# Introduction

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Over the past twenty years, the United States has experienced a series of natural and human-caused disasters—events that have significantly impacted its society, economy, and culture. Despite the devastating losses, the nation has largely emerged from these events stronger and better able to handle the next. This has been possible because its people are resilient by nature—when disaster strikes, they come together, help those in need, and implement measures to reduce the potential for similar harm in the future. However, as populations grow, urban areas expand, and interconnectedness increases, the potential for a disaster event to have deeper and further-reaching consequences also increases. As a result, there is a need to implement measures that increase societal, economic, and cultural resilience—*community resilience*.

Resiliency is about the ability to plan and prepare for, absorb, recover from, and more successfully adapt to adverse events regardless of whether the subject is an individual or our society, a business or our economy, a single bridge or all critical infrastructure. Each of these components ties together communities: homes, places of employment, utilities and transportation infrastructure, which everyone relies upon, and more. When adverse events occur, all gears in the local system must continue to function. A building constructed to the most current code, that stands tall in a disaster, must be reachable by transportation systems and sidewalks during and after that disaster to be continued to be used. The building must have electrical power and functioning communication systems. If grocery store shelves are bare for extended periods, people may not be able to stay or function at peak efficiency. The resilience of each community function, and how well each function can respond to adverse events, must be well understood for a community to be resilient. Resilience in the built environment starts with strong, regularly adopted, and properly administered building codes. However, to attain whole community resilience,

**Figure 1**

The remaining section of the World Trade Center is surrounded by a mountain of rubble following the September 11 terrorist attacks.

*Photo by Bri Rodriguez/FEMA*

**Figure 2**

Aerial views of flood and fire damage in the Breezy Point neighborhood as a result of Hurricane Sandy. Following the hurricane, a nor'easter struck the area causing more power outages and additional flooding.

*Photo by Andrea Booher/FEMA*

**Figure 3**

Interconnection of buildings and infrastructure

*Photo by Brian Meacham*

communities must look at the resiliency of all interconnected systems and functions of the community as well.

Widespread acknowledgment of the need for community resilience became clear after such events as the Loma Prieta (1989) and Northridge (1994) earthquakes, the terrorist attacks on the World Trade Center and Pentagon (2001), and Hurricanes Katrina (2005) and Sandy (2012). While the United States has long provided support for response and recovery to such events, it has become increasingly clear in recent years that being proactive reaps more benefits than being reactive. By better understanding how hazard events can disrupt communities, and by implementing measures to mitigate the impact of those events in order to quicken recovery, communities become more resilient. In addition, investing in mitigation before an event occurs can significantly reduce losses when the event occurs. With respect to natural hazard events alone, recent studies have demonstrated that for every $1 invested in mitigation from a specific set of hazard mitigation grants, the nation receives $6 in benefits as avoided future losses—a benefit-to-cost ratio of 6 to 1.[1]

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While this return on investment is significant, the picture is incomplete. It does not include the social, economic, and cultural benefits gained by adopting and enforcing the most current building and planning codes, nor does it include benefits derived from private-sector mitigation investments. Each of these benefits is also significant. Considering only the adoption and enforcement of building codes, a recently completed study of the effectiveness of the Florida Building Code[2] (FBC) in reducing

Following the Northridge earthquake in Southern California many buildings with steel frames (structural steel moment frames) and prefabricated walls (tilt-up walls) were severely damaged. Subsequent analyses of the damages resulted in several code changes that:

1. Strengthened wall anchorage requirements;
2. Enhanced observation and testing requirements for key structural connections; and
3. Required seismic strengthening across several building and material types.

1. Multihazard Mitigation Council (2017). Natural Hazard Mitigation Saves: 2017 Interim Report. National Institute of Building Sciences, Washington DC.
2. Simmons, K.M., Czajkowski, J., and Done, J.M. (2017) “Economic Effectiveness of Implementing a Statewide Building Code: The Case of Florida,” (July 25, 2017). Available at SSRN: https://ssrn.com/abstract=2963244 or http://dx.doi.org/10.2139/ssrn.2963244, last accessed 4 June 2018).

wind-related losses shows that for the 10-year period from 2001 through 2010, implementation and enforcement of the FBC reduced windstorm losses by up to 72%. Financially, the estimated benefit-to-cost ratio is similar to the effectiveness of hazard mitigation grants noted above: up to $6 dollars in reduced losses for every $1 dollar of added cost of mitigation. In the case of the FBC, a payback period of approximately 8 years was estimated.

This type of loss reduction during future events is indicative of benefits gained when the most current building codes, which include the latest in technologies and methodologies for loss reduction, are implemented and enforced. Similar outcomes in terms of loss reduction associated with building codes have been observed as associated with earthquake, tornado, and other natural events. Unfortunately, building codes have not been regularly adopted and implemented in every state and local jurisdiction. Furthermore, in some jurisdictions that have adopted a building code, it may be based on a model code that is 10 years or more behind the most recent edition, therefore without the benefit of the 10 years plus of enhanced mitigation data, technologies, and methodologies. To increase community resilience to hazard events, particularly natural hazard events, more extensive adoption, implementation, and enforcement of the most current model building codes is needed.

The ICC goal of building safety and resiliency supports making our nation's communities more resilient, and the ICC is a founding member of the Alliance for National & Community Resilience (ANCR).[3] ANCR aims to provide the information that communities need to understand and benchmark their current level of resiliency, identify and understand options available to fill gaps and increase resiliency, and to understand the future benefits to be gained by

**Figure 4**

A lone, mitigated home stands in Long Beach, Mississippi. Hurricane Katrina caused extensive damage all along the Mississippi gulf coast.

*Photo by Mark Wolfe/FEMA*

**Figure 5**

Complete destruction in Bay St. Louis, Mississippi, three weeks after Hurricane Katrina.

3. http://www.resilientalliance.org/

**Figure 6**

Downed power lines in a neighborhood devastated by Hurricane Irma in Ramrod Key, Florida, on September 21, 2017.

*Photo by J.T. Blatty/FEMA*

investing in advance of the next hazard event. Helping communities to understand the measurable benefits of adopting the most current building and planning codes, as an important component of community resilience, is a particular focus of this initiative.

In addition, the ICC works with other countries, including high-, middle-, and low-income countries, to bring these concepts into play. Low- and middle-income countries have the least capacity to cope with disasters. In many of these countries, the populations of urban centers are rapidly expanding, and the existing building regulatory infrastructure and capacity is struggling to keep up. As a result, many are living in low-quality housing with limited access to stable utilities and public services, which puts them at higher risk of being exposed to an extreme hazard event. The implementation of better building regulatory systems will help reduce the devastation of natural hazard events and increase community resilience.

This publication has been created to help policy makers, and those who are responsible for enhancing community resilience, better understand the fundamental components of community resilience and the critical role that regularly updated, adopted, and properly administered modern building codes serve in facilitating community resilience. The concepts noted above are explored in more detail throughout this publication. Also provided are examples that illustrate the benefits to be gained from making this a national, state, and local priority.

The I-Codes are developed by a public-private collaboration that provides modern model codes to government jurisdictions. As a result, government does not have to take on the high cost of developing its own codes and benefits from the code uniformity among adopting jurisdictions.