level apartment. The second floor was extended to accommodate a master bedroom and full bath. Extra height was also added to the third floor to make room for needed insulation in the roof assembly; the taller ceilings brought the extra benefit of giving the rooms there a more airy, open feeling.

Carroll Gardens; Photos courtesy of Build with Prospect

PASSIVE HOUSE METRICS

Heating energy	1.21 kWh/ft²/yr	4.12 kBtu/ft²/yr
Cooling energy	1.02 kWh/ft²/yr	3.49 kBtu/ft²/yr
Total source energy	8.83 kWh/ft²/yr	30.12 kBtu/ft²/yr
Treated floor area	3,154 ft²	
Air leakage	1 ACH_{50}	

PROJECT TEAM

Architect LOUIS MACKALL ARCHITECT

Passive House Consultant/Builder BUILD WITH PROSPECT, INC.

PASSIVE HOUSE COMPONENTS

Ventilation ZEHNDER AMERICA
Air/Moisture Control STO CORP.
Windows ZOLA

Tighthouse

Brooklyn, New York

Tighthouse represents the next wave of residential living. Originally built in 1899, this row home was certified as a Passive House retrofit in 2012 and won a 2014 International Passive House Design Award.

During the renovation the home was fully gutted, and a new rear façade and third-floor master suite were added. A new insulated slab enabled the creation of a double-height artist studio in the cellar. The modern interiors and large operable windows demonstrate that any home can meet the Passive House standard without sacrificing design aesthetics or natural light.

A continuous airtightness layer and insulation envelope ensure that the building retains its heat or coolness. The roof is R-56 with foil-faced polyisocyanurate at the exterior, while the walls are R-30. The rear façade features a rain screen with exterior mineral wool insulation, and the front façade is an EIFS system.

Tighthouse; Photos by Hai Zhang

PASSIVE HOUSE METRICS

Heating energy	1.35 kWh/ft^{2}yr	4.6 kBtu/ft^{2}yr
Cooling energy	0.45 kWh/ft^{2}yr	1.4 kBtu/ft^{2}yr
Total source energy	10.31 kWh/ft^{2}yr	35.2 kBtu/ft^{2}yr
Treated floor area	2,203 ft^2	
Air leakage	0.38 ACH$_{50}$	

PROJECT TEAM

Architect Julie Torres Moskovitz, **FETE NATURE ARCHITECTURE, PLCC**

PHPP Consultant **ZEROENERGY DESIGN**

PASSIVE HOUSE COMPONENTS

Façade Panels **RICHLITE**
Air/Moisture Control **475**
Air/Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**
Windows **SCHUCO BY EAS**

Park Slope Retrofit
Brooklyn, New York

This four-story brownstone in Park Slope has a landmark status, making a challenging Passive House retrofit just that much more complicated. Started in 2009, this rehab was the first project in the city to try tackling the EnerPHit standard, so the whole approach had to be developed mostly from scratch. And it succeeded. Many of the brownstone's original details were carefully preserved, such as the carvings that grace the exterior façade and its arched stained-glass windows. The year-round comfort, minimal conditioning energy use, and quiet inside are what's new.

Measuring just 21 feet by 45 feet, the building now houses a garden-level apartment, an upper triplex, and a full cellar that connects to the triplex. To make the cellar a livable space and to add insulation under the slab, the old cracked slab was excavated. After digging down an additional 12 inches, a drainage system was installed, topped by 2 inches of a soy-based spray foam insulation and a 4-inch concrete slab.

Spray foam was also used to seal and insulate the interior of the front and back brick walls and 3 feet of the party walls on either side, although the desired airtight specifications were only achieved after repeat applications and time-consuming labor. These difficulties led to switching to a membrane air barrier approach in future retrofit projects—a lesson that was greatly valuable for the nascent Passive House community at the time. The party walls were sealed with an elastomeric coating.

Three existing fireplaces were masonry sealed to prevent air leakage; two of them were retrofitted with fireboxes that burn ethanol. Another tricky source of air leakage was the original double front doors, which the landmark commission vetoed replacing. A custom cabinetmaker had to install double gaskets on them.

Two heat-recovery ventilators (HRV) bring fresh air into the retrofitted brownstone, and two mini-split heat pumps provide heating and cooling, as needed. The systems are jointly ducted with a backdraft damper determining whether heating, cooling, or just fresh air gets delivered. A rooftop solar thermal system supplies 75% to 80% of the annual hot water demand.

Park Slope Retrofit; Photos by Adam Bell

PASSIVE HOUSE METRICS

Heating energy	1.39 kWh/ft²/yr	4.75 kBtu/ft²/yr
Cooling energy	0.74 kWh/ft²/yr	2.54 kBtu/ft²/yr
Total source energy	7.15 kWh/ft²/yr	24.41 kBtu/ft²/yr
Treated floor area	3,735 ft²	
Air leakage	1.4 ACH_{50}	

PROJECT TEAM

Architect and Builder Jeremy Shannon, **BUILD WITH PROSPECT INC.**
Passive House Consultant David White, **RIGHT ENVIRONMENTS**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control **475**
Ventilation **ZEHNDER AMERICA**
Air/Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**

Red Hook Passive House

Brooklyn, New York

Located in Brooklyn's decayed shipyard district, this modest renovation will be New York City's first Passive House sound studio. The project's aim is to reduce the building's energy use enough so that all energy uses can be met by a rooftop photovoltaic (PV) array, allowing the project to be self-sufficient and net-zero within the limited footprint of a dense urban site. As this building was flooded by 30 inches of seawater in 2012 during Superstorm Sandy, the renovations also include measures to reduce water damage during future storms.

The existing building had concrete block walls with a wood floor and roof structure and a slab on grade at the first floor. First, the existing interior finishes were removed. Then, predominantly used polyisocyanurate insulation that had been salvaged was added to both the walls and the roof. In the areas that would likely be exposed to floodwater in the event of another flood—the existing slab on grade and the lower walls—type 9 EPS was used. The air barrier consists of a fluid-applied elastomeric coating on the block walls and a fluid-applied roof membrane.

The sound studio will be dedicated to the recording of electronic music and digital sound art. As such, it is a place to electronically create an essential human expression, in harmony with nature by powering the equipment from the sun.

Red Hook Passive House; Rendering by Ryan Enschede

PASSIVE HOUSE METRICS

Heating energy	2.13 kWh/ft²/yr	7.29 kBtu/ft²/yr
Cooling energy	0.20 kWh/ft²/yr	0.69 kBtu/ft²/yr
Total source energy	8.53 kWh/ft²/yr	29.1 kBtu/ft²/yr
Treated floor area	1,811 ft²	
Air leakage	0.96 ACH_{50}	

PROJECT TEAM

Architect Ryan Enschede, **RYAN ENSCHEDE STUDIO**
Passive House Consultant
Jordan Goldman, **ZEROENERGY DESIGN**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control & Insulation **STO CORP.**

HANAC Corona Senior Residence

Corona, New York

Founded as a nonprofit in 1972 in Astoria, New York, the Hellenic American Neighborhood Action Committee (HANAC) was established to address the social and economic needs of the growing Greek immigrant community. HANAC has grown into a multi-service agency serving over 25,000 individuals with diverse programs, including providing affordable rental housing. HANAC's pipeline of new projects includes the 68-unit HANAC Corona Senior Residence, slated to break ground in 2016.

Given HANAC's mission to create residential environments that are comfortable, healthy, and affordable, HANAC is aiming to certify this project as a Passive House. Part of the ground floor, approximately 5,000 ft^2, will be an early childhood development program serving 54 children. This intergenerational model supports the creation of a community impact center with social engagement opportunities for its residents and the greater Corona community.

To create a welcoming environment and an asset for the larger community, the design approach for this 8-story building emphasizes its integration within the neighborhood, which is mostly low-rise with several 8-story buildings across the street. The building is set back from the street, and its façade materials, colors, window patterns, and wall planes were chosen with an eye to further breaking down the building mass.

The exterior wall assembly will be a cast-in-place concrete structure with an exterior rain screen that is secured using fiberglass thermal spacers, minimizing thermal bridging. Within the thermal spacer depth, there will be 4 inches of mineral wool insulation in front of a continuous air barrier, sheathing, and stud wall. The roof will be a typical flat-roof modified bitumen assembly with 8 inches of polyisocyanurate insulation over a 9-inch reinforced concrete slab.

HANAC Corona Senior Residence; Rendering courtesy of Think! Architecture and Design

PASSIVE HOUSE METRICS

Heating energy	0.46 kWh/ft^2/yr	1.59 kBtu/ft^2/yr
Cooling energy	1.21 kWh/ft^2/yr	4.12 kBtu/ft^2/yr
Total source energy	9.75 kWh/ft^2/yr	33.29 kBtu/ft^2/yr
Treated floor area	43,140 ft^2	
Air leakage	0.2 ACH_{50} (design)	

PROJECT TEAM

Architect THINK! ARCHITECTURE AND DESIGN
Passive House and Energy Program Consultants ASSOCIATION FOR ENERGY AFFORDABILITY (AEA) and DUNCAN ARCHITECT
Mechanical Engineer NEW YORK ENGINEERS

Climate Change Row House

Queens, New York

A poorly modernized 1903 row house was transformed into the vibrant Climate Change Row House (CCRH) after a retrofit designed to meet EnerPHit standards. As the site is within the East River floodplain, elevating the building by 3 feet to reduce flooding risks complicated the design challenges inherent in meeting the EnerPHit requirements, starting with having to seal off the enlarged crawlspace from the building envelope.

What draws the eye instantaneously to this row house is the renovated façade, which is made from ceramic masonry and recycled glazes. Raising the building meant none of the windows or doors lined up or blended in with the neighbors' features anyway; the new façade adds playfulness to this non-alignment.

This façade is part of a newly constructed wall. The original brick wall was demolished and replaced with structural steel with 3 inches of extruded polystyrene exterior insulation, 6 inches of closed cell spray foam within the studs, and 1 inch of polyisocyanurate on the interior, resulting in a 16-inch thick wall. The front walls have an R-value of 39, as do the back walls. Thanks to 4 inches of polyisocyanurate and 12 inches of stone wool, the roof assembly has an R-value of 47. A heat-recovery ventilator (HRV) brings in a constant supply of fresh air.

There are other sustainability features throughout the building, noticeably the Maple flooring that came from a sustainably managed forest in New York State. A green roof, covering part of the building's top surface, helps to absorb stormwater and decrease runoff. A solar thermal panel and a small greenhouse share the rest of the rooftop.

Climate Change Row House; Photo by Jesse Winter Photography

PASSIVE HOUSE METRICS

Heating energy	1.67 kWh/ft^2/yr	5.7 kbtu/ft^2/yr
Cooling energy	0.85 kWh/ft^2/yr	2.9 kbtu/ft^2/yr
Total source energy	8.44 kWh/ft^2/yr	28.8 kbtu/ft^2/yr
Treated floor area	2,943 ft^2	
Air leakage	0.98 ACH_{50}	

PROJECT TEAM

Architect **THOMAS PAINO, R.A.**
Passive House Consultant and HVAC Designer
Jordon Goldman, **ZEROENERGY DESIGN**
Contractor Mike Miceli, **ALL DIMENSION**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control & Insulation **STO CORP.**
Insulation **ROXUL**
Windows **SCHUCO BY EAS**

Great South Bay Passive House

Bellmore, New York

Superstorm Sandy destroyed the previous home at this site, triggering an electrical fire and flooding the roads so that emergency trucks and fire engines could not reach the house. It burnt to the ground leaving only a destroyed foundation. The rebuilding required the design to meet the new flood plain regulations. With some explanation of what a Passive House is, the owners were excited to also incorporate this goal into their plans.

The new home features a master bedroom and bath, three other bedrooms with hall bath, and a generous, open first floor with a dining room, kitchen, and family area. The site overlooks the channels to the Great South Bay. To capture these views the design incorporates roof decks leading from the master bedroom and facing the channels.

The house had to be raised at least 3 feet above the existing grade, requiring the first floor to be suspended and set on piers—leading to numerous design challenges in insulating six surfaces and connecting the air and vapor barrier. The house is set on three main girders with TJI joists for the first floor and second floors. The walls and roof are pre-insulated steel panels with 2 x 4 insulated furred interior walls.

The heating and cooling system is a ducted 2-ton mini-split system, and a ducted energy-recovery ventilator (ERV) supplies balanced ventilation. A heat pump water heater provides the domestic hot water. The building includes a 7.5-kW PV array.

The owners moved in in November and were instantly impressed that the thermostat read 70 °F the next day, without the heat coming on, even though the night temperatures were in the low 40s. Now, when they vacation elsewhere, they can't wait to return to their comfortable, healthy, draft-free home. Their Passive House has exceeded their expectations, even earning them a monthly credit on their electric bill.

Great South Bay Passive House; Photo by Anthony Musso

PASSIVE HOUSE METRICS

Heating energy	2.5 kWh/ft²/yr	8.6 kBtu/ft²/yr
Cooling energy	1.1 kWh/ft²/yr	3.61 kBtu/ft²/yr
Total source energy	11.1 kWh/ft²/yr	38 kBtu/ft²/yr
Treated floor area	2,025 ft²	
Air leakage	0.6 ACH_{50}	

PROJECT TEAM

Architect and CPHC ANTHONY J. MUSSO
CPHC NINA SHAH-GIANNARIS
HERS and Passive House Rater Glenn Hooper, RESIDENTIAL ENERGY CONSERVATION

PASSIVE HOUSE COMPONENTS

Insulation ROXUL
Windows YARO WINDOWS & DOORS

The Black Project; Photo by archphoto

The Black Project

Westport, Connecticut

The Williams-Levant house, built originally in 1934 by Barry Byrne, was given a second life in 2011 as a Passive House. Before its renovation the poured concrete building had become weathered, cracked, and was generally falling into decay. The overall form though was well worth preserving.

To reach Passive House levels of comfort and efficiency, the entire building was surrounded from the outside in a blanket of 10 inches of insulation. Minimizing the use of petroleum-derived products—and eliminating building materials fabricated with known toxins—are top priorities for the developer, so the insulation used was made from recycled glass.

Solar thermal panels supply hot water to the residence, with an electric heat pump water heater for backup. This hot water provides heat to both a 10x10 radiant floor system and a post-heater, which is downstream from the energy-recovery ventilator that provides fresh air year-round. Together, these keep the house toasty throughout the winter.

A 1-ton heat pump dehumidifies and cools the house during the hot, moist summers. This heat pump could be used for heating but almost never is. In five years, says the homeowner, he has turned on the heat pump in winter maybe three times.

The developer loves the building science of Passive House and can't understand why everyone doesn't. His experience with the Black Project inspired him to develop a line of high-performance, all-electric homes that start with Passive House as the building block and add to it an emphasis on pure and natural interiors and luxury.

PASSIVE HOUSE METRICS

Heating energy	2.32 kWh/ft²/yr	7.93 kBtu/ft²/yr
Cooling energy	2.42 watts/ft²/hr	8.24 Btu/ft²/hr
Total source energy	9.57 kWh/ft²/yr	32.66 kBtu/ft²/yr
Treated floor area	3,488 ft²	
Air leakage	1.0 ACH$_{50}$ (design)	

PROJECT TEAM

Developer Douglas Mcdonald, **THE PURE HOUSE**

Passive House Consultants Ken Levenson, **475 HIGH PERFORMANCE BUILDING SUPPLY** and Gregory Duncan, **DUNCAN ARCHITECT**

The White Project

Westport, Connecticut

Billed as a luxury home without the guilt, The White Project combines Passive House's rigorous requirements with luxurious comfort. Looking out over the Newman Poses Nature Preserve, this high-performance, all electric home delivers practically grid-free living and the highest indoor air quality, thanks to the exclusive use of non-toxic finishes and building materials throughout the home.

The preference for environmentally friendly materials led to creating a continuous insulation layer using dense-packed cellulose on the exterior walls and the roof. The interior walls are insulated with wool, which helps to prevent sounds carrying from one room to another. Outside of the building envelope, XPS was used to insulate the slab. A heat pump supplies the little bit of heat needed and the cooling required for year-round comfort.

No effort was spared to meet the highest comfort standards while eschewing the use of petroleum products, including delivering the hot water through copper pipes, rather than the plastic tubing that is more commonly used for plumbing systems. A whole-house water filtration system ensures a premium water quality. All the rain that falls on the house is captured, stored, and reused to irrigate the xeriscaping.

With Passive House as the foundation to sharply cut the building's energy demand and a photovoltaic (PV) system on the roof, the house barely puts any demand on the grid. A built-in charging station for electric vehicles facilitates cutting transportation emissions as well—all adding up to a life well lived in a healthy, environmentally aware, and luxurious home.

The White Project; Photo courtesy of The Pure House

PASSIVE HOUSE METRICS

Heating energy	1.28 kWh/ft²/yr	4.37 kBtu/ft²/yr
Cooling energy	0.43 kWh/ft²/yr	1.46 kBtu/ft²/yr
Total source energy	9.49 kWh/ft²/yr	32.4 kBtu/ft²/yr
Treated floor area	4,997 ft²	
Air leakage	0.30 ACH_{50}	

PROJECT TEAM

Douglas Mcdonald **THE PURE HOUSE**

New Jersey Passive House

Ramsey, New Jersey

This modern take on the classic American farmhouse sets fun, geometric volumes under a gabled roof. The house represents the family's core commitment to sustainable living where food is grown in their organic garden, meals are created and shared together, and lessons in social and environmental responsibility are a part of everyday living.

A cost-effective Larsen truss assembly, built on-site and stuffed with dense-pack cellulose, was essential in achieving the high level of performance and optimized comfort that the Passive House Standard delivers. Carefully taped OSB formed the interior air barrier, while a vapor-open housewrap was used on the exterior. Most of the glazing was put on the south-facing side to maximize solar gains, but about 20% was installed on the north-facing side to take advantage of the views in that direction, necessitating additional insulation in the roof and walls.

While the main heat source will be the solar gain and occupants' activities, any needed additional heating and cooling is being supplied through a ducted mini-split system. An energy-recovery ventilator (ERV) is supplying the fresh air.

The large, triple-pane windows in the dining room, library, and stairwell invite generous amounts of light to bathe the common areas that are central gathering places for family life. Marble countertops take center stage in the kitchen while the trendy brass hardware adds warmth.

New Jersey Passive House; Photo by Darren Macri

PASSIVE HOUSE METRICS

Heating energy	1.30 kWh/ft²yr	4.44 kBtu/ft²yr
Cooling energy	1.20 kWh/ft²yr	4.12 kBtu/ft²yr
Total source energy	10.77 kWh/ft²yr	36.78 kBtu/ft²yr
Treated floor area	3,908 ft²	
Air leakage	0.29 ACH_{50}	

PROJECT TEAM

Builder and **CPHC:** Darren Macri, **BLEU NEST**

Architect James and Juhee Hartford, **RIVER ARCHITECTS**

Interior Design Kim Macri, **BLEU NEST**

Mechanical Engineer Cramer Silkworth, **BAUKRAFT ENGINEERING**

Mechanical Install **BLEU NEST**

PASSIVE HOUSE COMPONENTS

Air/Moisture Control **475**

Insulation **OPCORE G**

Windows **INTUS**

Heating/Cooling **FUJITSU**

Flip-Flop House

Long Branch, New Jersey

In the wake of Superstorm Sandy a phased Passive House, heightened resiliency retrofit was begun on a 950-ft^2 single-family cottage on the Jersey Shore. Inspired by the imperviousness of a "flip-flop" sandal, the lead architect worked with the Civilian Conservation Corporation to choose moisture-resistant, quickly drying building materials to minimize damage in the event of another coastal flood.

This affordable housing project was subsidized through the Re:New Jersey Stronger grant program and aims to be a proof-of-concept Passive House retrofit for low to middle income coastal communities.

The first phase included a new thermal-bridge free building envelope with 6 inches of an exterior stone wool insulation board and a panelized vented rain screen façade. By combining a highly vapor permeable water resistive barrier (WRB) with vapor permeable stone wool insulation and a drained and ventilated rain screen façade, the home can dry quickly toward the outside.

The interior existing stud wall was filled with 4 inches of stone wool batt insulation. The interior service cavity was clad with painted wood bead board—instead of gypsum board—as the bead board can easily be deconstructed, cleaned, dried, and re-installed.

The floor is a "sacrificial" floating floor on top of taped OSB and 1.25 inches of the rigid stone wool insulation. The floor joists are filled with 12 inches of stone wool batts above the vented crawl space. The pitched attic rafters are filled with 4 inches of stone wool batts held in place with 3 inches of rigid stone wool attached to the underside.

Flip-Flop House; Photo by Civilian Conservation Corporation

PASSIVE HOUSE METRICS

Heating energy	1.3 kWh/ft^2/yr	4.44 kbtu/ft^2/yr
Cooling energy	1.5 kWh/ft^2/yr	5.12 kbtu/ft^2/yr
Total source energy	10 kWh/ft^2/yr	34.13 kbtu/ft^2/yr
Treated floor area	950 ft^2	
Air leakage	<1.0 ACH_{50} (design)	

PROJECT TEAM

Architect SHORE POINT ARCHITECTURE
PH Consulting CIVILIAN CONSERVATION CORPORATION
Builder MANGAN DEVELOPMENT GROUP
Carpenter Dave Fowler, GREENLINE DESIGN BUILD

PASSIVE HOUSE COMPONENTS

Air/Moisture Control COSELLA-DORKEN
Façade Panels RICHLITE
Insulation ROXUL

Margate Residence

Margate, New Jersey

This 2,600-ft² home was designed as the primary residence for a family of five in a coastal New Jersey town. When designing this Passive House, the architect's prime considerations were maximizing the opportunities for daylight and wintertime solar gains in this home, which is situated on a tight infill lot within a traditional neighborhood. Mindful of the potential for flooding events in this region, the home's design also incorporates multiple resiliency strategies.

By positioning the home along the northern side of the lot, the south side receives the best exposure to winter sun. To avoid overheating in summer, a wood trellis wraps the house to shade both the front porch and the south-facing windows on the first floor. In all seasons, the strategically placed windows bring in ample daylight to brighten the home's clean, modern interior.

As a first defense in the face of a flood, the first level of the home was elevated four feet above grade. A front porch creates a welcoming entrance, while masking this change in elevation. Windows are typically the vulnerable spots in a building during a storm, and, once shattered, they provide easy access points for rain or other moisture. A shutter system, which is artfully incorporated into the window trim, bolsters the home's resiliency during a hurricane by protecting the triple-glazed windows from flying debris.

The R-44 walls incorporate dense-packed cellulose in 2x6 walls with 4 inches of rigid polyisocyanurate insulation on the exterior. The R-68 roof uses a similar assembly but with 12-inch TJIs dense-packed with cellulose and another 4 inches of rigid polyisocyanurate on top. A 5-kW photovoltaic system graces the roof.

Margate; Photos by Eric Roth

PASSIVE HOUSE METRICS

Heating energy	1.29 kWh/ft²/yr	4.39 kBtu/ft²/yr
Cooling energy	1.53 kWh/ft²/yr	5.22 kBtu/ft²/yr
Total source energy	7.06 kWh/ft²/yr	24.1 kBtu/ft²/yr
Treated floor area	2,207 ft²	
Air leakage	0.47 ACH_{50}	

PROJECT TEAM

Architecture & Passive House Consulting ZEROENERGY DESIGN

Construction C. ALEXANDER BUILDING

PASSIVE HOUSE COMPONENTS

Windows SCHUCO BY EAS

Passive House Resources

NEW YORK PASSIVE HOUSE (NYPH): 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.

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.

PASSIVE HOUSE INSTITUTE: an independent research institute that has played an especially crucial role in the development of the Passive House concept.

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

PASSIPEDIA: The ever-expanding knowledge database on energy efficient building and Passive House, comprising over two decades of research.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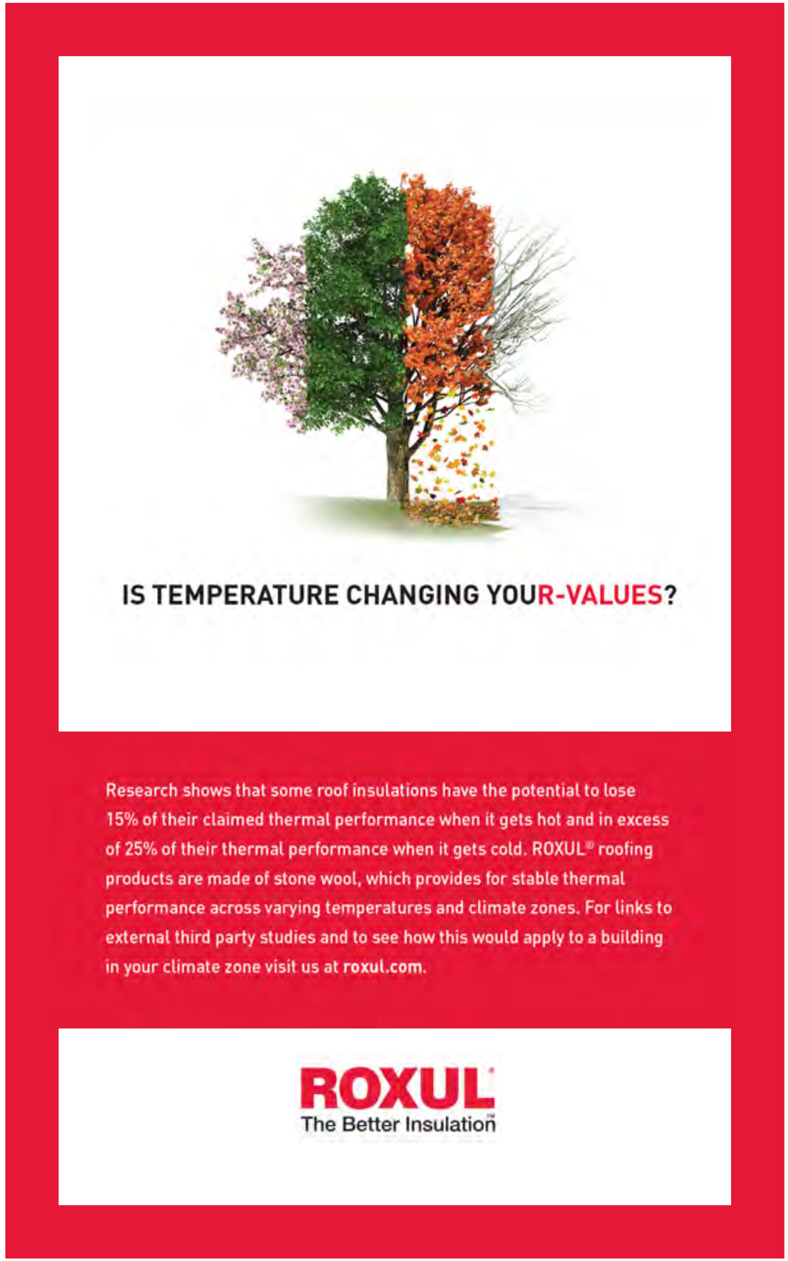
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"**PASSIVE HOUSE** *makes sense as a phrase, but I think* **IT IS AN ACTIVIST NOTION—A TRANSFORMATIVE NOTION...** *This is one example of how New York City can show the world a model that works in today's reality...*"

—Mayor Bill de Blasio

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