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Inspectors assess the damage to a home on the Florida coast following Hurricane Matthew, which struck in October 2016.

Photo courtesy of FEMA.

Building to better weather the storm

New dashboard developed by the MIT Concrete Sustainability Hub helps builders calculate the breakeven cost of hazard mitigation in hurricane-prone areas.

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The Atlantic hurricane season has officially begun and the National Oceanic and Atmospheric Administration (NOAA) is predicting “above normal” storm activity this year. That could mean significant damage to coastal communities — some of which are still recovering from last year’s hurricane season.

As officials in hurricane-prone communities are calling on residents to be prepared for upcoming storms, researchers with the MIT Concrete Sustainability Hub (CSHub) are encouraging officials to make preparation a priority from the very earliest stages of building design, starting with data-driven changes to building codes.

To help, CSHub has developed a new dashboard that lets users calculate, on a county-by-county basis, the right amount to spend up front on hazard mitigation for residential buildings in hurricane-prone communities along on the U.S. East and Gulf coasts. The tool lets users determine how much can be invested in mitigation during construction while still breaking even on future repair costs, and is based on case studies that employed the CSHub’s Break-Even Mitigation Percentage (BEMP).

“Designing homes and buildings in hazard-prone areas with the expectation that damage will

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occur can make communities safer and reduce the costly repairs that follow extreme weather events," says Jeremy Gregory, executive director of the CSHub. "In areas prone to natural disasters, more spending on mitigation is absolutely justified. The BEMP helps to identify how much extra spending is recommended, and the dashboard makes it faster and easier to see that calculation."

Mehdi Noori, a CSHub postdoc, is the developer behind the dashboard and is now leading the effort. The CSHub team introduced the BEMP calculation last year when the project was headed by researcher T. Reed Miller, who is now a PhD student at Yale.

"Through the BEMP and the dashboard, we're offering a more scientific approach to support investment in hazard mitigation," Noori says.

The BEMP uses publicly-available data about hazards in a given area and employs fragility curves to determine the impact of those hazards on a given structure. The dashboard tool allows users to calculate the break-even cost for a change from a baseline wood design to an enhanced concrete design for a multi-family residential building.

Noori says preliminary results of the analysis indicate that the BEMP is higher in areas near the coasts. In Florida's Miami-Dade and neighboring Monroe counties, for example, an extra amount equaling around 17 to 18 percent of initial total investment could be spent on hazard mitigation and still result in break even costs over the lifetime of the building. Even so, some communities inland "would also benefit from windstorm mitigation mechanisms," Noori says.

Noori notes that there were 15 weather and climate disasters in the U.S. last year that each had losses exceeding $1 billion. Losses due to extreme weather events, including hurricanes, could again be significant this year.

An average season produces 12 named storms of which six become hurricanes, including three major hurricanes. According to NOAA, forecasters are predicting "a 70 percent likelihood of 11 to 17 named storms" with winds of 39 mph or higher. Of those, five to nine could become hurricanes with winds of 74 mph or higher, including two to four Category 3, 4, or 5 hurricanes with winds of 111 mph or higher.

Across the country, builders make decisions about which materials or techniques to use first with costs in mind. Although the resulting structures are technically built to code, in many hazard-prone communities the long-term costs of repairs and the impact of those early decisions mean greater financial burdens for future owners and the community at large.

"In some areas of the country, coastal communities especially, hazard-induced maintenance costs can be significant over a building's lifetime — sometimes even exceeding the initial building cost," Gregory says. "Our goal through this project is to drive the widespread adoption of codes that take hazard mitigation into account. By adopting stronger codes, communities can reduce recovery costs and also lessen the impact on human lives."

CSHub's work also includes pavement and concrete science research and seeks to reduce the impact of the production and use of concrete. It also develops tools that support

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infrastructure decisions, including life cycle environmental impacts, life cycle costs, and hazard resistance. CSHub research is supported by the Portland Cement Association and the Ready Mixed Concrete Research and Education Foundation.

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