CONCLUSION: DESIGNER'S CULTURAL RESPONSIBILITIES

Designers, thus, can have positive or negative effects. Culture, once destroyed due to lack of consideration, action, or knowledge, is near-impossible to reconstitute again (Jaulin 1971). Attending to the various cultural requirements is therefore crucial.

Designers can play an important role in enriching users' lives by drawing on and respectfully using local cultural wisdom; making meaningful products through culturally appropriate design; facilitating cultural experiences (e.g., spaces for contemplation, peace, tranquility); incorporating and specifying local arts and crafts and local materials, products, and labor; and through socioculturally inspirational design that becomes a pride of the community. Additionally, whether required or not, they can address intractable problems, and provide "socially conscious" elegant, affordable, culturally appropriate, imaginative, eco-sensitive, healthy, and safe solutions that make the project suitable for persons with disabilities, children, and the elderly, powerless, and poor (Oliver 2003). Designers are in a special position to lead the way by seeing every project as an opportunity.

For More Information

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House Form and Culture (Prentice Hall, 1969) by Amos Rapoport.

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4.2 The Role of Architects in Disaster Response and Recovery

Rachel Minnery, AIA, NCARB, LEED AP

Architects have an opportunity to fully embrace the unique and valuable contributions they can make as design leaders in communities at risk of natural hazards. This article discusses how architects can be effective in disaster response, recovery, rebuilding and resilience to help shape truly sustainable communities.

INTRODUCTION

In the United States, the number of federally declared disasters has been steadily and swiftly on the rise. In 1958 there were 8 declared disasters; just 50 years later in 2008, there were 10 times as many. What accounts for the dramatic increase? Some view climate change and global warming as a factor, others perceive an increase in the involvement of the federal government in state and local affairs. Most agree that the compounded effects of population growth, aging infrastructure, and the expansion and development of cities contribute to the increased scale and intensity of hazardous events.

The United States is prone to various life-threatening natural hazards, including hurricanes, floods, tornados, earthquakes, volcanoes, and wildfires. History and science show that numerous faults on the Pacific coast are due or overdue for a seismic event.

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Although flooding, which accounts for more than 75 percent of federally declared disaster areas, is the most prevalent disaster event in the United States, it is excluded from typical homeowner insurance policies. Without flood insurance programs, damage due to floodwaters leaves homeowners physically and economically vulnerable.

Hurricane Katrina had a stunning impact on the nation, yet disasters of truly catastrophic proportion have largely been unseen by Americans in this past century. While the risk of occurrence is low, the threat will exist for generations to come. With over half of the American population living within 50 miles of a coastline, many are aware of the direct risk of hurricanes and windstorms. Japan's Tohoku earthquake in March of 2011 was also a reminder of the indirect risks when an earthquake many miles away sounds tsunami alarms in the United States. For some perspective: A single earthquake off the Gulf Coast could trigger a tsunami affecting 35 million people, and one off the East Coast could impact 65 million people.

When Hurricane Katrina hit in 2005, it was a wake-up call. This storm cost the federal government $85 billion, and natural disasters caused $960 billion in damage to U.S. property and infrastructure in 2010 alone. According to the United Nations International Strategy for Disaster Reduction, the severity of this financial impact of natural disasters is directly linked to unplanned development and destruction of ecosystems. Hurricane Katrina was the costliest natural disaster in the history of the United States. In New Orleans this cost was due in part to infrastructure failures: Breached levees caused the destruction of 4,000 homes in the Lower Ninth Ward. This was the sixth-strongest recorded storm, yet it claimed the lives of 1,836 people and damaged or destroyed 850,000 homes, leaving many coastal communities and neighborhoods still struggling to recover years later. In addition to the monetary costs, there is a humanitarian cost. Until Hurricane Katrina, the largest displacement of Americans had been caused by the Civil War.

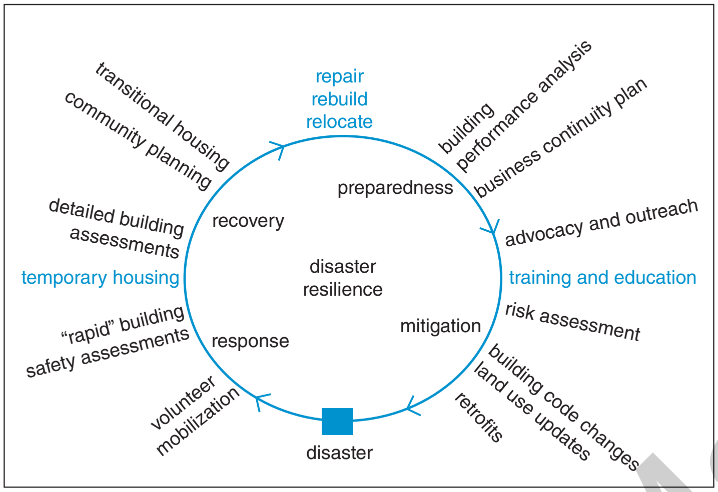
The impacts on Gulf Coast communities have been astounding: fewer than 50 percent of the residents of New Orleans had returned to their city more than five years after the storm. This aspect of prolonged displacement raises an immediate issue after the disaster: When is it safe to return to one's home?

Eager to rebuild their lives, some residents returned to damaged homes too soon, unaware of safety and health risks to themselves and their families. Doctors' visits and prescription use surged in the first year following the disaster for burns, wound care, illness, and injury. A common complaint came to be called "the Katrina cough" due to the mix of high temperatures and flooding in homes (Falk and Baldwin, "Environmental Health and Hurricane Katrina," *Environmental Health Perspective* 2006). Mental health is also fragile. A Harvard University study found that up to 50 percent of Katrina survivors were diagnosed with post-traumatic stress disorder, and another 20 percent with mental illness.

Disasters don't just cause short-term health problems; the more people are exposed to stressors, the more they are at risk for developing long-term mental illness (Gardner, "Mental Health Woes Doubled," *Health Days* 2007; and Hurricane Katrina Community Advisory Group, Overview of Survey Baseline Results, 2006). Ongoing illness and the threat of long-term illness is one of many reasons the recovery costs continue to rise. The more quickly people are able to safely return to their homes, the healthier they will be.

Design professionals and the construction industry have a significant role in the health and safety of the environment and in disaster management (see Figure 4.2.). Their role includes a range of activities designed to maintain control over emergency situations, providing a framework for helping those who are at risk to avoid or recover from the impact of the disaster (Kelly, *Limitations to the Use of Military Resources for Foreign Disaster Assistance*, 1996). FEMA recognizes both as unfilled roles, stating "the literature on natural hazard mitigation directed toward the architectural profession is scarce in spite of the fact that architects can make a significant contribution to hazard risk reduction" (FEMA, *A Manual for Architects*, 2006).

As a first priority, the American Institute of Architects has been advocating for architects to engage with local building departments and state emergency management



Rachel Minnery, AIA

FIGURE 4.2 **Disaster Resilience Cycle and the Role of the Architect**

agencies to perform building safety assessments when needed. This community engagement reduces the need for temporary housing and prevents further injury or loss of life by ensuring that structures are safe to occupy. See Figure 4.3 for an image of temporary shelter in Haiti provided by one of dozens of nongovernmental relief organizations after the January 2010 earthquake.

BUILDING DAMAGE AND SAFETY ASSESSMENTS

Most jurisdictions and emergency management agencies approach building damage assessments in three phases: windshield assessment, rapid assessment, and detailed assessment. The same assessment approach is used by the Applied Technology Council (ATC), a nonprofit professional organization that develops resources and applications for use in mitigating the effects of natural hazards on the built environment.

- *Windshield assessment*, just as the term implies, is a drive-by cursory view of damage. This is typically performed by emergency personnel, local firefighters, and police, from a vehicle or in conjunction with search and rescue work, to assess the severity of the damage and public safety impacts of the event.

Rachel Minnery, AIA

FIGURE 4.3 **Haiti Temporary Shelter**

- *Rapid assessments* are performed by local building departments to determine the habitability and extent of damage of individual structures, often conducted only at the request of the owner. Typically teams of two perform up to a 30-minute exterior and interior review of the building damage, sufficient to determine habitability and if there is a need for further investigation. Buildings are tagged on the exterior with red, yellow, or green placards to communicate to the owner, resident, and community where the building is safe to occupy and under what conditions: a red tag indicates it is unsafe to occupy; a yellow tag indicates a restricted occupancy; and green-tagged buildings are determined safe, though they may have minor damage. Unfortunately, after Hurricane Katrina, red-tagged structures were misconstrued as demolition notices, and, regrettably, historic structures were destroyed across the Gulf Coast when demolition crews haphazardly dismantled and removed red-tagged buildings.
- *Detailed assessments* are the in-depth reviews and assessment of complex buildings, and are the final step before recovery and rebuilding begins.

The AIA provides training to architects, building officials, and engineers in how to perform these crucial assessments to help building departments during what is likely to be an overwhelming situation. Following a disaster, even a minor one, local building departments very quickly become inundated by requests for help from residents and business owners. A job that could take up to six months to complete by building department staff, and often the victims of the event themselves, can be reduced to days with the help of a volunteer team of architects and engineers. This increased capacity allows residents to return more quickly and safely to their homes and places of work.

After Hurricane Katrina, 80 California Emergency Management Agency Safety Assessment Professionals, in two 10-day shifts, assessed homes and business in the face of very difficult, sometimes harrowing, conditions, reviewing and tagging over 17,500 of the 28,000 properties in St. Bernard Parish. In Alabama, after the April 27, 2011, tornadoes, 73 volunteer architects donated more than 1,300 hours and performed 7,000 inspections over a five-day period. Nonstructural components typically account for 60 to 80 percent of the overall cost of building construction, so the initial rapid building damage assessment is a job suited for the architect, as a generalist design professional. Furthermore, damaged nonstructural elements such as plumbing, mechanical equipment, light fixtures, suspended ceilings and furniture often pose a greater hazard than the building itself.

When architects provide rapid assessments, engineers are freed up to focus valuable assessment efforts on detailed review and complex buildings.

Any given home is evaluated to some extent up to six times after an event: one or more times by local authorities, FEMA, insurance providers, design professionals, and nongovernmental disaster response organizations (NGOs). In the case of Hurricane Katrina, volunteer architects, with interns at their side, performed voluntary Goodwill Assessments at the request of a homeowner or small business owner for up to a full year following the storm. The Goodwill Assessment is an objective professional evaluation of the building damage and may include recommendations for repair. These reports proved invaluable to many property owners in obtaining repair work reimbursements as they engaged in extended negotiations with home insurance providers and FEMA.

Even an earthquake as minor as the 6.8 magnitude 2001 Nisqually Earthquake in the Pacific Northwest left 400 people injured. Architects and engineers were retained for private detailed assessments of buildings. Properly trained architects aided the City of Seattle in handling rapid assessments for homeowners concerned about wall cracks and chimney damage.

THE AIA DISASTER ASSISTANCE PROGRAM AND COMPREHENSIVE RESPONSE SYSTEM

Recognizing the complexity of the problems communities face as a result of disasters and the absence of any similar program or service related to the built environment, the AIA began providing disaster assistance to communities in 1973. One of the first projects undertaken by the AIA was the recovery and plan for rebuilding after a tornado destroyed downtown and East Nashville. Architects with experience in similar disasters provided much-needed insight for the rebuilding process. They were able to effectively facilitate public workshops and design charrettes with local community stakeholders. As an outcome of this disaster and design assistance team, a nonprofit community design center was formed that remains in existence today to support the community.

Over the years, the AIA Disaster Assistance program has evolved in response to changes in emergency management practices. In 2006 the Disaster Assistance Program, led by volunteer architects from all corners of the United States, was formalized, and the Comprehensive Response System (CRS) was created. The CRS includes guidelines and protocol for architects engaged in the full cycle of disaster management: emergency, relief, and recovery.

There are five critical components of the model AIA policy for the Disaster Assistance Program, with a focus on the safety assessment process.

1. *Liability coverage.* For architects, this is typically provided through a state-enacted Good Samaritan Law. These laws protect architects and engineers while providing emergency services in a specific area within a designated time frame. While often similar in language, the Good Samaritan Law varies from state to state and is not enacted in all states. As more states exercise the use of the professional Good Samaritan Law, it has come under notable criticism for its lack of legal protection. Without indemnification, a citizen can bring suit against a volunteer architect for negligence. The process to exonerate the volunteer can be lengthy and expensive.
2. *Clarity on workers' compensation.* If an architect experiences an injury or fatality while performing voluntary damage assessments in an emergency, who is responsible for medical care or other associated costs?
3. *Standard for professional training for rapid assessment.* Many jurisdictions do not recognize a formal training program for responding architects and engineers. Those that do commonly refer to training first developed by the Applied Technology Council (ATC) with seed funding from FEMA. ATC initially created training and protocol for assessment of earthquake-stricken structures. In 2005, utilizing the same basic protocol, ATC developed a training program for structures exposed to wind and water damage. In recent years, using the methodology of ATC, the state of California developed the Safety Assessment Program (SAP) for building officials and other design professionals to assess damage due to a wide variety of natural and man-made hazards.

   With the growing number of training programs and increasing exposure to liability risk with each event, the AIA has been supporting the American Society of Civil Engineers' proposal to FEMA to establish uniform standards of training and credentialing of engineers and architects to be used nationwide. The training provided by qualified architects has allowed architects to gain firsthand response experience and provide leadership and guidance to local governments, especially valuable where hazardous events have been rare and/or formal emergency management protocol has not been developed.
4. *Network of trained volunteers available and ready for activation.* Acknowledging that response and recovery is the responsibility of the local community, the AIA State Coordinator Network was formed to encourage identification of a Disaster Assistance Coordinator and to create an individual disaster assistance program for each state. The network of volunteers is activated only when a request for professional emergency assistance comes from a local building department or state emergency management agency. Over the past 10 years, thousands of architects nationwide have been trained in the SAP or ATC program offered through the AIA, SAP, ATC, International Code Council, and engineering associations.

After Hurricane Katrina, the Governor of Mississippi, a state that is still without a Good Samaritan law for architects, provided a letter authorizing architects to be temporary contract workers of the state. Minutes later, the first team of architects headed off to the coast with state-employed building professionals to perform rapid damage assessments. Without liability coverage, the architects could not have volunteered, as it would have jeopardized their careers or employers in the states where they practice.

5. *Portability of licensure.* Because architects are licensed by each individual state, not at a national level, this fifth component of the model policy is critical for larger-scale disasters. In a disaster, local architects may be tending to their own families and businesses and thus out-of-state volunteer architects are invaluable. However, they may not be able to help unless the state architectural licensing board adopts emergency policies allowing licensed architects from other states to serve as "emergency workers" when deemed necessary by the state. Yet there is concern that allowing outside architects to participate in the emergency response phase will lead to lost work and future revenue for local architects. The disaster assistance team must be sensitive and cautious in their evaluation of the request for assistance. The Florida SAP trained architects who volunteered to help after the 2011 Alabama tornadoes were denied because they would be "practicing architecture without a license" in the state.

ARCHITECTS IN RESPONSE AND RECOVERY EFFORTS

While disasters are a problem for all nations, they are an especially critical issue in third world countries. Natural disasters are the cause of 95 percent of deaths in third world countries (United Nations Intergovernmental Panel on Climate Change, Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptations, 2012). U.S.-trained architects have been made available to other countries in need of assistance, as in the case of Haiti following the 2010 earthquake. Two teams of American architects and engineers were able to perform damage assessments there, via the nongovernmental disaster relief organization All Hands Volunteers.

The network of architects in the Southern United States was activated in April of 2011 when a series of tornados struck urban and rural areas of Alabama and Missouri. Members of the AIA Disaster Assistance Committee conducted damage assessment training sessions for architects in Alabama. The training sessions paid dividends to communities like Tuscaloosa, providing services valued in excess of $300,000 (see Figure 4.4.). Residents were able to quickly and safely return to their homes, allowing resources to be focused on food and other necessities rather than shelters and temporary housing. Simple prioritizations allow the community to begin recovery and rebuilding efforts quickly.

Michael Lingerfelt

FIGURE 4.4 Volunteer Architect Michael Lingerfelt Tags a Damaged Building in Alabama.

Past community recovery success stories like that of Greensburg, Kansas, offer insight and inspiration to communities struck in 2011, like Tuscaloosa, Alabama, and Joplin, Missouri. Communities affected by a disaster are eager to return their lives to the normal condition they knew before the event. The Greensburg success story offers hope to survivors of other disasters by demonstrating that opportunities for positive change can be born from devastation and pain.

Architects can provide vision and community facilitation to create a unique road map for recovery in the creation of a community's "new normal." While government agencies are best suited for response and relief efforts, it is the private sector that usually leads recovery and reconstruction. Universities and nonprofit organizations with established community networks have been a vehicle for architects, designers, and students to contribute to recovery efforts. Nonprofit design centers have sprung up and rooted themselves permanently in communities as a result of a disaster. Architecture for Humanity is one well-known organization that provides humanitarian design-build services after disasters.

Architects are eager to help after a disaster, yet those good intentions need to be guided to be effective or, if real-world parameters are not understood, they could do harm. In Mississippi, architects and historians worked together to develop design standards for repair and rebuilding the city of Biloxi. Design competitions can be a great way to energize a community by soliciting innovative ideas for reconstruction, and are especially effective when the design process is inclusive of future residents and stakeholders. The Make It Right Foundation built sustainable, storm-resistant houses in New Orleans to model responsible rebuilding on flood-prone land. Yet making structures viable and resilient has the potential to also make them unaffordable to the average homebuyer. The feasibility of reconstruction is based on many variables, first of which is the availability of funding and financing for property owners.

As a response to significant criticism of the health and habitability of the FEMA trailer, several architects developed designs for temporary and transitional housing following Hurricane Katrina. One of the most well-known is the "Katrina cottage," a 308 square foot single-story home designed by Marianne Cusato. At a cost equal to or less than the FEMA trailer, Cusato's adaptable design could be made permanent and allow for future additions and renovations. All too often, temporary housing has become permanent because of a lack of resources, and still local government officials feared that the small houses would drive property values down (Jarvie, "Post-Katrina cottages get a lukewarm welcome," *Los Angeles Times*, 2007). Yet due to their success and popularity, national retailer Lowe's began selling the house kit not just locally but nationally as an economical DIY housing alternative, similar to the Sears & Roebuck kit houses of the early 1900s.

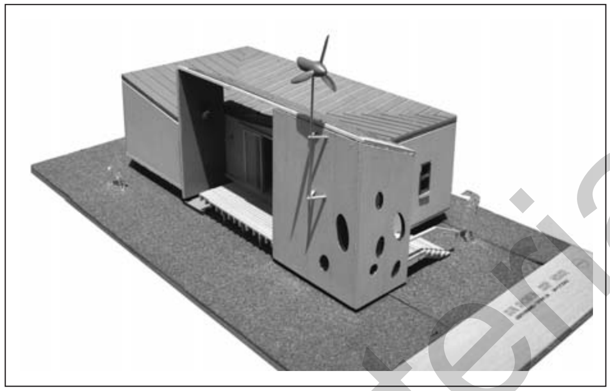
ARCHITECTS LEAD IN KANSAS DISASTER RECOVERY

In May 2007, when a 1.7-mile-wide tornado tore through the rural town of Greensburg with 205-mph winds, an AIA Kansas Disaster Assessment Team responded by performing building safety assessments of the 10 percent of structures left standing. With significant participation of the 1,400 residents of the town that was left completely devastated by the storm, the disaster assessment team and Kansas design teams facilitated the recovery decision-making process after identifying and gathering stakeholders.

Under the leadership of sustainability-minded architects and design professionals, all public buildings were rebuilt to a standard that earned them a Platinum rating from the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) program. To educate residents and make them aware of their options for reconstruction, AIA Kansas hosted a green building exposition, inviting vendors of green building products and contractors to attend. This distinctive recovery effort is considered a great success and has served as a model for sustainable post-disaster recovery, with more than 50 percent of Greensburg residents having returned within three years, rebuilding their homes and businesses.

ARCHITECTURE FOR HUMANITY

Architecture for Humanity (AFH) links a broad network of young professionals through its design fellowship program and chapter organizations. The organization fields requests from communities struck by conflict, natural disaster, or other crisis and will often collaborate with other nonprofit agencies and firms to complete projects. Formed in 1999 by Cameron Sinclair and Kate Stohr, today the San Francisco–based office employs 36 full-time staff and manages numerous volunteers for their global work to alleviate poverty, build community, and address climate change. Owing to Haiti's lack of resources, the group was already working there when the earthquake struck in January 2010. In a country with only 30 architects, AFH became involved in seven master planning projects to help the country recover. While international post-disaster aid is typically earmarked to specific projects like new housing, other essential needs for recovery remain unmet. Survivability is more complex in a place that has nonexistent or inadequate water treatment, so addressing the obstacles to sustainable development has been critical to long-term recovery. As the organization has grown and learned from their post-disaster experiences, the roles of the nonprofit organization have diversified to adapt and make an impact. Collaboration and learning new skills in financing, grant-writing, land development, and public outreach have been critical to getting projects off the ground.



Judith Kinnard, FAIA, and Tiffany Lin

FIGURE 4.5 Sunshower House by Judith Kinnard, FAIA, and Tiffany Lin

Creative solutions for post-disaster homes and shelters have evolved to improve the way sustainable homes are designed for the masses. Judith Kinnard, FAIA, and Tiffany Lin's Sunshower House, as shown in Figure 4.5, is a climate-adaptable modular home design that is packaged to be flexibly transported by a single shipping container. Inspired by the walk-in coolers that had the distinction of surviving hurricane Andrew, the design features structurally insulated panels that withstand wind speeds up to 156 mph. While "deep green" sustainability promotes living "off-grid," survivors of a disaster are forced to live in those conditions. A structure that could be considered both resilient and sustainable, the roof generates electricity from either solar panels or a wind turbine and collects water from the roof for reuse.

DISASTER RESILIENCE AND BUILDING MITIGATION

Communities can prepare themselves for potential disasters and *mitigate* or reduce the impact of hazards so that they will not have to rebuild their homes and businesses. When risks are addressed ahead of time, the potential for damage will decrease. As expressed by FEMA, "mitigation has long been perceived and practiced as an essential tool for helping to save lives, reduce property damage, and decrease the money spent on disaster recovery efforts." Informed and trained architects can be advocates for increased public education and awareness by conveying the risks owners face and demonstrating how those risks can be reduced through specific building mitigation methods.

Government leadership can prioritize community needs and resources to address the hazards and mitigate the potential consequences. Vulnerability is reduced with thoughtful design and construction methodologies. Common building practices have evolved to create safer, healthier, and more affordable buildings, enhancing quality of life. Post-disaster building performance assessments and scientific analysis inform design professionals and those responsible for building code changes and flood mapping revisions.

The increasing occurrence of disasters coincides with concern over climate change because both present significant modifications in the environment that require adjustments in design approach. As climate change brings more floods and droughts, demand for clean water is projected to increase. Rising sea level will diminish coastlines and impair infrastructure. Therefore, addressing the impact of climate change is integrally connected to achieving disaster resilience. The World Mayors Council on Climate Change is working toward strengthening cities' commitment to mitigation measures. Disaster resilience can be strengthened by sustainable design methods that incorporate long-term ecological resilience: green storm water infrastructure reduces urban flooding, coastal wetlands buffer storm-surge, green roofs cool buildings, and parks reduce heat island effect.

One of the most significant issues facing the built environment is the current stock of largely unregulated existing buildings. Architects, engineers, and authorities work to ensure that buildings are constructed properly, yet after buildings are constructed little is required of a building owner in terms of testing and monitoring the building's safety.

Building Retrofits

For existing buildings, *passive retrofits* are implemented when new building codes are put into effect when property owners voluntarily decide to add, renovate, or demolish a structure or rebuild after a disaster. In some cases, local jurisdictions have enacted *active retrofit policies* to retrofit certain building types in advance, for public safety. In other cases, code requirements for seismic bracing or modest life safety improvements are not always enforced.

Retrofit and mitigation practices incorporated into building codes are credited with saving homes and lives. These are fairly simple measures such as hurricane clips, shear walls, and hold-down anchors, among other refined construction practices. Though not required in coastal communities, the use of hurricane shutters, fabric, or impact-resistant glass along with heavy-duty garage doors is shown to prevent extensive damage by protecting openings that otherwise would expose the interior of the house.

Financial incentives for pursuing existing building retrofits work well when used in combination with compliance deadlines, as is the case for early adopters of newly classified flood zones. Home and building insurance discounts and rebates provide further promise when they incentivize elective retrofits and mitigation, reducing homeowners' insurance rates up to 50 percent. In devastating tornados, safe rooms—small, fortified, self-contained rooms typically made of steel and bolted to a building's foundation—have frequently been the only vertical portions of the structure left standing. In 2012, it was reported that a safe room in Mississippi withstood an EF-5 tornado, protecting the 10 people who sought shelter in it during the storm. These lives might have been lost if the storm had occurred just a few years ago, prior to the Mississippi State Emergency Management Agency's program "A Safe Place to Go." The program incentivized homeowners with a 75 percent reimbursement of the installed cost (up to a maximum of $4,000) of a safe room.

Challenges to Disaster Resilience

Change is inevitable after a disaster strikes a community. If local governments want future federal post-disaster assistance, they are required to implement policies that will mitigate principal damage. With evidence of flood and storm surge risks, FEMA updates its Advisory Base Flood Elevations (ABFE) for inclusion in new building and land use codes and retrofit guidelines for elevating structures above grade. During Hurricane Katrina, the highest winds on land were clocked at 175 mph, though the active building code set a design wind speed of 110 mph. As a result, the 2009 International Building Code has increased the design standard to 150 mph. When the building code and land use policies change, the cost of recovery is reduced.

An obvious challenge to disaster resilience is the economic burden. Low-income populations are inherently more vulnerable in a disaster due to a lack of resources.

CASE STUDY: RETROFIT FOR A NONPROFIT HUMAN SERVICES ORGANIZATION

A highly regarded nonprofit organization in Seattle, Washington, that provides community-based human and emergency services occupies a 51,000 square foot three-story unreinforced masonry school building originally constructed in 1911. In 2003 a remodel design, which included seismic upgrades per the 2003 building code, was put out to bid. The upgrade was estimated to cost $268,000, approximately 10 percent of the overall cost. In 2010, when remodel funding was secured, the code's approach to seismic design had changed so dramatically that the seismic retrofit was estimated to cost almost five times its original bid. The project remains stalled due to increased costs, so the building has not been remodeled to meet the tenant's changed needs, and it has not been seismically retrofitted. This cost-based catch-22 is another lose-lose situation for the owner and the public. If funding becomes available, a difficult decision must be made: Demolish the 100-year-old, culturally historic, yet unsafe building, or rebuild to create a fully code-compliant facility for approximately $7 million.

The predicament the organization faces is not uncommon to nonprofit organizations and those with limited resources.

Those with the fewest resources often build and live on the least desirable land. Even without a disaster, finding affordable homes and places of business in poor communities can be a challenge, and renters are dependent on property owners to maintain safe and available homes. Seismic technologies, for instance, add on average 10 percent to the cost of residential construction. For families struggling to meet their basic needs, this slight increase can be the difference between a having a home and not having a home.

New Building Codes

For building construction to be cost effective and safe, the methodology of the building code is to preserve life, not to protect against loss of property or function. Building codes represent minimum standards, and the few who design in excess of the code usually do so because of an owner's risk management practices. The standards to which a building is designed and constructed is critical because it will determine a safety baseline, the building's capacity to weather change over time, and therefore its resilience.

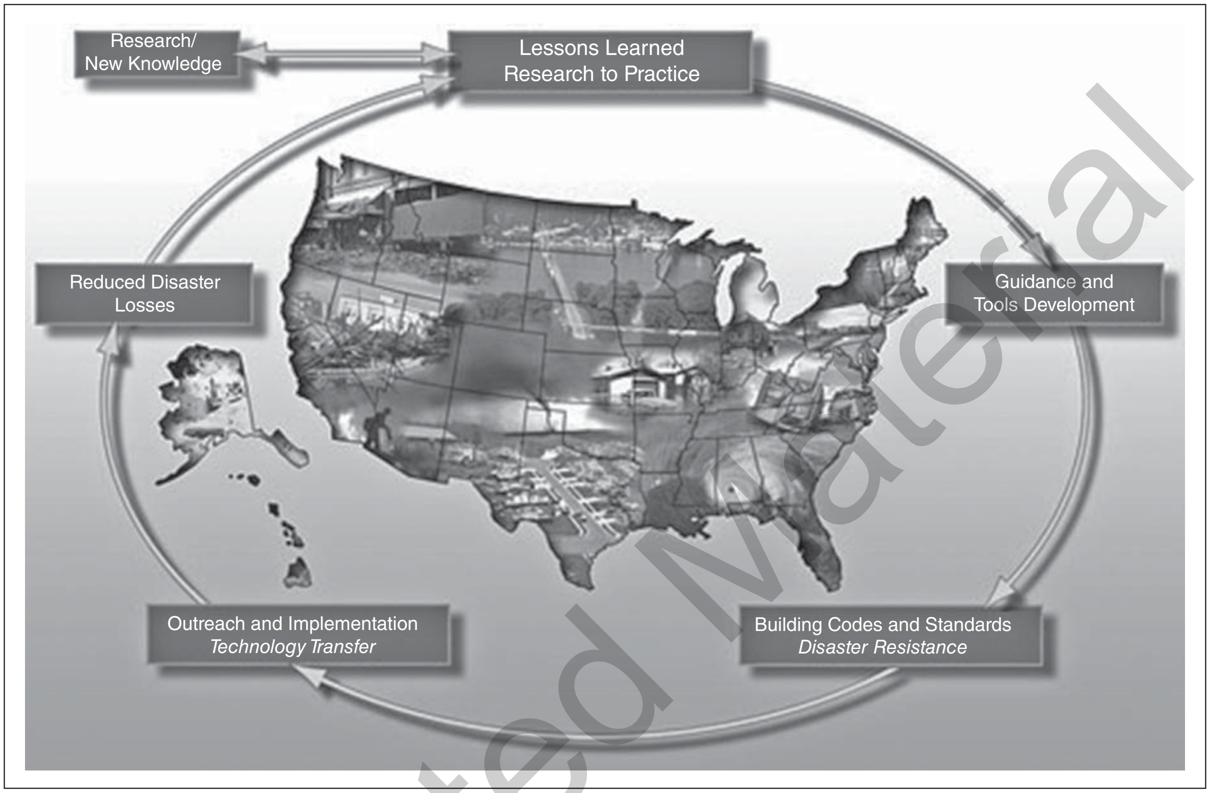
Resilience refers to an ability to adapt to change over time. A fully resilient community would suffer limited negative consequences of a natural hazard. The State of Washington, for example, has defined a resilient state as "one that maintains service and livelihood after a major hazard. In the event that services and livelihoods are disrupted, recovery occurs rapidly, with minimum disruption, and results in a new and better condition affecting *Property Protection*, *Economic Security*, *Life Safety and Human Health*, and *Community Continuity*, where all communities should have the capacity to maintain social networks and prevent social discrimination and social bias."

The resilience of the built environment is defined well in terms of its resilience as a whole system. ResilientCity.org is a not-for-profit network of design professionals whose mission is to develop creative, practical, and implementable planning and design strategies that help increase the capacity for resilience. They define a resilient city as "one that has developed capacities to help absorb future shocks and stresses to its social, economic, and technical systems and infrastructures so as to still be able to maintain essentially the same functions, structures, systems, and identity" (www.resilientcity.org).

The San Francisco Planning and Urban Research Association, or SPUR, a nonprofit with the goal to make cities truly resilient, acknowledges the direct relationship between building codes and resilience. "When we select engineering [and design] standards for buildings and lifelines, we are really choosing how many deaths, how many building demolitions, and how long a recovery time we have for various levels of earthquakes." This distinction, and the degree to which new buildings are capable of withstanding natural hazards, is largely misunderstood by the general public, who often assume that a new building can weather any storm, so to speak.

One tool to inform the design team and communicate expectations to the owner and building official is building performance modeling—the use of drawings, photos, and the like to construct a unique model within simulation software. Although modeling is only as good as its data input, it could be a useful tool for prioritizing mitigation technologies (see Figure 4.6.). With the intent to encourage the design of buildings to higher standards and with increased reliability, building codes have been moving toward a performance-based design approach. Performance-based design focuses the design on meeting a set of established goals rather than a building program based on minimum design standards.

Adoption of building codes by a jurisdiction is voluntary, and code enforcement poses a significant challenge to local building departments, whose resources are often stretched and whose personnel may lack adequate training in code enforcement. The consequence of irregular enforcement has resulted in inadequate construction and ultimately unnecessary damage and destruction of structures. Conditions such as these were discovered during damage assessments of tornado-stricken homes in the Midwest.



FEMA

FIGURE 4.6 Building Damage Mitigation Cycle

Approaches to Resilient Design

As a result of the Disaster Mitigation Act and Stafford Act, most cities have mapped their hazards, determined likelihood of occurrence, and anticipated impacts. Risks associated with those hazards are incorporated in mitigation plans to reduce loss from those hazards and to help prioritize local and federal mitigation funding. HAZUS, a software program developed by FEMA, estimates losses due to natural hazards at a regional level and can include utilities, bridges, and general number of structures. These tools inform decision making for land use and future development.

Architects can support a community's hazard mitigation plan by establishing resilience goals for their development projects. This is facilitated through site assessment, including collecting data from National Weather Service, FEMA's National Flood Insurance Program (NFIP), United States Geological Survey, and state or university surveys and research. Some jurisdictions have GIS mapping that includes hazards for floods, liquefaction, landslides, and the like. A detailed site-specific investigation, including the availability and condition of existing infrastructure, may illuminate development feasibility.

Having early conversations with clients to understand their comfort with risk will help determine acceptable levels of disruption in a disaster and establish appropriate design standards. It is important to communicate to owners that code compliance sets a minimum life safety standard with very limited protection of property. This may cause owners who depend on continuity of service for the long-term survival of their business to choose a design standard that exceeds the building code. Expectations can be outlined with a *vulnerability assessment*, where potential hazardous event scenarios are defined, modeled, holistically assessed, and analyzed for performance impacts and costs. This assessment would include investigations of resources and systems outside property limits: uses, site access, utility/infrastructure, backup systems for water, waste, electricity, and communications. This additional knowledge may alter design to provide additional safety and improve durability of the building through hazard mitigation.

Mitigation begins at the outset of design when decisions are made regarding the building's configuration and footprint, yet mitigation is not exclusively structural. Nonstructural building elements account for up to 80 percent of the value of a building—including windows, ceilings, interior partitions, equipment, furniture, and utilities—and are inherently less durable. Therefore, they are more susceptible to damage and may also negatively affect the structural performance of the building and prevent habitability.

▶ The backgrounder accompanying this article, Resilient Design, further explores the concepts of resiliency.

As seen with recent developments in the building code, the philosophy of mitigation is moving toward a resilient design, in that robust and resistant design is being replaced by design that is adaptable, flexible, and responsive.

CONCLUSION

The Loma Prieta earthquake of 1989 provides perspective on the long-term effects of a disaster in modern times. A post-earthquake economic recession struck northern California with building damage and loss greatly exceeding projections. Development decisions might have been different if building owners had understood the level of protection offered by building code standards. Engaging the public in decision making on acceptable building performance is important because the actual performance expected of a code-compliant building, and particularly existing buildings, is not widely understood. As difficult as the Loma Prieta recovery was, time has a way of minimizing if not erasing the memories of lessons learned.

FEMA statistics show that resilience is improved through mitigation. The potential for loss can be greatly reduced when mitigation practices are incorporated into both retrofits and new construction. Every dollar spent on mitigation saves at least four dollars in recovery, yet mitigation saves more than dollars—it also saves lives. However, to consider the resiliency of a home, one must consider the resilience of the community at large. As such, homeowners experiencing recurring floods who choose to relocate their families to a safer location will also have relationships and routines to rebuild to make a new house feel like home.

There will never be a lack of need for safety assessments of damaged buildings and for the skills that architects can offer to aid in the recovery from a disaster. The AIA model policy for a Comprehensive Response System is one starting point, created to equip architects with the guidance and tools they need, prepare them for the risks they face, and help them protect the communities they serve. Awareness, knowledge, and options for positive action can empower individuals to create resilient sustainable communities.

For More Information

AIA Disaster Resources: www.aia.org/disasterresponse/.

California Safety Assessment Program: www.calema.ca.gov/Recovery/Pages/Safety-Assessment.aspx.

Applied Technology Council: www.atcouncil.orgFEMA.gov/plan/prevent/bestpractices/index.shtm.

FEMA 454, "Designing for Earthquakes: A Manual for Architects": http://www.fema.gov/library/viewRecord.do?id=2418.

Federal Emergency Management Agency (FEMA) Coastal Construction Manual (CCM): www.fema.gov/residential-coastal-construction#1.

National Earthquake Hazards Reduction Program (NEHRP): NEHRP.gov.

The National Tsunami Hazard Mitigation Program of NOAA, "Planning for Tsunami: Seven Principles for Planning and Designing for Tsunami."