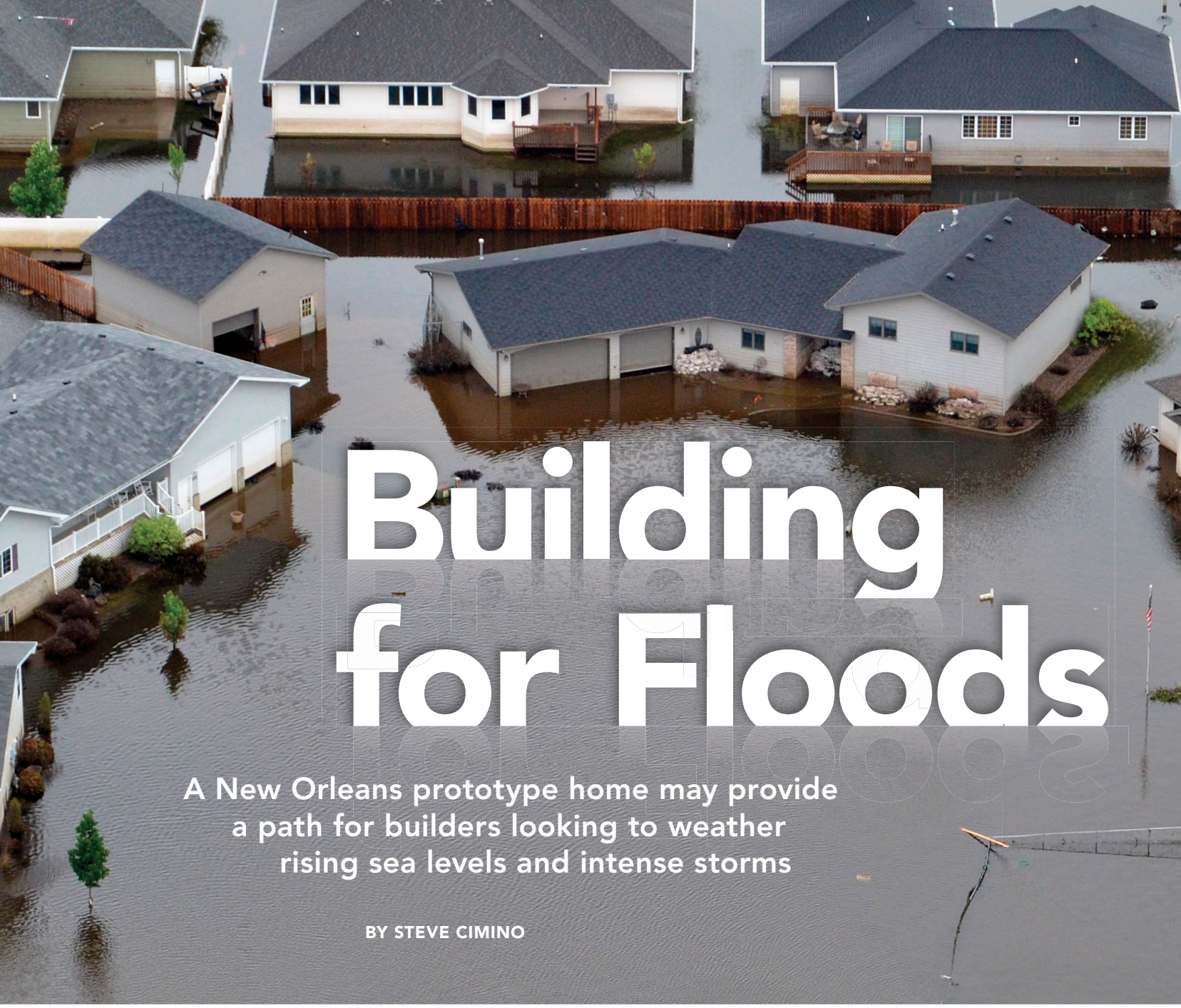


Building for Floods

A New Orleans prototype home may provide a path for builders looking to weather rising sea levels and intense storms

BY STEVE CIMINO

According to Vol. I of the Fourth National Climate Assessment, a comprehensive federal climate report released in 2017, the global sea level has risen 7 in. to 8 in. since 1900—three of those inches since 1993. A study from the National Academy of Sciences predicts that by the year 2100, global sea levels could rise by at least two more feet, resulting in more frequent and severe flooding. At the same time, storms like Hurricanes Harvey, Maria, and Florence, which set various state and national rainfall records, are increasingly responsible for catastrophic flooding.

With these floods come devastated communities. Research from the Union of Concerned Scientists estimates that as many as 2.4 million homes, worth roughly one trillion dollars, could be at risk by the end of the 21st century. As these major storms intensify and families in flood zones prepare for potential destruction, you'd think the residential design market would be teeming with plans for resilient homes that anticipate not only hurricanes but the rising waters that follow. Surprisingly, you'd be wrong—these projects remain outliers in a market in which cost is still king.

That said, a prototype for reasonably "future-proofed" homes has stood tall in New Orleans since 2010. Known as Green Dream 2, it is a single-family house built in the aftermath of Hurricane Katrina that directly answers uncertainties about how to design affordably and resiliently in areas prone to flooding. Its mere existence raises the question: Why aren't there more like it?

Strategies and hurdles

The Green Dream 2 project was led by Building Science Corporation (BSC) in partnership with the Louisiana State University Agricultural Center (LSU AgCenter). It was sparked by a request from

Photo: courtesy of Providence Journal

Portland Community College and Catholic Charities's Operation Helping Hands. It was preceded by Green Dream 1, a similar New Orleans–based project on a smaller scale that was also designed by Betsy Pettit, FAIA, and her team at BSC.

"The Green Dream concept was to build a home with not only high energy efficiency but also a resistance and resilience to local natural hazards, to a level above the code and ordinance minimums," says Claudette Hanks Reichel, Ed.D., director at the LSU AgCenter and advisor on the project.

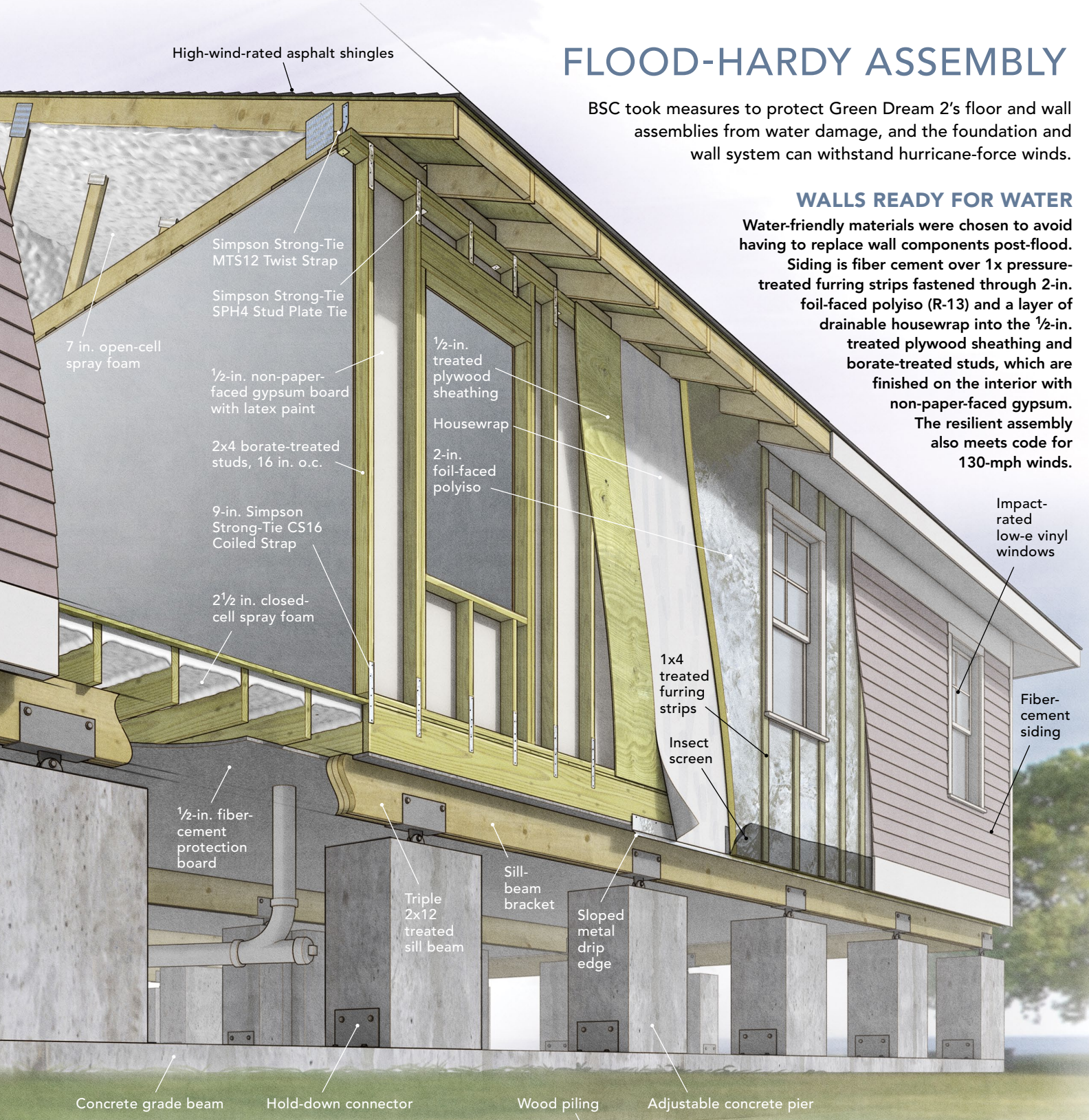
At 1944 sq. ft., the one-story Green Dream 2 house is modest in both size and presentation. It was built to "code-plus"—beyond minimum requirements—but rather than hire an engineer, BSC chose to follow the 130-mph prescriptive guide in the American Wood Council's Wood Frame Construction Manual, which provides a tested system that was fairly easy to construct. Reichel calls it a "cookbook approach" that hews more conservative but is considered builder-friendly.

Some choices were no-brainers, such as energy-efficient windows with both an impact rating and a low solar heat gain coefficient. The foundation features adjustable concrete piers on the grade beams, added to compensate for the sinking New Orleans soil. "That was a local invention and a necessity because the soil in that area is like muck," Reichel explains. "If you have uneven subsidence, instead of lifting up your house and adding shoring to the piers or the foundation, which is a major expense, you can just adjust the piers to keep everything level."

Green Dream 2 uses a closed-cell spray-foam system, which is compatible with climates like New Orleans's—where constant use of air conditioning will lead to inward water-vapor drive and inevitable decay—but takes the burden off the builders. "With closed-

FLOOD-HARDY ASSEMBLY

BSC took measures to protect Green Dream 2's floor and wall assemblies from water damage, and the foundation and wall system can withstand hurricane-force winds.



WALLS READY FOR WATER

Water-friendly materials were chosen to avoid having to replace wall components post-flood. Siding is fiber cement over 1x pressure-treated furring strips fastened through 2-in. foil-faced polyiso (R-13) and a layer of drainable housewrap into the ½-in. treated plywood sheathing and borate-treated studs, which are finished on the interior with non-paper-faced gypsum. The resilient assembly also meets code for 130-mph winds.

FLOOD-READY FLOOR

The raised 2x10 floor assembly bears on triple 2x12 beams and is insulated with closed-cell spray foam, which is more resistant to water damage than other types of insulation. Above the joists is ¾-in. treated subfloor sheathing and vinyl flooring. Below is a layer of ½-in. fiber-cement board for protection against critters.

RAISED HIGH ON PIERS

Rather than a standard foundation with flood vents, the house is built on piers, 3 ft. above grade. Wood pilings along with concrete grade beams and adjustable precast concrete piers accommodate any shifts that result from unstable clay soils. Metal saddles and bolts at the four corners of the house anchor the frame.

Drawing: John Hartman. Photo facing page: courtesy of Building Science Corporation.

cell spray foam, if there's a problem, you have to scrape it away and then either get a Froth-Pak [to patch it] or hire someone to restore it," Reichel says. "But it's an easier first install, and you can do it no matter how high off the ground you are. Plus, it's a bit less expensive than the rigid-foam-board system, when you factor in the installation cost."

Even while making strides toward buildability, the durability of the assemblies was never compromised. The house was designed to be fully flood-damage resistant, or "flood-hardy," as Reichel calls it. For instance, owing to concerns about having to replace flood-damaged OSB sheathing, the lower level is all solid wood and plywood, with spray-foam insulation and polyiso insulating sheathing used further from the ground. Although not waterproof, all of these elements are more water resilient, so in the event of a flood, "this house would be washable, drainable, and dryable, without having to cut it," Reichel says.

To protect the house's mechanical components from water damage, equipment that might normally have been located in a basement or crawlspace was installed in the unvented conditioned attic where it would be well above flood waters. This includes an air-source heat pump and inline dehumidifier—the latter is crucial to maintaining comfort and air quality in a tight home in a humid climate.

"This house would be washable, drainable, and dryable, without having to cut it."

Negotiations and complications

Even with a major disaster as the catalyst for a resilient build, getting all involved parties on the same page can be difficult. "Deciding how high these houses should be raised was very controversial," Pettit says. "A lot of people didn't agree that 3 ft. off the original grade was high enough. There was a lot of talk about flood vents, which would allow water to go through the crawlspace or a latticed-in area below. But we didn't want to trust a flood gate. Our feeling was, the more open you can make it, the better."

BSC preferred a scenario where the underside of the floor structure was the enclosure on the underside of the building, and water could go through as needed; when the Army Corps of Engineers themselves couldn't guarantee that there was a "right" elevation height, the firm stuck with 3 ft.

"When the levies failed during Hurricane Katrina, the water was 8 ft. high," Reichel notes. "At that point, you're likely getting water either way. So regardless of raising the house 3 ft. or 5 ft., the flood-hardy system was our response to that. I always remind people, if there's even the remote possibility of flooding—if you're not on a mountain—then it makes sense to make your first floor as flood-hardy as possible." Regardless of any debate over design-build specifics, Reichel sensed a genuine excitement as to what Green Dream 2 could mean for more resilient homes in the devastated community. "It was the kind of project where, if you can do it and have success with it, the word spreads, and then builders who can handle that level of work can market it," she says. "You can get ahead of the curve and sell it as preventative instead of essential."

What will trigger residential resilience?

Recent hurricanes in Houston, Puerto Rico, and the Carolinas have decimated neighborhoods and reinforced the need for resilient designs. So why isn't the market demanding homes that can stand up to rising waters, and why aren't firms producing them?

For starters, Reichel notes that certain minimum requirements—like those that guide building elevation—are set not because they're the safest but because they're closely tied to how insurance companies determine premiums. The companies make decisions based on flood maps, which focus on the 1% probability of the 100-year flood without factoring in changes in drainage, topography, or the increasingly frequent storms that accompany climate change. "These required elevations provide an insufficient level of protection," she says, "yet we adopt them as a building standard."

Another obstacle is cost. "Closed-cell foam insulation is more expensive than a fibrous product," Reichel says, noting that treated wood adds cost, as does using plywood instead of OSB. This matters in a modest home market. "Getting into a decent home that accommodates a family's needs is tight enough; additional costs make it even more challenging."

"I think the architecture community is quite interested in resilience," she adds, "but they don't do a lot of single-family housing below the high-end market. Those that are for middle incomes and below are done by builders. And builders are understandably risk-averse and have low margins; it's a competitive business to be in. It is difficult for them to change unless the market is really demanding it."

Pettit concurs, noting that her firm isn't the only one that has embarked on forward-thinking residential projects like Green Dream 2 but also that others don't readily come to mind. "The codes have to spark change," she says. "That's really the only thing that will make a builder, a developer, or even an architect do anything different. But changing codes requires a lot of evidence-based research, and we're one of the few industries that doesn't invest a portion of profits in R&D."

Eventually, homes that are up against large bodies of water will need to be renovated or redesigned—with these principles of resilience and durability at the forefront—or risk ruin. But for now, projects like Green Dream 2 stand out as precursors for the inevitable evolution in climate-centric residential design. □

Steve Cimino is a Los Angeles–based writer and editor.