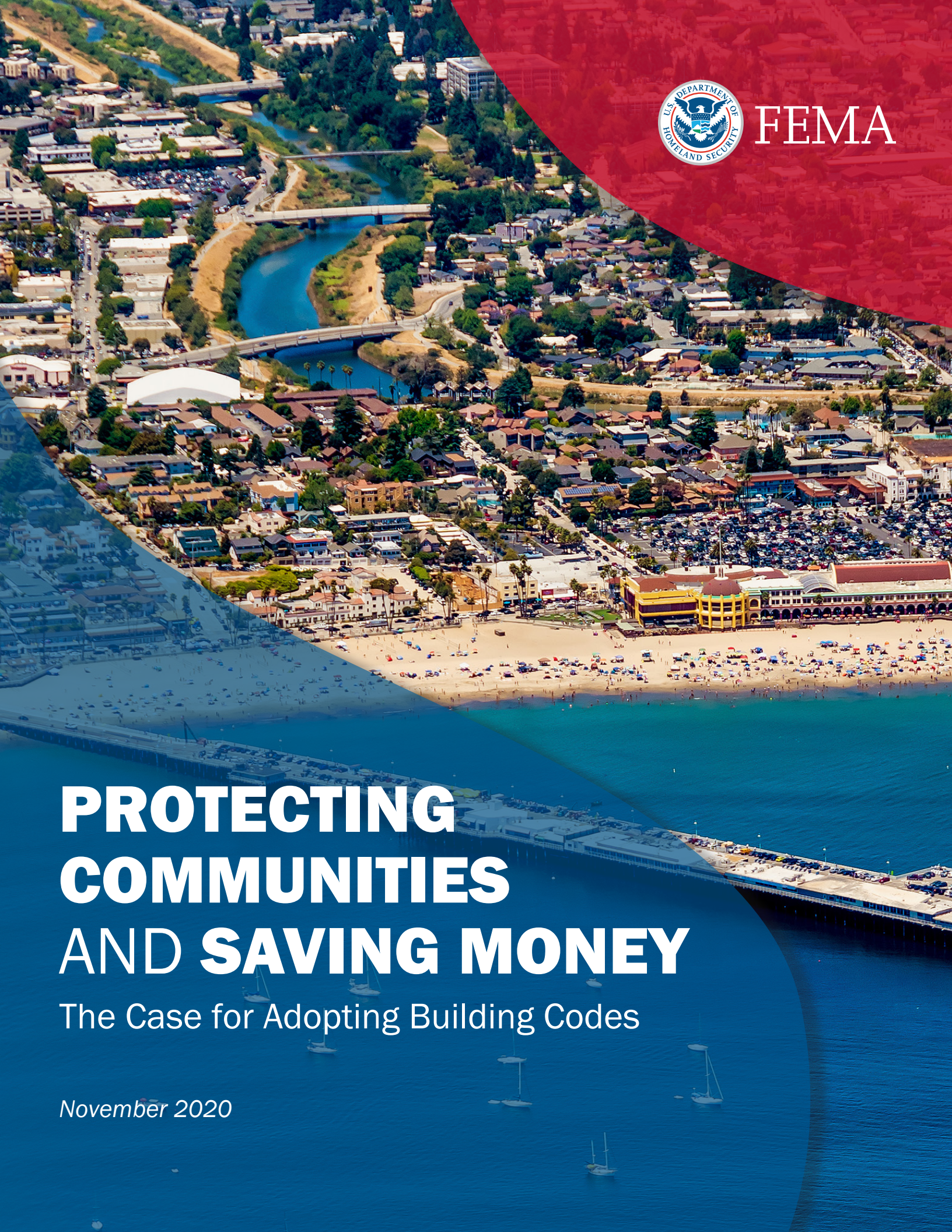


FEMA

PROTECTING COMMUNITIES AND SAVING MONEY

The Case for Adopting Building Codes

November 2020

ADOPT MODERN BUILDING CODES!

One of the most cost-effective ways to safeguard our communities against natural disasters is to adopt and follow hazard-resistant building codes. Not only are casualties reduced, but the cost of building damage is also reduced during a natural disaster. Building codes also help communities get back on their feet faster by minimizing indirect costs such as business interruptions and lost income.

65% of counties, cities, and towns across the U.S. today still have not adopted modern building codes

$132 BILLION

Estimated reduction in property losses based on forecasted consistent growth associated with use of modern building codes from 2000-2040.*

With hazard-resistant codes, buildings are constructed to withstand high winds, flooding and earthquakes. **The additional cost of the building features (roof tie-downs, window protection, strengthened walls and roof coverings, etc.) is on average less than 2% of total construction costs.****

A new FEMA study has made the impact of building codes on sustainability clear. The cost of not adopting building codes is too high.

The Results Are In

FEMA has released its landmark study, "Building Codes Save: A Nationwide Study," which shows that modern building codes* lead to major reductions in property losses from natural disasters. The analysis, which was based on a database of 18 million actual buildings, the frequency of hazard events in each locality, and the type of building code in effect, showed that over a 20-year period cities and counties with modern building codes would avoid at least $32 billion in losses from natural disasters, when compared to jurisdictions without modern building codes. The actual savings would be higher, when you consider that:

> the study focused only on buildings constructed since 2000, which represent only **20% of the 100+ million buildings in the country**, and it did not include "indirect losses" such as business interruptions, time off the job to rebuild, and tax revenues lost by local jurisdictions.

The FEMA report calculates losses from three types of natural hazards (earthquakes, flooding, and wind) for each state and Washington, D.C. For details, see *www.fema.gov/building-codes-save.*

**Such as the International Building Code (IBC), International Residential Code (IRC), or similar code*

***NIBS 2019, refer to page 8*

The Good, the Bad and the Avoidable

Modern building codes address many concerns, including public health and safety, resiliency, and affordability.

While local government officials, construction industry professionals, and many citizens are aware of this fact, currently, in the U.S. 65% of counties, cities, and towns across the country have not adopted modern building codes. The people living in those places are bearing a dangerous, costly, and unnecessarily high level of risk in the face of natural disasters.

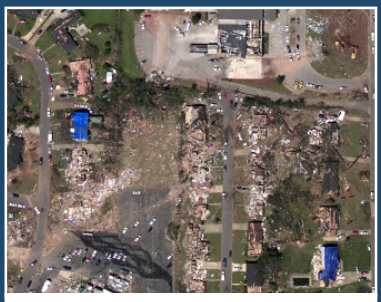
Many state, local, tribal, and territorial jurisdictions across the country can break the cycle of destruction by adopting modern, hazard-resistant building codes. This will buy down risk, which benefits local residents, communities, and leaders.

National Investment Strategy

To achieve our mission, we must address underserved communities most often suffering disproportionally during and after a disaster and proactively consider the impacts of future conditions.

Above-ground residential safe room that was in the garage of a home hit by an EF5 tornado in Joplin, MO (2011)

THE ESCALATING THREAT OF NATURAL DISASTERS

	REGIONAL THREATS*	SIGNIFICANT EVENTS**
California, **EARTHQUAKE**	**EARTHQUAKE** From the San Andreas fault in California to the Cascadia zone in Oregon and Washington states, the entire Pacific Coast faces a constant risk of seismic activity. The Wasatch fault, which extends along most of the populated areas of Utah, has also been active recently.	***2020 Salt Lake City, UT*** M5.7 on the Richter scale $48.5M in losses ***2006 Kiholo Bay, HI*** M6.7 on the Richter scale $200M in losses ***1994 Northridge, CA*** M6.7 on the Richter scale 57 dead $49B in losses
Kansas, **TORNADO**	**TORNADO** The central plains and the states fronting the Gulf of Mexico are exposed to windstorms and tornadoes. While mandatory "safe rooms" are saving lives in some localities, many people remain exposed to these deadly hazards.	***2019 North Texas*** $2B in losses ***2011 Super Outbreak*** (16 states) 321 dead $11B in losses ***2007 Greensburg, KS*** 11 dead $153M in losses
Illinois, **FLOODING**	**FLOODING** The Midwest -- including the states bordering the Mississippi River and its tributaries -- is among many regions highly exposed to flooding. Causes include rising water levels, spring snowpack, and increasingly frequent and intense storms. Lost topsoil is threatening the viability of farming.	***2019 Mississippi River Floods*** 12 dead $20B in losses ***2008 Midwest Floods*** (12 states) 11 dead $6B in losses including $5.4B in Cedar Rapids, IA
 South Carolina, **HURRICANE**	**HURRICANE** The East Coast and the Gulf Coast take the brunt of hurricanes and tropical storms affecting the continental U.S. Over the past 20 years, damage from hurricanes has surpassed all other types of damage combined.	***2017 Hurricane Harvey (TX, LA)*** 89 dead $126.3B in losses ***2012 Superstorm Sandy (NJ, NY)*** 233 dead $88.4B in losses ***2005 Hurricane Katrina (FL, LA, MS)*** 1,833 dead $160B in losses

FUTURE OUTLOOK

The probability of another major earthquake at EQ M6.7 or greater within the next 30 years has been estimated at 99% chance of somewhere in CA. The other states vary, having a significant but smaller exposure, except for Alaska which is comparable. Many localities still do not have earthquake-resistant codes.

Source: https://pubs.usgs.gov/fs/2015/3009/

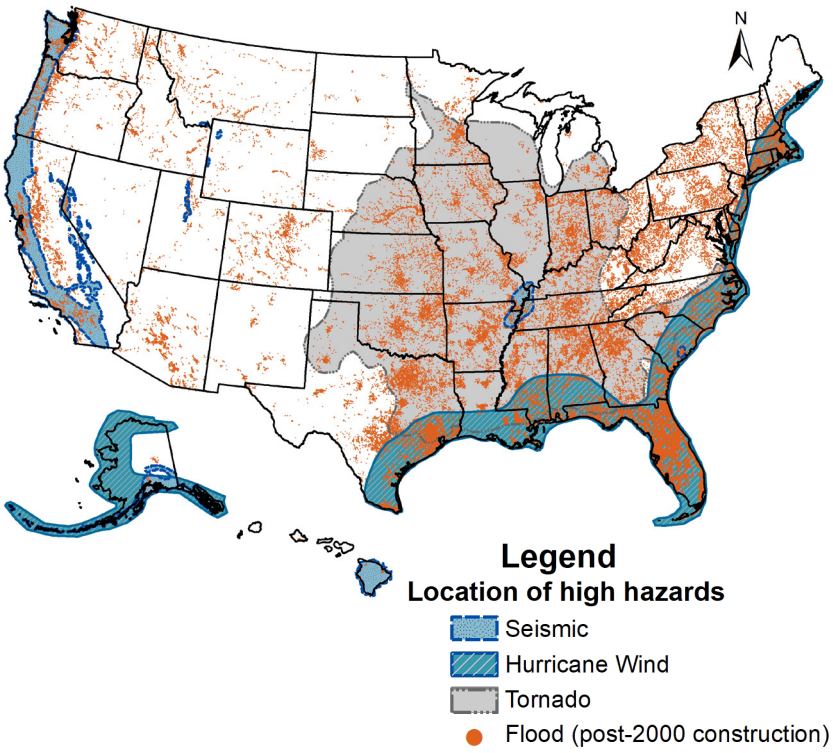
Recent data suggest that tornadoes will continue to threaten the center of the country... if not with increased frequency, then with increased power.

The water levels of the Great Lakes, the Mississippi River, and its tributaries are expected to remain high for the next few years, exacerbating flooding. Rain events will be more frequent and more intense.

Hurricanes and tropical storms are becoming more frequent and more intense. Sea level rise will increase vulnerability to storm events.

**Regional examples*
***Sources on page 12*

THREATS BY LOCATION



Adopting building codes is the single most effective thing we can do! One change in building codes can save lives and protect property for generations to come.

Increasing Risk

Since 1980, the average number of billion-dollar disasters has been six per year. From 2016 to 2018, the number jumped to 15 per year.

BREAKING THE CHAIN OF DESTRUCTION

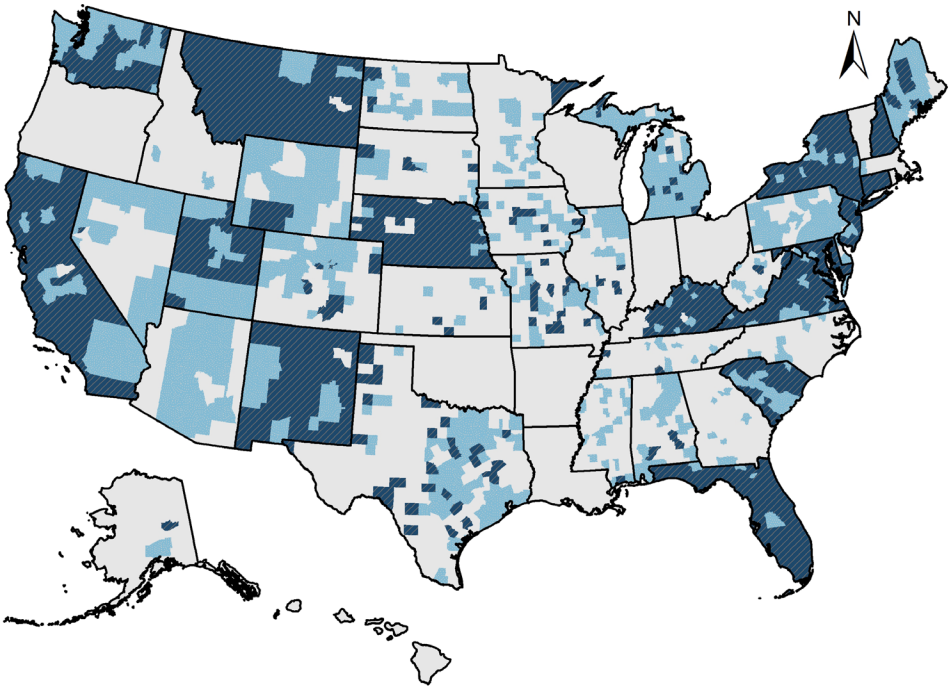
Some states have broken the chain of destruction by adopting modern building codes that protect property and people during natural disasters. Florida and California, pioneers in this field, have had modern hazard-resistant building codes in place since the 1990s. Other states such as Virginia, New York, and Montana have followed suit, putting in place state-wide building codes that local jurisdictions are required to adopt.

Other states have broken the chain from the bottom up; that is, local jurisdictions have pushed the envelope with the adoption of hazard-resistant building codes and raised the bar on their home states to do the same. For example, Miami-Dade County, Florida raised the standards for roof construction and mandated the use of impact-resistant windows. The state incorporated these requirements into its mandatory state-wide code. Similarly, the City of San Antonio blazed a new trail in the state of Texas with the regular adoption of modern code updates, most recently the ICC 2018 International Building Code. Other local jurisdictions in Texas can provide a higher level of protection to their citizens and adopt modern building codes, too.

Many states still lack a state-wide modern building code that local jurisdictions are required to adopt. This includes many tornado-prone states in the southern/central part of the country and some other flood-prone states in the northern midwest. These areas represent some of the greatest or best opportunities to strengthen U.S. communities in the face of natural disasters.

$1.8 BILLION

Estimated reduction in property losses over 20 years associated with California's modern building codes during earthquake and flood events



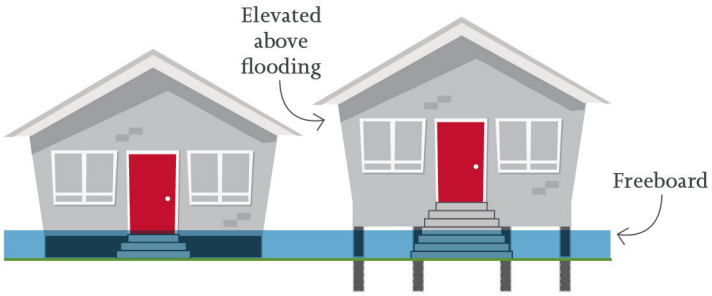
This map shows the varying levels of building code adoption at the county level. Code adoption is uneven.

- **ALL COMMUNITIES HAVE HAZARD-RESISTANT CODES**
- **SOME COMMUNITIES HAVE HAZARD-RESISTANT CODES**
- **NO COMMUNITIES HAVE HAZARD-RESISTANT CODES**

Based on BCEGS data provided by Insurance Services Office (December 21, 2018)

GREENSBURG, KS

In 2007 a powerful tornado took 11 lives and destroyed 90% of the buildings in Greensburg. With a view to rebuilding to a higher standard of sustainability, the City of Greensburg worked with the community, the state, and the federal government on the preparation of a Sustainable Comprehensive Master Plan. They also adopted a modern, hazard-resistant building standard (ICC 600-2008) for residential and commercial structures. Greensburg has become a national leader in building resilient communities and a model that the state of Kansas could replicate.

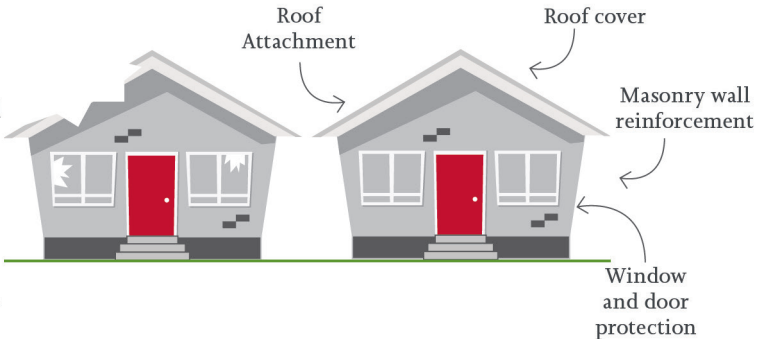


CEDAR RAPIDS, IA

As part of its 2008 flood recovery, the City of Cedar Rapids worked closely with state officials to increase their resilience to inland flooding. They implemented a variety of measures, including re-assessing flood risks, buying high-risk properties to create a new greenway, building a new levee, and most importantly, adopting modern building codes. This comprehensive package of measures was put to the test in 2016 by the second-highest flooding on record. Cedar Rapids performed well, with much less damage than during the 2008 flood.

SALT LAKE CITY, UT

To manage the risk of earthquakes more comprehensively, Salt Lake County brought together every local jurisdiction within its boundary to prepare a county-wide mitigation plan. The plan included the adoption of new zoning ordinances and modern building codes (ICC 2018). During the M5.7 earthquake in 2020, the county suffered only minor damages (<$50M) due to the adoption of the modern building codes. This successful progress also revealed the need to strengthen thousands of weak and older structures in more populated Salt Lake City metropolitan areas.



CHARLESTON COUNTY, SC

Charleston County pioneered the adoption of modern building codes. Following the development of disaster preparedness and recovery plans, in 2018, the county adopted modern building codes that required roof tiedowns, window protection, and higher “freeboard.” The state of South Carolina followed the county’s lead in adopting state-wide modern building standards (ICC 2015). The estimated savings in avoided property damage over 20 years is $1.9B.

DON'T WAIT FOR THE NEXT DISASTER

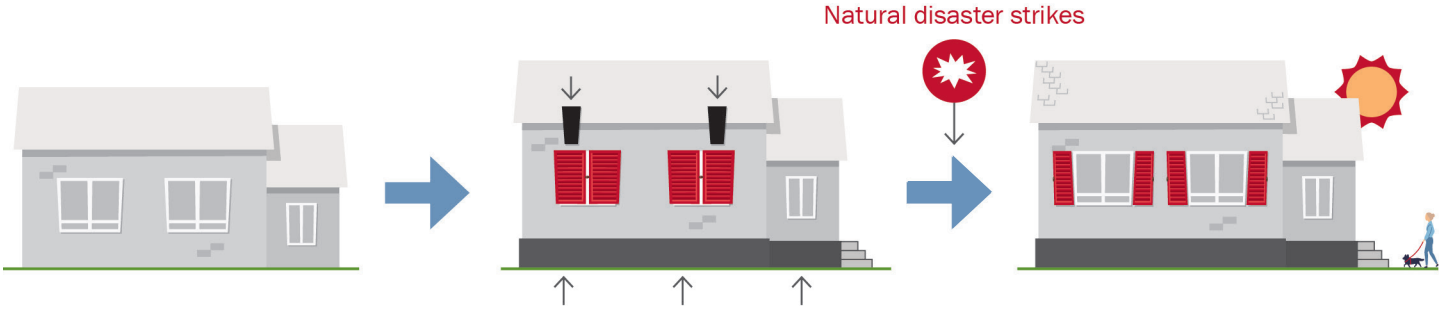
ADOPT MODERN BUILDING CODES NOW!

Hazard-Resistant Building Codes Are Affordable

The construction features that allow buildings to survive natural disasters are not expensive: on average they amount to 1%–2% of total building construction costs. For a 0.7% cost increase, a building will have the extra stiffness to withstand shaking during an earthquake. A 1% cost premium will provide the roof tie-downs, window covers and other features that help a house survive high winds during a hurricane. In addition, 1.2%–1.7% cost increase over standard construction costs will raise the ground floor, generating the "freeboard" needed to withstand most floods. As shown in the graphic below, a small upfront investment buys a lot of protection.

Every $1 spent on mitigation in new code construction saves $11 in disaster repair and recovery costs

Building Codes Generate Big Benefits at a Low Cost



Average home construction cost: $300,000

Average cost of code requirements to safeguard a new home

Hurricane: $4,500 (1.5%)

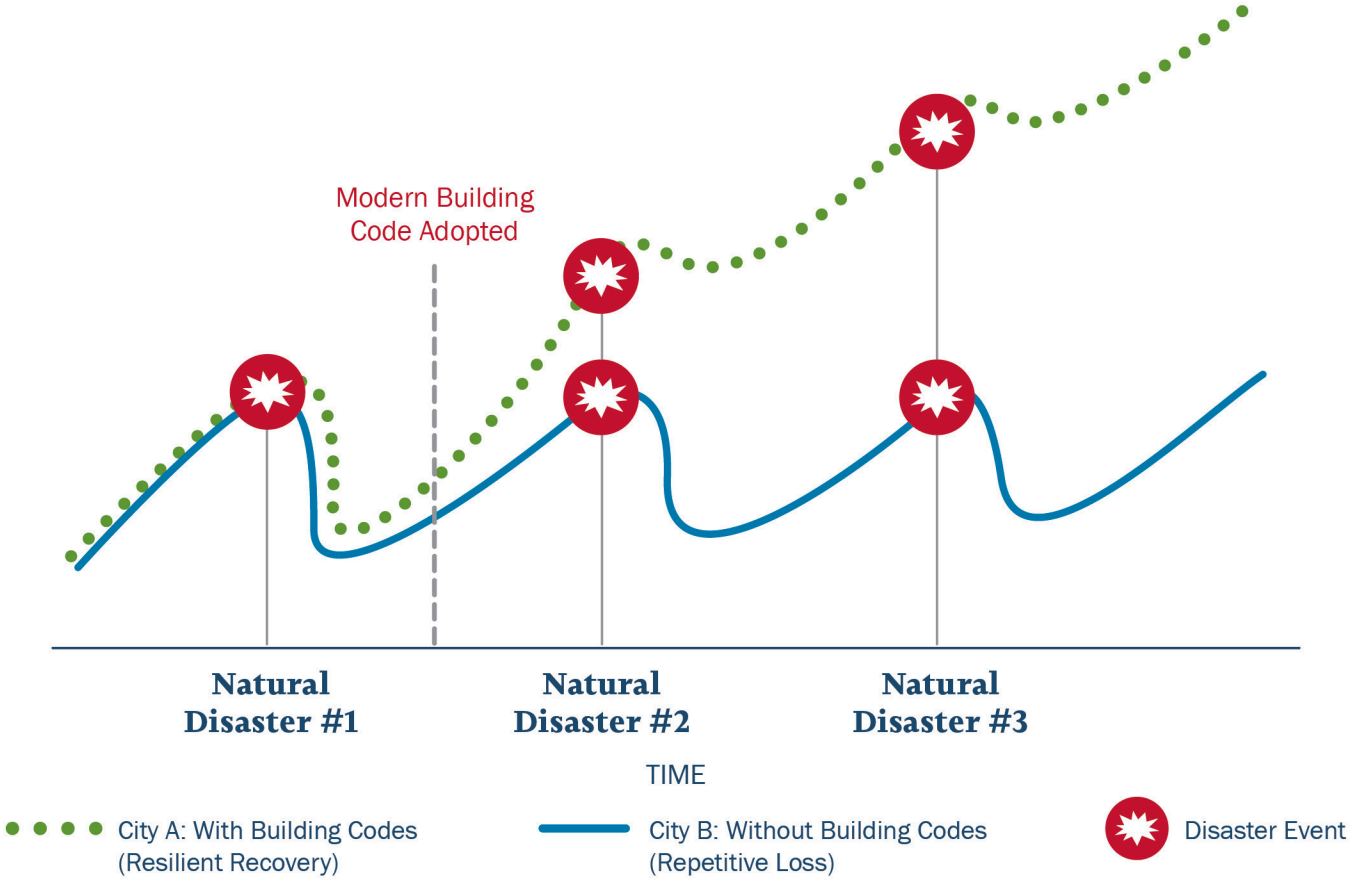
Average losses avoided from natural hazards over 30 years

Hurricane: $1,600 losses avoided per year
$48,000 cumulative losses avoided

Sources:

FEMA, "Building Codes Save: A Nationwide Study," 2020; (source of cost data).
NIBS, "Natural Hazard Mitigation Saves: 2019 Report," 2019; (source of dollar spent on mitigation).

Sustained Loss Avoidance with Modern Codes



It's Not Just About Direct Costs

The indirect costs of recovering from disasters are also huge: business interruptions, lost personal income, outsized debt, homelessness, lost municipal tax receipts, etc. For these reasons, it can take years for communities to recover from natural disasters.

40% - 60%

of small businesses do not reopen after a flood or hurricane, which affects the overall viability of a community.

The Cost of Doing Nothing is Too High

Now that the FEMA study has made crystal clear the impact of building codes on economic sustainability, who can afford not to adopt them in our own communities?

Asking the Hard Questions?

1. What is my community's contribution to the $132 Billion in property loss reduction?
1. How can we increase these savings to $600 Billion by 2060?
   - All new buildings built to modern building codes
   - Promote I-Code adoption
   - Community support of I-Code adoption

WHAT WILL BE OUR LEGACY?

As stewards and members of our communities, we will be remembered for our actions in the face of the greatest challenges of our time. Prominent among these is being able to survive and rebound from natural disasters, which pose an escalating threat to life and property across the U.S. The evidence clearly points to the cost-effectiveness of modern building codes in strengthening disaster resilience. Achieving universal coverage of modern building codes is a big challenge. How do we get there?

01.

Ascertain the building code currently in effect in your community

Consult websites such as your local government's and/or inspecttoprotect.org to find out whether your jurisdiction implemented or adopted a modern, disaster-resistant building code.

02.

Build a team

Engage local stakeholders in the mission to develop and implement a modern building code, along with hazard mitigation plans. Typically, these stakeholders include public, private and civil society parties, including:

- Community associations and individual residents and citizens
- Local and state government leaders
- Community planners and/or planning associations
- Construction and real estate development industry professionals
- The broader business community
- Civil society organizations
- Emergency management agencies

03.

Formulate a shared strategy for reducing disaster risk

Put a new/amended building code in the context of a broader strategy for reducing disaster risk. Codes constitute one tool among many, including urban growth management (plans, zoning ordinances), infrastructure improvements (such as levees), and public information campaigns.

This task can strengthen the team formed under step #2.

04.

08.

Adopt the code

Adopt modern building codes at the state-wide and/or local jurisdiction level. Preferably, the state will mandate the adoption of a modern building code by all jurisdictions. Then the county or city will comply with said mandate, by strengthening it to account for local conditions.

07.

Draft the code

Making use of International Code Council (ICC) and other model building codes that are available at no charge online, prepare a customized building code ordinance that reflects the priorities, preferences, technical capacity and market conditions of the jurisdiction in question.

06.

Advocate

Relying on the team built under step #2, encourage the adoption of the building code with key decision-makers at the state and local levels. Raise awareness of the public. Engage with the business community as needed. Create awareness and support presentations for in-person and online promotion of the effort to upgrade to modern hazard-resistant codes.

Map out the process for building code adoption

Determine the approvals required and the agencies that must issue them. Identify statutory requirements for each approval. Prepare a timeline and an approval strategy.

05.

Build the case for modern building code adoption

Draw from materials within the "Building Codes Save: A Nationwide Study" and the toolkits provided by inspecttoprotect.org and ICCsafe.org to develop succinct arguments for why a given state or locality should formulate, review, approve and adopt a new building code.

For details, see

https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes-save-study
https://www.nibs.org/page/mitigationsaves
https://www.isomitigation.com/bcegs/
https://www.iccsafe.org/advocacy/code-adoption-resources/
https://inspecttoprotect.org/
https://www.fema.gov/news-release/20200220/fema-releases-national-mitigation-investment-strategy

Sources of Significant Events

https://www.usgs.gov/news/m57-earthquake-felt-near-salt-lake-city-ut
https://www.usgs.gov/center-news/volcano-watch-continued-rumblings-2006-kiholo-bay-earthquake
https://www.usgs.gov/observatories/hawaiian-volcano-observatory
https://www.usgs.gov/mission-areas/water-resources/science/historical-flooding?qt-science_center_objects=0#qt-science_center_objects
https://quake.utah.edu/special-events/2020-magna-earthquake-sequence-faq
https://www.deseret.com/utah/2020/4/9/21213767/earthquake-damage-millions-salt-lake-county-5-7-magnitude
https://academic.oup.com/ije/article/27/3/459/625402
https://www.earthquakecountry.org/northridge/facts/
https://www.weather.gov/mob/katrina
https://www.weather.gov/crp/hurricane_harvey
https://www.weather.gov/media/ddc/Greensburg_1year_later.pdf
https://www.noaa.gov/news/blog-remembering-tornado-outbreaks-of-2011
https://www.ncdc.noaa.gov/sotc/tornadoes/201913
https://www.ncdc.noaa.gov/sotc/national/200713
https://earthobservatory.nasa.gov/images/event/144599/flooding-in-the-mississippi-watershed-2019
https://pubs.usgs.gov/pp/1775/pdf/pp1775.pdf
https://www.ncdc.noaa.gov/sotc/national/200807
https://www.nhc.noaa.gov/data/tcr/AL092017_Harvey.pdf
https://www.fema.gov/blog/6-months-report-superstorm-sandy-pre-disaster-recovery
https://www.nasa.gov/mission_pages/hurricanes/archives/2012/h2012_Sandy.html
https://web.archive.org/web/20131219105454/
http://www.nws.noaa.gov/om/assessments/pdfs/Katrina.pdf
https://www.aoml.noaa.gov/general/lib/lib1/nhclib/mwreviews/2005.pdf
https://www.usgs.gov/news/m57-earthquake-felt-near-salt-lake-city-ut

Contact:

For additional FEMA building science information, or to ask questions, please contact any of the following resources:
The FEMA Building Science Helpline
FEMA-buildingsciencehelp@fema.Dhs.Gov
(Office) 866-927-2104

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https://public.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_122

Thank you to these industry stakeholders for their outreach and contributions:

ICC - International Code Council https://www.iccsafe.org/
ASCE - American Society of Civil Engineers https://www.asce.org/
FLASH - Federal Alliance for Safe Homes https://www.flash.org/
EERI - Earthquake Engineering Research Institute https://www.eeri.org/
ISO - ISO Mitigation https://www.isomitigation.com/
IBHS - Insurance Institute for Business & Home Safety https://ibhs.org/

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