Climate Justice in Architecture

Design centering both the environmental and social aspects of climate change.

Climate justice in architecture refers to engagement, advocacy, planning, and design that draw down emissions; build resilience and capacity; support human, cultural, and ecological health; and protect all communities in the era of climate change.

Committee on the Environment

AIA Knowledge Community

Hurricane Strong Home, front elevation
Image Credit: Eric Soltan for +lab Architect PLLC

Hurricane Strong Home

This case study highlights an exemplary architecture project that prioritized both environmental and social aspects of climate change in its design process, community engagement approach, and final design. It aligns with many aspects of the AIA Climate Justice in Architecture Taxonomy across the building, neighborhood, regional, and global scales.

Hurricane Strong Home

Queens, NY

Hurricane Strong Home, side and back porch
Image Credit: Eric Soltan for +lab Architect PLLC

Summary

In October 2012, Hurricane Sandy battered the Breezy Point neighborhood in Queens, New York—a peninsula jutting out into the Atlantic southeast of Manhattan—with high winds and storm surge. The storm caused structural damage and building fires that destroyed more than 300 homes in the neighborhood and damaged many others.

The Hurricane Strong Home is a 1,200 square foot, one-story single-family home that replaced the previous house on the property. The owner, a lifelong resident of Breezy Point, lives on a fixed income. Her new home is designed to both protect her from future storm events and reduce her daily utility bills. The home was designed as a prototype for climate-resilient, environmentally sustainable, cost-effective, and attainable housing in New York, the U.S., and internationally.

Project overview

BUILDING PROGRAM TYPE(S):
Single Family Housing

PROJECT TYPE:
New Construction/Addition

CONDITIONED FLOOR AREA:
1,200 sq. ft.

TOTAL USERS:
1

SITE AREA:
3,675 sq. ft. (35' x 105')

NUMBER OF FLOORS:
1

PROJECT CLIMATE ZONE:
ICC Climate Zone 4A

PROJECT SITE:
Previously developed land

PROJECT SETTING:
Suburban

YEAR OF SUBSTANTIAL COMPLETION:
2019

COST OF CONSTRUCTION (EXCLUDING FURNISHING):
$492,000

THIRD PARTY RATING SYSTEM:
IBHS FORTIFIED Home Gold – Resilient Building Standard for High Wind & Coastal Flooding; Home Energy Rating System (HERS); Federal Alliance of Safe Homes (FLASH) Designation

Project team

OWNER:
Diane Hellriegel

ARCHITECT:
+lab Architect PLLC

MP ENGINEERS:
MAR Consulting Engineers, LLC

STRUCTURAL ENGINEER:
Cragnolin Engineering & Design

CIVIL ENGINEER:
Norman C. Lok, P.E. MBA

GENERAL CONTRACTOR:
Malbro Construction

"The ethos of [the Hurricane Strong Home] is that … resilience is a human right. Health, safety, and welfare go back to the core of who we are as architects, our standard of care. Resilience must now be considered an essential part of our standard of care. So, the idea of it being resilient became a question in the owner's mind – will it stand out or be different? It doesn't have to look different, it just has to perform differently. It has to be accessible in terms of the way you look at it … and attainable in so many ways, such as affordability and through the use of common materials."
—Illya Azaroff, FAIA, Architect, +lab Architect PLLC

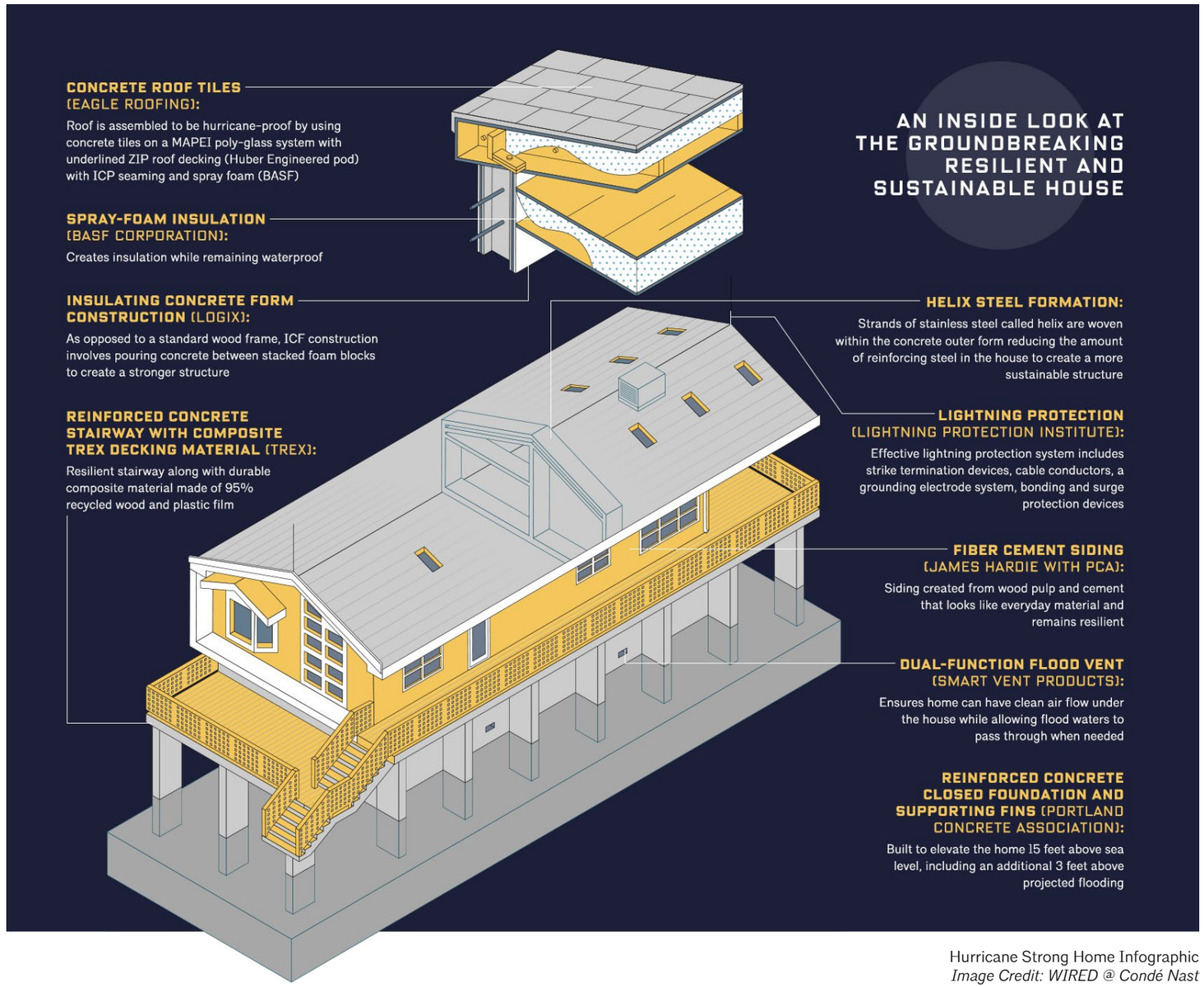
Design Process

After Hurricane Sandy destroyed her home, homeowner Diane Hellriegel decided not to rebuild to the same standards as the original. Instead, she partnered with architect Illya Azaroff, FAIA with +lab to build a home that maximizes both resilience and energy and water efficiency on a modest construction budget.

The design process started with a multi-hazard assessment of the neighborhood, including time as a dimension. According to federal agencies like the Federal Emergency Management Agency (FEMA) and the U.S. Forest Service, the neighborhood is at extremely high risk for coastal and riverine flooding and at high risk of exposure to extreme heat. The property is located in a 100-year flood plain. And, Queens County is at greater risk of wildfire than 82% of counties in New York State. The team considered how the design could reduce exposure to extreme heat and extreme cold in addition to the high winds, flooding, and storm surge associated with hurricanes. The ultimate design combines best practices and performance standards for each hazard to develop holistic key performance criteria tailored to the location's current and future environmental exposures.

Creating something new with common building materials

The social implications of climate change often manifest as financial hardship and forced displacement following storms like Hurricane Sandy. To address the homeowner's fixed income status, +Lab turned the project into an opportunity to test the ideal combination of common building systems and materials to achieve four goals: reduced construction cost, low ongoing utility and maintenance costs after occupancy, climate resilience, and environmental sustainability. The design team convened industry partners such as the Portland Concrete Association (PCA), Simpson Strongtie, and BASF; not-for-profit organizations like the Federal Alliance of Safe Homes (FLASH); and New York City agencies like Housing Preservation and Development (HPD), the Mayor's Office of Resiliency (MOR), and the Office of Emergency Management (OEM), to pilot test materials and building systems.



Hurricane Strong Home Infographic
Image Credit: WIRED @ Condé Nast

A prototype for resilient design

After the home was completed, it became an educational tool for local building officials, design teams, and homeowners interested in maximizing cost savings, climate resilience, and environmental sustainability. The team realized a demonstration project could help overcome widespread assumptions in the market that an efficient and resilient home costs more and requires more complex building systems than the industry standard. The home's welcoming design, use of familiar materials, and proven ability to protect the homeowner and her neighbors during storms have helped groups like FLASH. They use it as an example to convince home builders that taking a similar approach can generate value for both them and future homeowners with minimal tradeoffs.

The project was included as a case study in the New York State Climate Impacts Assessment. The project documents are available online as an open-source prototype, aiming to influence the homebuilding design process worldwide.

Project financing

Habitat for Humanity gutted the home immediately following Hurricane Sandy. To turn the rebuild into a living laboratory, the project received federal funding through New York City's Build It Back program, which is designed to enhance resilience in waterfront neighborhoods. That funding helped unlock additional funding from the Federal Emergency Management Agency (FEMA).

"Building beyond code is essential because code is merely a minimum standard. When we conduct an all-hazard assessment, we design for the specific climatic conditions and risks revealed by data—not just for today, but for the next 100 years. As architects, we are designing for the future, not just the present. If we let data guide us and align our final design with the true needs of the project, we will always exceed code. And that's exactly what we should be doing—because our standard of care and ethical responsibility to the health, safety, and welfare of the public demand it. High-performance buildings don't just protect individuals; they safeguard entire communities."
—Illya Azaroff, FAIA, Architect, +lab Architect PLLC

Essential climate justice design components include:

1. **Centering the design around the functional and aesthetic needs of the homeowner:** The home is affordable to operate and maintain, an essential feature for a homeowner on a fixed income. Its design fits in with the neighborhood architecture, featuring similar massing, details, and building materials.

2. **Integrating climate resilience with passive house design strategies:** The design team took an all-hazards approach, researching current and future environmental exposures that could be mitigated through building design. They integrated those insights with passive house design principles to create a home that is both resilient during extreme weather events and energy- and water-efficient in daily use.

3. **Contributing to neighborhood resilience:** Rebuilding one home is not enough to rebuild a tightknit community like Breezy Point. The Hurricane Strong Home enhances neighborhood resilience by incorporating infrastructure that supports a neighborhood microgrid. Homeowner Diane has also invited her neighbors to use her home as a refuge during storms that disrupt electricity and water supply to the peninsula.

AIA Climate Justice in Architecture Taxonomy

Climate change creates new, and amplifies existing, environmental and social challenges across the following seven themes or categories: social determinants of health, cultural connection to place, economic development without displacement, environmental justice, ecosystem health, climate change health and resilience, and decarbonization. The Climate Justice in Architecture Taxonomy centers both the environmental and social aspects of climate change and helps teams respond with an architectural design impacting the themes across three scales: building occupants, the surrounding neighborhood, and regionally and globally. The taxonomy aligns and connects with the AIA Framework for Design Excellence, which represents the defining principles of design excellence in the 21st century. The Framework is comprised of 10 principles and informs progress toward four outcomes – a zero-carbon, healthy, resilient, and equitable built environment.

The Hurricane Strong Home addresses all three scales in the taxonomy.

Climate Justice Taxonomy	Impact of Design Features by Spatial Scale			Alignment with Framework for Design Excellence
	Building	Neighborhood	Regional/ Global	
Social Determinants of Health	●		●	Water, Economy, Energy, Well-being, Resources
Cultural Connection to Place		●		Integration, Well-being, Change
Economic Development without Displacement		●		Economy
Environmental Justice				
Ecosystem Health				
Climate Change Health & Resilience	●	●	●	Water, Change, Discovery
Decarbonization	●		●	Equitable Communities, Water, Economy, Energy, Well-being, Resources, Change, Discovery

Overview of the AIA Climate Justice in Architecture Taxonomy themes and spatial scales: Hurricane Strong Home. Source: Biositu, LLC

Hurricane Strong Home, ICF construction
Image Credit: +lab Architect PLLC

Social determinants of health

Installing non-absorptive and low-emitting materials to reduce the risk of exposure to airborne toxins and mold growth: People with chronic diseases, like asthma, are at heightened risk of poor health outcomes following exposure to toxins in building materials and mold growth after flooding events. To address these risks, the Hurricane Strong Home installed non-absorptive and low-emitting materials that do not emit toxins into the air and are easily cleanable after flooding events.

Maximizing energy and water efficiency for low- and fixed-income homeowners: The Hurricane Strong Home design upgraded the home to meet the highest standards of energy and water efficiency, as well as insurability. This was particularly impactful for the homeowner, who lives on a modest fixed income.

Designing with off-the-shelf building systems and materials increases access for low- and fixed-income homeowners: The home was purposefully designed to use widely available, off-the-shelf building systems and materials to demonstrate that resilient, efficient homes are accessible to people at all income levels.

Calibrating the payback period to the homeowner's timeline: For most Americans, a home is their highest-value asset and long-term investment. While the Hurricane Strong Home costs about 9% more than a typical home of that size and price point, its 8-10-year payback period is likely to be recouped by the homeowner. The upgrades not only enhance the home's resale value but also reduce day-to-day expenses. These considerations are particularly relevant in a neighborhood where 96.9% of homes are owner-occupied—compared with 45.2% in Queens, 32.9% in NYC, and 64.8% in the U.S.

"Resilience should be accessible to everyone. That's why we partnered with FLASH who brought in companies like Home Depot, BASF, and Kohler—brands people already trust when making home improvements. The materials in this home, from Hardie plank siding to Anderson windows and doors, are familiar to builders and homeowners alike. The idea is simple: if you need to replace a door, you're not just getting a new one—you're getting a better one, an impact-rated one, right off the shelf. This project proves that building resilience doesn't have to be complicated or out of reach—it can be as easy as making the right choice at the local store."
—Illya Azaroff, FAIA, Architect, +lab Architect PLLC

Cultural connection to place

Using finish materials and design elements that blend with the surrounding neighborhood: The project used finishing materials that can be purchased off-the-shelf at big box stores, such as fiber cement siding. Its design, including shape and detailing, aligns with the surrounding neighborhood, which reduces the mystery around a net-zero, climate-resilient home and has increased curiosity in the neighborhood about the added value a climate-resilient and green building design brings to the homeowner.

"I had no idea that a resilient house could look so beautiful."
—Diane Hellriegel, owner (AIA Designed to Last, 2019)

Designing to last 100+ years to support community resilience: After the widespread destruction caused by Hurricane Sandy in Breezy Point, the Hurricane Strong Home was designed to last over 100 years—a testament to the homeowner's commitment to rebuilding a resilient neighborhood.

"What it means to be safe and at home are synonymous. And, that feeling of home is quite important for the psychology for someone who has gone through disasters in the past."
—Illya Azaroff, FAIA, Architect, +lab Architect PLLC (AIA Designed to Last, 2019)

Hurricane Strong Home, interior
Image Credit: Eric Soltan for +lab Architect PLLC

Economic development without causing displacement

Designing to reduce maintenance, utility, and insurance costs to increase home affordability in neighborhoods at risk of gentrification: Breezy Point shows signs of impending gentrification. For example, the high percentage of adult residents over the age of 65 (23.3%, compared with 16.5% in Queens, 15.5% in NYC, 16.5% in U.S.) and high housing and transportation burden (47% of household income, compared with 41% in Queens, and 36% in NYC) contrast with a disproportionately high median household income and low poverty rate ($134,563 median income/3.9% poverty rate, compared with $82,431 income/11.7% poverty in Queens, $76,607 income/17.2% poverty in NYC, and $75,149 income/12.5% poverty in the U.S.). The flood insurance premium for the Hurricane Strong Home is one example of ways resilient housing can slow financial pressures for existing residents to move out of the neighborhood. Priced at $675, compared with $5,075 for a typical home of that size in that location—an 87% reduction—the homeowner will save $44,000 in insurance premiums over 10 years.

> "For our client, a retired homeowner on a fixed income, this house isn't just a place to live—it's a key to financial stability. Its energy efficiency and resilience keep money in her pocket with lower operating costs, reduced energy bills, and lower insurance premiums. A well-built home isn't just about protection; it's about long-term affordability and peace of mind."
> —Illya Azaroff, FAIA, Architect, +lab Architect PLLC

Climate change health & resilience

Elevating the home 15 feet above the flood line plus an additional 3 feet for projected future sea level rise to enhance flooding resilience: The designers considered both current and future flood risk when deciding how high to elevate the structure above the flood line.

Designing the foundation to resist floating debris impact and reduce hydrostatic pressure: The reinforced concrete foundation protects the structure from storm surge, impact from floating debris, and erosion. Stainless steel, dual action flood vents allow storm surge to enter and exit the foundation, which can reduce hydrostatic pressure. Vents also allow air flow beneath the structure, which reduces the risk of moisture damage and mold growth throughout the year.

Integrating wind and flood resistant structure and façade materials to enhance the home's hurricane resilience: Resilient building materials include: A poured in place concrete structure with stacked polystyrene block forms designed to withstand 300-mile per hour peak gust, or 225-mile per hour winds and driving rain; fire-resistant fiber cement board siding; interlocking concrete roof tiles affixed to the roof with screws capable of resisting wind borne debris from a category 5 hurricane; underlined ZIP roof decking, ICP seaming, and spray foam; hurricane ties connecting walls to each other, connecting the walls and the roof, and connecting the structure and its foundation; windows installed with safety glass designed to withstand impact from flying debris; a reinforced concrete stairway; cast iron plumbing; and an armored electrical cable.

Designing the home as a tornado "safe room" to increase the safety of sheltering in place for the entire neighborhood: The Hurricane Strong home is one of the first single family homes in New York to pilot as a shelter in place with city emergency management.

Installing a natural gas backup generator to enhance resilience to power outages and establish the home as ready to link to a future neighborhood micro-grid: The combination of passive house net zero design features and the on-site generator make it possible to keep the house fully functioning during power outages.

"Everybody in her neighborhood of Breezy knows her house. It stands out—not because it looks different, but because of how it performs. Neighbors constantly ask about it, especially after recent storms. 'Why did all of our generators fail when yours didn't?' Her home isn't just a structure; it's a testament to resilience, sparking conversations and setting a new standard for what's possible.'"
—Illya Azaroff, FAIA, Architect, +lab Architect PLLC

Organizing the design process as a demonstration project to lead to numerous guidance documents and case studies, all aimed at making climate resilient design standard practice for residential buildings: Construction videos, diagrams, case studies, and project documentation were disseminated by industry partners, non-profit educational organizations like FLASH and AIA, and the New York State Climate Impacts Assessment.

"I've never seen a resilient home like this. Weaving everything together into one platform with so much documentation of process is significant. It's going to set the standard for resilient building practices."
—Joel May, BASF, contractor (Wired, 2019)

Decarbonization

Meeting passive house standards to lower the home's energy demand to near net zero: Passive house design features included an insulated slab and roof, as well as a wall system with spray foam insulation,

Integrating passive design features to reduce the home's energy demand: The placement of windows maximizes daylighting and cross ventilation—two passive features that reduce the need to run building systems.

Reducing water demand and offsetting water use with on-site rainwater strategies to reduce the home's operational embodied carbon budget: The home features dual flush toilets and low flow faucets, as well as well as minimizing the building footprint and maximizing site and landscape permeable surfaces to capture and reduce storm water runoff.

Selecting structure and finish materials that reduce embodied carbon: The 1,375-sq.-ft. T-beam floor slab used 48% less concrete than a typical slab (19 yards compared with 37 in a typical slab). Helix steel was woven into the concrete wall formwork, reducing the total quantity of rebar required for the structure. Finish materials also prioritized recycled content, such as the Trex 95% recycled wood and plastic porch decking material.

Installing a radiant floor heating and LED lighting to lower adoption barriers for energy-efficient technologies: As a demonstration project, the Hurricane Strong Home models the durability, low maintenance, and long-lasting characteristics of these highly efficient lighting, heating, ventilation, and air conditioning (HVAC) systems—many of which remain an emerging choice for single-family homes. The design's decarbonization strategies reduced total operating costs by 80% while increasing the square footage of the replacement house by 20%.

Hurricane Strong Home, Radiant floor heating installation in floor slab for thermal mass and comfort
Image Credit: +lab Architect PLLC

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Contributors

COTE Knowledge Community and AIA staff.

Special thanks

+lab Architect PLLC, interview participants.

Additional information

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