



For Hurricane Surge, Designing to Exceed 2015 Codes Provides \$7 Benefit for Each \$1 Invested

Introduction

Natural hazards present significant risks to many communities across the United States. Fortunately, there are measures governments, building owners, developers, tenants and others can take to reduce the impacts of such events. These measures—commonly called mitigation—can result in significant savings in terms of safety, prevent property loss and disruption of day-to-day life.

The National Institute of Building Sciences Multihazard Mitigation Council (MMC) undertook a study in 2017 to update and expand upon the findings of its *2005 Mitigation Saves* study on the value of mitigation. In the *2017 Interim Report* (now incorporated into the *2018 Interim Report*), the project team analyzed two areas of mitigation programs:

- **Federal grants:** The impacts of 23 years of federal grants made by the Federal Emergency Management Agency (FEMA), Economic Development Administration (EDA) and the Department of Housing and Urban Development (HUD), resulting in a national benefit of \$6 for every \$1 invested..
- **Beyond code requirements:** Designing new structures to exceed select provisions of the *2015 International Building Code (IBC)* and *International Residential Code (IRC)* and the adoption of the *2015 International Wildland-Urban Interface Code (IWUIC)*. This resulted in a national benefit of \$4 for every \$1 invested.

Results of Exceeding Code for Hurricane Surge

Building new single-family dwellings higher above the base flood elevation (BFE) than the 1-foot required by the 2015 IRC appears to be cost-effective in coastal surge areas identified as V or VE by FEMA in all states. Surge in coastal V-zones is different from riverine flooding, and so its costs and benefits are different.

When the incrementally efficient maximum (IEMax) increase in building height is assessed on a state level, the aggregate BCR (summing benefits and costs over all states) is approximately 7:1, e.g., \$7 saved for every \$1 spent to build new coastal buildings in V- and VE-zones higher above the shoreline. It would cost approximately \$7 million extra to build all new buildings to the IEMax elevation above BFE for one year, and would produce approximately \$51 million in benefits.

Table 1 provides BCRs for each natural hazard the project team examined. Figure 1 shows the overall ratio of costs to benefits for the design of new buildings to exceed hurricane related coastal flooding requirements of the 2015 IRC. The IEMax additional height varies by state, as illustrated in Table 2. The results strongly suggest that greater elevation of new coastal single-family dwellings in V-zones is widely cost-effective. All states have an IEMax building height above code of at least 5 feet. These costs and benefits refer to building new coastal single-family dwellings higher above BFE, not of elevating existing houses. The project team aggregated state and local BCRs to determine the national-level BCR. The costs reflect only the added cost relative to the 2015 IRC.

Mitigation Saves:

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The stringency of codes adopted at the state and local level varies widely. The project team used the unamended 2015 IBC and IRC as the baseline minimum codes for this study. While minimum codes provide a significant level of safety, society can save more by designing some new buildings to exceed minimum requirements of the 2015 Codes. Where communities have an older code or no code in place, additional costs and benefits will accrue. If all new buildings built the year after were also designed to exceed select I-Code requirements, the benefits would be that much greater, in proportion to the quantity of new buildings.

National Benefit-Cost Ratio Per Peril <small>*BCR numbers in this study have been rounded</small>		Federally Funded	Beyond Code Requirements
Overall Hazard Benefit-Cost Ratio		6:1	4:1
Riverine Flood		7:1	5:1
Hurricane Surge		Too few grants	7:1
Wind		5:1	5:1
Earthquake		3:1	4:1
Wildland-Urban Interface Fire		3:1	4:1

Benefit: \$51 million

- 68% – Property: \$35.0
- 14% – Living expenses, sheltering: \$7.0
- 12% – Insurance: \$6.0
- 6% – Indirect business interruption: \$3.0
- 0% – Casualties & PTSD: \$0.2

millions 2016 USD

Cost: \$7 million

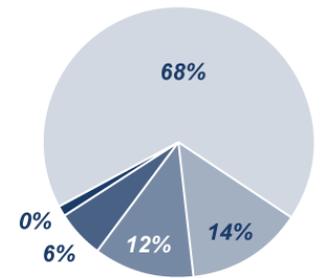


Table 1. Benefit-Cost Ratio by Hazard and Mitigation Measure.

Figure 1. Nationwide benefits by category for designing to exceed 2015 I-Code requirements for flood.

State	First Floor Height above BFE up to IEMax	BCR
Texas	+2 to 8	20.2 to 9.1
Louisiana	+2 to 10	11.3 to 4.8
Mississippi	+2 to 10	27.6 to 10.1
Alabama	+2 to 10	31.1 to 11.7
Florida	+2 to 10	21.1 to 8.4
Georgia	+2 to 6	6.7 to 3.8
South Carolina	+2 to 10	11.8 to 5.0
North Carolina	+2 to 10	12.6 to 5.2
Virginia	+2 to 6	6.7 to 3.8
Delaware	+2 to 6	6.7 to 3.8
Maryland	+2 to 6	6.7 to 3.8
New Jersey	+2 to 6	6.7 to 3.8
New York	+2 to 6	6.7 to 3.8
Connecticut	+2 to 6	6.7 to 3.8
Rhode Island	+2 to 6	6.7 to 3.8
Massachusetts	+2 to 6	6.9 to 3.9
Total		16.9 to 7

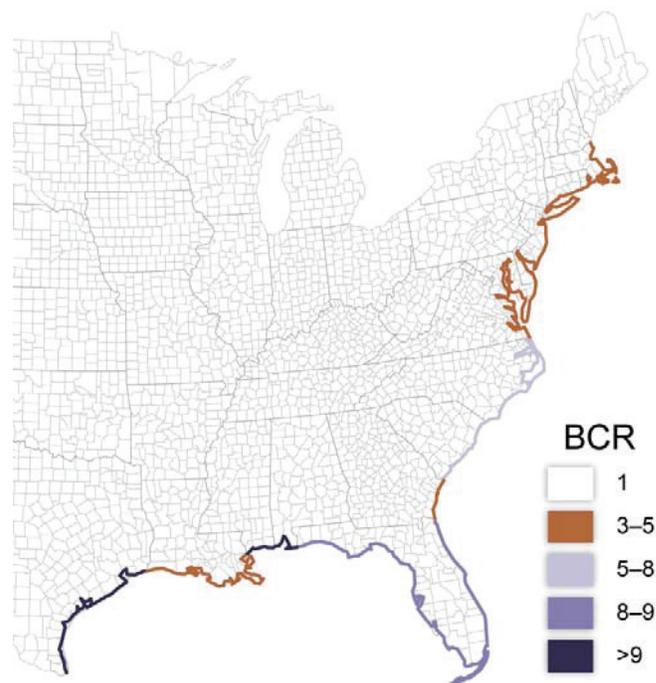


Figure 2: BCR of coastal flooding mitigation by elevating homes above 2015 IRC requirements (by state).

Table 2. BCRs for various heights above BFE for new coastal V-zone buildings up to the point where the incremental benefit remains cost-effective.