# CLIMATE CORNER

## Design for Resilience

Structures, even ones that are highly sustainable and are intended to last for generations, are becoming increasingly vulnerable to accelerating weather events. Architects are needed to design for a future that is better prepared for higher temperatures, increasing flood risks, intensifying wind patterns, and resource scarcity.

**Adaptation strategies act as a shock absorber against impacts to the built environment and to the people it serves.**

Credit: AP, Aftermath of Hurricane Helene, October 2, 2024, Chimney Rock, NC

## Determining Risk

Conducting a Vulnerability Assessment in the early design phase considers the physical, environmental, and social factors that affect the program, establishing the priority hazards and strategies to mitigate impacts from disaster events and long-term stresses. This is an interdisciplinary process involving the design team, client, and (often) the community.

### 1. Establish Parameters

Much like a conventional site analysis, this involves gathering data on the area, scale of the project, value at risk, and interdependencies. What are the geographic and property boundaries? Is it a single building, campus, or neighborhood? What services are required or provided by the building? Include demographic information, density, land use, and vegetation. If the project includes an existing building, establish the condition and compliance with current codes. Establish the anticipated service life of the project, using 100 years as the default lifespan.

### 2. Assess and Prioritize Hazards

Review the environmental and weather hazards that may impact the project site over the length of its service life: assess intensity, frequency of occurrence, area of impact, and potential duration, recognizing that sites are vulnerable to multiple hazards. Consider the probability of occurrence over the service life of the building. A good place to start are the National Climate Assessment[1] and state or local hazard mitigation plans[2] (see Resources for additional sources). Examine each hazard to determine whether it is a Routine hazard event with high probability (50% chance over 50-year period), Design-level event with medium probability (10% over 50-year period), or Extreme event with low probability (2-3% over 50-year period). Prioritize hazards from high to low based on the highest chance of occurrence and the greatest potential consequences to the project.

### 3. Determine Criticality

Essential structures should remain at least partially-functional to support response and recovery, while standard buildings should perform at a level to protect human life. What consequences or impacts should the structure (and owner/occupant) be able to sustain – insignificant, minor, significant, major, severe – and what is the expected level of performance after the event? Consider also the social value of the structure to the community as a gathering place, point of distribution, or service provider.

| National Institute of BUILDING SCIENCES | ADOPT CODE | ABOVE CODE | BUILDING RETROFIT | LIFELINE RETROFIT | FEDERAL GRANTS |
|---|---|---|---|---|---|
| Overall Benefit-Cost Ratio | 11:1 | 4:1 | 4:1 | 4:1 | 6:1 |
| Cost ($ billion) | $1/year | $4/year | $520 | $0.6 | $27 |
| Benefit ($ billion) | $13/year | $16/year | $2200 | $2.5 | $160 |
| Riverine Flood | 6:1 | 5:1 | 6:1 | 8:1 | 7:1 |
| Hurricane Surge | not applicable | 7:1 | not applicable | not applicable | not applicable |
| Wind | 10:1 | 5:1 | 6:1 | 7:1 | 5:1 |
| Earthquake | 12:1 | 4:1 | 13:1 | 3:1 | 3:1 |
| Wildland-Urban Interface Fire | not applicable | 4:1 | 2:1 | not applicable | 3:1 |



https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report

1 https://nca2014.globalchange.gov/report

2 https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/status

## 4. Establish the Value at Risk

What is the physical property value and replacement cost? What impact would be caused by the incapacity or destruction of the structure, its contents and services? What is the economic cost of lost productivity, business interruption, repair and reconstruction? What are the social impacts of relocation, sheltering, and medical services for building users?

## 5. Visualize Scenarios

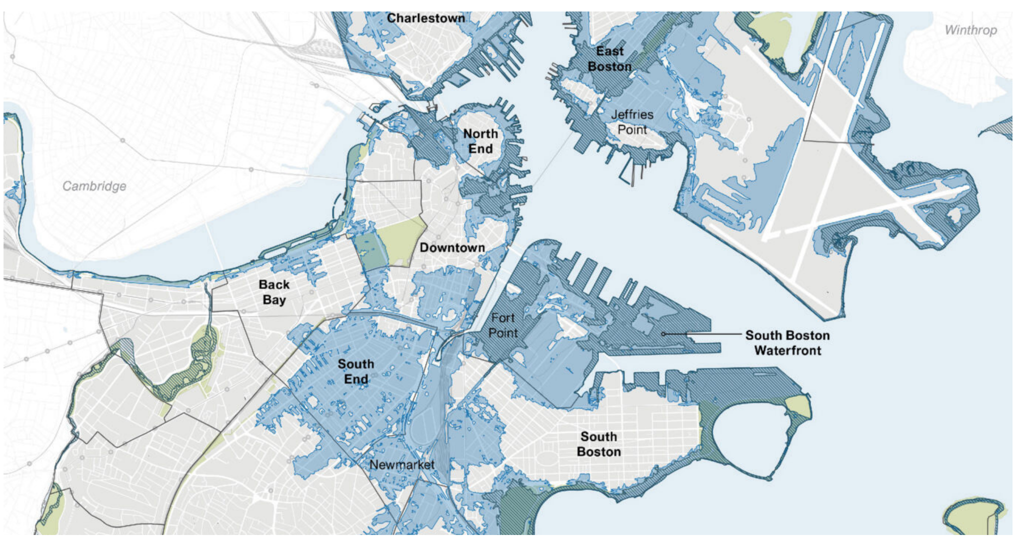
Imagine the building interacting with the priority hazards. Quantify anticipated loads over the service life of the building: wind, hydrostatic, hydrodynamic, thermal, seismic, and wildfire. For hurricanes, visualize how higher storm surge may expand velocity zones. Illustrate higher wind loads and potential uplift forces on a building roof. Consider drought tendencies and future changes to rainfall intensity to predict wildfire risk. Develop scenarios for Extreme events with catastrophic impacts and Routine events with minor interruptions to operations.

## 6. Establish Performance Goals

Most projects select a level of protection somewhere between a Routine hazard event and an Extreme event to establish the Design-basis event. Determine if the desired level of protection indicates loads higher than those in the current building code. Hazard-resilient buildings are intended to maintain occupancy and functionality with minimal repairs during and after a natural disaster. Functional recovery is the time required to recover basic functions after a disaster. What is the desired functional recovery time? Immediate occupancy may enable buildings to remain functional or to experience interim loss of function for a limited time. Re-occupancy allows safe reentry for the purposes of providing shelter or protecting building contents. Determine whether Continuity-of-Operations elements are necessary to maintain building occupation and function during and after an event.

## 7. Identify Design Strategies

Create a menu of mitigation options for each building or component at risk. For example, options to improve opening protection in a high wind region might include: replacement with impact-resistant windows; permanent or deployable shutters or hurricane fabric screens; or creating a double envelope. Each option has its own information on cost, effectiveness, and feasibility which can be used to analyze the Benefit-Cost Ratio. High-value assets may demand multiple layers of protection.




Boston Coastal Flood Resilience Design Guidelines

https://www.utiledesign.com/work/boston-coastal-flood-resilience-design-guidelines-zoning-overlay-district/

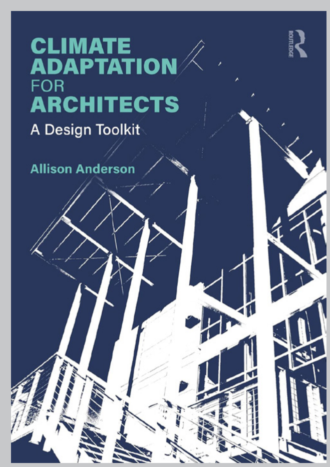
## Resilience Outlook

Flood zones will continue to expand, restricting development in coastal and velocity zones and floodplains. Flood Insurance Rate Maps (FIRM) continue to lag behind real risk because modeling is weighted toward historical events rather than future trends.

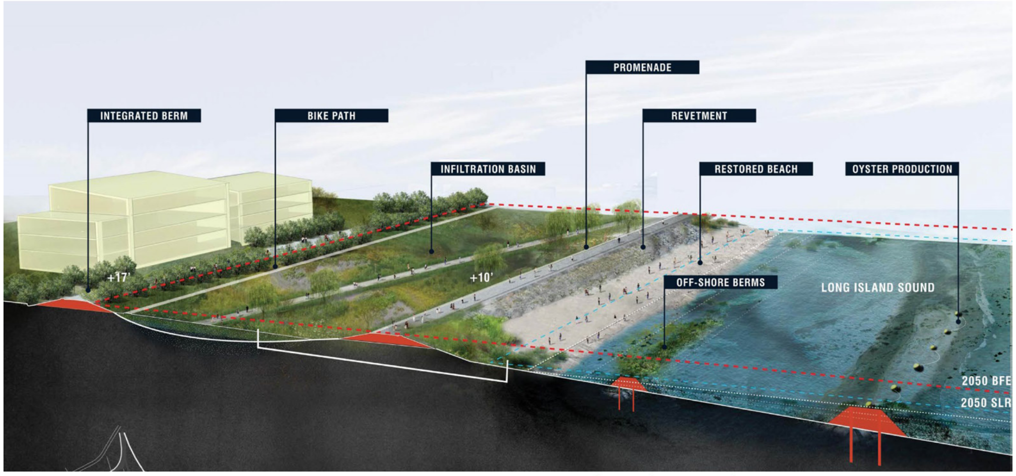
Building codes will continue to incorporate adaptation into building standards. This is a slow process due to the consensus-based process, a focus on minimum requirements, the three-year update cycle, and the slow pace of adoption (two-thirds of jurisdictions in the US have not adopted current model codes).

Conversely, insurance companies are utilizing advanced climate risk modeling to understand the potential financial impacts of climate change. They encourage architects to use future-forward climate projection data in design practice – even if not yet mandated – because the professional standard of care is rising. They may also require Climate Change Risk Information Disclosure for projects subject to hazard risks. This is in line with the Securities and Exchange Commission 2024 adoption of rules to enhance and standardize climate-related disclosures by public companies.

## FEATURED BOOK




Climate Adaptation for Architects: A Design Toolkit by Allison Anderson




Rebuild by Design: Resilient Bridgeport
https://rebuildbydesign.org/work/funded-projects/ct-resilient-bridgeport/

nature-based protection

## Advocacy

Following three consecutive years of major flooding, South Carolina created the Floodwater Commission to study the impact of extreme weather on vulnerable populations, infrastructure, and human health. The recommendations of this Commission led to the creation of the SC Office of Resilience in 2020. With the input of many stakeholders across the state, including AIA architects, SCOR released the Strategic Statewide Resilience and Risk Reduction Plan in 2023. The plan focuses on vulnerabilities around the state and future climate trends. Then highlights current processes, funding, and recommendations for additional resilient measures. SCOR also created a Disaster Recovery Reserve Corp, which has provided architects a way to assist in recovery efforts. Many other states have formally adopted some level of state resilience planning. We would encourage members to advocate for meaningful Resilience planning at the state and local level.

Resilience Planning - South Carolina Office of Resilience

Planning for State Resilience: A 50-State Breakdown

## Definitions

**Hazard:** A potential source of danger caused by a naturally occurring or human-induced process or event with the potential to create loss.
**Vulnerability:** The degree to which a system is susceptible to, and unable to cope with, adverse effects. (IPCC)
**Capacity:** The combination of all the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to achieve established goals. (IPCC)
**Risk:** The potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood and the associated consequences. (IPCC)
**Resilience:** The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. (IPCC)

## Wellness

With all the recent news on climate change, many people may feel overwhelmed or paralyzed by anxiety. The issue seems so vast that avoiding it can feel easier than confronting it. However, this insightful blog post explores that struggle and offers practical ways to overcome it.
7 Mindful Tips to Deal with Climate Anxiety

## RESOURCES

Continuing Education
AIA Resilience and Adpation Online Certificate Program

Project Process
AIA Resilient Project Process Guide

Social Vulnerability
CDC Social Vulnerability Index Map

Multiple Hazards
ASCE Hazard Tool

Determine Risk
FEMA National Risk Index

Climate
US Climate Resilience Toolkit

Benefit- Cost Ratio
FEMA Benefit-Cost Analysis

Cost Savings Analysis
NIBS National Hazard Mitigation Saves: 2019 Report

Reference Codes
ICC 500-2014 Storm Shelters
FORTIFIED Homes

Historic Preservation
Resilience in Historic Buildings (US NPS)
Adivsory Council on Historic Preservation

Design for Change + Glossary
AIA Framework for Design Excellence

Resilience in Action
Boston's Coastal Flood Resilience Design Guide
Charleston's Comprehensive Water Plan

## What's Next?

As we begin to take resilience in the built environment to the next level, we must look at design as a way to restore or improve the natural environment. Through centuries of man's interventions, many sites have been left damaged by lost hydrology or lost plant and wildlife habitats. Regenerative design seeks to not just reverse damage but rather create better conditions to support a quality eco-system. Stay tuned for an upcoming issue of Climate Corner focused on Regenerative Design.