Disaster Resilience Rising Means the Time is Right

After a decade that included Hurricane Katrina and Superstorm Sandy, the resilience movement is evolving the definition of disaster survival success from basic building survival to resilient communities overall. We must conform the U.S. building code system accordingly by redefining success from buildings that deliver minimum life safety to structures that allow people to survive, recover swiftly, and build back even stronger.

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Introduction

In the ten years since Hurricane Katrina struck the Gulf Coast on August 29, 2005, catastrophes of all kinds have provided stark evidence that all communities have a universal need to build with natural disasters in mind. As a result, voices across the globe are lining up to support the cause of resilience[i], and for good reason. Public and private sector economic, catastrophe losses are increasing; sea levels are rising; and a shared acceptance has taken hold that change is needed in how and where we build.

This climate presents disaster resilience advocates with a clear mandate and an unprecedented opportunity to lead change that will forever break the cycle of build/destroy/rebuild, but it will only last so long. How can we seize this opportunity?

The International Code Council's (ICC) Building Safety Month is a public awareness campaign reinforcing, "the need for adoption of modern, model building codes, a strong and efficient system of code enforcement and a well-trained, professional workforce to maintain the system."[ii] This year's theme was *Resilient Communities Start with Building Codes*.

We couldn't agree more with this initiative. Strong building codes are the foundation for resilience. We applaud the ICC for focusing on this message at a crucial time—and not just in the United States, but globally.

In this spirit of collaboration, we stopped to reflect on how the adoption and enforcement of model codes can be furthered by the resilience movement. More generally, we've provided our pragmatist's prescription for how to harness the resilience revolution and advance our cause while we can.

In exploring these issues, we have drawn upon our unique perspective as a nonprofit organization with a diverse identity comprised of more than 120 public, private, and nonprofit interests. Over 16 years, we've interacted with the various building code stakeholders, including, of course, the ICC.

So where do we start?

Building safety starts with how we build, and building codes articulate the minimum requirements for a legal building. Accordingly, the most promising opportunities for enhancement are inextricably linked to the way the U.S. develops, accepts/rejects, and implements building codes.

The ICC has the challenging role of balancing competing interests to produce a consensus-based code product, and they do so skillfully. The ICC values and encourages innovation in building code development and administration, as can be noted by many of its initiatives, including the recent cdpACCESS—making code development participation accessible online. With this type of innovation, we are inspired to examine what other innovations could more fully connect the value, relevance, and impact of model codes with respect to disaster resilience. Connecting the building code system and the disaster resilience movement will strengthen and preserve the continued progress and leadership role of the ICC, which we support as the best way to deliver continuity, avoid market confusion, and maintain decades of progress toward an integrated, trusted, model code system that is in use throughout the globe.

With this strong system in place, we are seeking ways to build upon it to ensure construction of safe and affordable, but also resilient and sustainable homes. Here are our six recommendations to advance disaster resilience:

1) Establish a standing code and standard development process to accelerate post-catastrophe, forensic engineering insights into model codes and standards.

2) Optimize property protection opportunities in model code and standard development by balancing all of the existing values, including public health, safety, and welfare.

3) Evaluate, integrate, and leverage public and private sector beyond-code standards and programs into the ICC system to ensure continuity, increase awareness, and support disaster resilience innovation.

4) Enhance code development by broadening the representation of interest groups on the International Residential Code technical committees.

5) Support code adoption and enforcement mechanisms through an enhanced, well-resourced system of information provision to state and local officials as well as the public regarding benefits and mechanics of building codes and disaster-resilient construction.

6) Increase engagement by all stakeholders in the building code system through robust participation in each phase, including model code development, state and local adoption, and enforcement.

Is There a More Efficient Way to Incorporate Building Performance Insights into Codes?

Recommendation #1 – Establish a standing code and standard development process to accelerate post-catastrophe, forensic engineering insights into model codes and standards.

This first recommendation focuses on how to ensure that beneficial research and post-disaster engineering insights are not just consistently factored into model codes and standards, but factored in on a timely basis. Model building codes are developed on a three-year, recurring cycle. Referenced standards in the model codes usually have longer, varying cycles.

Ironically, we are making this recommendation just as certain states and jurisdictions move away from the most current codes by elongating code adoption cycles from three to six, or even nine years. In states like Minnesota and North Carolina, the extended code cycles not only leave citizens without the benefit of current model building codes, but set us back even further from the goal to rapidly incorporate beneficial, post-disaster findings into model codes.

And as Pennsylvania, Utah, and Washington contemplate similar action, we find this to be an unproductive policy direction in light of the many credible, national efforts underway to measure resilience and establish standard community scores for same. We have evaluated many of these efforts, and while they differ in methodology, each assumes that adoption and enforcement of current, model building codes is a major consideration in any objective measure of disaster resilience. As a result, we wonder if leaders in these states understand that institutionalizing older codes can handicap communities' efforts to achieve resilience. Do they understand how, over time, the older codes can create a path to obsolete housing stock that cannot compete with neighboring states for new residents who want resilient building practices, enhanced energy efficiency, and more?

Ordinary code development and adoption cycles aside, we believe that significant insights gained after major disasters should not have to conform to three-year development cycles. Rather, they should enjoy special status to ensure they are rapidly incorporated into model codes. To do otherwise leaves deadly and costly disaster lessons behind.

Let's examine the existing methods we currently use to identify and assimilate post-disaster building science insights into better building practices.

Dubbed the "Disaster Detectives" in a *Risk Management Magazine* article in May of this year, the FEMA Building Science Branch leads one of the most comprehensive, post-event investigative efforts[iii]. Their integrated group called the *Mitigation Assessment Team (MAT)* is charged to quickly assemble and deploy to evaluate building performance tested by natural and man-made hazards, conduct field investigation at disaster sites, and work with state and local officials to provide mitigation recommendations as well as addressing building design and construction improvements, and code development.[iv]

Case in point: even before the wind died down and the waves retreated in the wake of Superstorm Sandy, teams of engineers and scientists were coming together, mapping out the damage path and planning their ground investigations to determine why buildings survived or failed.

Since 1992, there have been 18 MAT reports in response to hurricanes, flood disasters, tornadoes, the Oklahoma City Murrah Federal Building bombing, 9/11, and Superstorm Sandy. [v]

Through forensic engineering analysis post-event, the MAT program members can identify structural failure and successes and provide recommendations to avoid similar problems or enjoy similar strong performance in the future.[vi] Successes from the MAT Program are many, including improved building codes in Florida and in several other parts of the country. [vii] MAT results are captured in FEMA publications (e.g., P-259/P-312 Residential Flood Retrofitting) to ensure widespread access and transparency. For example, observations from the Sandy MAT were drafted into brief, focused Sandy MAT Recovery Advisories to address observed issues quickly.[viii]

In the *Risk Management Magazine* article, First Deputy Commissioner of the New York City Department of Buildings Thomas Fariello commented, “FEMA has the benefit of going from disaster to disaster, growing their knowledge. They offer something that no one else can because of their nationwide experience.”

Other entities also perform valuable post-event assessments that have helped improve the built environment. For example, the National Science Foundation (NSF) has given grants for rapid response research,[ix] including a research grant to analyze the May 20, 2013 Moore, Oklahoma Tornado. Dr. Chris Ramseyer, was a member of the NSF team that assessed the damage from the May 20, 2013 Moore, Oklahoma Tornado.[x] Then in February of 2014, Dr. Ramseyer, also a University of Oklahoma engineering professor and director of its Fears Structural Engineering Laboratory, was asked to give recommendations to the Moore City Council on high-wind building code upgrades.[xi] These recommendations were followed with the implementation of a groundbreaking improvement to the building code to increase resistance to tornadoes and high-wind events, addressed more fully later in this paper.

Additionally, the Applied Technology Council (ATC) 20 is widely used for post-earthquake safety evaluation of buildings, as well as ATC 45 regarding safety evaluation of buildings after wind storms and floods.[xii] ATC conducted the FEMA P-1024 Performance of Buildings and Nonstructural Components in the 2014 South Napa Earthquake, as the FEMA MAT program is not currently structured to investigate the performance of buildings after earthquakes.[xiii]

The National Institute of Standards and Technology (NIST) is another federal agency that conducts technical investigation post-disaster. The NIST Engineering Laboratory – *Technical Investigation of the May 22, 2011 Tornado in Joplin, Missouri* provided a comprehensive analysis of the building performance during that event, and it provided recommendations to improve building performance. NIST summarized the impact of this study as follows:

> [The Technical Investigation was the] first to scientifically study a tornado in terms of four key aspects: storm characteristics, building performance, human behavior, and emergency communications—and then assess the impact of each on preventing injury or death. It also is the first to recommend that standards and model codes be developed and adopted for designing buildings to better resist tornadoes.[xiv]

The ICC staff frequently participates in the MAT process, sharing valuable insights on building performance. In fact, the ICC was assigned to lead the implementation of three of the above Joplin NIST recommendations—specifically, 7, 10, and 11 regarding tornado shelter standards, aggregate used as surfacing for roof coverings, and enclosures of egress systems (elevators, exits, stairways) in critical facilities.[xv]

The discussion here does not include all post-disaster, forensic investigations, and there are additional evaluation efforts, both private and public, that meaningfully contribute to safer, post-event building design.

The underlying theme is that post-storm investigations provide unassailable evidence that natural disasters like earthquakes, floods, hurricanes, tornadoes, and wildfires provide a large scale, systematic testing ground for construction materials and methods. Case in point, when tens of thousands of gable-shaped roofs fail in a nearly identical fashion as they did after Hurricane Andrew in 1992, we can confidently conclude that we need to brace them differently.

Lessons like these can be incorporated into codes for dissemination through model code development at the national level, or they can be incorporated in a grassroots approach, as they were in Florida post-Andrew and New York post-Sandy. Regardless of method, we only benefit from the expensive lessons learned in Mother Nature's lab if they are incorporated intact and on a timely basis.

Leaders are increasingly recognizing this critical opportunity. For example, one of the recommendations in the President's 2013 Hurricane Sandy Rebuilding Task Force report is for states to use the most current building codes, states that

> us[ing] the most current code ensures that buildings and other structures incorporate the latest science, advances in technology and lessons learned. These codes help ensure that more resilient structures are built and that communities are better protected from all types of hazards and disasters….[xvi]

Whether top-down or bottom-up, when we incorporate the expensive lessons of past disasters into building codes and standards, we can prevent building failures and enhance overall building performance in the future.

But taking a step back, isn't this an expensive way to upgrade our building practices?

Consider how dramatically disaster costs have grown in the U. S. Since 1980, the U.S. has sustained 178 weather and climate disasters where overall damages/costs reached or exceeded $1 billion, and the total costs of the 178 events exceeded $1 trillion.[xvii] In 2014 alone, eight weather and climate disasters in the U.S. resulted in 53 deaths and losses exceeding $1 billion.[xviii]

Despite earnest recovery efforts, rebuilding will never ensure risk reduction until it embodies the concept of "Building Back Better".[xix] This is especially important as much of the U.S. population is noted to live on the coast—one figure citing some 53 percent living within 50 miles of a coastline. [xx] And the population is expected to grow,[xxi] as is the building stock. One 2004 paper cited that "half of what will be the built environment in 2030 doesn't even exist yet."[xxii]

We can achieve the goal to "Build Back Better", but only if we establish a more comprehensive, formalized system to do so. We wholly support the ICC building code development system, and we believe that a standing method to fast track post-disaster insights would enhance overall U.S. disaster resilience. Further, we support an investment in and consideration of a National Transportation and Safety Board, or NTSB-style[xxiii], post-disaster building performance "crash" investigative board to raise the profile of this issue, and support high-speed incorporation of scientific insights into model codes and consensus standards.

How Can We Build It Right the First Time to Achieve True Resilience?

Recommendation #2 – Optimize property protection opportunities in model code and standard development by balancing all of the existing values, including public health, safety, and welfare.

The stated purpose of the International Residential Code is described as:

> The purpose of this code is to establish minimum requirements to safeguard the public safety, health and general welfare through affordability, structural strength, means of egress facilities, stability, sanitation, light and ventilation, energy conservation and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations.[xxiv]

Even more relevant to homes, the preface of the 2015 International Residential Code (IRC) states:

> This code is founded on principles intended to establish provisions consistent with the scope of a residential code that adequately protects public health, safety and welfare; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Understandably, the question of expense is of paramount importance as codes cannot deliver safety or welfare if they are unadoptable or unenforceable due to cost, but is the survival of the building losing ground?

Focusing on this issue of cost, let's examine the progression of the cost impact issue in model code development within the ICC system.

- Conversation about the cost impacts of code requirements started in the mid-1990s when members of the Council of American Building Officials began moving towards consistency and uniformity in building regulations across the U.S. Prior to 2000, there was no cost impact requirement in the ICC Council Policy CP#28, Code Development.[xxv]

- On November 12, 2000, for the first update to the International Building Code (2000 edition), proponents were requested to voluntarily state if a code change would increase the cost of construction; not increase cost; or if no statement is made on cost impact of construction.

- On October 31, 2001, the policy was changed to require proponent to indicate if code change proposal would increase cost or not.

- On October 10, 2011 the language was further changed to state that the proponent shall indicate one of the following regarding the impact of the code change proposal: 1) the code change proposal will increase the cost of construction; or 2) the code change proposal will not increase the cost of construction. The proponent should submit information supporting their claim, and any cost information submitted will be considered by the code development committee.

- On September 27, 2014, the building industry requested that ICC require cost-benefit statements to accompany all proposals to change the I-Codes. The ICC Board of Directors responded by amending Section 3.3.5.6 Cost Impact, which currently applies to 2015 cycle:

  Cost Impact: The proponent shall indicate one of the following regarding the cost impact of the code change proposal: 1) the code change proposal will increase the cost of construction; or 2) the code change proposal will not increase the cost of construction. The proponent shall submit information which substantiates either assertion. This information will be considered by the code development committee and will be included in the bibliography of the published code change proposal. Any proposal submitted which does not include the requisite cost information shall be considered incomplete and shall not be processed.[xxvi]

A cost-impact requirement serves an important function: to protect the short-term financial impact of proposed changes upon the construction industry and homebuyers. However, long-term financial savings must also be considered—not to mention the most important value of life safety.

Accordingly, the real savings, and the best building safeguards, come with a balanced approach to safety that considers so-called “first-costs” as well as full life-cycle costs to the builder and consumer while increasing protection for the public at large through safer structures.

So how does the welfare goal fit in? According to the Oxford dictionary, welfare is defined as, “the health, happiness, and fortunes of a person or a group.” Surely, American’s fortunes are tied to our largest, lifetime investment—the family home.

We appreciate how cost has evolved into a supersized emphasis after the housing collapse and ensuing economic downturn; however, we believe it is time for a more balanced approach to develop modern, model codes that deliver on society’s expectations. We need to recalibrate the understandable, but overemphasized, focus on cost vs. benefits in the post-2008 economic era because the current approach masks the long-term cost and ultimate vulnerability of buildings when they cannot withstand disasters.

Our motivation for this recommendation is our commitment to the consumer. Our 16-year experience working with families has taught us that they assume that building codes are the gold standard for construction. They believe that homes are built to an ideal level of strength, durability, and resilience.

They are surprised when they learn that codes are a minimum, and sometimes unenforced standard, instead.

Today’s system follows an approach of minimal building requirements, with beyond-minimum options triggered by consumer demand. This system targets safety, but does not focus on disaster resilience. As a result, meaningful, beyond-minimum practices that can improve building performance in disasters are often lost.

Further, leaving options up to consumer demand is a flawed approach as home buyers often enter into the home buying transaction after key resilience-driving design decisions are already in place, e.g., engineering for seismic or wind loads. Additionally, many structural aspects of homebuilding are too complex for lay consumers to understand even if they are involved at the outset of drafting and design. And, most home purchases are of existing homes, so new construction decision-making (the most affordable time horizon to integrate stronger building practices) is no longer available.

We are not saying that model codes, when adequately enforced, do not protect property, but the present focus on affordability, only at the initial phase of construction or renovation—instead of affordability throughout the duration of the building’s life cycle—can leave valuable innovation behind.

Unfortunately, the cost issue is used by some as a predicate to either undermine code improvement or, even worse, weaken existing model codes. For example, the 2006 IRC required that existing asphalt shingles be removed prior to installing new roof coverings in areas of moderate or severe hail exposure. The 2012 IRC deleted this requirement, and it is absent from the 2015 IRC as well. However, documented performance of asphalt shingles during hail shows us that not removing old asphalt shingles before installing new ones results in weaker roof performance (sponge effect) and effectiveness.[xxvii]

According to the *Insurance Information Institute*, 2014 insured hail losses topped the $1 billion mark, so why not construct roofs that are best suited to handle hail and reduce losses? Insurers suffer the financial consequences, but so do the homeowners through higher rates, deductible payments, or the inability to secure insurance at all. The short-term cost of removing the older layer of shingles is certainly worthwhile when you calculate the benefit of optimal roof performance over time.

We understand that requiring cost benefit analyses of building code adoption and enforcement is part of a larger policy trend across the country to identify the cost of any regulation prior to its implementation. In response to this need, the ICC amended Section 3.3.5.6 Cost Impact, as noted above and incorporated it into model code development so the analysis would be available to the jurisdictions, and spare local governments from additional analysis costs. Unfortunately, however, opponents of current, model codes are using the cost analysis requirements in some cases as a means to stall or block code adoption. For example, Senate Bill 1679 in Texas[xxviii] would have required an expensive cost benefit analysis prior to code adoption for all jurisdictions larger than 40,000 in population. Fortunately, Texas legislators declined to pass this measure that would have most certainly created a road block to code adoption.

Perhaps this failed Texas effort points up an additional, potential policy benefit from codes valued for both life safety and property protection (welfare) as it may reduce the steady stream of costly battles, large and small, over whether a building innovation delivers life safety or “only” building protection. This gray area wastes time, delays code improvement, and undermines public confidence.

Most importantly, building for life safety and property protection could ensure that we build to meet the needs of individuals and the community by avoiding construction of homes that fail to survive ordinary wear and tear, individual losses, or large-scale natural disasters.

How Do Beyond-Code Performance Standards Fit Into Codes?

Recommendation #3 – Evaluate, integrate and leverage public and private sector beyond-code standards and programs into the ICC system to ensure continuity, increase awareness, and support disaster-resilience innovation.

One way that disaster-resilient construction methods can be identified for consideration as building code enhancements is through voluntary, beyond-code appendices that address disaster-resilient practices/options.

For example, the state of Georgia was awarded a grant through the U.S. Department of Housing and Urban Development (HUD) for the development of new, optional disaster-resilient building code appendices to the Georgia-adopted versions of the IBC and IRC.[xxix] These appendices are now available for local jurisdictions to adopt, in whole or in part, to increase their resilience, through increased construction requirements against natural disasters. [xxx]

Currently, two jurisdictions have adopted portions of the appendices, and training webinars are being conducted to educate building officials.[xxxi] The Georgia standards represent an innovative public sector, beyond-code effort that was locally driven, and federally funded.

A private sector example of a voluntary standards program is the Insurance Institute for Business & Home Safety[xxxii] Fortified for Safer Living program. Fortified standards specify construction, design, and landscaping guidelines to increase disaster-resilience for new home construction.[xxxiii] The insurance industry created Fortified more than 15 years ago to drive the use of beyond-code, innovative property-preserving building practices to help reduce losses and increase insurability of homes. The program now has a companion program, FORTIFIED Home, which outlines practices for retrofitting pre-code, or older homes to a higher building standard as well.

One of the most significant aspects of these FORTIFIED initiatives is that property insurers may offer discounts or other incentives for homeowners who build to FORTIFIED standards.[xxxiv] And, when standards align with financial incentives like annual credits/discounts, or increased insurability overall, the standards can appeal to both builders and buyers.

Some believe that beyond-code initiatives indicate dissatisfaction with the minimum nature of building codes. We believe that beyond-code initiatives represent the leading edge of code development and double as “code-future” when they leverage innovation. Additionally, beyond-code standards provide local stakeholders, public or private, an essential tool to manage growing financial and social losses in disaster zones.

It is possible to improve, and preserve, the existing code system if we integrate appropriate beyond-code standards into the ICC codes as appendices to the national model codes. This would provide a uniform playbook for builders who want to build beyond code. It would eliminate the need for communities or industries to self-help, and it would send a clear signal that we can work within the existing system while still innovating and enhancing the underlying codes themselves.

This suggestion is not without precedent. One example comes from the sustainability movement and the ICC 700, *National Green Building Standard.* ICC 700 is the result of a collaborative effort between the ICC and National Association of Home Builders. It provides builders with four levels of green practices that can be customized to local specifications, business needs, and regional housing markets.[xxxv]

The successful creation of the ICC 700 demonstrates that finding common ground and creating shared value while achieving a larger, societal goal is possible.

And, disaster-resilience appendices could also help address growing impatience on the part of key public and private stakeholders as some states fall behind due to elongated code cycles, overemphasis on cost vs. benefits, or other drivers that create a gap between ideal building practices and minimum requirements.

Regardless of approach, any successful effort to integrate beyond-code standards into the ICC system will require leadership, public and private collaboration, and input from the academic and research community. But the interest is clearly in place. Homeowners should have clear options regarding a path to make their homes stronger, and builders can benefit by providing resiliency options to their clients.

Can a home be affordably built to be safe, sustainable and resilient? We believe so.

Are There Opportunities to Increase Stakeholder Diversity in Model Code Development?

Recommendation #4 – Enhance code development by broadening the representation of interest groups on the International Residential Code technical committees.

This recommendation is driven by a basic tenet of the ICC's Code Development Process: that diverse stakeholder representation is crucial to a balanced, consensus-based system. We agree, and we see opportunity to strengthen the system with informed, but diverse input from key stakeholders. Not only does this add value to the end product, but it could also enhance the impact and acceptance of model building codes from the national level through to the local level where adoption and enforcement trends are lagging.

The standing committee membership of the International Code Council Residential Committee appropriately includes architects, code officials, engineers, and homebuilders, but we believe that other key stakeholders are missing.[xxxvi] One way to address this concern is to add new voices with equal social and financial stake in high performing buildings.

We suggest adding seats to bring in consumer, emergency management, insurance, local elected, and even meteorology voices to ensure due consideration of building performance in disasters. Understanding that this committee is technical in nature, we are confident that qualified individuals could be identified to serve in each seat, and that a harmonized model building code could be capably produced. National associations and professional societies, including the American Meteorologists Society, Insurance Institute for Business and Home Safety, National Emergency Management Association, National League of Cities, and of course, our own—Federal Alliance for Safe Homes (FLASH)—could be tapped to identify suitable candidates.

Regardless of how recruitment is achieved, enhancing the field of participants that develop the International Residential Code model code would deliver useful benefits. It would raise the public profile, heighten leadership appreciation for building codes, and create a way to attract broad-based participation in the code development process overall. This recommendation aligns with the most urgent recommendation for innovation inside the building code system.

How Can We Increase Code Adoption and Enforcement at the State and Local Level?

Recommendation #5 – Support code adoption and enforcement mechanisms through an enhanced, well-resourced system of information provision to state and local officials as well as the public regarding benefits and mechanics of building codes and disaster-resilient construction.

Code Adoption

ICC model code development at the national level is the first of three essential steps along the path to a system of codes and standards that support building excellence. The next two steps are to promptly adopt the codes and provide adequate enforcement resources for training and maintenance of a professional code department.

In our experience, an important first step to supporting building code adoption by officials is the provision of objectively verified, accurate information about the costs and benefits of building codes, as well as the impact of severe weather and other perils on residential structures. As states and local jurisdictions are constantly balancing personnel and financial restraints, this type of credible information is the most persuasive tool to empower reasoned decision-making for the state and local leaders charged with improving resiliency.

Last year in *Building Codes: The Foundation for Resilience*, we wrote about the new building code in Moore, OK that incorporates the *Dual-Objective-Based Tornado Design Philosophy*. This landmark thinking defies traditional assertions that “there is nothing you can affordably build to withstand tornadoes,” and comes in response to field investigations by engineers that documented a pattern of disproportionate structure collapse in tornado outbreaks. They point out how even small design changes can make a difference, and they have developed guidelines to estimate the tornado-induced loads.

Local officials from Moore took the insights to heart and codified the new, stronger building practices into the residential building code after the deadly tornado outbreak on May 20, 2013 that killed 24 residents, injured 400, and damaged or destroyed nearly 2,400 structures. The new code requires that homes are built to withstand winds of up to 135 mph by using better wall bracing, improved roof tie-downs, and overall stronger connections.

Dr. Kevin Simmons of Austin College recently conducted a cost-benefit study on the new residential building codes in the City of Moore. The analysis stated that the added features of the new residential building standard adopted by the City of Moore will increase the cost of a home by $1.00 per square foot.[xxxvii] It then went on to find that $10.7 billion of losses could be avoided because of the new Moore codes, thereby illustrating that the new residential codes provide benefits that more than offset the costs. [xxxviii] The calculated payback is 3.2 to 1 on the mitigation investment provided by the Moore building code. [xxxix] The author went on to recommend that the state seriously consider adoption of the same code. [xl]

But the question remains, as the Moore code has been hailed around the global wind science community for its greatly enhanced life- and property-saving principles, why is it that neighboring Oklahoma City has yet to adopt it? If we cannot export the breakthrough engineering principles to a community next door that has seen its own share of deadly tornadoes, what can we do differently to inspire communities throughout the high wind area of the U.S. to act proactively?

Oklahoma isn't unique in this respect. Other communities with the same hazards and loss experience have diverged in their thinking regarding whether to build and prepare better for the next event. For example, New York's statewide building code now requires all homes in flood hazard areas have two feet of freeboard (a safety factor measured in feet elevated above a flood level).[xli] Yet, neighboring states like New Jersey, Connecticut, and Pennsylvania have yet to adopt the same requirement even though they share New York's devastating Superstorm Sandy legacy and vulnerability to catastrophic flooding.

This spring, Oklahoma endured another deadly round of tornadoes and devastation, making the need and value of better, stronger codes even more obvious. What could explain any failure to act in favor of better building after this latest round of deadly reminders? Is it fear of cost? Do leaders fail to recognize their risk? Is so-called cognitive dissonance, an understandable human tendency of denial for citizens of communities in harm's way? Would it make a difference if we helped them understand that everyone faces some form of disaster risk?

In January of this year, we analyzed and released updated data from the NOAA Storm Prediction Center that indicated 89% of U.S. counties had experienced tornado watches for an average of 27 hours per year from 2003 to 2014. This surprised some, but not those who are familiar with the *U.S. Wind Zone Maps*. Aligning weather data with building code information helps leaders understand the impact of their decision-making to either foster or impede community resilience through adoption of strong, model building codes. Hopefully, the understanding gives them a basis for action in favor of better building.

Helping communities better understand their hazards is key to overcoming inaction, especially when the insights present a surprise. Many community leaders are surprised to learn that, according to *FloodSmart.gov*, nearly 20% of flood insurance claims are outside of high risk areas and come from moderate-to-low risk areas.[xlii] This raises the question of how well people in these areas understand their risk.

Do leaders generally have an accurate gauge of the perils they may face?

We do not believe that any leader intentionally overlooks opportunities to improve building performance, but we have witnessed many occasions when the decision-maker simply does not have all the credible information necessary to make the right decision.

When that happens, it is our collective failing as a movement. Of course, this is a resource issue as the time and expense necessary to ensure continuous provision of comprehensive, specific, and relevant information to leaders—when they need it—is a significant undertaking. The U.S. Census Bureau (2007) reports that there are 39,044 general purpose local governments.[xliii] Clearly, adopting, enforcing, and maintaining a strong building code in each jurisdiction is no small task.[xliv] And, the reality leaves us in a posture of putting out proverbial policy fires while fighting to protect the codes we have.

Recently, we made a successful appeal to Michigan leaders to preserve life-saving arc fault circuit interrupter requirements in place. For three years, we have been working to preserve the structural building codes in Tennessee. We are striving to help Texas leaders' understand that counties, not just cities, need clear residential building code enforcement authority. As we witnessed the tragic Texas floods during May, we wonder if that epic catastrophe will give urgency to this message.

But we will never achieve resilience this way. We need to get out in front by making the case for building codes long before these questions arise.

That is why we have introduced comprehensive, model curriculum on the significance of building codes to design, construction, and engineering professionals that is now offered in world class engineering colleges like Clemson. That is why we partner with mayors to present resilience symposia. That is why we have graduate scholarships on resilience for future actuaries, architects, construction managers, engineers, meteorologists, risk communicators, and social psychologists.

But there is so much more to do.

Code Enforcement

The next critical step after adoption is to dedicate adequate resources for enforcement. Without meaningful enforcement, building codes have no value. Jurisdictions need authority to enforce building codes and ensure that buildings perform when tested by nature or over time.

In March of this year, we joined representatives from every subject matter expert group relevant to the built environment. We gathered as part of the ongoing effort to support the Federal Mitigation Framework Leadership Group (MitFLG) and Recommendation 25 of the *2013 Hurricane Sandy Rebuilding Task Force.* The recommendation asserts that using "disaster-resistant building codes is the most effective method to ensure new and rebuilt structures are designed and constructed to a more resilient standard."

The group included academics, architects, code officials, corporations, engineers, hazard experts, homebuilders, insurers, local, state and federal government representatives, executive branch leadership and relevant federal agencies. Everyone concurred that building code enforcement is essential to successfully creating resilience, and further, all agreed that enforcement is likely where we are losing the most ground.

So, it is surprising with that near universal agreement on the importance of code enforcement, that we still have states like Alabama and Georgia with voluntary enforcement systems, or Texas counties that consider themselves without clear legal authority to enforce building codes. But the bigger question is how can anyone advocate for *voluntary* regulation when it comes to matters of public safety and welfare? The very purpose of regulation is to ensure we protect our citizens in those specific instances when citizens are either not present to oversee the delivery of the product, or the product delivery is too complex for consumer oversight. That is why car manufacturing, medicines, even county fair rides are regulated.

Adopting a code without mandatory enforcement is like posting a speed limit, but never checking to see if drivers comply.

As enforcement is the purview and responsibility of local governments, we believe that the existence of a credible enforcement program should be a factor in determining who qualifies for disaster relief. Local governments hold the key to the most fundamental element of resilience through adoption and enforcement of codes, so they must do their part upfront to reduce losses before they happen. We owe this to the taxpayers.

What Is Our Opportunity for the Most Immediate Impact in Improving Codes?

Recommendation #6 – Increase engagement by all stakeholders in the building code system through robust participation in each phase, including model code development, state and local adoption, and enforcement.

This final recommendation may be the most important of all the recommendations we are making. Perhaps Theodore Roosevelt said it best,

> It is not the critic who counts; not the man who points out how the strong man stumbled, or where the doer of deeds could have done better. The credit belongs to the man who is actually in the arena….[xlv]

One industry that is leading by example is the hospital industry, specifically the American Society for Healthcare Engineering (ASHE). At one time, their member hospitals were facing compliance with overlapping requirements of the ICC I-Codes and NFPA 101.[xlvi] Working under two different codes caused unnecessary redundancies and increased costs of compliance. [xlvii]

To resolve this problem, ASHE worked with the ICC to establish an ICC ad-hoc committee. The committee worked through the inconsistencies and helped eliminate the overlap.

The ASHE experience is a good model for how we can resolve legitimate concerns regarding our building code system, but only if we work together in a way that focuses on the core goal of strong, safe, durable, and resilient structures.

The only way to marshal the resources necessary to fulfill this recommendation is through collaborative effort and shared commitment. All voices are essential to provide information necessary to build and deliver a sound case for investment in adoption of current model codes, properly trained code officials, and effective systems for code enforcement.

Conclusion

We believe that the above-described recommendations could transform the system that produces minimum building codes to one that supports construction of safe, durable, and affordable homes that are built to withstand disasters and pass the test of time.

Until we embrace this type of transition, we cannot meaningfully move to a true resilience framework focused on overall community function. It's time to evolve from focus on only specific building performance and disaster-resistance where engineering takes center stage, to a focus where people, their survival, and their continuity are at the core.

When we have a system that gets people back to home, back to work, and back to a new and better normal post-disaster, we will be resilient and adaptable to future disasters of all kinds. Adapting our building code system with resiliency in mind is the first and most essential step toward that goal.

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[i] FLASH adopts FEMA's National Disaster Recovery Framework (NDRF) definition of resilience: "Resilience – Ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies."
[ii] International Code Council. *Promoting Awareness Through Building Safety Month.* Available: http://www.iccsafe.org/about-icc/building-safety-month/2015-building-safety-month-is-may/.
[iii] FEMA is a FLASH *Legacy Partner*
[iv] FEMA (Federal Emergency Management Agency). *Mitigation Assessment Team Program*. Available: https://www.fema.gov/mitigation-assessment-team-program.
[v] FEMA (Federal Emergency Management Agency). *What is the Mitigation Assessment Team Program?* Available: https://www.fema.gov/what-mitigation-assessment-team-program. FEMA's Mitigation Assessment Team (MAT) Program is an important part of hazard mitigation that is achieved through advances "in codes and standards, designs, methods and materials used for new construction and post-disaster repair and recovery." FEMA (Federal Emergency Management Agency). *Mitigation Assessment Team Program*. Available: https://www.fema.gov/mitigation-assessment-team-program. The MAT Program is an updated, enhanced version of the previous Building Performance Assessment Team (BPAT) Program. FEMA (Federal Emergency Management Association). *What is the Mitigation Assessment Team Program?* Available: https://www.fema.gov/what-mitigation-

assessment-team-program. The *MAT Standard Operating Procedure (SOP)* provides more information about the MAT process.

[vi] FEMA (Federal Emergency Management Agency). *What is the Mitigation Assessment Team Program?* Available: https://www.fema.gov/what-mitigation-assessment-team-program.

[vii] FEMA (Federal Emergency Management Agency). *Hurricane Sandy – Lessons Learned from FEMA Mitigation Assessment Team (MAT).* Mar. 5, 2013. Available: http://aiany.aiany.org/Sandy_MAT_Facilities-AIA_Lessons_Learned-03-05-13(1).pdf. For additional information regarding successes of the MAT program see Tezak, E. Scott. *FEMA Mitigation Disaster Response and Investigations: Mitigation Assessment Teams.* URS Corporation (BESTT Joint Venture). Available: http://www.digitalhurricane.org/2009%20Digital%20Hurricane%20Symposium_files/Tezak%20-%20FEMA%20Mitigation%20Disaster%20Response%20and%20Investigations.pdf; Plisich, John. *FEMA Mitigation Assessment Team Program: An Overview.* May 9, 2013. FEMA. Available: http://www.cste2.org/disasterepimeeting/15-FEMA%20MAT%20Overview_Plisich.pdf.

[viii] FEMA (Federal Emergency Management Agency). *Hurricane Sandy – Lessons Learned from FEMA Mitigation Assessment Team (MAT).* Mar. 5, 2013. Available: http://aiany.aiany.org/Sandy_MAT_Facilities-AIA_Lessons_Learned-03-05-13(1).pdf.

[ix] National Science Foundation. *Grant Proposal Guide.* Jan. 2009. Available: http://www.nsf.gov/pubs/policydocs/pappguide/nsf09_1/gpg_2.jsp#IID1.

[x] Graettinger, Andrew, et al. 2014. *Tornado Damage Assessment in the aftermath of the May 20th 2013 Moore Oklahoma Tornado.* Available: http://www.ou.edu/content/dam/CoE/Fears/Moore%20Tornado%20Final%20Report.pdf.

[xi] Hampton, Joy. *Moore City council considers storm-resistant building code upgrades.* Mar. 17, 2014. The Norman Transcript. Available: http://www.normantranscript.com/news/local_news/moore-city-council-considers-storm-resistant-building-code-upgrades/article_c4b4d99b-17e6-5fe3-a32f-4ca22a93af9f.html.

[xii] See ATC-20, *Post-earthquake Safety Evaluation of Buildings* and ATC-45, *Safety Evaluations of Buildings after Wind Storms and Floods.*

[xiii] FEMA (Federal Emergency Management Agency). P-1024. February 2015. *Performance of Buildings and Nonstructural Components in the 2014 South Napa Earthquake.* ATC.

[xiv] *NIST Issues Final Joplin Tornado Report, Begins Effort to Improve Standards and Codes.* Mar. 28, 2014. NIST *Tech Beat.* Available: http://www.nist.gov/el/building_materials/joplin-032614.cfm.

[xv] *NIST Issues Final Joplin Tornado Report, Begins Effort to Improve Standards and Codes.* Mar. 28, 2014. NIST *Tech Beat.* Available: http://www.nist.gov/el/building_materials/joplin-032614.cfm.

[xvi] Hurricane Sandy Rebuilding Task Force. August 2013. *Hurricane Sandy Rebuilding Strategy: Stronger Communities, A Resilient Region.* Available: http://portal.hud.gov/hudportal/documents/huddoc?id=hsrebuildingstrategy.pdf.

[xvii] NOAA. *Billion-Dollar Weather and Climate Disasters: Overview.* Available: https://www.ncdc.noaa.gov/billions/overview.

[xviii] NOAA. *Billion-Dollar Weather and Climate Disasters: Overview.* Available: https://www.ncdc.noaa.gov/billions/overview.

[xix] "Building Back Better" as a widely used term, was first employed during the recovery effort after the Indian Ocean Tsunami. See Sandeeka Mannakkara, Suzanne Wilkinson. 2014. *Re-conceptualising "Building Back Better" to Improve Post-Disaster Recovery*. International Journal of Managing Projects in Business, Vol. 7 Iss: 3. Pre-print version. Available: http://www.resorgs.org.nz/images/stories/pdfs/journal/reconceptualising-building-back-better.pdf. The term has since been used in post-disaster recovery/rebuilding efforts, and as part of disaster risk reduction and recovery initiatives through organizations like the United Nations.

[xx] 2011. *Building Community Disaster Resilience through Private-Public Collaboration.* National Research Council of the National Academies. p. 23. *Citing* Markham, V.D. 2008. U.S. Population, Energy & Climate Change. New Canaan, CT: Center for Environment and Population. Available at www.cepnet.org/documents/USPopulationEnergyandClimateChangeReportCEP.pdf.

[xxi] 2011. *Building Community Disaster Resilience through Private-Public Collaboration.* National Research Council of the National Academies. p. 23. *Citing* Beach, D. 2002. *Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States.* The Pew Charitable Trusts. April 8. Available at www.pewtrusts.org/our_work_report_detail.aspx?id=30037.

[xxii] Nelson, Arthur. 2004. *Toward a New Metropolis: the Opportunity to Rebuild America.* A Discussion Paper Prepared for The Brookings Institution Metropolitan Policy Program. p. v-vi. Available: http://www.brookings.edu/~/media/research/files/reports/2004/12/metropolitanpolicy-nelson/20041213_rebuildamerica.pdf.

[xxiii] The National Transportation Safety Board. *The Investigative Process.* Available: http://www.ntsb.gov/investigations/process/Pages/default.aspx.

[xxiv] International Code Council. 2015 International Residential Code. Chapter 1, Scope and Administration

[xxv] This Council Policy prescribes the Rules of Procedure utilized in the continued development and maintenance of the International Codes.

[xxvi] International Code Council. *CP#28-05 Code Development.* Available: www.iccsafe.org/AboutICC/Documents/CP28-05.pdf.

[xxvii] The Roofing Industry Committee on Weather Issues (RICOWI) Hailstorm Investigation Report http://www.ricowi.com/docs/reports/RICOWI_OKCity_Hail_Report.pdf (p. 9) confirms that roofs with asphalt shingles overlaid over other roof coverings experienced damage at smaller size hail than roofs on solid decks. Stiffness plays a critical role in hail resistance and layered shingles or roof coverings create a "sponge" effect with the top layer being more susceptible to penetration by hailstones, thus increasing the risk of water penetration.
[xxviii] Texas S.B. No. 1679. 2015. Available: http://www.legis.state.tx.us/tlodocs/84R/billtext/pdf/SB01679E.pdf#navpanes=0.
[xxix] Georgia Department of Community Affairs. *Disaster Resilient Building Construction Appendices Workshops.* Available: http://www.dca.state.ga.us/development/constructioncodes/programs/DRBCWorkshop.asp.
[xxx] Georgia Department of Community Affairs. *Disaster Resilient Building Construction Appendices Workshops.* Available: http://www.dca.state.ga.us/development/constructioncodes/programs/DRBCWorkshop.asp.
[xxxi] Georgia Department of Community Affairs. *Disaster Resilient Building Construction Appendices Workshops.* Available: http://www.dca.state.ga.us/development/constructioncodes/programs/DRBCWorkshop.asp
[xxxii] The Insurance Institute for Business & Home Safety.
[xxxiii] IBHS. *FORTIFIED for Safer Living Standards Guide.* Available: https://www.disastersafety.org/fortified/fortified-for-safer-living-standards-guide/.
[xxxiv] *Frequently Asked Questions: FORTIFIED Home.* Available: https://www.disastersafety.org/fortified/fortified-home-frequently-asked-questions-2/.
[xxxv] ICC, NAHB. *2012 ICC 700 National Green Building Standard.* Available: https://builderbooks.com/2012-icc-700-national-green-building-standard.html. See also the ICC's International Energy Conservation Code.
[xxxvi] International Code Council. I-Code Development Consensus Committees. Available: www.iccsafe.org/membership/i-code-development-consensus-committees/.
[xxxvii] Simmons, Kevin, et al. 2015. *Tornado Damage Mitigation: Benefit/Cost Analysis of Enhanced Building Codes in Oklahoma.* Other factors are noted with the study's calculations as they could affect the values of same.
[xxxviii] Simmons, Kevin, et al. 2015. *Tornado Damage Mitigation: Benefit/Cost Analysis of Enhanced Building Codes in Oklahoma.* Other factors are noted with the study's calculations as they could affect the values of same.
[xxxix] Simmons, Kevin, et al. 2015. *Tornado Damage Mitigation: Benefit/Cost Analysis of Enhanced Building Codes in Oklahoma.* Other factors are noted with the study's calculations as they could affect the values of same.
[xl] Simmons, Kevin, et al. 2015. *Tornado Damage Mitigation: Benefit/Cost Analysis of Enhanced Building Codes in Oklahoma.* Other factors are noted with the study's calculations as they could affect the values of same.
[xli] FEMA. *Freeboard.* Available: https://www.fema.gov/freeboard.
[xlii] FloodSmart.gov. Available: https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/defining_flood_risks.jsp.
[xliii] National League of Cities. *Number of Municipal Governments & Population Distribution.* Available: http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-structures/number-of-municipal-governments-and-population-distribution.
[xliv] Of course, some states have statewide building codes, in which adoption takes place at the state level. Nonetheless, education and enforcement remain crucial roles, even in states with a statewide building code.
[xlv] Roosevelt, Theodore. "The Man in The Arena" Speech at the Sorbonne Paris, France. April 23, 1910. Available: http://www.theodore-roosevelt.com/images/research/speeches/maninthearena.pdf.
[xlvi] Information provided by the ICC. See also ASHE News Release regarding creation of ad-hoc committee at *ICC, ASHE to Develop Code Changes for Hospitals, Ambulatory Care Facilities.* Available: http://www.ashe.org/press/2011/icc_code.html#.VawKePnl-7g for additional information.
[xlvii] Information provided by the ICC. See also ASHE News Release regarding creation of ad-hoc committee at *ICC, ASHE to Develop Code Changes for Hospitals, Ambulatory Care Facilities.* Available: http://www.ashe.org/press/2011/icc_code.html#.VawKePnl-7g for additional information.