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POLICIES TO ENHANCE RESILIENT COMMUNITIES

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Conference Topic: Performance of Buildings under Natural Disasters

ABSTRACT

Natural disasters are physically, socially, and psychologically devastating to a community. It can be extremely difficult to rebuild and restore the lives of residents after the destructive event. Moreover, leading scientists now believe our vulnerability will increase due to climate change. Building resiliency, while reducing future greenhouse gas emissions, is a necessary and complementary strategy for dealing with the accelerated rate of adverse events.

Where do organizations and governments begin to help its constituents? FEMA, USGS, NOAA, EPA, NIBS and IBHS all offer solutions for disaster preparedness with a myriad of processes or protocols in place for dealing with the unthinkable. What is missing however is the development of specific policies to advance the security and disaster risk reduction of our infrastructure.

Resilient infrastructure policies move the community from reactive approaches to a proactive stance where stakeholders actively engage in reducing many of the broad societal and economic burdens that disasters can cause. Investing in resiliency, from strengthening building codes to restoring natural ecosystems, can be surprisingly cost-effective, greatly reducing the impact of natural hazards. Policies affecting building practices can also be instrumental in increasing economic investment in making the socio-economic dimension of our society resilient and climate proof.

This paper describes strategies that bring together the tools and activities from many different sectors in an effort to address resilience including:

1. Leveraging green-building momentum to include resilience.
2. Development of ordinances and mandatory building codes.
3. Addressing durability with lifecycle costs and ongoing maintenance.
4. Increasing and improving infrastructure investment from all stakeholders.

By spreading awareness of the resilient options available to help hazard-risk communities to prepare, policy makers can catalyze the building of efficient, livable communities that are healthier and stronger right now.

POLICIES TO ENHANCE RESILIENT COMMUNITIES

Introduction

For millions of people in the United States, the consequences of natural disasters have become increasingly real, personal and devastating. In 2012, there have been 11 natural disasters costing $1 billion or more in damage, making 2012 the second highest year with billion-dollar disasters (NOAA 2011). Early season tornadoes, the widespread and intense drought that covered at least 60 percent of the contiguous U.S. and Hurricane Sandy are expected to go down in history as the most costly weather-related disasters in U.S. history. Now, with the world's attention on the Philippines after Typhoon Haiyan, communities in the United States are rethinking the way we build to meet the challenge of the next natural or man-made disaster.

Globally, insurers lost at least $108 billion on disasters in 2011 and $77 billion in 2012 (Masters 2011). Reinsurer Swiss Re Ltd. said that 2011 was the second-worst year in the insurance industry's history. Only 2005, with Hurricane Katrina and other major storms, were more costly (Swiss Re 2013). However, most of the increased disaster losses cannot be attributed to an increased occurrence of hazards but with changes in population migration and wealth. Frequency of major US hurricane landfalls has remained constant (Figure 1) in the last 60 years (Weinkle et al. 2012), and the trend of strong to violent tornadoes (F3+) has, in fact, decreased (Figure 2) since 1954 (NOAA 2013b). So what cause is attributed to the increase in losses?

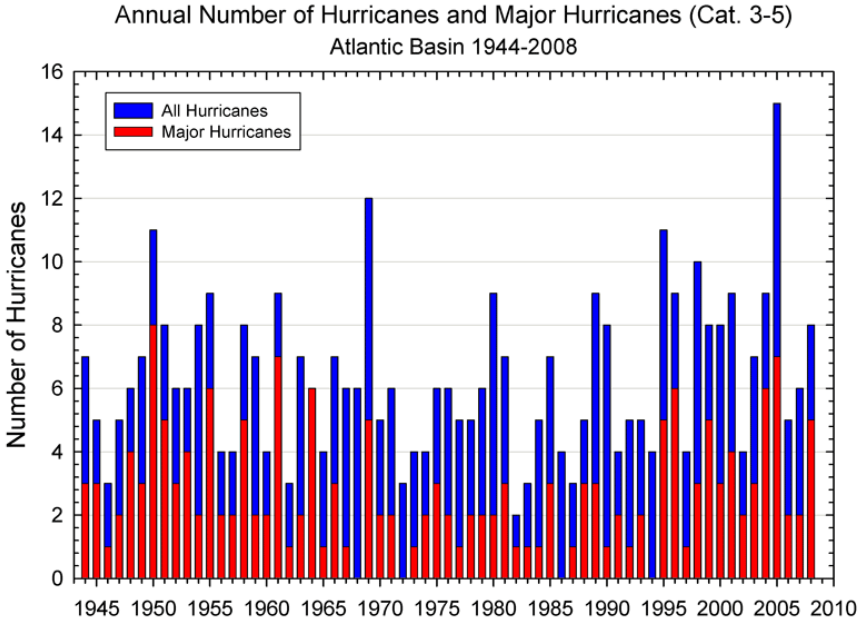

Figure 1. Frequency of Major Hurricanes (NOAA, 2013)

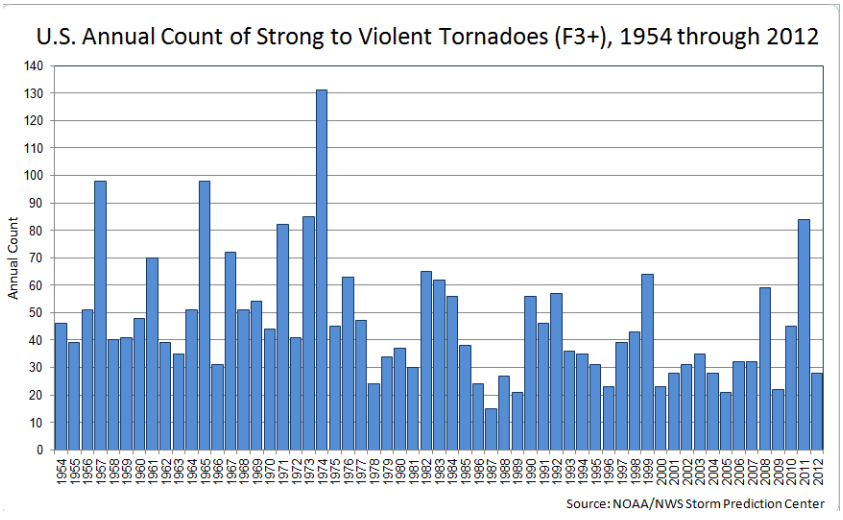

Figure 2. Frequency of US Violent Tornadoes (NOAA, 2013)

In the last several decades, population in the United States has increased and migrated toward the coasts, concentrating along the earthquake-prone Pacific coast and the hurricane-prone Atlantic and Gulf coasts. Over 60% of the U.S. population lives within 50 miles of one of its coasts (including the Great Lakes) (CRSR 1997). At the same time, wealth and the value of their possessions have increased substantially. For example, while California's Los Angeles County accounts for only 2.5% and Florida's Dale County account for only 14% of their respective states land area, yet they contain 30% of their state's property value (Guin and Saxena 2002). These changes in concentration of population and property values are significant contributors to the increased property losses from natural hazards. Moreover, many elements of our aged infrastructure are highly vulnerable to breakdowns that can be triggered by relatively minor events (Masters 2011).

Disasters result not as much from the destructive agent itself but from the way in which communities are (or are not) prepared. Disasters happen when the natural systems are encroached upon by human development. There is no such thing as a natural disaster. The extent of disruption caused by a disaster is greatly influenced by the degree to which society chooses to be fortified for the event. It's well established that the poorest people in our communities suffer disproportionately. Lives, assets, products and crops are lost; livelihoods are cut off; economic growth is curtailed or sent into reverse.

It is apparent that there needs to be significant shift in how we address natural disasters, moving away from the traditional focus on response and recovery toward emphasis on resiliency, that is, preventive actions to reduce the effects of a natural hazard.

Resilience Is The New Sustainability

Resilience can be understood as the capacity to anticipate and minimize potential destructive forces through adaptation or resistance. Basically addressing changes in the environment requires actions to mitigate their negative effects. If we identify resiliency, not solely as a state of preparedness for disaster, but as a desired characteristic of a sustainable society, one that is more in control of its energy and food production, access to water supplies, as well as being one that enables local social capital, we can begin to see the relationship to sustainability. The term 'sustainability' usually describes some aspect of maintaining our resources from the environment to the quality of life, over time. It can also refer to the ability to tolerate—and overcome—degradation of natural environmental services, diminished productivity and reduced quality of life inflicted by human's relationships to the planet and each other.

Critical infrastructures and other essential services have enabled societies to thrive and grow and become increasingly interconnected and interdependent from the local to global levels. As a society, we have placed a great deal of emphasis on recycling rates and carbon footprints. It is ironic that we are surprisingly willing to invest considerable amounts of upfront capital for a LEED (Leadership in Energy and Environmental Design) (USGBC 2013) Platinum certified building to achieve a mere 14% energy efficiency, yet we are completely satisfied if the structure meets only the code minimum requirements for seismic or wind load.

Change is coming. The California Green Building Code (California Building Standards Commission), the ASHRAE 189.1 Standard (ASHRAE), and the ICC700 (National Green Building Standard) (NAHB) all cite life-cycle assessment (LCA) as a means to promote sustainable building practices. The latest version of the LEED rating system developed by the U.S. Green Building Council (USGBC) introduces special emphasis on regionalization and LCA criteria, but does not recognize disaster resilience as one of its standard criteria. The building service life plan (BSLP) elective by the International Green Construction Code (IGCC) (ICC) gives credit to proposed projects designed to have a 100 year or 200 year life span as approved by the jurisdictions.

This is a good start as building service life is rarely considered but is critical to any analysis of long-term sustainability. Balancing long term development plans with the ability to adapt to the needs of a rapidly evolving society is vital to the ultimate success of a building life plan. But for green building standards to truly address sustainable construction, they will have to address the concept of disaster resilience.

Planners should consider the building's potential for future use and re-use as well as long service life with low maintenance costs. In addition, a sustainable building should be designed to sustain minimal damage due to natural disasters such as hurricanes, tornadoes, earthquakes, flooding and fire. Otherwise, the environmental, economic and societal burden of our built environment could be overwhelming. A building that requires frequent repair and maintenance or complete replacement after disasters would result in unnecessary cost, from both private and public sources, and

environmental burdens including the energy, waste and emissions due to disposal, repair and replacement.

It doesn't make sense to design a modern building, commercial or residential, to meet LEED or other green building requirements that could be easily destroyed as a result of a hurricane, earthquake or other force of nature. That would mean that all of the green technology and strategies used in the building would go to the landfill. What is the point of installing low flush toilets in a home to conserve water if it ends up in a landfill after a tornado blows through?

Disaster Resilient Communities Workshops 2012-13

Many federal agencies – FEMA (FEMA 2012), USGS (Holmes et al. 2013), NOAA, EPA- all offer solutions for disaster preparedness with a myriad of strategies or protocols in place for dealing with the unthinkable. What is missing however is the development of specific policies at the tactical level to advance the security and disaster risk reduction of our infrastructure.

In 2012-13, motivated by the regularity of devastating events, a coalition of concerned manufacturers, trade associations and the insurance industry joined together to deliver a series of workshops to educate the public on the vital role of resilient, high-performing structures. The following presents the findings proposed by participants of the *Adopting Disaster Resilient Construction at the Local Level Workshop* (Workshop) (NRMCA 2013) and is a record of the lively discourse around disaster mitigation and preparedness that took place during the Workshops.

The Workshops covered a wide range of topics designed to formalize the process of implementing disaster resilient construction at the community level. Emphasis was given to mitigation over response or solely preparation so that it may serve local communities who intend to work in the area of planning and disaster resilience which demand interdisciplinary thinking. The Workshops attracted over 300 concerned citizen at every level, from design professionals, state agencies to local building officials and risk managers. The locations visited were as diverse as the participants representing the comprehensive list of hazard risks including: Springfield, MO, Sioux Falls, SD, Louisville, KY, Portsmouth, NH, Richmond, VA, Jackson, MS, Wilmington, NC and Orlando, FL.

The recommendations below demonstrate that disaster risk reduction can be combined with infrastructure planning to significantly boost resilience: people's ability to withstand shocks in their environment – and critical for helping us address climate change, and lessen the vulnerability of those with less means. While various parts of the nation experience different hazard risks, the Workshop saw an alignment of the responses organized around five (5) key Recommendations with a variety of Tasks a community engage at the local level:

A. Raising Awareness
B. Defining Vulnerabilities
C. Codes & Fortification Standards

D. Storm Shelters & Safe Rooms
E. Incentives

A. Recommendation: Raising Awareness

Significant knowledge gaps still remain, especially with respect to understanding the exposure and vulnerabilities within a given population. More education is needed to fully understand the risk tolerance thresholds of communities with respect to specific hazards. Addressing knowledge gaps through training and educational seminars requires multi-, inter-disciplinary teams, including emergency management professionals, design professionals, scientists, insurance agencies, governmental agencies, etc. working together.

Task A1- Developing school curricula to further educate students about storms and shelters.

Task A2- Encourage the design community toward a greater focus on resilience. This may include incorporating these concepts into formal educational programming in schools of architecture and engineering so that buildings increasingly have disaster resilience as a core consideration from the beginning, reducing the need for retrofitting buildings over time.

Task A3- Provide compelling examples to the public of how disaster mitigation works financially; do a better job aggregating the costs of responding to natural disasters and revealing their impact on government budgets, at both the federal and local levels.

Task A4- Provide educational outreach to make property owners aware of the financial benefits of upgrading their buildings.

Task A5- Require appropriate training for people managing buildings to increase both efficiency and resilience.

Task A6- Keep professional communities engaged with natural hazard mitigation through sessions at industry/trade association annual meetings, newsletters, and accreditation programs.

Task A7- Include building resilience to natural hazards as a criterion for LEED and other green standards because of the reduced environmental impact involved in saving existing buildings rather than rebuilding after a disaster.

Task A8- Launch an ongoing awareness campaign that educates local businesses, governmental agencies, non-profits and citizens about how to prepare for a natural disaster and about resources available when disasters strike.

Task A9- Organize a conference to discuss strategies to prepare for natural disasters and engage government, the private sector, and communities.

Task A10- Civic, educational, faith-based and other organizations could be enlisted to promote disaster awareness.

Task A11- Create public service messages to spread safety tips through print (with the Press), through broadcast.

Task A12- Sponsor seminars on how to apply for disaster mitigation grants, submit insurance claims and deal with contractors while after disasters.

Task A13- Utilize Facebook, Twitter, YouTube and other social media platforms to provide conduits for delivering resilience messages, answering questions interactively, and during actual emergencies, spreading warnings.

Task A14- Utilize social media to encourage ongoing, interdisciplinary discussions and exchange of best practices, policies, and strategies.

Task A15- Provide educational outreach to ensure that stakeholders have a clear understanding of their authority and responsibilities in disaster situations.

Task A16- Establish Community Emergency Response Teams (C.E.R.T.).

B. Recommendation: Defining Vulnerabilities

All planning and implementation of disaster preparedness measures should be based on an assessment and prioritization of the hazards and risks that people face, as well as their ability or inability to cope with and withstand the effects of those hazards.

Task B1- Identify the characteristics, frequency and potential severity of the hazards a community faces. Utilize tools provided in the Workshop including Insurance Institute's IBHS's disastersafety.org, Natural Resource Defense Council's (NRDC) www.nrdc.org/health/climate, FEMA's Resilient Star and/or US Department of Homeland Security's (DHS) OPRtool.org.

Task B2- Identify the main sectors of a community (population, infrastructure, housing, services, etc.) affected by a specific type of hazard and anticipate how they might be affected. Assess the ability to withstand and cope with the effects of the phenomena.

Task B3- Identify the particular geographical areas and communities that are most susceptible and vulnerable to those hazards.

Task B4- Consider the costs associated with the risk of natural hazards in developing zoning rules and enforcement standards.

Task B5- Work with FEMA to update Flood Maps.

Task B6- County EMAs and municipalities to assess their emergency needs ("gap analysis,") and then determining if there are enough resources on hand.

Task B7- Target older/historic buildings for resilient retrofits.

C. Recommendation: Codes & Fortification Standards

Whether a State mandates a statewide building code or allows its local jurisdictions to adopt building codes by themselves, regulation of building design and construction is primarily conducted through authorities of local jurisdiction. Due to various challenges at the local level, building code adoption and enforcement by the local jurisdictions can be a critical weak link.

Task C1- Participate in code formation, like the current process by the International Code Council, so that all model codes include hazard mitigation for water, energy, conservation, and land use.

Task C2- Establish local fortification standards for construction of new, rebuilt and extensively remodeled homes to save lives and property when severe weather moves through the community; provide in the code inspection procedures and enforcement rules that apply statewide.

Task C3- Reconsider existing codes and zoning rules to identify those codes that interfere with more resilient planning and design by preventing adoption of measures that go beyond the existing practices.

Task C4- Reconsider and update standards and codes along high-risk areas (i.e. coast).

Task C5- Encourage use of green infrastructure strategies and natural systems to help mitigate the impact of some disasters like flooding. Protect natural systems so that they can function as buffers in large events.

Task C6- Upgrade building codes to make structures more disaster resistant, and leverage solutions applied to other code priorities like security.

Task C7- Budget money for code compliance and change the current fee-driven structure that results in cutbacks in inspection and enforcement resources when construction activity is down.

Task C8- Require existing hospitals and clinics to meet not only building codes but also FEMA's code enhancements.

Task C9- Integrate disaster planning into larger economic planning.

D. Recommendation: Storm Shelters & Safe Rooms

More shelters — either those specifically designed to withstand fierce winds and flying debris or other fortified structures where taking refuge improves people's chances of surviving killer storms — should be designated where they already stand, built where none currently exist and publicized better.

Task D1- Increase the number of storm shelters available to the public, and publicize their locations so people know where to go when severe weather approaches.

Task D2- Factories, schools, shopping centers, "big box" stores, office and apartment complexes, municipal and public safety buildings, and mobile home parks that don't already have storm shelters should consider adding them.

Task D3- Everyone's personal disaster plan should include identifying nearby shelters beforehand and even practicing getting to them quickly.

Task D4- Work with industry representatives to require that community storm shelters be included at any new apartment complexes and mobile home

communities built in tornado-prone regions, and offer incentives for adding them to existing facilities.

Task D5- Seek opportunity to use a proposed project as "demonstration" of resilient construction

E. Recommendation: Incentives

Yes, it costs money to buy and install a prefab safe room or build one from scratch or structurally reinforce an existing room. But anyone who has survived a deadly storm in a safe room or lost family members for lack of one or witnessed some of the worst destruction will agree that the investment is worthwhile. It was made clear from the 2005 Multihazard Mitigation Council (MMC) of the National Institute of Building Sciences Study (NIBS 2005) that for every dollar spent on mitigation, saved four dollars in avoided future losses. The benefits of mitigation were defined as the potential losses to society that were avoided as a result of investment in mitigation.

Task E1- Offer incentives to add safe rooms to new construction as well as existing homes and businesses.

Task E2- Utilize the existing system by which FEMA, using disaster assistance funding, offers matching grants that reimburse homeowners for 75 percent of safe room costs.

Task E3- Initiate discussion with State Insurance Commissions regarding premium incentives for building to code-plus or FORTIFIED (IBHS 2013b) standards or with robust materials.

Task E4- Propose income tax credits for building to code-plus or FORTIFIED standards modeled on other successful programs that reward, for example, the purchase of energy-efficient heating, ventilating and air conditioning systems, windows, insulation, or solar panels.

Task E5- Tax incentives should be extended to businesses offering essential services during storm events (gas stations so that fuel supplies are assured, pharmacies so that vital medicines can be dispensed, kidney dialysis, etc.).

Task E6- Advocate for code-plus, FORTIFIED (IBHS 2013b) or other programs on hazard reduction and ensure the results are widely distributed.

Task E7- Focus more resources on building science research by type of natural hazard through national entities such as National Science Foundation.

Task E8- Use life-cycle costs and savings rather than short-term expenditures to determine infrastructure spending.

Task E9- Since disaster preparedness depends on shared goals and activities across sectors, it is important that the concept be integrated into all on-going projects. For instance, all climate change planning should include assessment of potential natural hazard impacts. Partner with carbon reduction goals.

Task E10- Propose the US Green Building Council should expand its definition of environmental sustainability certification to include resiliency issues.

Task E11- Initiate discussion with banking industry regarding resilient mortgage rates (similar to energy-efficient mortgages based on Energy Star) for building to code-plus or FORTIFIED standards or with robust materials.

Mitigation Benefits Everyone

Disaster mitigation is not solely the work of experts and emergency responders from government emergency management organizations. Local volunteers, citizens, organizations and businesses have an active and important role to play before, during and after major emergencies and disasters. Therefore community-based disaster mitigation is a process that seeks to develop and implement a locally appropriate and locally "owned" strategy for disaster mitigation and risk reduction.

Based on the Recommendations and Tasks, the following describes sample Action Agendas that bring together the tools and activities from many the building sectors in an effort to address resilience including:

- Leveraging green-building momentum to include resilience.
- Development of ordinances and mandatory building codes.
- Addressing durability with lifecycle costs and ongoing maintenance.
- Increasing and improving infrastructure investment from all stakeholders.

Action Agenda A4: Understanding Cost of Resilient Construction Building to a disaster resilience standard does cost more but typically results in cost savings over the long run. The FORTIFIED for Safer Living program (IBHS 2013b) of the Insurance Institute for Business and Home Safety (IBHS) is a voluntary programs aimed at incorporating building techniques into construction to provide an optimum level of protection against a variety of natural hazards. IBHS is a not-for-profit applied research and communications organization supported by the insurance industry. One report conducted by Blue Sky Foundation of North Carolina found that the additional cost of building a home to the FORTIFIED for Safer Living standard cost an additional $3,936 or about 5% more than a home with a retail value of $80,000. Amortized at 6% simple interest over a 30-year mortgage, the additional monthly cost would be about $24 per month. According to the report, this additional cost is easily offset by likely repairs of the home after the 5-10 hurricanes anticipated over the mortgage period (BSE 2005).

Action Agenda A7: LEED Resilient Construction Pilot Credit: Resilience has become an important dimension of sustainability, and a key element of the value proposition for high performing buildings because it recognizes both the immediate risks of extreme weather and the long-term effects of climate change. The National Ready Mixed Concrete Association (NRMCA) has developed and submitted a Pilot Credit to address the “physical” dimensions of resilience. The Pilot Credit enhances the resilience of buildings and infrastructure through designed robustness, durability, longevity, disaster resistance, and safety which should be a priority for every sustainable community stakeholder.

The Pilot Credit rewards design strategies that reduces the materials required to repair and retrofit from a hazard event, enhances the robustness through the IBHS

FORTIFIED designation, or increased durability by utilizing the principles in CSA S478-95 (R2001) - Guideline on Durability in Buildings. As of this writing, the Pilot Credit is under review by the USGBC.

Action Agenda C1: Adopt a building code. Building codes are effective for reducing disaster risk. A building code sets standards that guide the construction of new buildings and, in some cases, the rehabilitation of existing structures. Currently, building codes set minimum construction standards for life safety. Maintaining the functionality of structures is important for high-risk areas, but more importantly may be critical for certain populations groups that are more vulnerable to natural hazards, those and who do not have a choice on where they live and work.

To date, among the eight States in the New Madrid Seismic Zone, five (Arkansas, Indiana, Kentucky, Missouri and Alabama) have statewide building codes for residential construction as minimum requirements, but three (Illinois, Mississippi, Tennessee) do not and they pass the responsibility to the local jurisdictions to adopt the codes themselves (IBHS 2013a). Although earthquakes are high-consequence events, seismic mitigation in Mid-America generates little public interest because earthquakes in this region are low frequency.

If we are to take people's vulnerability seriously, we must deploy—and insist on—much greater technical expertise in code adoption. Building standards and land-use codes offer important opportunities to standardize resilience and durability in buildings and infrastructure.

Action Agenda C6: Adopt High Performance Building Standards. The Portland Cement Association recently developed High Performance Building Requirements for Sustainability that go beyond the basic building code and enhance the key concepts of durability and disaster resilience. Essentially these provisions state that for a building to be considered green, it must not only conserve energy and water, use materials efficiently, and have a high-quality indoor environment, but it must also reasonably withstand natural disasters. In other words, a sustainable building must be long-lasting and durable (PCA 2012).

In addition, high performance buildings should not be a burden on their communities. They should be sufficiently resilient to disasters to ensure continuous operation and not place excessive demand on community resources such as emergency responders including fire, police and hospitals. Communities with disaster resilient buildings are more likely to be able to continuously operate hospitals, schools, and businesses after a disaster. Stronger homes and buildings mean people will have places to live and work after a disaster. Less disruption for a community means robust commerce and consistent tax revenue.

Action Agenda D5: Build with Robust Materials. A key step towards disaster resilience is to build with robust building materials. Some of the qualities of robust building materials include versatility, strength, wind and water resistance, seismic resistance, fire resistance, energy efficiency and durability. Concrete building systems are especially suited to provide resistance to natural hazards. Concrete has the

necessary hardness and mass to resist the high winds and flying debris of tornadoes and hurricanes. Concrete is fire resistant and non-flammable, which means it can contain fires and will not contribute to the spreading of fire. Reinforced concrete framing systems can be designed to resist the most severe earthquakes without collapse. Concrete doesn't rot or rust even if it is subject to flooding.

The Case for Robust Materials

> Case Study 1: There are many examples of structures built with heavy building materials, such as concrete, surviving major disasters. When Hurricane Katrina slammed into the coastal counties of Mississippi with sustained winds of 125 mph and a storm surge that reached 28 feet, the only house to survive along the beachfront of Pass Christian, MS was the Sundberg home. Scott and Caroline Sundberg were 85% complete building their dream home along the Mississippi coast when the Hurricane hit. When the winds died down and the water retreated, the Sundberg home had survived the storm. All other homes on the beachfront were completely destroyed. They built their home using insulating concrete forms (ICFs) for the walls and cast-in-place concrete frame construction for the lower level, floors and roof precisely for this reason—to survive the devastating effects of a hurricane.
>
> Case Study 2: Wildfires consume an average of nearly 7,000 square miles annually since 1960. In the last decade, that number has increased to over 10,000 square miles (NIFC 2012). A 1993 wildfire in Laguna Beach, CA, consumed 17,000 acres and destroyed 366 homes in a single day. The home of To Bui and Doris Bender Los Angeles Times named the "miracle house" (Underwood 1995) shows the lone survivor which remained protected by an envelope of non-combustible stucco wall cladding and concrete roof tiles. Detailing such as stucco cladding on walls, eaves and trim, as well as Class A concrete tile roof, prevented combustion of the exterior amidst the firestorm that swept through the community.
>
> Case Study 3: The EF-4 tornado that roared through Tuscaloosa, AL, on April 27, 2011, leveled block after block in the Forest Lake neighborhood. The only thing left standing was a closet at the Blakeney residence on 16th Street East. The closet was built as a safe room using 8-inch reinforced concrete masonry to withstand high winds and flying debris caused by tornadoes (Jones 2011). Small windowless rooms such as a walk in closet are ideal locations for a safe room in a home.

Action Agenda E6: Encourage Voluntary "Code Plus" Construction. The FORTIFIED for Safer Living program of the Insurance Institute for Business and Home Safety (IBHS) (IBHS 2013c) are voluntary programs aimed at incorporating building techniques into construction to provide an optimum level of protection against a variety of natural hazards. IBHS is a not-for-profit applied research and communications organization supported by the insurance industry. Their focus is to reduce or eliminate residential and commercial property losses due to wind, water, fire, hail, earthquake, ice and snow. The programs also address other business

continuity issues such as such as interior fire, burglary, lightning protection and electrical surge.

Over 250 homes have been designated as FORTIFIED since 2001. The program was battle tested by Hurricane Ike on the Bolivar Peninsula in Texas in September 2008. Ten of 13 FORTIFIED homes survived a direct hit from Hurricane Ike, including a 20 ft. storm surge. These FORITIFIED homes were the only structures left standing for miles around, precisely because they were specifically designed and built to withstand extreme wind and water damage. The three FORTIFIED homes that did not survive were collapsed when other homes in the area slammed into them.

Conclusion

Disaster mitigation works and is cost effective. Spending time and money up front to reduce the likelihood of loss during a natural disaster can bring significant benefits to building owners and communities including lower insurance costs, higher property values, security to residents, maintaining a consistent tax base, and minimizing the cost of disaster response and recovery.

The authors recognize that not everyone will agree with each recommendation or action agenda outlined in this paper. That's understandable. We were not looking for the easiest path. Instead, we wanted to create a path for disaster risk reduction with common-sense solutions. We wanted proposals that would increase preparedness without expanding the footprint of government. But this is an opportunity for the community, and we must not waste it. The policies the Workshop participants puts into place in the next six months to a year will potentially impact millions of people for decades to come. We need planning that will transcend political administrations and short-term corporate interests. Resilience promotes greater emphasis on what communities can do for themselves before a disaster hits, and how to strengthen their local capacities, rather than be dependent on our ineffectual governmental agencies and aging centralized infrastructure.

Consider the reality for 2013: As of September 2013, there have already been 7 natural disasters in the U.S. costing $1 billion or more in damage, with September 2013 as the globe's 4th warmest September since records began in 1880, according to NOAA's National Climatic Data Center (NOAA 2013a). There were both devastating tornadoes and multiple earthquakes in Oklahoma. Record rainfalls triggered historic flash flooding across in Colorado September, killing at least nine people and doing $2 billion in damage with more of the Atlantic hurricane season still to come.

Certainly, the people in the communities directly affected by these disasters, natural or man-made, have been humbled by the destruction of that day. Those of us more fortunate to have escaped a major disaster should take heed as they recover and make plans for a stronger future. We have heard their stories, we can learn from their lessons.

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