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NATIONAL APPROACH TO ENHANCING RESILIENCE

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Abstract

In the United States, private sector building and community safety organizations are essential participants in developing a national approach to enhance community resilience. The adoption and enforcement of building codes are essential to a community's resilience, but they are insufficient alone. A coordinated strategy is needed to assure the safety of individual buildings through: the adoption of building codes, support of the social and economic resilience of a community through recognition of the need for buildings to remain functional after an event, and the availability of metrics to help evaluate current efforts to improve building resilience across multiple community functions and identification of pathways to improvement.

The International Code Council and the Alliance for National & Community Resilience (ANCR) are working with federal and local governments and other stakeholders to support a national approach to resilience. This paper examines the complex landscape of developing a cohesive strategy and how ICC and ANCR are navigating these complexities. The paper explores the model code development process, how codes are adopted and enforced within states and localities, the efforts underway to move beyond the traditional basis of building codes (life-safety), and how expertise on building safety is being translated into resilience across the whole community. This paper utilizes the latest studies on the benefits of investing in hazard mitigation from the National Institute of Building Sciences which found that every dollar spent on disaster mitigation yields a return of between 4 and 11 dollars of benefit.

Keywords: community resilience; ICC; ANCR; building code; disaster mitigation

1. Introduction

In the United States of America (U.S.), private sector building and community safety organizations are essential participants in developing a national approach to enhance community resilience. The adoption and enforcement of building codes are essential to a community's resilience, but they are insufficient alone. A coordinated strategy is needed to assure the safety of individual buildings through the adoption of building codes, support of the social and economic resilience of a community through recognition of the need for buildings to remain functional after an event, and the availability of metrics to help evaluate current efforts to improve building resilience across multiple community functions and identification of pathways to improvement.

The International Code Council (ICC) and the Alliance for National & Community Resilience (ANCR) are working with federal and local governments at all levels and other stakeholders to support a national approach to resilience. This paper will examine the complex landscape of developing a cohesive strategy and how ICC and ANCR are navigating these complexities. The paper will explore the model code development process, how codes are adopted and enforced within states and localities, the efforts underway to move beyond the traditional basis of building codes (life-safety), and how expertise on building safety is being translated into resilience across the whole community. The paper utilizes the latest studies on the benefits of investing in hazard mitigation from the National Institute of Building Sciences (NIBS) which found that every dollar spent on disaster mitigation yields a return of between 4 and 11 dollars of benefit.

2. Codes and Community Resilience

Building codes are a fundamental contributor to community resilience. A community cannot bounce back quickly after a disaster without resilient buildings and the codes that support their development. As identified in an initial report on building codes and resilience by ANCR, "Resilience in the built environment starts with strong, regularly adopted, and properly administered building codes."[1]

A comprehensive building regulatory system enables the achievement of many social and economic objectives by defining minimum levels of expected performance in terms of health, safety, welfare, accessibility, sustainability, and resiliency. A building regulatory system also facilitates economic development and stability by establishing effective, efficient, and reliable regulatory practices that incentivize economic investment. It does so by providing the market with a clear set of design and construction requirements and quality standards, which in turn minimizes barriers to trade and facilitates investor confidence.

3. Model Code Development Process

Components of a comprehensive building regulatory system include legal activities, planning, building and fire code development and maintenance, and implementation and compliance mechanisms. The building regulatory system (building departments) is supported by regulatory infrastructure, which includes requirements for education and training, licensing of practitioners, insurance, accreditation of businesses and evaluation of products. The building regulatory and support systems function together to ensure that any new construction and upgrades to an existing building are able to achieve expected regulatory and market objectives for acceptable performance (life safety). These tenets are not only the basis of the building regulatory system in the United States, but they are shared by governments and non-governmental organizations around the world.[2]

The model codes developed in the United States achieve safe and efficient buildings while remaining highly cost effective. This is attributable to a unique process where the I-Codes are developed in the private sector through an open, consensus process that brings together expertise from across the public and private

sectors. Many countries have a government-driven process to update codes that includes less engagement from the private sector and provides less frequent updates, making a national code less responsive to changing practices, new technologies and new research. Even among countries that do permit private sector involvement, the three-year cycle for updates is unusual. Europe, for example, is in the process of updating building codes for the first time since 2007 while Canada has a five-year cycle.

The codes are created by a private membership organization of building officials, engineers and architects, contractors and manufacturers. This membership organization is called the International Code Council and the codes it develops are called the International Codes or I-Codes. This suite of model codes reflect new developments in the construction industry as well as time-honored practices which continue to work in modern buildings.

A new edition of a code evolves from the submittal of code change proposals by building officials and practitioners in the construction industry as well as the general public for incorporation into the building code. These changes are reviewed by committees composed of building officials, designers and manufacturers and either approved or disapproved (Figures 1 and 2).

Fig. 1 – 2019 ICC Public Comment Hearings

The fundamental concepts of code change include:

- Anyone may submit a proposed code change
- Code Development Hearings are open to the public
- Anyone may testify at the Code Development Hearings
- The hearing process is easy to follow
- Committee members are regulators and users of the code
- Hearings are held in the spring, then, after a public comment period, final hearings are held in the fall.
- The voting at the public comment hearings is done by the regulatory employees responsible for enforcing the codes (building officials) who have no material interest in the outcomes.

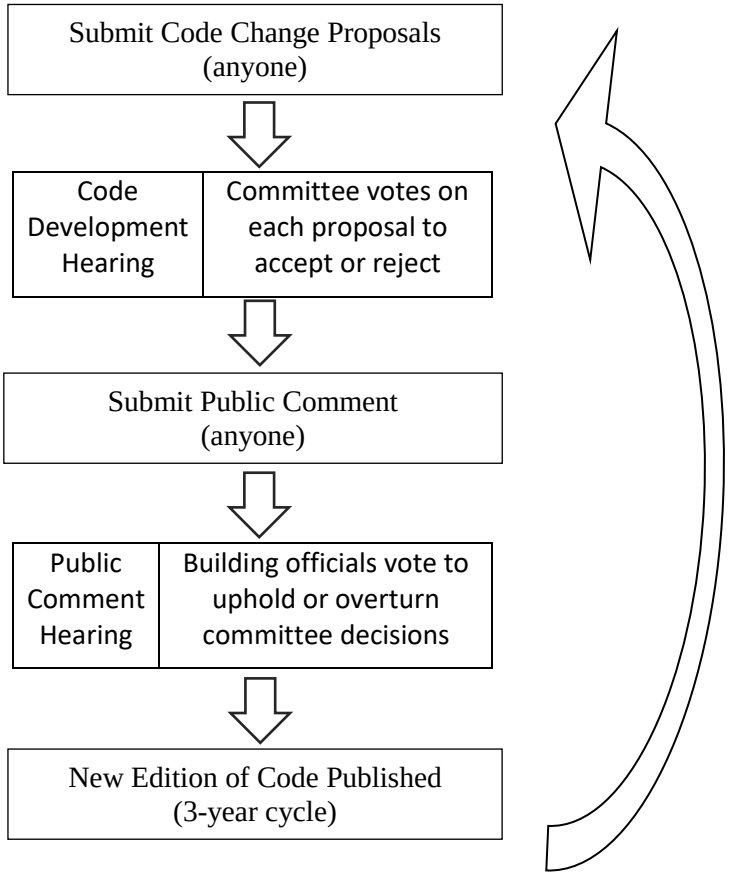

Fig. 2 – Model Code Development Process

4. Codes Adoption and Enforcement in Local Regions

The authority to adopt codes is granted to the individual states by the federal government in Article 4 and Amendment 14 of the United States Constitution. While some states adopt a mandatory state code, others allow the local jurisdictions (generally a city or county) to adopt any code they determine will best suit the needs of their community. These local jurisdictions may also amend their adopted code when to address specific issues unique to their jurisdiction within the model code.

This multi-level approach to rulemaking and enforcement can be confusing for the construction industry (Figure 3). To clarify requirements across regions, the federal government and some states have pushed for decades for a common basis for local authorities to use in creation of their local codes.

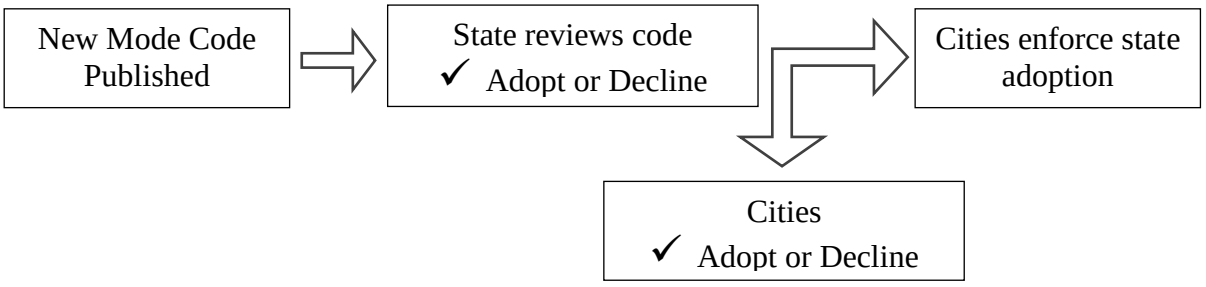

Fig. 3 – Code Adoption in the United States at Federal, State and Local Levels

4.1 Model Codes versus Building Codes

The result of the desire to have a uniform code basis has been a non-profit group, in this case the International Code Council, publishing a new edition of each of their model codes every three years. One of these codes is the *International Building Code* which covers construction requirements for buildings (Figure 4). The model codes are reviewed by each state or local authority and amended (modified) to meet local needs. The **model code** is a written set of regulations that provides the means for exercising reasonable control over construction and is available for adoption by cities, counties, states or countries.

Fig. 4 – *2018 International Building Code*

Once a state legislature or other duly appointed governing body passes legislation making the model code their local law, the model code becomes a building code. A **building code** is a legal document that regulates the construction of structures and buildings. It also regulates the installation of fixtures, equipment and accessories. A building code is an organized, systematic presentation of a body of law that pertains to all facets of building construction. Basically, a building code regulates new construction and changes to existing construction.

4.2 Enforcement of Building Codes in the U.S.

In brief, regulatory groups (building officials) manage enforcement of the code day to day. The local authority gives the building official the legal duty to enforce the regulations (provisions of the building code). Each building official then delegates the responsibility to review construction plans and inspect construction to the staff of the building department. Staff approves each set of construction documents by checking for accuracy and compliance with minimum code requirements. Staff then verifies work at a construction site using the approved construction documents. When completed, if the project has complied with the construction documents and all local regulations, the building is given a certificate of occupancy to allow the owner use of the building.

5. Beyond Life-Safety in Codes

In the United States there are private and public groups who desire to see guidance, or potentially code requirements limiting construction under narrowly defined circumstances, for building designs to meet more stringent requirements of no major damage to a building (immediate occupancy), or even no damage (operational) to a building after a significant earthquake or other natural disaster.

At the federal level, the National Institute of Science and Technology (NIST) and Federal Emergency Management Agency (FEMA) have an ongoing seismic initiative to define and quantify what functional recovery means and what it might look like for a single building. Within the public-private interface, another group is looking at seismic functional recovery as a range of outcomes. From what is needed to allow a single business owner to understand what is required to have their building be operational hours after a natural disaster to how guidelines coming from NIST/FEMA projects might be enforced by a local building department to benefit a community. Both groups want to answer the fundamental questions of functional recovery:

1. Does the goal of functional recovery for a single building require a beyond life-safety code? What happens when that building is an island?
2. Does functional recovery for a community require enforceable beyond life-safety building codes? What does this look like?

Many communities are asking these questions, some due to recent flooding, others due to wildfires or tornadoes, some due to recent hurricanes or earthquakes hitting regions and communities similar to their communities (Figure 5). For these cities and towns to effectively create a community-wide program to keep people, jobs and businesses in their community, the design and regulatory professions must consider their role in assisting local groups both large and small.

Figure 5 – (a) Single building left after disaster, (b) Christchurch recovery

6. Building Safety Adds to the Resilience of the Entire Community

Building departments deal with requests to make significant changes to existing buildings and requests to build a new building daily. They verify that designs for buildings meet a minimum level of safety, based on the building code, then go to job sites to observe construction and verify that the construction of the building meets or exceeds the intent of the building designers and the code minimum. This process accelerates after a disaster. The community wants to build back rapidly and the building department verifies that, even during the process of rapid reconstruction, buildings are safe for owners, tenants and the public. A building department works with a city's zoning department to verify that the type of building proposed is acceptable in the area where it is currently located or will be built. After a disaster this may mean a building must move to a new location to be deemed safe to construct or the style of construction must change. For example, in many flood-prone regions buildings are lifted off an existing foundation and placed on piers to keep the structure above expected flood water levels.

7. Investment in Hazard Mitigation

Major disasters persistently test the United States' capacity to recover and adapt. In 2017, more than 25 million Americans (nearly 8 percent of the U.S. population) were affected by disasters. These events included flooding, hurricanes and wildfires. These significant losses didn't affect just one person or family, rather the disasters affected entire communities. More than anything else, events in 2017 highlighted the need to change the way we prepare for and mitigate against future hazards. We need to change the way we think and create a true culture of preparedness. Investing in mitigation activities before the next disaster is a key to building a more resilient nation.

The Natural Hazard Mitigation Report from the National Institute of Building Sciences (NIBS) demonstrates for the first time that, on average, investments made by local communities and homeowners for hazard mitigation measures that exceed currently adopted building codes can save the nation $4 for every $1 spent. This is $15.5 billion in savings from one year of building new construction beyond current code requirements.

Every level of government has different approaches, funding sources, mandates, and requirements for investing in efforts to mitigate disaster risk. This disparity has created a complicated mix of priorities and pathways through which communities must navigate if they want to mitigate disaster risk or build back stronger after a disaster.

From the report, mitigation represents a sound financial investment (Figure 6). The report examined mitigation strategies and found that society saves a benefit to cost ratio (BCR) of:

4:1 – for construction which exceeds provisions of the 2015 IRC and IBC
11:1 – for the adoption of up-to-date building codes (assuming current codes at least 20 years old)
4:1 – for upgrade of utilities and transportation infrastructure
6:1 – for mitigation grants funded through federal agencies[3]

National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded	Exceed common code requirements	Meet common code requirements	Utilities and transportation	Federally funded
Overall Hazard Benefit-Cost Ratio	4:1	11:1	4:1	6:1
Riverine Flood	5:1	6:1	8:1	7:1
Hurricane Surge	7:1	Not applicable	Not applicable	Too few grants
Wind	5:1	10:1	7:1	5:1
Earthquake	4:1	12:1	3:1	3:1
Wildland-Urban Interface Fire	4:1	Not applicable	Not applicable	3:1

Fig. 6 – Benefit Cost Ratios for Various Mitigation Measures

Just adopting current codes and offering mitigation to bring buildings to current codes rather than reconstruction grants to rebuild to the existing condition before an event, the study found would prevent hundreds of deaths, a million injuries and add tens of thousands of new long-term jobs in construction.[2] The federal government passed a bill in 2018 directing FEMA to incentive states and local authorities to adopt and enforce the latest code. The federal government increases its support and cost sharing after a

disaster based on the amount of mitigation planning done by the local authority. Meanwhile communities also receive resources for implementing building codes post-disaster.[4]

The study considered construction exceeding current codes – this is new construction that chooses to exceed current code standards. Examples of mitigation including cladding a house with stucco and soffits with small openings to prevent wild-fire intrusion into a building; placing a house or commercial building on piers to prevent flooding; or isolating a building from its foundation to reduce damage due to an earthquake. All of these examples exceed the **2015 IBC** and **IRC minimum requirements**. Cost of these mitigation practices vary but would be included within the cost of the new building based on the owner's belief that savings occur by doing the mitigation during construction rather than after a disaster. The study results suggest that savings are 4 to 1, in other words for an initial cost of $10,000, repairs of $40,000 would be avoided.

The study also considered areas where code adoption has been significantly delayed and buildings are built to codes more than 20 years old. Within this group of buildings are existing buildings built before 1995 that have been upgraded rather than rebuilt to original condition. With an existing building, if construction meets modern code requirements, i.e. the 2015 codes or more recent editions, there is a savings of 11 to 1 after a disaster. In other words, upgrades costing $10,000 now would avoid repairs of $110,000 later. This is a huge savings and easily apparent to building owners. The results of the NIBS study point out the benefit of updating code requirements by regulatory groups on a frequent basis and show that money spent in mitigation rather than reconstruction after a disaster greatly benefit individuals and communities.

The study looked at four specific natural hazards: flooding, hurricanes, earthquakes and fires. Actual benefits with large scale adoption of new building codes and a focused effort to retrofit existing buildings could be greater than estimated. What we know today is that upgrading one building leaves an island of functionality, upgrading multiple buildings throughout a community will leave buildings and resources that can rely on one another and help maintain the community.

8. Acknowledgements

The authors gratefully acknowledge the work of numerous volunteers for NIBS and FEMA who strive to make guidelines to create safer cities. And the building department employees who work tirelessly to improve the quality of our building stock across the country.

9. References

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