

# ENR

Engineering News-Record

**SPECIAL REGIONAL COVERAGE**

STARTS ON PAGE CA1

# California



# BUILDING RESILIENCY

RETOOLING TO RESIST NATURAL HAZARDS (P. 28)

**INSIDE** THE TOP 200 ENVIRONMENTAL FIRMS



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**SPECIAL REPORT**

**THE TOP 200 ENVIRONMENTAL FIRMS**

**35** Resurging real estate and accelerating energy work are among positive market trends, even as tighter public budgets and global politics challenge participants.

Cover photos by AP Wideworld; image right courtesy of Bechtel National



**FIRED UP** Work proceeds on construction of a \$12-billion nuclear-waste treatment plant at the Hanford federal site in Washington state. The building pictured is 65% complete, says Bechtel.

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**Too Little Progress**

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# HELP WANTED

**A call is out for a national resiliency 'czar' to champion and coordinate diverse building initiatives** By Nadine M. Post

Looking for free building-vulnerability assessment tools? The Dept. of Homeland Security's web pages offer plenty. Details on federal resilient-building initiatives can be found on FEMA's website. For those seeking post-Superstorm Sandy advice from insurers or architects, websites such as [disastersafety.org](http://disastersafety.org) and [postsandyinitiative.org](http://postsandyinitiative.org) offer up plenty of material to download.

Anyone doing a web search using keywords such as BOMANY, ASCE/SEI, NIST, NIBS, AIA, ASHRAE, ICC or NFPA will discover thousands of results on almost any subject related to resilient buildings. Scores of posted reports, advisories and guides on adapting buildings and communities to extreme natural hazards—hurricanes, high winds, floods, storm surges and



wildfires at the urban edges—are available to anyone after just a few clicks. But web searches on the implementation of these resiliency methods yield far less.

Sites that sell removable building barriers and hardened houses are scattered across the web, including plenty with material about amphibious buildings. There is even design guidance for tornado- and tsunami-resistant structures.

Multihazard-mitigation and adaptation planning is not new. Risk-assessment tools and services have been available for years. But Sandy's unprecedented storm surge last Oct. 29, which swamped the coastal Northeast—including Lower Manhattan—turned the private sector's attention, as never before, toward resilient commercial buildings. Rebuilding and retrofit



planning exploded for all sorts of occupancies.

Though there are dozens of initiatives around resilient buildings, some say there has been little progress toward resiliency. "The U. S. has been somewhat paralyzed in the development of an effective building-resiliency response by the extreme politicizing of the topic of climate change," says Ben Sandzer-Bell, chief resiliency officer for Climate Adaptation Solutions. "The level of political toxicity prevents effective engagement by a large segment of the American body politic, industry, academia, NGOs and media."

One consequence of this "toxicity," says Sandzer-Bell, is the absence of national coordination linking diverse initiatives, which results in a failure to achieve a whole that is greater than the sum of its parts.

He has a solution. "The Obama administration ... can provide [non-partisan] national leadership through the establishment of a building resilience 'czar' with coordinating authority to [seek] synergies and highlight gaps in current work by uncoordinated public- and private-sector actors," says Sandzer-Bell.

Robet C. Wible, a building regulatory reform consultant, agrees. "We cannot afford to keep reinventing wheels, spending precious public- and private-sector funds and staff time on duplicative and, at times, conflicting actions," says Wible. "We need someone and some place to connect the dots."

Wible envisions a resiliency ombudsman who would report to the president or vice president and be

**UPLIFTING IDEA**  
Finalist scheme in an ongoing AIA NY-led design competition protects an 80-acre waterfront village by elevating the streetscape.

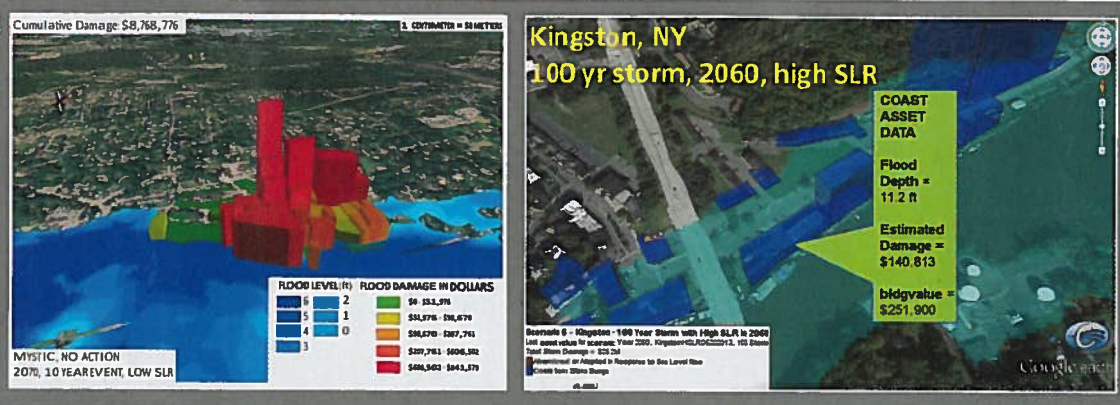
**MOVING IN**  
Removable flood barriers for commercial buildings are designed to be installed or stored, as needed.

housed with a staff in the Office of Science and Technology Policy. The OSTP is linked to the existing National Science and Technology Council's Committee on Homeland Security and its subworking group, which consists of representatives from federal agencies that build. The ombudsman would coordinate with stakeholder associations, professional societies, academia and groups representing state, regional and local government.

A presidential appointment would be helpful because, currently, there is no central clearinghouse, place for discussion or ability to understand the big picture, agrees Ryan Colker, adviser to Henry Green,



**FREE SOFTWARE**  
COAST, or Coastal Adaptation to Sea Level Rise Tool, is built on six years of research led by the New England Environmental Finance Center at the University of Southern Maine's Muskie School of Public Service.



## AMPHIBIOUS-HOUSE PROMOTER IS ON A CRUSADE FOR NEW HOMES AND RETROFITS THAT GO WITH THE FLOW

**ELIZABETH C. ENGLISH** holds four advanced degrees—including a PhD—in architecture, urban planning and engineering. She has taught at 10 institutions of higher learning. But after more than six years, she still hasn't been able to get her solution for amphibious flood-resistant buildings off the ground—at least in the U.S.

The barrier is that amphibious houses with buoyant, boat-like foundations sit on dry land most of the time. In a flood, they float, rising in place along stationary guide posts. In the U.S., houses that rise and fall with flooding are not eligible for inexpensive National Flood Insurance because they do not meet the requirements for permanent static elevation above the zone's base flood elevation.

Undaunted, English is pushing for a reinterpretation of the statutes of the insurance program, which is administered by the U.S. Dept. of Homeland Security's Federal Emergency Management Agency. Her latest hope is a submission by the Buoyant Foundation Project (BFP),

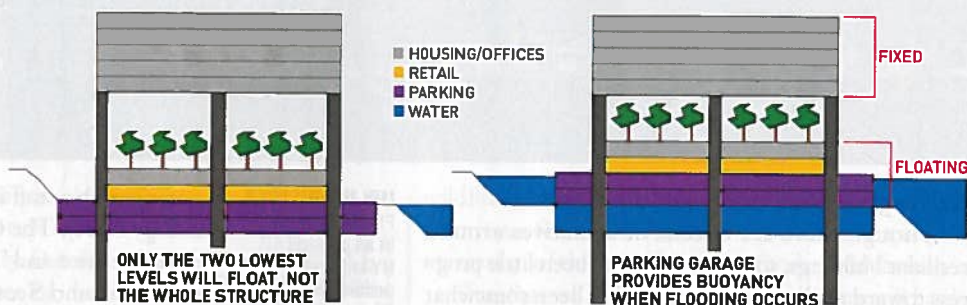
a non-profit she founded and directs, to the U.S. Dept. of Housing and Urban Development's "Rebuild by Design" competition. At ENR press time on Aug. 5, English was on tenterhooks, waiting for HUD's Aug. 9 announcement of the competition's 10 winners.

"I haven't given up. I think there is an air of change," she says. Meanwhile, English and her BFP team have expanded their sights and sites to Latin America. Later this year or early next year, work is expected to begin on a prototype for a 10-house pilot project in Titicaca, Nicaragua, funded by the government.

The simple, affordable houses, which will allow the indigenous population to continue life near the water rather than relocating against their will to higher ground, will be built from kits of bamboo (see rendering, p. 32). "The challenge is coming to market with a solution that is affordable," says Ben Sandzer-Bell, a BFP team member and chief resilience officer for Climate Adaptation Systems.

### STREETSCAPE SAVIOR

The Buoyant Foundation Project's concept for a hybrid multistory building would preserve the streetscape during dry times. Only the lower levels would float up during a flood. The upper stories would bear on freestanding columns and remain static.



SOURCE: BUOYANT FOUNDATION PROJECT

National Institute of Building Sciences president.

The Insurance Institute for Business & Home Safety, which is about to update its 2011 report rating state residential building-code and enforcement systems for life safety and property protection in hurricane-prone regions, paints a different scenario. IBHS supports the U.S. Commerce Dept.'s National Institute of Standards & Technology (NIST) as coordinator. It promotes forming an interagency coordinating committee on windstorm and flood-impact reduction to augment federal earthquake programs and a national advisory committee on natural-hazard impact reduction that would exclude federal employees.

That could happen. Proposals were due on July 25 for a federal funding opportunity (FFO) for an engineering laboratory cooperative-agreement program within NIST for disaster resilience of buildings, infrastructure and communities. "I have confidence the FFO will provide a road map to get everyone on the same page," says Robert E. Solomon, the National Fire Protection Association's division manager for codes.

Not everyone supports a resiliency czar. "I am not in favor of making large government even larger," says



Dennis J. Wessel, senior vice president at Karpinski Engineering and an ASHRAE director.

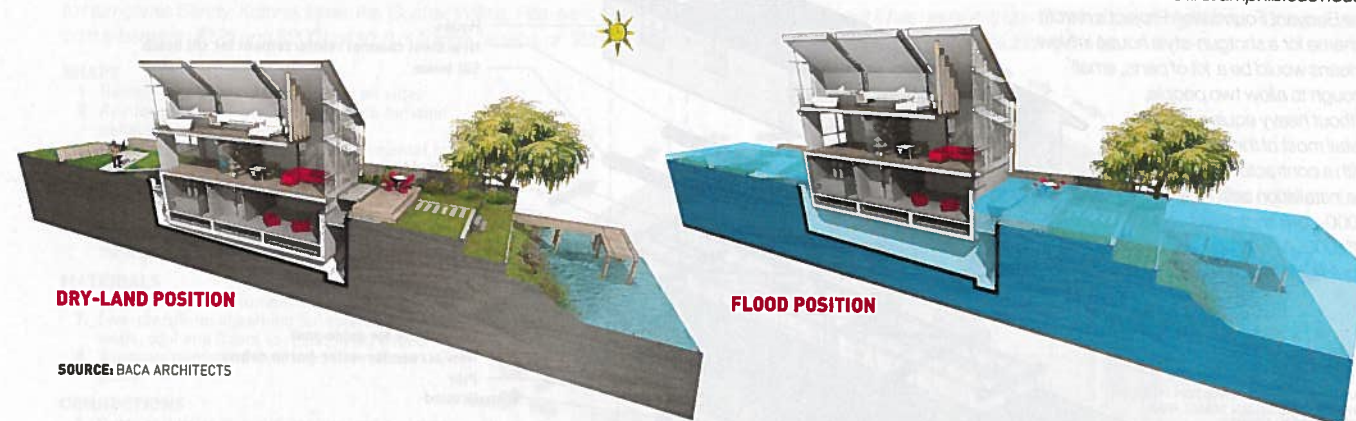
Others say there is no need for a czar because Florida and the Gulf Coast states—with Georgia, South Carolina and North Carolina—charted the resiliency course by adopting stringent codes, test protocols and guidelines after 1992's Hurricane Andrew and 2005's Katrina. "Lessons learned after Andrew and Katrina are similar to those that [people in] the Northeast are facing, except [the Northeast is] at the epicenter of news media outlets creating news perceived as unique," says Michael Lingerfelt, a private-practice architect in Orlando and 2013 chairman of the American Institute of Architects disaster-assistance committee.

Mechanical engineer Joseph Lstiburek, a principal of Building Science Corp., agrees. "We're pretty good at this already," he says. "Just look at Florida."

But Sandy's surge exposed the never-considered vulnerabilities of commercial buildings and critical facilities and raised the specter of costly retrofits. Businesses in flood-prone areas started looking to design professionals for low-cost ways to protect assets.

This a "critical time," says Cooper Martin, AIA's

### THAMES ISLAND RESILIENCE Set to be completed next year, a house on a small island in the Thames will be the U.K.'s first amphibious house.



DRY-LAND POSITION

FLOOD POSITION

SOURCE: BACA ARCHITECTS

The Titicaca house is expected to cost about \$20,000.

In 2007, the BFP tested a prototype for amphibious retrofits of shotgun-style houses in New Orleans (see drawing, p. 32). The system would come as a kit of small-enough parts that most of it would be able to be installed by two people without heavy equipment—for about \$10,000. Full installation by a contractor would cost about \$20,000 for a maximum 1,000-sq-ft shotgun house. "We can say it would cost \$20 to \$25 per square foot or probably less over time with more experience," says English.

The largest installation of amphibious houses is in the Netherlands at a project called Maasbommel, built in 2007 (see photo, p. 33). In a 2012 flood, the 16 houses performed very well, with no damage, says Chris Zevenbergen, managing director for business development at Maasbommel's builder, Dura Vermeer Group NV. There are plans for

more than 40 more houses in two other projects, he says.

Maasbommel foundations consist of a small concrete bowl within a bigger, fixed bowl. When the bigger bowl fills with water, the smaller bowl floats. Vertical posts guide it. "The buoyant systems are fabricated elsewhere and transported to the site," says Zevenbergen.

Amphibious buildings are starting to catch on. Work has begun on the U.K.'s first amphibious house, designed by Baca Architects. Completion is expected next year. The house is located on an island in the Thames in Marlow, Buckinghamshire.

There are no amphibious high-rises. That will change, if English has her way. In her scheme, fixed upper levels would bear on two-story-tall freestanding columns above amphibious levels, possibly topped by a green roof. The scheme is ideal for low-lying cities because it doesn't destroy the streetscape, says English. ■

director of resilient communities. "If designers don't provide solutions, insurance companies are going to drive change by raising rates and driving whole communities out of their homes," he says. Martin calls this "the messiest and most inhumane way to achieve resilience."

Elizabeth English, founder-director of the non-profit Buoyant Foundation Project, knows about the power of insurance. She has been on a six-year crusade for amphibious houses and retrofits (see facing page). The buildings are currently not eligible for inexpensive National Flood Insurance, administered by the U.S. Dept. of Homeland Security's Federal Emergency Management Agency, because they are not permanently elevated.

"I haven't given up," says English. "FEMA is interested in [being] more flexible, which is very hopeful."

Making buildings resilient is not rocket science, say Lingerfelt and Lstiburek: Waterproof the foundation, zip up the envelope, tie the roof to the walls, elevate or waterproof critical systems and build at least the first floor from a strong, water-resistant material.

Lingerfelt says there is devastation with each storm

because 90% of residential construction in the U.S. is not designed by a licensed professional. The situation is further aggravated by the absence of codes in many places and poor enforcement in others.

"This isn't an engineering problem. It's a code-enforcement problem," Lingerfelt says.

Some question whether even Florida's code will work in the future. "Maybe the road followed is not indicative of the road ahead," says Chris Pyke, the U.S. Green Building Council's research vice president.

For USGBC, resilience is part of sustainability. "We need to be sure we are designing buildings and infrastructure for the plausible experience of the system over its lifetime," adds Pyke. "This is a standard-of-care issue as much as it is a code issue."

Timothy A. Reinhold, IIBHS' senior vice president for research, agrees. There are issues with how structural engineers address surge and flooding because design is based on historical weather data, he says.

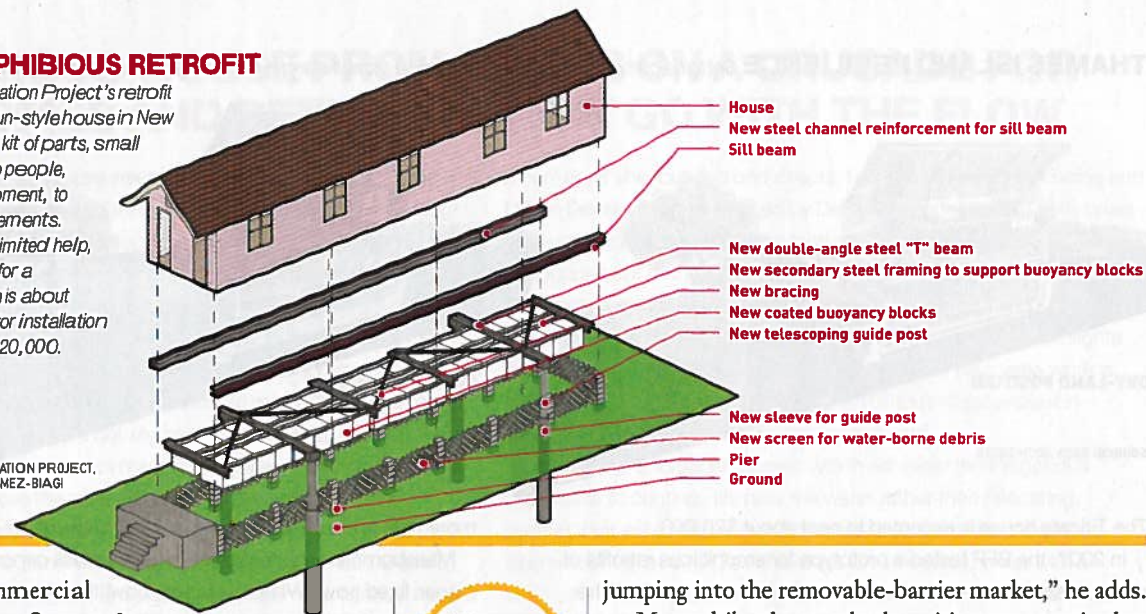
But Wessel says it's not possible to predict the future, and current energy models already allow adjustments for weather. Designing for the worst-case scenario results in inefficiency and extra expense, he says.



## TESTED AMPHIBIOUS RETROFIT

The Buoyant Foundation Project's retrofit scheme for a shotgun-style house in New Orleans would be a kit of parts, small enough to allow two people, without heavy equipment, to install most of the elements. With a contractor's limited help, the installation cost for a 1,000-sq-ft shotgun is about \$10,000. A contractor installation would cost about \$20,000.

SOURCE: BUOYANT FOUNDATION PROJECT. RENDERING BY JULIAN GOMEZ-BIAGI AND ELIZABETH FENUTA.



On the commercial side, the Building Owners & Managers Association of Greater New York Inc. has been working with the office of Mayor Michael Bloomberg (R) and the New York City Council on pending legislation, prompted by Sandy, to amend zoning and building codes. "We are supportive of the aims of the legislation to move emergency generators, fuel pumps and other critical building systems and are providing the practical side of how the provisions would work," says Sylvester A. Giustino, BOMA NY's director of legislative affairs.

Not too many owners are rushing to move systems to higher ground. "It comes down to whether there is space available and how much revenue will be lost," says John Brandstetter, BOMA NY's weather-response subcommittee chairman and managing director of the building-resiliency-planning and flood-risk-mitigation consultant that bears his name.

The bigger discussion among existing building owners—driven by insurance companies—is how to stop the water from getting inside in the first place, says Brandstetter. In reaction, "a lot of people are



**BUOYANT BAM-BOO** Design for an amphibious house framed in bamboo, including the buoyant foundation, is for a pilot project in Nicaragua. The cost would be \$20,000.



jumping into the removable-barrier market," he adds.

Meanwhile, the standards-writing community has been busy for some time working on extreme-weather issues. The Structural Engineering Institute of the American Society of Civil Engineers is discussing new wind-speed maps for critical and essential facilities. And SEI even expects to include a chapter on tsunami load effects in the 2016 edition of ASCE/SEI 7.

For the first time, the 2015 edition of the model International Building Code (IBC) includes a mandatory storm-shelter provision for certain occupancies, such as schools. FEMA has a program subsidizing construction of shelters, which they call "safe rooms."

The next IBC also will have flood-related provisions tied to new risk categories for coastal zones. And stricter wind-load provisions for vertical glazing are coming in the 2015 IBC.

Digital tools to help assess vulnerabilities to all hazards are available for free from the U.S. Dept. of Homeland Security's Science and Technology Directorate.

Some are developing resilience ratings. FEMA has trademarked "Resilience STAR" for resilient products, styled after the U.S. Dept. of Energy's Energy STAR program. The U.S. Resiliency Council has a prototype for a Certification of Resilient Engineering rating, styled after the USGBC's LEED green-building rating. Eventually, CoRE will assess safety, reparability and functionality under all hazards. But the first generation will address only earthquake risk.

IIBHS's Reinhold is leery of credit-based ratings. Resilience must be evaluated holistically, he says. A weak link can negate resiliency, even if a rating is high.

"It is interesting to consider a LEED pilot credit around a third-party criteria, like Resilience STAR," says USGBC's Pyke. "However, we need these efforts to come into sharper focus before we can take action."

The U.S. Dept. of Housing and Urban Develop-

**HARDENED HOUSE** Deltec Homes has built some 1,000 homes in coastal areas of the U.S. and the Caribbean since 1968. They have been subjected to Hurricanes Sandy, Katrina, Irene, Ike, Gustav, Wilma, Rita, Ivan, Charley and Andrew. Deltec says it has never lost one of its houses to high winds. Construction cost is between \$125 and \$200 per sq ft of finished space, or \$250,000 to \$400,000 for a 2,000-sq-ft house, not including the lot.

### SHAPE

- 1 Resists wind pressure buildup on all sides
- 2 Reinforced clear-span roof has pitch for wind deflection and reduced lift
- 3 Circular structure transfers environmental loads efficiently and is redundant for better performance

### ENGINEERING

- 4 Radial truss array in roof and floors
- 5 Potential sustained wind energy is dispersed throughout structure

### MATERIALS

- 6 2,400-psi framing lumber in trusses and walls
- 7 Five-ply 5/8-in. sheathing for exterior walls, roof and floors to resist flying debris
- 8 Windows reinforced with impact-resistant glass

### CONNECTIONS

- 9 Oversized truss hangers anchor roof system to walls
- 10 Multiple construction ties from walls to floors to transfer shear forces
- 11 Continuous metal strapping from roof trusses to foundation

### SUSTAINABILITY

- 12 Solar water heater
- 13 Enhanced insulation
- 14 High-wind-rated reflective metal roof
- 15 Passive solar design

SOURCE: DELTEC HOMES/DELTECHOMES.COM



ment's Hurricane Sandy Task Force is set to release its rebuilding strategy on Aug. 19. HUD announced, on Aug. 9, the 10 winners of its regional "Rebuild by Design" competition to promote innovation in resilient buildings. HUD plans to fund construction of the winning concepts using some of the \$15.2 billion in community-development block grants the U.S. Congress appropriated for post-Sandy rebuilding.

There are local contests, too. On Oct. 24, AIA New York will announce the winner of the "For a Resilient Rockaway" competition to garner ideas for a sustainable community on an 80-acre waterfront site in Queens.

On June 13, AIA and Architecture for Humanity announced an ideas competition for resilient communities. And on May 7, FEMA announced 30 recipients of up to \$35,000 in seed money from the FEMA 2012 Community Resilience Innovation Challenge.

In June, President Obama directed federal agencies

to make sure any new project funded with taxpayer dollars is built to withstand increased flood risks. To help, the National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers released a sea-level-rise planning tool that provides users with information about future risks of coastal flooding in parts of New York and New Jersey.

"We are all still taking baby steps when it comes to understanding what resilient communities really are and what resilient standards might look like in the future," says Kevin Shanley, CEO of landscape architect SWA Group. "For now, it's really perfect that so many people are talking about the issues and are exploring possible solutions."

"The optimal strategies should emerge from this outwardly confusing but ultimately efficient creative effort," Shanley adds. "In time, standards-setting bodies can adopt the best approaches." ■

### VETERAN FLOATERS

Amphibious houses (left) in Maasbommel, The Netherlands, float through floods on buoyant foundations (right). They were built in 2007.

