CSHub
MIT CONCRETE SUSTAINABILITY HUB

BUILDING RESILIENCE - HAZARD MITIGATION

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Natural disasters cause billions of dollars of damage to our nation's infrastructure every year. While builders generally make decisions about materials and techniques with upfront costs foremost in mind, the long-term cost of repairs in hazard-prone communities can generate increased financial burdens for both building owners and communities. Factoring resilience into building design can help reduce lifetime repair and maintenance costs in hazard-prone areas and allow communities to recover more quickly from a disaster.

Life cycle cost analysis (LCCA) provides a framework that building designers can use to consider and mitigate future economic impacts. The CSHub LCCA approach incorporates a risk-based analysis of hazards specific to a building's geographic area:

- Between 1996 and 2014, damages in the US due to hazards (hurricanes, tornadoes, floods, earthquakes, etc.) totaled over $377 billion, according to the National Weather Service.
- In areas that are most vulnerable to natural hazards, hazard-related repair costs can exceed the initial costs of building a structure.
- Hazard-related repair costs are estimated by combining the probability that a hazard will occur with the expected damage from the hazard over the life cycle of the building.

CSHub's Break-even Mitigation Percentage (BEMP) calculation provides a risk management tool for communities to determine the break-even point for investments in mitigation.

- The calculation provides a suggested amount to spend (expressed as a percentage of initial building costs) given the possibility of future damage.
- The BEMP uses publicly-available data about hazards in a given area.

This research was carried out by CSHub@MIT with sponsorship provided by the Portland Cement Association and the Ready Mixed Concrete Research & Education Foundation. CSHub@MIT is solely responsible for content. Published May 2018.

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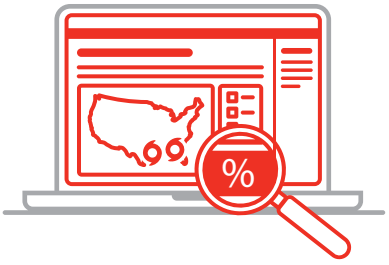

The CSHub's interactive BEMP "dashboard" helps building designers and owners calculate the risk and level of investment for residential buildings in hurricane-prone communities along on the U.S. East and Gulf coasts. Visit the dashboard at **https://cshub.mit.edu/bemp-dashboard**

- Users can calculate the break-even cost for a change from a baseline wood design to an enhanced concrete design for a multi-family residential building.
- In New Orleans, the BEMP was found to be 8.4%, meaning $714,000 could be spent on mitigation for an $8.5M midrise apartment building—and break even over the building life.
- The highest BEMPs are in cities in southeastern Florida, where the values are approximately 18%.

ABOUT MIT CONCRETE SUSTAINABILITY HUB

The MIT Concrete Sustainability Hub, CSHub, is a dedicated interdisciplinary team of researchers from several departments across MIT working on concrete and infrastructure science, engineering, and economics since 2009. The MIT CSHub brings together leaders from academia, industry, and government to develop breakthroughs using a holistic approach that will achieve durable and sustainable homes, buildings, and infrastructure in ever more demanding environments.

To learn more, visit **https://cshub.mit.edu/**.

RESILIENCE CASE STUDY: NEW ORLEANS

- CSHub researchers compared the 50-year performance of a conventional design with an enhanced design for a two-story, wood-frame, single-family townhouse with 1800 square feet living area and attached two-car garage in the hurricane-prone city of New Orleans.
- Construction of the enhanced building is based on a higher standard intended to mitigate the impacts of hurricanes, which involves:
  - Increasing the nail size in roof panels
  - Increasing the resistance of roof shingles
  - Using windows with higher thickness
  - Using stronger hurricane clips for roof to wall connections
- The New Orleans analysis found that the expected cost of maintenance due to damage from hazards over a conventional building's lifetime can exceed initial construction costs.
- By contrast, the enhanced building has slightly higher initial costs but significantly lower hazard maintenance costs.

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