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Why new apartment buildings should adopt ancient cooling techniques

The ideas behind ‘Passive House’ standards have roots in the Middle Ages but may hold the key to the future of sustainable housing.



The construction of New York City's first net-zero community is on the Rockaway Peninsula in Queens. This project will bring 1,650 new units of housing, with 80% of them affordable, to an oceanfront site that has been vacant for more than four decades. [Image: © Local Office Landscape/Bernheimer Architecture]

BY JOHN H. MARTIN 7 MINUTE READ

America needs more housing. We need it fast, and we need it to be better—healthier and more sustainable. Buildings account for about [30% of U.S. carbon emissions](#), and multifamily residences are responsible for about half that number. Thanks to an increasing awareness of the critical nature of reducing these greenhouse gasses, the overall carbon emissions from buildings have

remained level since 2015. But to win the climate battle, we have to produce far more housing while actually reducing total carbon emissions. Passive House design principles can help get us there.

What is the promise of Passive House design? Better indoor air quality, acoustics, and lower utility bills for renters; higher rates of return over the building's life cycle for owners and developers; and drastically reduced carbon emissions over the life of the building.



Sendero Verde, located in the East Harlem neighborhood of New York City, will be the largest multifamily residential Passive House in the United States and the largest fully affordable Passive House in the world once completed. [Rendering: © Volley Studio]

WHAT IS PASSIVE HOUSE?

The Passive House approach “super insulates” the building’s exterior envelope and seals all of the joints between windows, walls, floors, and roofs to discourage heat transfer from the interior to the exterior. Much like a thermally insulated carafe, the interior of the home stays at a constant temperature despite large temperature fluctuations outside, which tend to be increasing as the climate crisis deepens.

Consequently, homes need far less heating in the winter and far less cooling in the summer. This means they require less oil, natural gas, or electricity, which means much less carbon in the atmosphere.

Because virtually no air leaks in or out of the building's walls, all of the air changes inside the apartments are supplied by HVAC equipment. This air can be passed through filters that screen out the smallest pollutants, dramatically increasing the indoor air quality in the living spaces. The HVAC equipment also can better regulate the humidity of the apartments, making them more comfortable across a broader range of temperature. And finally, the thick, airtight walls offer more acoustic privacy from outdoor noise.

Architects and engineers have been designing student housing and single-family housing using these principles for a number of years, but the approach has been slow to be adopted for the most scalable solution to our housing shortage—multifamily apartment housing. Most multifamily housing projects in the United States are developed by private companies that either sell the finished apartments to other investors or retain and operate them for their own benefit. In almost all cases, the utility costs for each apartment are passed directly to the renter, leaving the owner/developer little incentive to spend more money up front for more insulation, better windows, and sealed joints when any financial savings accrue to the renter.

But that tide is turning. Informed renters are beginning to look at the total cost of renting, not just the base rent cost. They're also seeking to lower their own carbon footprints and are looking for apartments designed to foster a better environment and a healthier lifestyle. And developers and owners are beginning to realize that apartments that meet the Passive House standard offer better long-term rates of return than others.

COSTS

Initial cost premiums are arguably the biggest barriers to Passive House adoption in this market segment. Today, most architects and builders report that a multiunit, large scale Passive House project costs around 4% more than a typical new apartment building, but that cost can be lower depending on the experience of the developer, the architects, and the construction team,

according to a [report](#) last year by the [Passive House Network](#) and [Steven Winter Associates](#).

“The cost premium goes down as the experience goes up, and we’ve seen that demonstrated through our work both on the boards and in the field,” says Deborah Moelis, a principal at Handel Architects. “A team that is experienced can solve problems more efficiently and can integrate high-performance concepts and materials more easily.”



Sendero Verde will contain 709 affordable units as well as community areas, retail space, outdoor gardens, a school, and a community center for seniors and youth. [Rendering: © Volley Studio]

In 2016, Handel Architects partnered with Steven Winter Associates to design Sendero Verde, an affordable housing development in New York City’s East Harlem neighborhood, which will be the largest Passive House project in the world when completed in 2024. “As your buildings become bigger, it’s easier to achieve Passive House,” says Louis Koehl, senior associate and director of sustainable design at Handel Architects.

Passive House design techniques were pioneered on smaller, single-family residences. These homes have a relatively large wall area (and subsequently larger heat gain or loss) per square foot of enclosed living area. Multifamily residences have apartments that abut one another. Consequently, the perimeter area has a much lower ratio to the enclosed area of multifamily apartment buildings. Typically only one or two of the walls of a multifamily apartment are exposed to the weather, whereas a single-family home will typically have all four walls exposed. At Sendero Verde, fewer perimeter walls in a typical apartment means less heat transfer and lower utility bills for each resident.

Local and state incentives can further reduce the initial cost barriers. In Massachusetts, [Mass Save](#) incentives now offer thousands of dollars for each unit contained in a Passive House building. With these incentives, the development team of [The Finch](#) in Cambridge managed to reduce the cost premium to about 1% over the original non-Passive House baseline. Many other states offer similar programs, and federal incentives will be offered through the recently passed Inflation Reduction Act.

There are some hidden savings as well. Using the air-tight, super-insulated walls to keep the internal temperature relatively constant not only requires less energy to heat and cool, but also enables engineers to downsize the mechanical equipment that produces and supplies the conditioned air. This means less robust HVAC equipment and less carbon expended to manufacture it. Architects refer to this cost as the “embodied carbon” of a project—the amount of energy (and carbon production) required to manufacture, transport, and assemble all of the components of a building. Embodied carbon alone is a sizable aspect of greenhouse gas emissions.



Second + Delaware Apartments in Kansas City, Missouri, is the largest Passive House apartment community in the world and uses 80% to 90% less energy than conventional buildings. [Photo: © Jeffrey M. White Architect]

Another example can be found in the case of Second + Delaware Apartments in Kansas City, Missouri, one of the largest multiunit residential Passive House buildings in the world. “During the planning stages of the project, we concluded that residents typically are not willing to pay more to live in a ‘green building’, but they also don’t expect to pay less,” says Jonathan Arnold, principal of Arnold Development Group. So rather than pass the utility cost savings on to renters, Arnold Development Group used the incremental income from the savings to finance the additional cost of a better building envelope.

By offering a highly sustainable building with improved thermal comfort for the same cost as the building across the street, Arnold and his development team were able to achieve full occupancy in a third of the time it normally takes, and at rates that exceeded the underwriter’s projections.



The residences at Second + Delaware have triple-pane windows in the living areas and bedrooms to provide abundant light; 16-inch thick concrete walls, with a layer of insulation, deliver 90% energy efficiency along with quiet and privacy. [Image: © Arnold Imaging]

INDUSTRY

Most architects and builders focus on small-scale, high-end projects, and developers of multiunit housing are a relatively small group. For example, only two of the nation's [largest architecture firms](#) are represented among the dozens of large apartment projects (over 50,000 square feet) in databases of [certified projects](#).

Training, education, and strengthening relationships between owners, architects, and builders will shift this trend. The Passive House certification process typically unfolds in two phases, the first being instruction on building science, which includes study of thermal environment, air quality, high-performance materials, and occupant health and comfort. The second phase involves a design challenge, which a candidate must solve using Passive House principles and calculations. Once the training is complete, designing and building Passive House certified projects becomes more efficient and effective.

“A lot of it is education,” says Esther van Eeden, director of high-performance building at [Kearns Mancini Architects](#) in Toronto. Having a communicative and

experienced architectural team is of the utmost importance when undertaking a project.

CONCLUSION

Passive House design and construction is an exercise in future proofing and the best pathway to meet increasingly stringent energy standards.

“Is the additional upfront cost to achieve Passive House certification worth it to owners?” asks Koehl. “As energy codes become more stringent, the premiums relative to the baseline cost become much smaller. If you’re already invested just to meet code, why not spend an additional 2% to make sure it’s verified.” The small additional investment yields multiple rewards: It pushes the energy performance beyond today’s requirements, giving owners a superlative product to market and a building that will meet tomorrow’s energy codes. It gives renters better indoor air quality and lower utility bills. And it puts less carbon into the atmosphere, which protects our planet.

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