Building Department Administration

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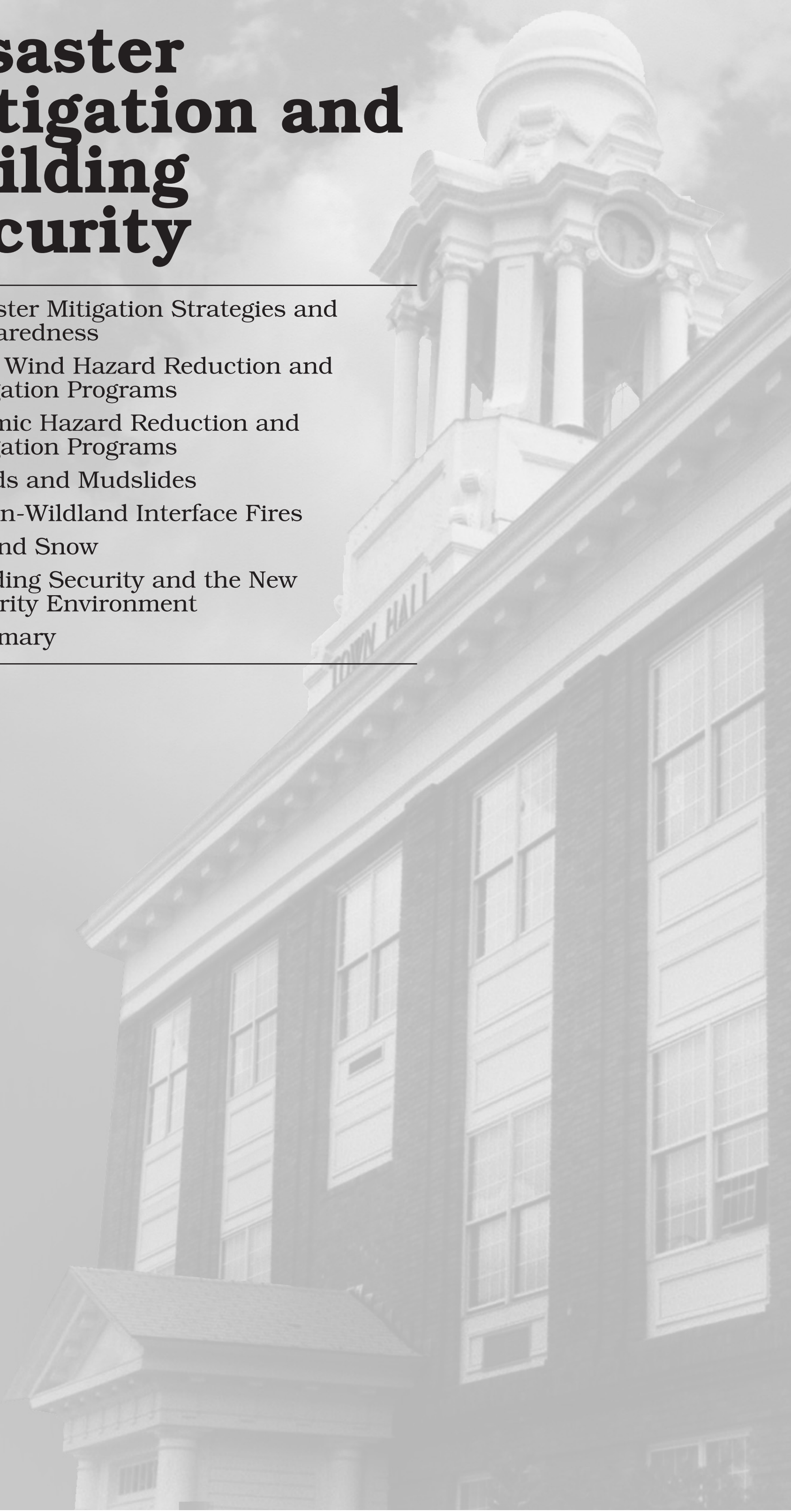

The recent trilogy of major catastrophes that included the South Asia tsunami late in 2004, Hurricane Katrina that struck the United States Gulf Coast in 2005, and the 2005 Kashmir earthquake have once again demonstrated the awesome and destructive power of nature. These mega-disasters were responsible for the loss of over 200,000 lives in the tsunami, 73,000 lives in the earthquake, and 1,200 lives in the hurricane. In addition to the previously unimaginable loss of life, these natural disasters each have had staggering long-term economic, ecological and social impacts on the communities in which the catastrophes occurred. See Figure 17-1.

Figure 17-1

Biloxi, MS, following Hurricane Katrina

Photo: Patrick Crawford

Even during years without disasters of such historic magnitude, the impacts of natural disasters are becoming increasingly costly. The global insurance company Swiss Re writes an annual report that looks at the global costs of disasters. It found that in 2003 man-made and natural disasters caused 60,000 deaths and about $70 billion in economic losses. In addition, it is estimated that the economic costs of such disasters threatens to double, reaching an average of $150 billion a year in the next ten years (Hess 2004, 4).

The World Watch Institute in their publication *State of the World 2001: A Report on Progress Toward a Sustainable Society* demonstrates the human cost of disasters by examining global deaths by disaster type and finding that floods were responsible for forty-nine percent of deaths, that earthquakes or volcanoes were responsible for thirty percent of deaths, that windstorms were responsible for fifteen percent of deaths and that all other disasters caused six percent of deaths. The World Watch report also notes that floods alone cause nearly one-third of all economic losses, half of all deaths, and seventy percent of all homelessness (Abramovitz 2001, 230).

It is imperative that governments take bold action to reduce the toll of disasters on communities by restricting risky behaviors. All levels of government can help to better protect lives and property by adopting policies that discourage new housing developments in risk-prone areas or by instituting and enforcing meaningful building codes that limit the amount of sub-par construction. Those communities that have taken steps to reduce their risks have realized significant returns on their investments. In fact, the World Watch Institute study found that every dollar spent on disaster mitigation and preparedness saves seven dollars in disaster-related economic losses (Abramovitz 2001, 240).

Disaster Mitigation Strategies and Preparedness

Disaster mitigation and prevention is commonly defined as any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event. When mitigation actions are effective they can help reduce the degree to which we must rely on the most costly phases of the emergency management continuum—the response and recovery phases. Mitigation saves lives and property, is cost-effective and promotes sustainable building and development. Wise investments in disaster risk reduction and mitigation strategies reduce the enormous cost of disasters to individuals and families, property owners and all levels of government. In addition, mitigation can protect a community's critical infrastructure, reduce exposure to liability and minimize community disruption.

A Brief History of Hazard Mitigation

Hazard mitigation began as an effort to address the damage-repair-damage cycle caused by natural disasters with a particular focus on repetitively damaged properties. In our nation's recent history, the primary mechanism for supporting state and local mitigation efforts has been the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP), which was established by the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act, 42 USC) in 1988. In 1993, the Volkmer Amendment increased potential funding for mitigation following presidential-declared disasters from an amount equal to ten percent of the funds spent by FEMA on relief and recovery efforts to fifteen percent. The Volkmer Amendment also adjusted the cost-share requirements from a fifty percent federal contribution and a fifty percent non-federal match to the current cost share arrangement where the federal share is seventy-five percent. The adjustment to the cost-sharing arrangement has proved to be good public policy and an effective incentive for encouraging state and local government participation in the program.

The first attempt to encourage mitigation before a disaster with federal grant funding was created with passage of the National Flood Insurance Reform Act (NFIRA) of 1994. This Act allowed a portion of the funds collected from flood insurance premiums to establish the Flood Mitigation Assistance (FMA) program. The goal of the FMA was to reduce or eliminate claims under the (NFIP). To accomplish this goal, the FMA program funds mitigation measures that eliminate or substantially reduce flood risk. The effort to increase pre-disaster mitigation opportunities was expanded in 1997 through an innovative pilot program known as Project Impact. By the time Congress formally authorized pre-disaster mitigation with the Disaster Mitigation Act of 2000, nearly 250 communities and 2,500 business partners had embraced the Project Impact approach. In advance of disasters, these communities initiated mentoring relationships, private and public partnerships, public outreach and disaster mitigation projects to reduce damage from potentially devastating events. The Project Impact program allowed communities greater grant flexibility that enabled them to tailor more strategic and holistic approaches for mitigating their risk. These strategies often included building support for local building/land use and codes revisions or building support for the passage of bond measures that allowed construction of prevention measures for the benefit to the entire community.

Beginning in 2001, efforts to eliminate pre-disaster mitigation programs and to reduce available HMGP funding signaled a de-emphasis of mitigation at the federal level. The Executive Branch initially excluded Pre-Disaster Mitigation (PDM) funding from its budget requests of Congress. Subsequent budget requests have sought the elimination of HMGP in exchange for an increased funding level for PDM. The result has been a decrease in the amount of HMGP funding from 15 to 7.5 percent of the total disaster grants awarded by FEMA after a disaster. This change in the HMGP funding formula has reduced the opportunities for mitigation during the very critical post-disaster window when many communities have found their citizenry to be more motivated to initiate necessary risk-reduction actions.

Further, the inclusion of FEMA within the Department of Homeland Security has resulted in a greater emphasis on terrorism prevention at the expense of natural hazards mitigation. The ultimate impact of this reorganization has yet to be fully studied, but many within the emergency management community are concerned that policies and funding at the national level may adversely impact natural hazards mitigation at the state and local levels.

Mitigation Tools

Four major categories of mitigation activities are frequently used to increase the level of protection from disasters and to significantly reduce risk. These categories include design and construction, land use planning, organizational planning and hazard control.

Design and Construction

Design and construction is frequently the most cost-effective method for mitigating risk. The adoption and enforcement of modern building codes helps to ensure that communities retain and build structures that have the greatest likelihood of withstanding hazards unique to their area. Since such codes typically are limited to new or substantially improved structures, communities are frequently unable to address their existing hazardous structures. Many communities have been able to establish incentives and have adopted either passive or active code triggers to improve the safety of the existing building stock. Two examples of code triggers include a change in building use or the sustaining of substantial disaster to a structure.

State and local governments have an important responsibility to adopt building codes that ensure a baseline level of protection for their communities, and when building professionals comply with those codes, they are in effect implementing mitigation measures. See Figure 17-2.

The codes that address building performance are intended to promote higher levels of structural integrity, but there are also important mitigation techniques that address

Figure 17-2
This Pass Christian, MS, home, built with reinforced concrete to FEMA standards, was the only house standing in the neighborhood following Hurricane Katrina.
Photo: John Fleck/FEMA

the non-structural elements of buildings. Actions include securing light fixtures to ceilings, installing wind shutters, and strapping or bolting generators to walls reduce the chance of injury and also allow for improved continuity of operation for the businesses and critical infrastructure in a community. Continued research into building performance and then the application of this research, with updated and improved codes, is essential for improving the safety of communities and the nation as a whole.

Land-Use Planning

While the process for communities to engage in comprehensive land-use planning can be difficult and sometimes controversial, this mitigation tool can significantly reduce damages caused by natural hazards. Land-use planning is generally most effective in areas that have not been developed or where there has not yet been significant investment in public infrastructure.

Because location is a key factor in determining the risks associated with natural hazards, land-use plans can be important tools for designating low-risk uses for areas that are most vulnerable to natural hazards impacts. For example, an area located in a designated floodplain that has been susceptible to repetitive flooding might be more suited for use as a park or golf course than as a housing subdivision. Comprehensive development and land-use plans are typically implemented through ordinances and policies, through police power and through a community's capital improvement program. Comprehensive land-use planning not only reduces the potential for damages, but the designation of open space frequently will enhance the marketability and attractiveness of the community, and may even reduce cost to developers.

A community also can influence the location and density of development through its capital improvement plans since the plans usually determine where the community places critical infrastructure needed for development. Not providing infrastructure such as roads, water supply and wastewater treatment to areas that are known to be at greater risk to natural hazards can result in lower density development in that area. Lower density development will sustain far less monetary damage than a densely developed area, which would likely occur if full infrastructure had been provided. Planning for low density development therefore reduces the opportunity for repetitive losses. Mechanisms such as density transfers, transfers of development rights, planned unit developments, cluster development and similar approaches can ensure that the property owners receive an adequate return on their investments while still providing community protection against natural hazards.

Organizational Planning

Organizations need to integrate mitigation into their operating and strategic plans. Governments have and can continue to play a leading role in this integration. An example of mitigation being integrated into planning includes the efforts to protect basic lifelines and to insure the continuity of service for public health and safety. State and local governments and larger private sector organizations have significant capital improvement plans for building new facilities and replacing inadequate facilities. These plans should provide for the upgrading or replacement of facilities using the most current mitigation techniques and strictly adhering to the most current codes, standards and specifications as new facilities are built. Corporate and government response plans for natural disasters should incorporate mitigation components. An important concept in mitigation planning is that of redundancies. Financial institutions have been particularly good about establishing computer facilities at alternate locations so that they may continue to operate when a disaster impacts a primary facility. Many organizations make arrangements to outsource their computer operations to a service provider located outside their area in the event of a disaster.

Hazard Control

Hazard control, as a method for mitigating the impact of disasters, is generally used to protect existing at-risk developments and structures. These solutions are seen by many as temporary solutions that are simply delaying the inevitable forces of nature rather than providing a permanent solution. Additionally, measures that seek to control a hazard frequently require some level of regular maintenance. An example of a commonly used and recognized hazard control structure is the levee. Levees have been used very effectively to protect flood hazard areas for decades. However, Hurricane Katrina in 2005, the Midwest floods of 1993 and many other flood events have clearly demonstrated the limitations of these structures. Levees can be overtopped or breached by floods that exceed their design; they can encourage further at-risk development behind the levee because they provide a temporary level of safety; they can worsen the flood hazard in other locations by pushing water elsewhere; and they can have an adverse impact on the natural environment by inhibiting the ecological processes that sustain wetlands. Measures to control hazards such as levees, dams or retaining walls have been traditional tools for protecting communities, especially when there are no other viable alternatives; however, more communities are viewing these options as last resorts due to the potential for failure, construction and continued maintenance expense, and the unintended consequences that sometimes result from such options.

Mitigation Programs

There are several avenues whereby the federal government can offer grant funding or technical assistance to support state and local disaster mitigation efforts. The grant programs include funding available through the Federal Emergency Management Agency's (FEMA) Public Assistance Program, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMAP), Pre-disaster Mitigation (PDM) Grant Program, and the Disaster Resistant University (DRU) Program. Technical assistance is offered through the Hazard Mitigation Technical Assistance Program, the National Earthquake Technical Assistance Program, and the Wind and Water Technical Assistance Program.

Mitigation within the Public Assistance Program (406 Mitigation)

Section 406 of the Stafford Act allows for mitigation measures to be identified and funded as a part of eligible public assistance projects. The Public Assistance Program provides funding for the repair, restoration or replacement of damaged facilities belonging to governments and to private nonprofit entities, and for other associated expenses, including emergency protective measures and debris removal. Additionally, the program allows for the funding of mitigation measures related to the repair of an existing damaged facility. The measures must either be required by code or be cost-effective and comply with program guidance. With "406 mitigation," FEMA funds at least seventy-five percent of the eligible costs of the mitigation measure.

Hazard Mitigation Grant Program (HMGP)

Section 404 of the Stafford Act gives FEMA the authority to provide grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration through the Hazard Mitigation Grant Program (HMGP). The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Hazard mitigation planning is a critical element of successful mitigation programs. States and communities are strongly encouraged to use the hazard mitigation planning process for setting short- and long-range mitigation goals and objectives. Hazard mitigation planning is a collaborative process whereby hazards affecting the community are identified, vulnerability to the hazards is assessed, and consensus is reached regarding the method for minimizing or eliminating the effects of these hazards. To emphasize the importance of planning, states with an approved enhanced state mitigation plan in effect at the time of disaster declaration may receive additional HMGP funding.

HMGP funds may be used to fund projects that will reduce or eliminate the losses from future disasters. Projects must provide a long-term solution to a problem. An example would be elevating a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. Examples of approved projects include the acquisition of real property and relocation of buildings, thereby allowing the property's conversion to open space; the retrofitting of structures and facilities to minimize damages from high winds, earthquake, flood, wildfire or other natural hazards; the elevation of flood-prone structures; the developing and implementing of vegetative management programs; construction of minor flood control projects that do not duplicate the flood prevention activities of other federal agencies; localized flood control projects, such as certain ring levees and floodwall systems designed specifically to protect critical facilities; and post-disaster building-code related activities that support building code officials during the reconstruction process.

Flood Mitigation Assistance (FMA) Program

The Flood Mitigation Assistance Program (FMA) provides grants to states and communities that allow them to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP).

The three types of FMA grants available include Planning, Project, and Technical Assistance Grants. FMA Planning Grants allow recipients to develop flood mitigation plans. NFIP-participating communities that have approved Flood Mitigation Plans are eligible to apply for FMA Project Grants. FMA Project Grants are available to states and NFIP-participating communities to implement measures to reduce flood losses. Ten percent of the Project Grant is made available to states as a Technical Assistance Grant. These funds may be used by the state to help administer the program. Communities receiving FMA Planning and Project Grants must be participating in the NFIP. A few examples of eligible FMA projects include the elevation, acquisition and relocation of NFIP-insured structures.

States are encouraged to prioritize FMA project grant applications to include repetitive loss properties. Repetitive loss properties are defined as structures with four or more losses each with a claim of at least $1,000 within a ten-year period. The state and communities are also encouraged to develop plans that address the mitigation of repetitive loss properties. Examples of eligible projects include the elevation of insured structures, acquisition of insured structures and real property, and the relocation or demolition of insured structures.

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program is authorized by Section 203 of the Stafford Act. Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist states and local governments (including Indian tribal governments) in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program.

Eligible activities include mitigation planning not exceeding $1 million, mitigation projects not exceeding $3 million, information dissemination directly related to mitigation planning, and project management cost. Projects that are generally not considered to be eligible include major flood control projects, preparedness projects such as alert and warning or communications systems, or projects that address man-made hazards. Each project funded as a part of the Pre-Disaster Mitigation Grant Program requires at least a twenty-five percent non-federal cost-share with the exception of small, impoverished communities that may be eligible for up to a ninety percent federal cost-share. Recent appropriation levels have ranged between $50 million and $250 million per fiscal year and have included designated funding for the Disaster-Resistant Universities initiative.

Disaster-Resistant Universities

In the last decade, disasters have frequently affected university and college campuses, sometimes causing death and injury, but always imposing monetary losses and disruption of the institution’s teaching, research and public service. Damage to buildings and infrastructure and interruption to the institutional mission has resulted in significant losses that can be measured by faculty and student departures, decreases in research funding and increases in insurance premiums. These losses could have been substantially reduced or eliminated through comprehensive pre-disaster planning and mitigation actions.

In an effort to encourage disaster mitigation on campuses, FEMA developed an initiative that has provided seed funding and technical assistance for universities seeking to reduce their disaster risk. As a part of this effort, "Building A Disaster-Resistant University" was developed to serve as both a how-to guide and a distillation of the experiences of six universities and colleges across the country that have been working over the past several years to become more disaster resistant. The guide, which can be downloaded from the FEMA Web site, provides basic information designed for institutions just getting started as well as concrete ideas, suggestions and practical experiences for institutions that have already begun to take steps to becoming more disaster resistant.

The Hazard Mitigation Technical Assistance Program Contract (HMTAP)

The HMTAP is an ad hoc technical assistance program created to provide assistance to the Federal Emergency Management Agency's Headquarters and Regional mitigation staff. This multi-hazards program was designed to provide architectural, engineering and other mitigation-related technical assistance in support of post-disaster mitigation initiatives. The HMTAP is available for use by all FEMA Regional and Headquarters Mitigation staff. Examples of HMTAP projects are environmental assessments, benefit cost analysis, engineering/architectural feasibility studies, remote sensing and geographic information systems assistance, post-disaster floodplain analysis to assist in mitigation activities, and training to assist in the implementation of mitigation activities.

The National Earthquake Technical Assistance Program (NETAP)

The NETAP is a technical assistance program created to provide ad hoc short-term architectural and engineering support to state and local communities related to earthquake mitigation. The program was designed to enhance states' and local communities' abilities to become more resistant to seismic hazards. This assistance cannot be used for actions that are covered under the States/Territories Performance Partnership Agreement (PPA). This program assists in carrying out the statutory authorities of the National Earthquake Hazards Reduction Act (NEHRP)

Technical assistance under the NETAP is available for use by the states and local communities within the forty-five eligible and or participating seismic states and U.S. territories. This assistance is provided at no cost to the requesting local community or state government. Examples of NETAP projects are seismic retrofit/evaluation training, evaluation of seismic hazards critical/essential facilities, post earthquake evaluations of buildings and development of retrofit guidance for homeowners.

The Wind and Water Technical Assistance Program (WAWTAP)

The WAWTAP is a technical assistance program created to provide ad hoc short-term assistance in support of the hurricane and flood programs. The program was designed to enhance the states' and local communities' abilities to become more resistant to flood and hurricane hazards. This assistance cannot be used for actions that are covered under the States/Territories Performance Partnership Agreement (PPA). The program assists in carrying out the statutory authorities of the National Flood Insurance Act.

Technical assistance under the WAWTAP is available for use by all states and U.S. territories that participate in the Hurricane Program or Flood Program. This assistance is provided at no cost to the requesting state or local community. Examples of projects that can be executed under WAWTAP are hurricane/flood mitigation planning assistance, technical guidance in developing flood/wind retrofit measures, study and analysis of storm phenomena, and training associated with flood/wind mitigation.

High Wind Hazard Reduction and Mitigation Programs

Severe windstorms, including hurricanes and tornadoes, cause dozens of deaths and billions of dollars in property damage each year. The two primary mechanisms for supporting high-wind hazard reduction have been the National Hurricane Program and a series of tornado/hurricane-safe-room initiatives designed to educate the public regarding the importance of safe rooms and to provide funding to construct them. Additionally, Congress has been considering legislation that would provide for the coordination of federal wind hazard reduction efforts through a multi-agency program similar to the National Earthquake Hazards Reduction Program (NEHRP). There are a series of risk-reduction measures that individuals and homeowners can take to significantly reduce their risk to high-wind hazards. Finally, both the HMPG and PDM programs make grant funding available to state and local governments along with individuals so that they can implement high wind hazard risk-reduction measures.

National Hurricane Program

The National Hurricane Program conducts and supports many projects and activities that help protect communities and their residents from hurricane hazards. Three key components of the program are Response and Recovery; Planning and Preparedness; and Mitigation.

Response and Recovery

The National Hurricane Program helps communities and individuals repair damage, rebuild and recover after hurricanes and coastal storms by providing liaison teams to assist the coordination of National Hurricane Center advisories and emergency evacuation activities among federal, state and local governments and by conducting post-flood evacuation studies. Failure to properly shield against natural disasters will lead to ever-increasing response and recovery expenses; see Figure 17-3.

Figure 17-3

Oakland, CA, Urban Search and Rescue Team in Biloxi, MS, following Hurricane Katrina

Photo: Patrick Crawford

Planning and Preparedness

The Hurricane Program works to lessen the impact of hurricanes and coastal storms on communities and their residents by evaluating and recommending improvements for emergency evacuation shelters, evaluating and developing emergency evacuation plans, and increasing public awareness of hurricane hazards through training and outreach programs.

Mitigation

The Hurricane Program reduces the damage caused by hurricane winds and flooding through improvements in the built environment, including residential and non-residential buildings and their utility systems. These mitigation activities are accomplished by assessing building performance after significant hurricanes and coastal storms, developing designs for hazard-resistant construction in new buildings and retrofitting techniques for existing buildings, and recommending improvements in state and local regulatory programs.

Tornado/Hurricane-Safe Rooms

When severe weather threatens, individuals and families communitywide need advance warning and protection from the dangerous forces of extreme winds. Individuals and communities in high-risk tornado and hurricane areas continue to address the need and combined benefits of structurally sound residential and community shelters and early alert systems. FEMA has developed and made available guidance on the construction of both residential safe rooms and community shelters.

FEMA's Hazard Mitigation Grant Program (HMGP) has been used by a number of states to fund wind-hazard shelters. Some states have elected to fund in-home shelters while other states have chosen to fund community shelters at schools and other publicly owned facilities. Oklahoma, Kansas, Iowa, Arkansas, Mississippi and Alabama have all funded shelters through various programs over the last four years. As a result of these initiatives, high quality and affordable wind-hazard shelters have and continue to be constructed in communities threatened by both tornadoes and hurricanes. Following the 1999 tornadoes that significantly impacted Oklahoma and Kansas, Oklahoma used HMGP funds to establish a homeowner reimbursement program for in-home safe rooms. Since homes damaged by the tornadoes were given priority by the state, larger numbers of safe rooms were built in the Oklahoma City area. In May 2003, the Oklahoma City area was again struck by a major tornado, and the safe rooms that were built under the HMGP program provided safe shelter to many families prompting state emergency management officials to acknowledge that safe rooms, built with FEMA's HMGP program funds, had saved many lives that day.

Residential Initiatives

The Tornado Shelters Act was passed to formally amend the Housing and Community Development Act of 1974 to authorize communities to use Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) funds to construct tornado-safe shelters in manufactured home parks. To be eligible, a shelter must be located in a neighborhood or park that contains at least twenty units, consists predominantly of low- and moderate-income households, and be located in a state where a tornado has occurred within the last three years. The shelter must comply with tornado-appropriate safety and construction standards, be large enough to accommodate all members of the park or neighborhood, and be located in a park or neighborhood that has a warning siren.

Public Initiatives

Various states have structured their own programs and/or leveraged existing federal funds to make tornado-safe rooms a priority for their state. In addition to FEMA guidance and technical assistance, the International Code Council (ICC) is currently developing a consensus standard for the design and construction of hurricane and tornado shelters. Currently, design and guidance exist in several publications including FEMA 320, *Taking Shelter from the Storm: Building a Safe Room Inside Your House;* FEMA 361, *Design and Construction Guidance for Community Shelters;* and the National Storm Shelter Association (NSSA)'s *Association Standard.*

FEMA has also focused on developing training to support technology transfer. FEMA, through its Emergency Management Institute, offers training in coastal construction for design professionals. Through the Multi-hazard Building Design Summer Institute, FEMA offers state-of-the-art training in wind-resistant construction to university architectural and engineering faculty. This training is delivered by some of the nation's leading wind engineers from Texas Tech University.

Wind Hazard Reduction Legislation

While FEMA and several other federal agencies have on-going efforts to study and implement wind hazard reduction efforts, Congress has been considering the creation of a National Wind Related Hazard Reduction Program as a way to better coordinate federal efforts to reduce losses caused by high winds during hurricanes, tornadoes and other severe storms.

Currently, there is no comprehensive program in place to coordinate federal efforts to minimize wind-related losses before they occur. Two organizations, the Wind Hazard Reduction Caucus in Congress and the Wind Hazard Reduction Coalition in the private sector, are working to establish the program that would minimize the loss of life and property and help homeowners implement mitigation measures before severe windstorms occur.

Legislation under consideration would provide for coordination of federal wind hazard reduction efforts through a multi-agency National Windstorm and Related Natural Hazard Impact Reduction Program to be coordinated through the Office of Science and Technology Policy, establish a wind hazard reduction technology transfer program and create a National Advisory Committee for Windstorm and Related Natural Hazards Impact Reduction. The proposal would also provide for the creation of a list of areas where wind hazard reduction research and development can make a significant impact on loss reduction and require submittal of a ten-year implementation plan to Congress with measurable goals to be coordinated with representatives of state and local government and the private sector, including annual progress updates. The legislation would authorize appropriation levels to bring the wind program closer to parity with the federally-funded earthquake research program. All aspects of the program would be linked to the goal of a major, measurable reduction in losses of life and property due to windstorms within ten years of the date of enactment.

Wind Hazard Mitigation Measures

The results of the National Hurricane Program and the various wind hazard risk reduction efforts by federal, state and local governments has resulted in a significant body of knowledge regarding the manner in which we can mitigate the impact of wind on structures.

There are several easy, non-structural mitigation measures that can be implemented to reduce wind-related losses including the replacing of gravel or rock landscaping material with shredded bark, keeping trees and shrubbery trimmed, and cutting weak branches and trees that could fall on a home.

When a homeowner is building or remodeling a home, replacing existing windows with impact-resistant window systems will allow windows to have a much better chance of surviving a major windstorm. An alternative to new window systems would be to install impact-resistant shutters that close over window openings to prevent flying debris from breaking windowpanes. Entry doors should have at least three hinges and a dead bolt security lock with a bolt at least one inch long, and door frames should be anchored securely to wall framing. Sliding glass doors are more vulnerable to wind damage than most other doors. Homeowners and developers should consider installing impact-resistant door systems made of laminated glass, plastic glazing, or a combination of plastic and glass. Alternatively, when a hurricane threatens, an easy, temporary and effective step is to cover the entire patio door with shutters made of plywood or oriented strand board (OSB).

Because of their size, garage doors are highly susceptible to wind damage. Garage doors more than eight feet wide are most vulnerable. A qualified inspector can determine if both the garage door and the track system can resist high winds. If necessary, it is worthwhile for the homeowner to consider installing permanent wood or metal stiffeners. Garage door manufacturers can also recommend temporary center supports that can attach and remove easily when severe weather threatens. If possible, the homeowner should replace the door and tracks with a stronger system. When homeowners consider garage doors, they should check for a Dade County, SBCCI (Standard Building Code Congress International) or other label indicating the door is rated for high wind pressures and debris impact.

When homeowners replace their roofs, steps should be taken to ensure that both the new roof covering and the sheathing it attaches to will resist high winds. Roofing contractors should remove old coverings down to the bare wood sheathing, confirm that rafters and trusses are securely connected to the walls, replace damaged sheathing, refasten existing sheathing with eight-penny ring-shank nails at six-inch spacing on all support members, seal all roof sheathing joints with self-stick rubberized asphalt tape to provide a secondary moisture barrier, and install a roof covering that is designed to resist high winds. It is important for the homeowner to ensure the end wall of a gable roof is braced properly to resist high winds and to check the current building code for high-wind regions for appropriate guidance, or consult a qualified architect or engineer. The points where the roof and the foundation meet the walls of a home are extremely important for resisting high winds and the pressures they place on the entire structure. The homeowner must make sure that the roof is anchored to the walls with metal clips and straps and make certain the walls are properly anchored to the foundation. For homes with more than one story, it is important to make sure the upper story wall framing is firmly connected to the lower framing. The best time to do this is when a home is being remodeled or is having siding replaced.

Seismic Hazard Reduction and Mitigation Programs

Earthquakes are among the most frightening and devastating of natural events since they strike without warning and allow no time for preparation or evacuation. In the United States, at least thirty-nine states are considered at risk from moderate to great earthquakes. Earthquakes have struck many areas of the United States, including Alaska and the Central and East Coast states. The 1994 Northridge, California, earthquake is just one example of the devastation caused by earthquakes. The Northridge earthquake resulted in over sixty deaths, more than 5,000 injuries, and over 25,000 people left homeless. Direct economic losses from the Northridge earthquake are estimated at $20 to $30 billion.

As devastating as the Northridge earthquake was, our nation has experienced earthquakes of much greater magnitude, and prediction models anticipate that more will be experienced in the future. The Northridge earthquake was a magnitude 6.7, which lasted roughly fifteen seconds. By contrast, the 1906 San Francisco earthquake was estimated as a Richter Magnitude 8.3 event, lasting forty-five seconds. The 1964 Alaska earthquake was a magnitude 8.4 and lasted over three minutes. While most earthquake activity has been experienced in the Western United States, two of the most severe earthquakes in U.S. history occurred east of the Rockies: one in Charleston, South Carolina, in 1886, and the other a series of three shocks centered near New Madrid, Missouri, in 1811 and 1812 that measured an estimated 8.5 on the Richter scale. If a similar magnitude earthquake were to occur today in the New Madrid area, it is estimated that it would cause a significant loss of life and property damage of $50 billion or more.

Earthquake Mitigation Measures

Earthquake retrofits are typically classified as nonstructural and structural. Generally, non-structural efforts are aimed at securing objects or architecture within a building whereas structural efforts seek to tie different parts of a structure together, including the roof, walls and/or foundation.

Nonstructural Retrofits

Non-structural retrofits protect the contents and people in a home or office against damage with little cost and effort. Examples of non-structural retrofits include the securing of water heaters, large appliances, bookcases, pictures and bulletin boards; latching cabinet doors; and using safety film on windows.

The effort to retrofit non-structurally begins by evaluating the likelihood and consequences for objects that could fall and break during an earthquake. In addition to considering items that are difficult to replace such as water heaters, bookcases and light fixtures, consideration should also be given to items of special significance or high dollar value. As inspections are conducted, thought should be given to the most cost-effective satisfactory means for securing objects.

While bookcases are essential for storage and display purposes, they can become very dangerous during an earthquake, causing considerable damage and injury. All bookcases in seismically active areas should be securely fastened to nearby walls. A common method for doing this is to attach either L-brackets or Z-brackets to the bookcase and the wall, making sure the brackets can accommodate the fasteners being used. When possible, heavy objects should be placed on lower shelves to help stabilize bookshelves and cabinets. When heavy objects such as televisions, computers and stereos are placed on top of cabinets, bookcases and tables, they should be fastened firmly so they will not slide off during an earthquake.

Photographs, bulletin boards and artwork displayed in homes and offices can easily fall during an earthquake if they are not properly fastened to a wall. It is best to use closed screw-eyes instead of traditional picture hangers for securing picture frames, bulletin boards and mirrors. Depending on the weight of the object and the screw-eye's maximum weight limit, one or more closed screw-eyes should be screwed into wall studs. Heavy or sharp wall hangings should always be mounted away from areas where they could fall on people.

If they aren't well attached and supported, ceiling lights, suspended ceilings and hanging fixtures, such as chandeliers and ceiling fans, can fall in an earthquake and seriously injure those below. Ceiling lights should be secured to supports using safety cables. If ceiling lights have covers, the covers should be fastened directly to the fixture itself or to the building's permanent structure. With fluorescent lights, plastic sleeves over the fluorescent light tubes will keep the glass from scattering if the tubes break, or some may consider using Teflon fluorescent lights, which are shatter resistant. Safety cables should be used every few feet to attach suspended or false ceilings to the structure. Chandeliers, ceiling fans and other suspended fixtures and hanging plants need to be safely secured to the permanent structures. All suspended items need to be connected to strong supports with safety cables capable of supporting each item's entire weight. Hanging items tend to sway easily, so it is important that a non-structural retrofit evaluation ensures that hanging items do not collide with anything if they swing in an earthquake.

In an earthquake, glass can break explosively, causing serious injuring to those nearby. One way to reduce the likelihood of scattered broken glass is for the homeowner to apply safety film to windows and glass doors. It is most effective to use a protective film with a minimum thickness of four mils on all types of glass, including tempered glass and annealed glass.

Earthquakes can cause refrigerators, washing machines and other large appliances to slide or fall over. Heavy objects on wheels may roll if brakes or stops are not provided and locked. Large appliances should be anchored to walls using safety cables or straps. The restraint should be located in the mid to upper portion of the appliance with hardware that is sized appropriately for the appliance. Water heaters can move or tip over in an earthquake, and the broken water pipe can cause flooding, potentially destroying ceilings, floors, walls, furniture and artwork. If a building's water heater runs on gas and the gas line breaks, the situation becomes far more serious. In many areas of the country where earthquakes are common, local building codes may require that water heaters be laterally braced or strapped to resist seismic forces.

Structural Retrofits

When an earthquake strikes, a building's structure is put to the test. The skeleton must absorb the earthquake's energy and provide a stable path to transfer the forces back into the ground. For this to happen, a building's structure must be tied together with the roof tightly attached to the walls, the walls fastened securely to each other, and the rest of the structure braced and anchored to a strong foundation. It is important that structural retrofit work conforms to local building code requirements.

Earthquakes can create ground motion in any direction. During a quake, a building's foundation moves with the earth, but the rest of the building reacts more slowly due to its inertia. This creates a tremendous amount of stress on the connections between the foundation and the remaining structure. If these connections are not strong enough, the building may slide or fall off its foundation. In fact, this is one of the most common and costly types of structural damage.

Slab-on-grade foundations are concrete slabs that rest on the ground. In an earthquake-prone area, a home's wood frame structure should be connected to the slab with either anchor bolts or other steel connectors, including steel plates. Foundations with a crawl space or basement typically have enough room underneath the first floor for the foundation and the underside of the floor-framing members, or joists, to be inspected, as long as the space is unfinished. The main difference between a crawl space and a full basement is the amount of headroom available. The walls that rise from the foundation footings to the first floor (foundation walls) are typically made with masonry blocks or concrete. In some cases, a short wood-stud wall, or cripple wall, is positioned above ground between the top of the concrete or masonry foundation wall and the first floor. Steel plates or minimum half-inch-diameter anchor bolts should connect the wood framing sill plate to the concrete or masonry wall.

For cripple walls, exterior lap siding alone cannot adequately resist the earthquake's lateral forces. Interior bracing may need to be added to prevent the cripple wall from collapsing in an earthquake. A structure can also be supported by a post-and-pier foundation, which comprises large beams running under floor joists that are held up by posts. Each post rests on a separate concrete footing or pier. Some post-and-pier foundations are hidden from view by a cripple wall that runs around the structure's outside perimeter. This type of foundation is very susceptible to collapse during an earthquake. To better resist seismic forces, all of the foundation's components, including the beams, posts and piers, must be securely tied together. One way the homeowner can help a structure better withstand an earthquake is to have the connection reinforced with steel plates, plywood or OSB connectors. Strong connections between the various components may not be enough; the earthquake's movement may still knock a structure off its foundation. Extra connections and lateral bracing may be necessary to adequately secure a foundation.

Earthquakes expose the floor to substantial forces that can distort and damage the floor system, jeopardizing the strength of a building. To reduce the possibility of rotation in an earthquake, each joist should be nailed to a band joist. Blocking or bridging can also be placed between joists to keep them from falling over. The forces absorbed by the band joist or blocking must, in turn, be transferred to the foundation. This connection can be secured through the use of metal ties or framing anchors.

During an earthquake, the walls of a structure, especially the exterior walls, play an important role in preventing buildings from collapsing. The walls along with the floors and roof create a box. As the ground shakes, the floors and roof sway back and forth, while the walls in between try to stop the structure from moving too far. To do their job, walls must be strong and securely tied to the roof, floor and foundation. Traditionally, the exterior walls of wood frame structures are supported with wood studs attached to structural-grade plywood, oriented strand board (OSB) or diagonal wood sheathing. To protect the exterior walls from the elements, they are covered with lap siding, stucco, stone or brick veneer. In order for this system to resist damage from earthquake forces, it must be well designed with the appropriate hardware in place to ensure a strong connection among all of the elements. Also, the homeowner should consider the number, size and location of the windows and doors. Too many can weaken the walls and lead to possible collapse in an earthquake. Unlike wood siding, brick and stone veneers require special attention because of their weight. During an earthquake, this heavy veneer can fall off, causing injury and significant damage. It is very important that veneered walls be tied to the wood-frames behind them with simple metal ties secured in the mortar.

Sound building practices usually provide sufficient ties for the first story, even when they are not designed specifically for earthquakes. Special attention, however, may be required for the size and spacing of the ties in the upper stories. Walls made entirely of brick, stone, clay tile, concrete block or adobe could be susceptible to earthquake damage. In newer masonry homes on the West Coast, these types of walls are often reinforced with steel bars grouted inside the walls. If the walls are reinforced and well anchored to the foundations, floors and roofs, they can usually withstand an earthquake. Masonry that is in poor condition, unreinforced or not securely tied to the rest of the structure has the potential to collapse.

National Earthquake Hazards Reduction Program (NEHRP)

The National Earthquake Hazards Reduction Program (NEHRP) is the federal government's program to reduce the risks to life and property from earthquakes. The NEHRP agencies are FEMA; the National Institute of Standards and Technology (NIST), the lead agency; the National Science Foundation (NSF); and the United States Geological Survey (USGS).

The four goals of the NEHRP are to develop effective practices and policies for earthquake loss reduction and accelerate their implementation, improve techniques to reduce seismic vulnerability of facilities and systems, improve seismic hazards identification and risk-assessment methods and their use, and improve the understanding of earthquakes and their effects.

Floods and Mudslides

As discussed earlier in this chapter, the most effective method for mitigating the impact of floods or mudslides is to limit development in areas that are most susceptible to flooding or mudslide hazards. For those communities that inherit structures in flood-prone or slide-prone areas, the next most effective alternative is to acquire and relocate structures from these highest risk areas. When acquisitions and relocation options are not viable, elevation can be a relatively effective measure for mitigating flood hazards.

Larger public works such as levees, dams, hill stabilization projects or retaining walls have frequently been undertaken by communities to mitigate flood and mudslide losses, but as was discussed earlier in this chapter, these solutions have been known to fail and have significant financial considerations in terms of construction and maintenance costs; see Figure 17-4.

Figure 17-4
Winter storms in La Conchita, CA, caused fatal mudslides in 2005.
Photo: John Shea/FEMA

Flood and Mudslide Mitigation for Individual Homeowners

Even in areas where flood waters are less than two feet deep, a house can be severely damaged if water reaches the interior. The damage to walls and floors can be expensive to repair, and the house may be uninhabitable while repairs are underway. One way to protect a house from shallow flooding is to add a waterproof veneer to the exterior walls and seal all openings, including doors, to prevent the entry of water. Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches and outlets are easily damaged by flood water. If they are inundated for even short periods, they will probably have to be replaced. Another serious problem is the potential for fires caused by short circuits in flooded systems. Raised electrical system components help to avoid those problems. Also, an undamaged, operating electrical system will help to begin recovery efforts and aid with the cleanup and repairs.

Unanchored fuel tanks can be easily moved by flood waters. These tanks pose serious threats not only to homeowners and their property but also to public safety and the environment. An unanchored tank outside a home can be driven into the walls of a structure, or it can be swept downstream, where it can damage other houses. When an unanchored tank in a basement is moved by flood waters, the supply line can tear free and the basement can be contaminated by oil. Even a buried tank can be pushed to the surface by the buoyant effect of soil saturated by water.

Heating, ventilating and cooling (HVAC) equipment, such as a furnace or water heater, can be damaged extensively if it is inundated by flood waters. The amount of damage will depend partly on the depth of flooding and the amount of time the equipment remains under water. Often, the damage is so great that the only solution is replacement. In flood-prone houses, a good way to protect HVAC equipment is to move it from the basement or lower level of the house to an upper floor or even to the attic. A less desirable method is to leave the equipment where it is and build a concrete or masonry block floodwall around it.

In some flood-prone areas, flooding can cause sewage from sanitary sewer lines to back up into houses through drain pipes. These backups not only cause damage that is difficult to repair but also create health hazards. A good way to protect homes from sewage backups is to install backflow valves, which are designed to block drain pipes temporarily and prevent flow into the house

Urban-Wildland Interface Fires

Nearly every state has experienced devastation by wildfires in the last century. More than 140,000 wildfires occur on average each year. Since 1990, more than 900 homes have been destroyed each year by wildfires. Whether started by humans or by lightning, wildfires are part of a natural cycle that helps to maintain the health of our forests. Today, more than ever, people are moving into once-remote areas without addressing the dangers that exist around them. A tremendous wildfire danger exists where homes blend together with the wildland, creating the wildland-urban interface.

The placement of homes there interrupts the natural cycle of wildfires. Ultimately, this contributes to a dangerous build-up of old vegetation, leading to an uncontrollable wildfire.

In a wildfire, local fire departments have two priorities: to remove people from harm's way and to stop the progression of the wildfire. The two basic fuel types in the wildland-urban interface are vegetation and structures; see Figure 17-5. Fuel in its natural form consists of living and dead trees, bushes and grasses. Typically, grasses burn more quickly and with less intensity than trees. Any branches or shrubs between eighteen inches and six feet high are considered ladder fuels. Ladder fuels help convert a ground fire to a crown fire (tree tops) that moves much more quickly. The closer the homes are together, the easier it is for the flames to spread from one structure to another. High temperatures, low humidity and swift winds increase the probability of ignition and the difficulty of control. Short and long-term drought further exacerbates the problem.

Figure 17-5
A wildfire in Los Alamos, NM, destroyed homes, vehicles and personal property.
Photo: Andrea Booher/FEMA

Mitigation through Smart Landscaping

Creating a zone around structures that will slow the wildfire down and possibly direct it can help to save homes. For homeowners to create a survivable space, they should take the following steps within thirty feet of a structure, or fifty feet in a heavily treed area, or 100 feet if the structure is on a hillside:

- Introduce more native vegetation.
- Space trees at least ten feet apart.
- Remove dead or dying trees and shrubs.
- Keep trees and shrubs pruned. Branches should be a minimum of six feet from the ground, and shrubs under trees should be no more than eighteen inches high.
- Mow regularly and dispose of cuttings and debris promptly.
- Maintain the irrigation system.
- Clear roofs, gutters and eaves of debris.
- Trim branches so they do not extend over the roof or near the chimney.
- Move firewood and storage tanks fifty feet away from structures and clear areas at least ten feet around them.
- Store flammable liquids properly.
- Do not connect wooden fencing directly to structures.

Mitigation through Construction with Non-flammable Materials

Another method for mitigating wildland fires is through the use of non-flammable building materials. Some non-flammable building techniques include:

- Using only non-combustible roofing materials.
- Boxing in the eaves, fascias, soffits and subfloors with fire-resistant materials like treated wood; reducing the vent sizes.
- Applying ¼-inch non-combustible screening to all vent or eave openings.
- Installing spark arresters in chimneys.
- Enclosing the undersides of decks with fire-resistant materials.
- Covering exterior walls with fire-resistant materials like stucco, stone or brick. (Vinyl siding can melt and is not recommended.)
- Using double-paned or tempered glass for all exterior windows.
- Installing noncombustible street signs.
- Making sure street addresses are visible from the street.

Ice and Snow

A major winter storm can be lethal. Preparing for cold weather conditions and responding to them effectively can reduce the dangers caused by winter storms.

The most effective methods for dealing with winter storms are preparedness related, such as the servicing of snow removal equipment, having enough rock salt on hand to melt ice on walkways and ensuring there is sufficient heating fuel as regular fuel sources may be cut off. Additionally, it is advisable to have safe emergency heating equipment available, such as an ample supply of wood, small camp stoves with fuel, or portable space heaters with adequate fuel.

Individual homeowners can mitigate the impact of cold weather by insulating walls and attics, caulking and weather-stripping doors and windows, and installing storm windows or plastic to reduce drafts. Preventing pipes from freezing is important to mitigate flooding from pipes that can burst. To prevent pipes from freezing, the homeowner should wrap pipes in insulation or layers of old newspapers and then cover the newspapers with plastic to keep out moisture. Letting faucets drip can also help to avoid freezing in extremely cold conditions.

Additionally, the same preparedness measures that one would take in the event of a power outage are applicable to winter storms that are frequently accompanied by ice that can bring down power lines. Preparedness for power outages includes having the following:

- Flashlight and extra batteries
- Portable, battery-operated radio and extra batteries
- First aid kit
- One-week supply of food (include items that do not require refrigeration or cooking in case the power is shut off)
- Nonelectric can opener
- One-week supply of essential prescription medications
- Extra blankets and sleeping bags
- Fire extinguisher (A-B-C type)
- An emergency communication plan.

In case family members are separated from one another during a winter storm, as with general family preparedness plans for all hazards, it is important to have a plan for getting back together. An out-of-state relative or friend should be designated to serve as the “family contact.” After a disaster, it’s often easier to call long distance. Everyone in the family should know the name, address and phone number of the contact person.

Building Security and the New Security Environment

Disaster mitigation planning traces its origins to planning for natural hazards. However, terrorist attacks on the Murrah Federal Building in Oklahoma City, the Pentagon, and New York's World Trade Center have necessitated that an all-hazard mitigation plan should also address hazards generated by human activities such as terrorism and hazardous material accidents. While the term "mitigation" refers generally to activities that reduce loss of life and property by eliminating or reducing the effects of disasters, in the terrorism context it is often interpreted to include a wide variety of preparedness and response measures. Mitigating terrorism includes specific measures that can be taken to reduce loss of life and property from human-caused hazards through modification of the built environment.

Antiterrorism and Counterterrorism

Antiterrorism refers to defensive measures used to reduce the vulnerability of people and property to terrorist acts, while counterterrorism includes offensive measures taken to prevent, deter and respond to terrorism. Thus, antiterrorism is an element of hazard mitigation, while counterterrorism falls within the scope of preparedness, response and recovery.

While it may not be possible to prevent an attack, it is certainly possible to lessen the likelihood of an incident or the potential effects of an incident by implementing antiterrorism measures. The process of mitigating hazards before they become disasters is similar for both natural and human-caused hazards. Whether dealing with natural disasters or terrorism, the process is similar in terms of the need to 1) identify and organize resources; 2) conduct a risk or threat assessment and estimate losses; 3) identify mitigation measures that will reduce the effects of the hazards and create a strategy to deal with the mitigation measures in priority order; and 4) implement the measures, evaluate the results and maintain the plan. This four-phase process is known as mitigation planning.

Three challenges arise when applying the traditional natural-hazard benefit-cost framework to terrorism and human-caused disaster mitigation measures: (1) the probability of an attack or frequency of the hazard occurrence is not known, (2) the deterrence rate may not be known, and (3) the lifespan of the measure may be difficult to quantify. Often those working to mitigate the risk of terrorism are forced to use a qualitative approach based on threat, vulnerability and criticality considerations to estimate the relative likelihood of an attack. This approach is much more subjective but can be used in conjunction with a quantitative estimate of cost-effectiveness (the cost of a measure compared to the value of the lives and property it saves in a worst-case scenario) to help illustrate the overall risk reduction achieved by a particular mitigation measure. It is possible to determine fairly accurately how effective mitigation efforts will be in preventing damages from a given type of attack. For example, structural engineers can determine how a hardening measure will protect a building's envelope. Naturally, the effectiveness of measures that rely on personnel and hardware can be more difficult to pinpoint.

At this time, the HMGP does not fund measures to mitigate the risk of terrorism. However, measures that provide multi-hazard benefits (such as seismic retrofits, which can help reduce blast damage) may be eligible. Additionally, planning money may be used to include terrorism in mitigation planning.

For natural hazards (earthquakes, grassland and forest fires, floods and winds) and building fire hazards (technological accidents), information is available in building codes, industry standards and FEMA guidelines. For man-made hazards, the suggested course of action is less well defined. The United States has not yet developed building standards similar to those of the United Kingdom, which has a greater history of contending with repeated terrorism on its home soil. Helpful information may be found in a strategic plan or a site master plan, or it may have to be developed during initial design through interviews with building owners, staff, occupants, utility companies, local law enforcement and others.

There are many tools and techniques available to the designer for the development of new building designs, the renovation of existing buildings and the mitigation of vulnerabilities. Structural hardening, glass-fragmentation films, physical security systems and many other building-related technologies provide the design professional with numerous tools to design buildings to better protect occupants from terrorist acts.

Another challenge for the design team is to present appropriate information to the building owner in a manner that allows the owner to make a rational, informed decision. Ideally, design-basis threats will be identified and agreed upon at the earliest stages of design. The reason for this is twofold. First, the designer must have a known quantity against which to design. Second, by considering all threats or hazards (especially man-made threats) early in the design, there are potential synergies among mitigating actions. One mitigation strategy can be beneficial against more than one hazard for little difference in cost. As an example, designing moment frame connections between floors and columns and reinforcing exterior walls can mitigate against winds, explosive blasts and earthquakes. Thus, in order to design mitigation measures for man-made hazards, the designer must have some appreciation of the assessment of the threat or hazard, asset value, vulnerability and risk to assist the building owner.

Summary

Natural disasters have long been a mortal enemy of mankind, and the recent tragic loss of life from the South Asia tsunami, the United States Gulf Coast Hurricane Katrina and numerous earthquakes across the world are proof of this fact. Protection against such disasters and the significant reduction of risk is dependent upon effective mitigation programs and mitigation tools. Many such mitigation tools and programs are available, and jurisdictions and the public must be educated and trained to take full advantage of them through proper planning. Until recently, disasters and mitigation strategies were directly related to natural events; however, increased terrorist activities and the targeting of civilians in buildings have now connected these terminologies to man-made events. As such, prevention, mitigation and planning for man-made disasters have now become an important element of the overall strategy.