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Cover: This corner building was heavily damaged by the Northridge Earthquake in 1994, but has been retrofitted and restored. Photo courtesy David W. Look.

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David W. Look and Dirk H.R. Spennemann

Disaster Management for Cultural Properties

Preservation professionals compile historic structure reports and condition assessments documenting the deterioration of materials in thousandths of an inch over decades. Much money is spent on such plans and the subsequent intervention. So far so good. But all can be lost in a matter of minutes if a disaster strikes. The magnitude of destruction is not in fractions of an inch but in whole sections of a building, whole buildings, and in some cases whole communities. In 1989, the Loma Prieta earthquake damaged over 400 historic buildings in the San Francisco Bay area. Within one month, approximately 100 of these damaged buildings were demolished. It is very difficult to protect and preserve historic buildings when they are in relatively good condition. Once they are damaged it is much more difficult. While it is not possible to prevent natural disasters from happening, we can—and must—reduce their impact if our past is to have a future.

Although there are renewed pleas for disaster preparedness after every major disaster, the truth is that very little is being done in disaster preparedness, especially for cultural resources. The vast majority of the work and funds spent on disasters is in response and recovery. Almost all of that goes into search and rescue; fighting the disaster (fighting the fire, sandbagging the floodwaters, etc.); emergency relief (medical, food, shelter, and clothing); restoring order and utilities; clearing and repairing circulation infrastructure (roads, bridges, railroads, airports, and hospitals). Cultural resources are seldom if ever mentioned in community emergency plans and if they were, they would not be a high priority since life and safety must come first.

The octagonal terra cotta turret on the tower of St. Dominick Roman Catholic Church in San Francisco was severely damaged by the Loma Prieta earthquake in 1989. Although the rest of the church was saved and retrofitted with new flying buttresses, the turret was removed and never rebuilt.

Disaster management includes everything that is or can be done before, during, and after a disaster. Disaster preparedness is the first step, often not taken, in disaster management. To be prepared one must know what types of disasters are possible for a given cultural property, the probability for each type, and the vulnerability of the resource to each type of potential disaster. Once these factors are determined, one can explore what can be done before, during, and after a disaster. A disaster or emergency plan documents all of this information in a very concise and useable form. It usually includes recommendations for future action and should be updated periodically so that the information is accurate and reliable. The plan usually includes lists of where to get help, things to do (where and how to turn off the gas, water, and electricity, if necessary), and supplies and where they are stored. There should be multiple copies of the emergency plan just in case some copies are destroyed in the disaster. Staff should be trained in how to use the plan. Training drills before the fire at Windsor Castle, for example, resulted in a substantial reduction in the loss to the building and contents.

Mitigation includes everything that can be done to reduce the vulnerability of the building to the disaster. Depending on the type or types of possible disaster, this may include, but is not limited to, posting evacuation routes; installing exit signs, fire extinguishers, emergency lighting, fire escapes, panic hardware, smoke detectors, and sprinkler systems; strengthening the building for high winds (anchoring roofs, bolting structures to their foundations, installing hurricane shutters, etc.); seismic retrofit (many different techniques from bolting structures to their foundation, anchoring parapets and chimneys to roofs, anchoring unreinforced masonry walls to floor

and roof systems, installing diaphragms, shear walls, diagonal bracing, braced frames, base isolation, to mention only a few). In reducing the damage to property there is usually a parallel reduction in the loss of life.

Almost all mitigation will have some effect upon the historic character and fabric of a resource. Alternative solutions can be evaluated using the Secretary of the Interior's *Standards for the Treatment of Historic Preservation Projects.* In many cases the loss of historic fabric can be restricted to less significant historic spaces and materials. Careful disassembly and re-assembly of parts of buildings may be necessary. During a disaster, nature will not restrict damage to the laundry room and spare the ballroom. Is it not better to make an informed decision before a disaster as to where to lose a little historic fabric than to leave the decision up to the fate of natural forces and risk losing everything?

Mitigation during a major rehabilitation is usually less expensive and more practical. On the other hand, work can be done incrementally as funds become available. If not carefully planned, the incremental approach can cause problems. For example, pipes installed for sprinkler systems may interfere with the selection or installation of various seismic retrofit solutions.

During the recovery period the state historic preservation offices, the National Park Service, and other preservation organizations have helped to assess damage and provide much needed technical assistance. These preservation teams have provided valuable documentation to local communities and help to historic building owners after Hurricane Hugo, the Loma Prieta earthquake, Hurricane Iniki, the Northridge earthquake, and the Oklahoma City bombing.

Preservationists and emergency managers have shared concerns and responsibilities in relation to protecting our cultural heritage. In this issue of *CRM*, Angela Tweedy addresses the current efforts to deal with some of the common issues of loss associated with natural hazards, and to provide recommendations toward accomplishing this end through an integrated planning approach. It is encouraging to learn that the Federal Emergency Management Agency (FEMA) now spends approximately 15% of its disaster assistance budget on state and local long-term mitigation measures. Hopefully, this percentage will increase resulting in a reduction in the need for response and recovery relief.

In their articles, Christopher Eck and Judith Estes emphasize how and why every collection, historic property, and community has a better chance at survival if it has a plan. Developing the plan forces us to consider what we need to do before, during, and after a disaster. The planning process also motivates us to take action while there is still time. Sultan Barakat and Rami Daher apply these planning principles in their article about the various disasters that have occurred in the region of Palestine and Jordan.

Every disaster has the potential to drastically reduce the historic character and fabric of the resource. Community support and determination plus good professional advice can reduce the loss. The response and recovery efforts described by Douglas Reed after a tornado damaged the Rocky Spring Presbyterian Church proves that historic fabric can be salvaged and reused. Volunteers can be a valued part of the team.

Too often a resource will survive the disaster only to be lost during the response and recovery. The daring emergency stabilization described in the article by Giorgio Croci reduced the chance of further damage to the Basilica of St. Francis of Assisi by aftershocks and increased the safety of the workers trying to save, protect, retrofit, and restore this priceless resource.

The recovery period is a good opportunity to solve problems and make improvements. Mary Catherine Martin and Lila King describe the re-evaluation of the Atlanta Fox Theatre's methods of archival storage and care for its collections after a devastating fire. In addition to the traditional professions needed on a preservation team, we may need to add a forensic toxicologist. In the restoration of Kathrineberg, Martin Weaver solved the problems of termites, bacteria, and toxic fungi by eliminating sources of moisture that supported the organic growth, using environmentally-friendly pesticidal treatments, and restoring the original systems and finishes of the building. Eva Osborne provides a summary of the issues affecting the preservation of historic structures in the wake of a terrorist attack.

As members of a large team of Egyptologists, anthropologists, geologists, architects, and engineers, James McLane and Raphael Wüst developed a master plan that will attempt to mitigate the impact of flooding on the tombs of the Valley of the Kings. Part of this mitigation is the reconstruction of an ancient diversion structure indicating that there has been attempts

By progressive failure the unreinforced-brick parapet and fourth-floor façade of this building on Bluxome Street collapsed onto the sidewalk and street during the Loma Prieta earthquake killing six people in a car pool.

to minimize the damage from floods for thousands of years. As was the case in ancient times, people with power and wealth usually have the means to live (and be buried) in the safest places and to alter their environment to provide additional protection.

Lisa Usman raises age-old questions in her article. Earthquakes, hurricanes, floods, and other disasters will continue to happen. It is not a question of "if" but "when?" Well-built buildings that are well maintained perform better during disasters than poorly-built structures with little or no maintenance. Buildings that have been retrofitted for seismic forces and hurricane winds in general perform better than those that have not been retrofitted. Mitigation is not fiction. The fiction is "We are doing enough and we will be ready for the next disaster."

Probably the more important question is "Why are we not doing more to strengthen our historic structures, both great monuments and vernacular houses, to withstand the forces of future disasters while there is still time?" The answer we usually get is, "there is not enough money to preserve and maintain historic structures, not to mention to provide mitigation for a future disaster that 'may or may not happen during my lifetime' or 'while I am living here and owning this property'." However, we are now living in one of the longest periods of prosperity in modern times, yet we are doing very little to protect our irreplaceable cultural heritage. Why? There are a number of reasons. Here are just a few.

The pace of life is increasing at an ever-alarming rate and for many people disaster preparedness is not even at the bottom of their "to do" list. Most people have never experienced a disaster or even seen one except on television or in the newspaper. Most people live in denial—disasters only affect other people, not us. This is a very false sense of security. FEMA reports that 75% of the United States is in one or more disaster zones. Even if we live and work in a relatively safe area, we may travel or vacation in areas that are prone to disasters.

Usually, preparing for a disaster does not show or is generally not perceived as valuable. Bolting your historic house down to the foundation usually is not visible and is certainly not a status symbol. Disaster preparedness is generally not a high priority, even in high-risk zones. However, once the disaster strikes it is a different situation. The resulting losses to business, industry, and tourism may be astronomical compared to the cost of planning and mitigation.

Public education and incentives are needed to make our heritage safer. These could be income tax incentives, investment tax credits for disaster preparedness and mitigation, property tax relief, insurance premium reductions, etc. All historic buildings cannot be retrofitted for disasters in any one-year, five-year, or ten-year period. However, if there were long-term programs of incentives, many historic buildings could be strengthened during major rehabilitations or incrementally as funds are available.

Those of us who are the owners and stewards of cultural properties and/or who are preservation and conservation professionals and advocates must constantly promote disaster preparedness through public awareness and education. Hopefully, this issue of *CRM* will help to focus on preparing for disasters in our planning while there is still time. It has often been said, "The difference between an emergency and a disaster is frequently preparation."

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Mr. Look and Dr. Spennemann are co-guest editors of this issue of CRM.

Photos by David W. Look.

Angela R. Tweedy

Beyond Disaster Response

Public Policy Challenge of the New Millennium

Every community throughout the world is subject to environmental hazards that threaten people's lives and property or drastically change the landscape around them. Although some areas face a different variety of hazards or level of risk than others, nature is an uncontrollable force that can catch even the most well planned community off guard. The impacts of natural hazards last year served as a dramatic exit to the 20th century and a stark reminder of the important ecological relationship humankind shares with the environment. Hurricane Floyd, the most severe and geographically extensive disaster of 1999, demonstrated the widespread cultural and economic destruction due to years, even centuries, of building in vulnerable locations. Land uses based on demographics, structural systems, the design of the built environments, and natural and geographic features are a few of the most important factors that can affect risks to life and safety, property, and the resulting sociological, psychological, environmental, and cultural impacts of disasters.

The many lessons learned from past disasters have resulted in crucial changes to the ways in which communities and governments prepare, mitigate, respond, and recover from disasters. As we enter the new millennium, both the fields of emergency management and preservation have advanced beyond just response to encompass planning activities and a more proactive approach to their overall mission. Thus, the year 2000 is a seminal opportunity for beginning to make significant strides at the local and state level in protecting historic and cultural properties from disasters before they occur and developing working relationships with emergency managers that parallel or exceed the relationships forged at the national level.

Major disasters have devastated historic resources in recent years, both in the United States and elsewhere in the world. In 1989, Hurricane Hugo swept across the Atlantic coast, ravaging historic districts in Charleston, South Carolina, as well as annihilating 62 of the 330 historic sites on nearby Sullivan's Island. A rare 500-year flood in southern Georgia in 1994, the state's worst flooding disaster on record, submerged 250 historic properties, mostly commercial districts and private residences. As recently as last September, Hurricane Floyd flooded entire historic districts, such as in Franklin, Virginia, and completely destroyed the collections of several libraries and museums. It is not only major disasters, however, that damage historic resources. Smaller localized hazards, such as fires or local flooding, are much more frequent and can persistently destroy historic resources.

The loss of important historical and cultural properties is of great concern to communities in natural disasters. The most immediate concerns are the risks that a damaged historic property places on human life and the personal loss it inflicts upon the property owner. From a broader perspective, however, destroyed historic and cultural resources remove knowledge of the past for public benefit and study in the future. Because of the social, economic, and physical impacts to the surrounding landscape in a disaster, communities rely on their historic built environment to reinforce the historical connection with their community and offer some comfort in the face of their losses. In many areas, historic resources also play a role in the local economy and are an essential component of the local tourism industry. They are a viable part of a community as residences, businesses, infrastructure, government facilities, schools, parks, and museums, among others.

Unfortunately, historic and cultural resources are often uniquely vulnerable to disasters. The same characteristics of location, resource type, design, materials, and function that define their historic significance also create special circumstances and needs when faced with

natural hazards. This is not to suggest that historic resources are inherently more vulnerable to disasters than modern resources. Both historic and modern (post-1950) properties face issues associated with lack of maintenance, weak building codes or lack of enforcement, improper use, hazardous locations, and other similar concerns. However, these issues tend to appear more frequently in historic properties and are often exacerbated by neglect, aging materials, and unique resource types (such as archeological sites) that are more sensitive to hazardous events.

Planning for and responding to hazardous events coupled with the significant pattern of loss from past disasters demand a relationship between local emergency managers and cultural resource managers that is grounded in common goals. One must only delve slightly below the surface to discover that both emergency managers and cultural resource managers share the desire to prevent the physical and economic destruction of communities. Building codes, land-use issues, and quality of life are just a few of the many issues emergency officials and cultural resource managers have in common. This bond should serve as a catalyst for the development of creative approaches to facilitate a reduction in human suffering and property damage and reduce the overall impact of disasters on community well-being and vitality.

Waioli Mission Hall (c. 1830), Hanalai, Island of Kauai, Hawaii. Damage from Hurricane Iniki in 1992 destroyed the lanai *(covered porch) that ran completely around the building. The building was restored and structurally strengthened using FEMA funding. Photo by Randolph Langenbach, FEMA.*

Several current trends exist in emergency management that can be integrated into a disaster planning philosophy for preservation. First, the foundation of disaster management is that local authorities are generally the "first responders" to disasters and are often the authorities with the principal legal responsibility for disaster response. Thus, the structure of emergency management follows a "bottom up" organization.[1] State and federal resources become involved only as localities have insufficient resources to respond and recover from the event(s). In fact, the vast majority of all disasters do not necessitate federal assistance for response and recovery. Second, emergency management has changed its focus from a disaster-specific approach to a more "all-hazards" approach, which streamlines the organization and efficiency of programs and policies.[2] This approach has slowly taken hold among legislators and is an important component of federal emergency planning efforts.

Next, a gradational shift has occurred within the Federal Emergency Management Agency (FEMA) during the Clinton Administration that has been purveyed to state and local management agencies. Under the guidance of James Lee Witt, FEMA's current director, the Agency has expanded its focus from a costly response and recovery approach to mitigation and planning activities to reduce the risks of disasters before they occur. FEMA now spends approximately 15% of its disaster assistance funds on state and local long-term mitigation activities.[3]

The newest initiative in FEMA is entitled "Project Impact: Disaster Resistant Communities," an integrative approach to disaster management, that acknowledges the concepts of mitigation, preparedness, and response and recovery are not separate, but cyclical. The specific purpose of this initiative is to build local, state, and federal partnerships in communities through mitigation and preparedness in order to reduce the often tremendous costs of response and recovery.

Hurricane Iniki in 1992 ripped the façade from this one-story vernacular store building on Kauia, Hawaii. The utility pole prevented the façade from falling onto the sidewalk and road. Photo courtesy David W. Look.

The initiative is grounded in the philosophy that the best means for the public and private sectors to obtain a "disaster resistant" community is to:

- Identify the hazards in the community.
- Assess the community's vulnerability to those hazards.
- Develop preparedness and mitigation strategies to improve the ability of the built environment to withstand those hazards.
- Form local, regional, state, and national public/private partnerships to provide a medium for sharing ideas, developing mitigation strategies, and enhancing response and recovery coordination capabilities in the event of a disaster.

Cultural resource managers and emergency managers should integrate these trends in emergency management into efforts in the preservation field to address the threat disasters pose to historic resources. In the past decade, designated by the United Nations as the International Decade of Natural Disaster Reduction, efforts at the national level to address disasters' effects on cultural resources have been impressive. Prior to the two major disasters in 1989, the Loma Prieta earthquake and Hurricane Hugo, the relationship between emergency managers and preservationists was virtually non-existent. These were the largest disasters that significantly affected historic properties in a period when both the fields of preservation and emergency management had become firmly established.

The severity of these disasters coupled with the general lack of preparedness in the cultural community and emergency management's sudden need for technical preservation expertise spawned a national effort to make disaster preparedness and response a priority in the preservation field. National organizations concerned with cultural objects, collections, and historic properties developed conferences, workshops, and educational materials to distribute to cultural institutions to use in preparing for and responding to disasters. More recently, FEMA has worked to bring cultural resource managers and emergency management officials together to address cultural resources in disasters. One of the primary outcomes of this effort is the National Task Force on Emergency Response, founded by FEMA, Heritage Preservation, and the Getty Conservation Institute, which consists of numerous federal agencies and national organizations who combine resources to assist communities and their cultural institutions after a disaster.

Presently, most disaster preparedness and response activities for historic resources at the local level, when they exist at all, are simply intra-institutional, and provide little coordination with governments, other preservation organizations, planners, or emergency management officials. Focused mostly on either preparedness or response issues for a specific disaster event (such as a flood or earthquake), the plans usually outline ways in which the specific institution will respond to a disaster that affects its own historic properties. The comprehensiveness of the plans varies, and the level to which the plan is updated or practiced is fairly low.

Although these intra-institutional disaster-specific preparedness efforts should be applauded for the concern they have focused on disaster issues and the creative approaches they have employed often with little resources, there are still many limitations. First, institutions do not benefit from the collective knowledge and capabilities of many similar groups in a locality, region, or state. For example, a large museum that has expended significant resources to develop a disaster plan may be able to share their plan with smaller local museums or may offer resources, such as emergency storage facilities or

technical assistance, to other institutions in a disaster.

Second, although a well-written and rehearsed plan may meet the needs of an institution, it does not provide a means for preservation education and advocacy for the key individuals responsible for implementing emergency management plans and policies. The institution may be able to meet its own needs in a disaster, but police, fire, and emergency officials may not fully understand how their response effort can assist or hinder the institution's needs.

Third, the primary goal of most intra-institutional plans is merely to be prepared to respond to a problem rather than prevent, or mitigate, the effects of disasters. For example, an institution with substantial archives stored in the basement and highly susceptible to flooding may develop a plan to salvage documents in case of a flood rather than develop ways to flood proof the building or move the archives to a higher level.

Finally, institutions do not benefit enough from the opportunity to learn how the emergency management process functions, and thus do not integrate their planning and technological capabilities into a larger local network. A thorough understanding of local emergency management policies and procedures is essential for cultural resource managers to implement effective preparedness, mitigation, and response and recovery strategies. In addition, a general awareness of natural and man-made hazards and the types of damage they cause to historic resources should be undertaken to further facilitate effective policy development and the protection of historic resources. It is impossible to plan for events that are not completely understood, especially emergencies. These limitations alone suggest the benefits of cooperative planning.

Local historic preservation advocacy groups also must not limit their efforts in disasters, whether in providing technical assistance to homeowners, educational materials and press releases to the public, or the salvage of historic materials (among many others), to what the organization or group can accomplish internally. Many local, state, and national public/private organizations have created an impressive assortment of information about historic properties and disasters that can be used by local groups. Local advocacy groups also have the opportunity to speak on behalf of preservationists to convey the importance of preservation and the needs of the preservation community in a disaster to local emergency management officials. Imagine what could be accomplished by building public and private partnerships in the community to discuss specific disaster issues related to cultural resources and then sharing each organization's creative ideas and lessons learned.

It is important for those interested in historic preservation at the local level to acknowledge the threat natural and man-made hazards pose to historic resources and actively seek ways to reduce this threat. This acknowledgment requires forging new relationships within communities and developing local capabilities for assuming this role. The development of a local or regional advisory group or task force on disaster planning and preparedness for historic resources may be the best place to begin establishing new relationships. In many cases, communities may already have local emergency planning committees that concerned members of the cultural community may be able to attend. In addition to emergency managers, an advisory group may include local planners (including preservation planners), environmental resource organizations, building officials, floodplain managers, representatives from fire and police departments, cultural institutions,

Richmond Inn, Miami, Florida. This building suffered extensive damage from Hurricane Andrew in 1992. Photo courtesy FEMA.

and historic preservation organizations, and others as appropriate. Clearly, for those 156 communities designated by FEMA as Project Impact communities, a natural network already exists for incorporating a historic preservation and cultural resource component to disaster resistance.

Developing local capabilities for cultural resource managers to address disaster management issues may be the most fundamental and difficult element of developing successful planning efforts. For some communities, the local preservation planner is well suited to this task. The preservation planner's relationship to the local government, access to state and federal resources, and knowledge of community preservation planning issues make this position ideal for coordinating the effort.

Information exchange is the key outcome of successful partnerships, and all parties have plenty to learn from each other. Imparting the significant relationship of cultural resource management to local emergency managers may not be a simple task. The preservation community must seize the initiative to manifest the common goals and benefits of successful coordination. It is important for local emergency officials to know the priorities the preservation community has set for the community's historic properties and to have contact information for architects and engineers who have knowledge of historic structural systems. In addition, cultural resource managers should understand the nature of public health and safety activities and when preservation intervention is appropriate and should have access to data concerning hazard and vulnerability analyses, as well as knowledge of current initiatives and programs to reduce risk to the community's built environment. Advanced technology such as Geographic Information Systems (GIS) may facilitate the exchange of this information and provide a basis for more informed, consistent, timely, and accurate decisions.[4] Not only can GIS provide the locations of historic resources in floodplains and other hazardous locations, but can incorporate historic resources into loss estimation models and other forms of risk analysis.

As the emergency management field develops, communities have much more control over the extent of damage caused by a disaster, allowing more integrative planning with special interests such as historic preservation. The grassroots nature and communal focus of historic preservation offers unique and challenging solutions to community problems that affect disaster risks. The response phase of a disaster has become much smaller, subsumed by the preparedness and mitigation activities before a disaster, as well as the extensive recovery phase after a disaster. Preservationists must use these other disaster phases to the fullest extent in order to make the needs of historic properties before and after a disaster known to local officials and to create an atmosphere where preservation involvement in disasters is natural and expected. The result? Safer and more livable communities.

Notes

1 Richard T. Sylves and William L. Waugh, *Disaster Management in the United States and Canada*, second edition (Springfield, IL: Charles C. Thomas Publishers, Ltd., 1996), 347.

2 Ibid., 6.

3 Ibid., 12.

4 Ann Margaret Esnard and E. Bruce McDougall, "Common Ground for Integrating Planning Theory and GIS Topics," *Journal of Planning Education and Research*, Vol. 17 (1997), 55.

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Angela R. Tweedy works in the Historic Preservation Program at the Federal Emergency Management Agency (FEMA). She began the development of a disaster preparedness plan for the historic resources in Delaware, including the formation of a statewide advisory group on disasters and historic preservation and the development of a model hazard and vulnerability analysis for historic properties.

Christopher R. Eck

Earth, Wind, Fire, and Water

Historic Preservation Disaster Planning in Miami-Dade County, Florida

Miami-Dade County is both richly blessed and periodically cursed by nature. Situated along the southeastern tip of the peninsula of Florida and basking in a balmy subtropical climate, the metropolitan Miami area is famous to tourists worldwide as a favorite vacation place for its dry mild winters, wet warm summers, and palm-studded beaches lapped by the clear, aquamarine waters of the Gulf Stream flowing northward along its shoreline. However, because of that same geography, weather, and water, Miami-Dade County is also the locus of tornadoes, tropical and thunder storms, and hurricanes that, as Shakespeare writes, "rage, blow and drench" not only our local steeples, but all of our historic sites, buildings, and cultural landscapes as well.

Blow, winds, and crack your cheeks! Rage! Blow!
You cataracts and hurricanoes, spout
Till you have drench'd our steeples, drown'd the cocks!
You sulphurous & thought-executing fires,
Vaunt couriers to oak-cleaving thunderbolts,
Singe my white head! And then, all-shaking thunder,
Strike flat the thick rotundity o' the world!
Crack nature's moulds, all germens spill at once
That make ingrateful man!

King Lear
William Shakespeare

The earthly foundation upon which the people of Miami-Dade County make their home is a nearly flat, geologically stable, low-lying limestone deposit with a thin overburden of sandy, organic soil. Except on the Atlantic coastal ridge and a few other scattered, slightly hilly natural formations that ascend to 15 to 25 feet above sea level, much of our landmass ranges only between 4 to 8 feet in elevation. Not being near a fault or rift and without any significant elevation composed of loose soil, earthquakes and mudslides are two potential disaster types that (fortunately) are not a concern in Miami-Dade County.

Prior to a half-century of artificial drainage efforts that began in the region nearly 100 years ago, the vast, but shallow, freshwater Everglades—with its broad expanse broken only sporadically by small islands—once stretched across nearly three-quarters of the county to land just west of the coastal ridge. Even in its present diminished state, in times of slight rainfall or drought, the withered, open sawgrass marsh of the Everglades and the remaining open fields and pinelands of the county serve as kindling for brush fires caused by lightning, arson, or careless human action that often scorch thousands of acres each year. Meanwhile, in times of heavy or sustained rainfall, flooding is often a substantial problem for many historic neighborhoods or sites because these areas were built over former wetlands or bay bottomlands. The wave action of marine storms creates severe erosion and violent storm surges that pose additional threats to thousands of historical and archeological sites found along the coast.

As a result of these natural conditions, the archeological and historical sites of modern Miami-Dade County are under continual threat

from the ravages of the ancient "elements" of earth, wind, fire, and water. In order to minimize the potential adverse effects from any one of these natural threats, the Office of Community and Economic Development's Historic Preservation Division has devised a course of action for such emergencies.

The initial preparation of the Historic Preservation Division's disaster response plan came about largely as a result of several distinct events. In August 1992, much of the county—including numerous archeological and historical sites—was devastated by Hurricane Andrew, which is considered to be the most expensive natural disaster in American history. Some of these sites were damaged not only directly by the storm itself, but also unintentionally by the cleanup efforts that followed. At times during the debris cleanup efforts, salvageable original building materials from a number of historic properties were thrown away by well-meaning but uninformed work crews. Shallow, fragile archeological sites were also adversely affected by vehicles and heavy machinery involved in debris removal or by workers assigned to remove damaged or non-native vegetation, particularly by pulling out the stumps of trees situated over the buried sites.

Over the last several years, the widespread windstorm, flooding, and fire damage that has affected Florida and a number of other states has reinforced the need to have a plan prepared that comprehensively addresses disaster management for historic properties. Particularly in disaster-prone south Florida, Miami-Dade County's Historic Preservation Division recognizes that disaster-related damage is inevitable and, by planning ahead for such events, the county and its citizens can minimize and ease the potential damages to their cultural resources.

More recently, our agency was provided an additional incentive to plan for disaster by the attention devoted to preparing for any turmoil that was expected to be caused by the Y2K computer-related programming problems. As everyone knows, this did not come to pass, but it justifiably compelled each county department—including the Historic Preservation Division—to consider what could be done to minimize harm to agency-related projects while continuing to provide service and assistance in the event of electrical and communication failures and public disorder.

Our office has learned that there are several preparatory actions that any public agency or community organization that manages cultural resources needs to do to help minimize potential harm as a result of a disaster. Many agencies do not prepare disaster response plans for a number of reasons, including having a staff that is already underfunded and overwhelmed by its daily routine. Some simply believe that "it can't happen here." Unfortunately, a disaster can and will eventually strike a beloved local landmark; being prepared is the best means of mitigating your loss.

To be prepared, a local historic preservation agency must first determine how and why it is protecting local resources. This means that the agency's staff must be knowledgeable about the scope of its legal and regulatory authority. In other words, "know thy ordinance and statutes." When a disaster befalls your locale, it is important to know what you have the authority to do and why. This will aid you immensely in coordinating the recovery response. During a time of crisis, determining who can do what and why should not be muddled, because time is usually of the essence. If there is any doubt, the historic preservation agency should assume the role of protecting the damaged resource. No one will fault your office for helping to save a site in distress, but, if you fail to act, an inordinate and unwanted amount of attention will be heaped upon your agency.

Second, the agency must determine what resources it is protecting and create a master site database. This requires the agency to conduct a comprehensive survey to determine all archeological and historical sites within its jurisdiction. Miami-Dade County initially conducted such a survey from 1978-1981 and recorded over 6,000 historical and archeological sites. Over the last 20 years, the survey data has been updated through additional site visits, published materials, and materials gathered from property owners. Nonetheless, with the passage of two decades, thousands of properties exist that were either missed during the original survey, were inadequately or inaccurately reviewed previously, or that have become eligible for designation since that time and need to be recorded. The county is now planning for its second countywide survey that will evaluate the current status of both previously unrecorded sites and an update on those already documented.

However, the data gathered from a comprehensive resource survey will not be of ready use to an agency during a disaster if it is disorganized. The database should include both the site's type (e.g., archeological, historical, monumental) and, more importantly, its location. The location information should be as specific as possible (e.g., address, folio number, UTM coordinates) to provide ready reference during a time of crisis evaluation. Additionally, all site files should include relevant descriptive details of a site's period of association, setting, features, architecture and the like, and a detailed photographic record of its present condition. In surveying urban areas, the fire insurance plat books once regularly produced and updated by companies such as Sanborn and Hopkins serve as invaluable resources in providing information on historical sites, including such details as building footprints, building materials, and certain landscape features. As often as possible, historic preservation agencies should regularly supplement the information gathered for each site through site visits and correspondence with property owners and other agencies (e.g., building and zoning). All of this will assist your agency in having the necessary level of information about a site should a disaster strike.

Third, each historic preservation agency should develop response guidelines for how to handle both small-scale and large-scale catastrophes. In the event harm befalls a site, the local agency should be prepared to contact the property owners of all affected sites (who will likely be in a degree of shock) to assist in providing damage assessment, advice, and coordination with other agencies, officials, service providers, and interested not-for-profit organizations. Over the last several years in Miami-Dade County, community and economic development funds have been regularly set aside as an emergency relief fund for owners of damaged historic sites that meet certain federal guidelines based on income or the removal of blight through historic preservation rehabilitation.

In order to supplement tight budgets, each historic preservation agency should also actively search for and maintain current contact lists for those sources of grant funds that might be called upon to assist disaster-damaged sites, such as grant programs from the federal Department of Housing and Urban Development (HUD), Federal Emergency Management Agency (FEMA), the state historic preservation office (SHPO), and private foundations. New federal laws, such as the Transportation Enhancement Act for the 21st Century (TEA-21), should also be considered as a likely funding source for those historic preservation projects that can demonstrate certain relationships to the surface transportation system. Though not threatened by a natural disaster, a significant archeological site located in downtown Miami that was to be destroyed by commercial development was awarded a one million dollar transportation enhancement grant by the local metropolitan planning organization for use by Miami-Dade to help ensure the site's purchase, preservation, and enjoyment for the public.

Based on the experience of Miami-Dade County, the measures outlined above will not prevent a disaster from striking, but they will help the historic preservation agency's response to such a crisis. In the end, regardless of whether nature rages from earth, wind, fire, or water or through human action, the local historic preservation agency can be there to make grateful "ingrateful man."

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Judith Estes

Disaster Preparedness

How Ready Are You?

The Huntington Historical Society, like many similar organizations, lacks a formal, written disaster plan, although there have been good intentions to do so over the years. Among the author's early responsibilities as Director of Curatorial Services at the Society was assessment of its disaster preparedness. The author began by learning as much as possible about Huntington, its background, topography, and the current condition of its buildings, related collections, and disaster preparedness.

The Society has a rich and colorful history as well as impressive and versatile collections. Land on Long Island, which was to become the Town of Huntington, was purchased from the Indians on April 2, 1653. Four years later the first school was established which began a long history of cultural tradition in Huntington. The Huntington Historical Society is mandated to continue the development of this cultural tradition through its Mission Statement:

> Huntington Historical Society preserves the heritage of the Town of Huntington by maintaining museums, collections and a research center by educating the public about our regional history and by promoting the preservation of historic sites.

The Society owns three buildings listed in the National Register, two of which are historic house museums. The diverse Decorative Arts Collection relates to the history of the Town of Huntington and is composed of many sub-collections. Among these are numerous examples of ceramics made locally. During the 17th century, the soil in the Huntington area was composed of a large amount of clay. This surplus was responsible for a successful export business delivering clay to Connecticut and New York City. Various potters often traveled and worked between Long Island, New York City, and Connecticut manufacturing and selling their products. Subsequently, production of various forms of utilitarian objects such as pots, jars, pitchers, bowls, and plates occurred here. Huntington became known as a center for the production of stoneware.[1] The fragility of these pieces of pottery requires a safe environment for everyday care as well as extra protection during a major storm. The Society has a Fine Arts Collection, which represents the works of several important Huntington and Long Island artists. The collections also include a very fine Reference Library specializing in the genealogy and history of Long Island as well as a Textile Collection dating from 1700 that has documented connections to Huntington.

Second in importance to the cultural development of Huntington is its location, close to the middle of Long Island's North Shore facing Long Island Sound. Just as the accessibility to water was beneficial to the Indians and the earliest settlers, the water can present a challenge to the preservation of that culture. Huntington, like most of Long Island, is vulnerable to nor'easters, flash flooding, hurricanes, and related power outages. Weather forecasts are continually monitored but more so during hurricane season. However, nor'easters can be just as destructive as hurricanes and come at any time of the year. Along with any of these storms, even the milder ones, comes a chance of power outages that can obviously upset security and climate control programs. Long-range weather experts have determined that these storms seem to come in 10-year cycles making Long Island overdue for a major hurricane. These conditions demand a well-designed, complete disaster plan.

A well-written and rehearsed plan engenders confidence and security in the event that implementation becomes necessary. The primary goal of all disaster planning is to produce a document under one cover that clearly states what needs to be done in any type of emergency. Also included are locations of supplies and where to obtain assistance necessary in order to reduce the loss of life and property.

Priorities to be considered are safety of staff and visitors, then the security of buildings, and finally the stabilization of the collections.

A disaster plan is composed of four major elements:

Survey. Includes the initial survey as well as frequent reviews

Before a disaster. Correction of problems revealed in the survey as well as details of preparation

During the disaster. Last minute preparation details and evacuation

Recovery. Utilizes details outlined in the rest of the plan

The foundation of a disaster plan is a detailed survey. It is important to review any plans and emergency supplies already in place. Then you can systematically determine what needs to be changed or added in order to assure the best possible preparations are made. If you are not experienced in disaster planning, it may prove more beneficial to hire a consultant for the survey than any other part of the plan. A qualified consultant experienced in disaster planning would save time by being readily able to identify shortcomings or pitfalls and help provide the proper information required by granting agencies.

Before beginning a formal plan for handling emergencies, it is necessary to spend some time thinking of your location, assessing the weaknesses in your physical plant, determining which structures you need to protect and what are your local hazards and climatic vulnerabilities. It is also important to rank objects in your collections based on relevance to the mission statement. (This ranking needs to be included in the final document and comes into play during the recovery phase.)

Since all emergencies are not natural disasters, warning systems need to be reviewed. Equipment that needs to be checked should include smoke and fire detectors, fire extinguishers, and intrusion and anti-theft devices. Be sure that all fire suppression systems are routinely monitored by a professional company to guarantee working order when needed.

Of course, we all know that back-up of data is crucial, but it bears repeating that there should be hard copies, as well as backups of computer data kept off site. Be sure this list is updated regularly with objects on temporary loan or other materials that may be on the premises for research. Computers need to be equipped with adequate surge protection and an uninterruptable power supply (UPS) to prevent loss of data during a power outage.

Have formal security response teams, headed by a captain, been created? Are they composed of qualified staff members? Are they equipped with the necessary phone numbers, security codes, and maps of the facilities which indicate the location of water and electrical shutoffs? Are the calling lists for each team current?

What emergency supplies are on hand? Are they containerized and reserved only for emergency use? Is there a schedule for regular inventories of the containers? Do they include large and small rolls of plastic sheeting, plastic "milk" crates, blotter paper, absorbent toweling, flashlights, rubber gloves, dust masks, a cutting tool, sponges, mops, buckets, and pencil and paper?

A thorough, written survey simplifies writing of the final plan. It is indicative of the strengths, weaknesses, and omissions of existing procedures as well as areas needing immediate attention.

The survey, however, is just the beginning. The actual writing of the plan and assembly of equipment is the next step. Since this can be time-consuming and costly the various granting agencies frequently have project support funds available to assist particularly small institutions in this endeavor. After the survey is completed and the funds are secured, writing of the disaster plan can begin.

Safety of the staff and visitors requires inclusion of a plan for evacuation. This part of the plan needs to take into consideration the scenarios possible at various locations. The plan should direct people to the nearest exits without interfering with the arrival of emergency vehicles. In case time does not allow for an evacuation, such as a tornado, places must be identified within the building that would provide the greatest amount of shelter. Small maps detailing exit routes should be placed at the main emergency exit doors. These maps should also indicate alternate routes out of the building in the case of blockage. Of course, docents, educators, and other staff should be well trained in the execution of these plans in order to assist visitors safely out of the area.

A detailed floor plan of all buildings must be included in a final plan. These plans should highlight gas, water, and electrical shutoffs as well as location of fire alarms and fire extinguishers. Location of objects listed as "priorities for rescue" should be noted on these floor plans.

During a natural disaster, fire, flood, snowstorm, power outage, etc., total evacuation of the

premises is the best policy. Collections are best cared for when the environment is stable. If compensating climatic systems are inoperative, due to a lack of electricity, opening and closing of doors by concerned staff could upset that stability and cause more harm than good.

Recovery is the final and most important aspect of disaster planning. The success of the recovery depends on how well plans have been made. During the recovery phase, phone calls soliciting help from various agencies listed in the plan will be made. These contacts should include conservators, commercial freezer companies (for freeze drying wet papers and books), fine arts movers, emergency storage areas off site, and local fine arts organizations that might be able to lend various forms of assistance.

A major disaster is something we hope never to experience. It is helpful, however, to learn from the experiences of others. There are many sources available with information on disaster planning. Do not overlook the Internet as a major source of help. The National Endowment for the Humanities has designed and produced a wheel[2] that contains information on various disasters and how to handle them. This is very user friendly and extremely helpful both in planning and recovery. Insurance companies that handle fine arts insurance are also an excellent source of information. Most archival supply catalogs now have sections devoted to various emergency supplies needed.

Writing a disaster plan is a long-term commitment. It not only involves the items mentioned here but a follow-up plan must also be included. There should be a periodic review of the plan from cover to cover to make sure that revisions are made as necessary and supply inventories are still current. The better the preparation, the greater chance for a successful recovery that means the survival of priceless collections.

Despite the fact that the Huntington Historical Society buildings are historic and vulnerable, they are in good condition and well maintained. Plans for enlargement are being considered that will take advantage of modern technology providing an even safer environment for people and objects.

Notes

1 Corbett, Cynthia Arps, *USEFUL ART: Long Island Pottery*, The Society for the Preservation of Long Island Antiquities, Cold Spring Harbor, Long Island, New York

2 National Endowment for the Humanities and The St. Paul Companies, *Emergency Response and Salvage Wheel*, National Institute for the Conservation of Cultural Property, Inc., Washington, DC.

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International Conference on the Seismic Performance of Traditional Buildings, Istanbul, Turkey, November 16-18, 2000

While many have seen the heartrending images of the collapsed concrete apartment houses in Turkey last year, few have seen the many brick and timber houses constructed in a traditional method still standing among the destroyed buildings. The fact that so many of these houses remained standing mocked the conventional wisdom about the safety of such construction. Since reinforced concrete has largely replaced masonry and timber construction throughout the world, rarely have present-day researchers addressed the inherent seismic resistance of particular forms of these traditional structures and the influence that earthquakes may have had on their evolution.

An international conference, entitled Earthquake-Safe: Lessons To Be Learned From Traditional Construction, will provide a forum to bring people from many parts of the globe to focus on these issues. It will also explore what can be learned from these historic structures that could lead to improvements in contemporary building practice. The purpose of this conference is to help bring attention to the kinds of buildings that are often accorded little value in developing countries by encouraging a more balanced view of the relative seismic performance of these traditional buildings when compared to more recent construction.

The conference is sponsored by ICOMOS (International Council on Monuments and Sites), and is supported by UNESCO, Government of Turkey, Ministry of Culture, the Kress Foundation and other donors.

All inquiries and applications for conference registration should be made to: conference@ahsap.com.

The conference web page can be accessed at the ICOMOS International Wood Committee home page at <www.icomos.org/iiwc/>.

Mary Catherine Martin and Lila King

A Lesson Well Learned

New Methods of Disaster Preparation for Atlanta's Fox Theatre

Atlanta's Fox Theatre is unique among movie theaters in Georgia in that it is individually listed on the National Register of Historic Places and is also a Georgia Landmark Museum Building. The Fox functions as both a working theater and a state and nationally recognized museum that holds several collections of artifacts that are in constant use. The collections include the building's original furniture, photography from 70 years of performances as well as of the extraordinary building, original and carefully reproduced lighting fixtures, vintage projection equipment and accessories, and architectural drawings.

The Fox Theatre suffered extensive damage from a 1996 fire that devastated portions of the General Offices and caused smoke and water damage in adjacent areas of the theater. The consequences of the fire led to a serious re-evaluation of the theater's methods of archival storage, care for its collections, and the safety of the building itself. These investigations resulted in new efforts to prevent and mitigate future disasters, especially as the potential consequences could affect the safety of the Fox's collections. These new efforts included analysis of firestopping in the building (blocking to slow the spread of fire within the wall cavaity) and attempts to resolve breaches in protection through reconstruction, and new safety and precautionary procedures for the staff.

As the Fox is a working theater, open more than 200 days a year, many of the items in its collections cannot be taken out of service; they are used everyday. The items that are not used everyday—photographs, architectural drawings, brenograph slides, movie posters—are stored in the theater's special collections room. In general, the Fox Theatre reserves its collections space for those items that are so valuable or delicate that public use is inappropriate, which makes the security and safety of the archives room critical.

Conditions Before the Fire

Many of the items in the Fox Theatre's collections had, until 1996, been stored in the basement of the building.[1] The room measures roughly 33 by 15 feet and contained several wood and metal shelves, long wooden tables, and nine filing cabinets into and on top of which were piled the holdings of the Fox's archives and collected theater ephemera. The room was below grade, of fire resistant construction, and was surprisingly consistent in temperature and humidity levels.

New Archives Space Construction

The 1996 fire did not severely damage the old collections storage space, but it did destroy the office of the Restoration department, which is the staff group responsible for the management and care of the archives. The reconstruction of the Restoration office provided an opportunity to create a new archives space designed to fit the security and safety needs of a valuable collection.

Fox Theatre Collections Room before the fire in 1996.

Fox Theatre collections room now.

The new collections space measures roughly 28 by 14 feet, with a 12-by-6-foot corridor on one side (slightly smaller than the old space, but designed with an eye toward efficiency). The safety features of the new space include a sprinkler system, two perimeter walls of four-hour masonry construction with one-hour rated gypsum wall board on metal-stud furring, and two perimeter walls of two-hour rated metal stud and gypsum wall board.

The new collections area is outfitted with rolling compact storage, oversize flat files for large architectural drawings and other large paper artifacts, a modular drawer cabinet, and a freezer for proper storage of photographic materials. The cabinets, manufactured by Rousseau Metal, Inc. and SpaceSaver, are composed of 14-gauge steel posts with 20-gauge steel shelves in steel carriages. All components have a powder-coated finish of epoxy-polyester. The rolling storage system is similar to those used in many libraries, as a steel track allows the shelves to be pushed closely together to conserve space while not in use. The flat files by PlanHold and modular drawer cabinet were manufactured by Rousseau as well, and feature similar construction and finishes. The freezer, intended for storage of photographs and slides, is a standard commercial food freezer that measures 36 by 84 inches. Photographic materials are packaged in small groups and housed such that each unit enjoys its own stabilized microenvironment.

Collection Catalogs

Because the Fox is a working theater, many of its collections are in constant use all over the building. After the fire, the Fox staff reconsidered the nature of this use and the various ways in which mishandling through overuse could be avoided. Several measures were taken to ensure that delicate items would be stored primarily in the new collections room, and that unnecessary handling and temporarily insecure placement would be kept to a minimum.

A significant factor in the reduction of handling is a series of catalogs developed by the theater's archivist, Michele Schuff. Her ongoing efforts[2] to organize and index each of the items in the Fox's collections have produced itemized catalog entries for each artifact, each of which includes a photograph, description, and in some cases a repair record and recommendation.

Each catalog has been created with a computer database program called FileMaker Pro.[3] The database program creates simple finding aids for artifacts, while the printed catalogs allow easy transport of information about the collections. Several catalogs are printed for each collection: at least one copy on archival paper and printed with a toner-based process[4] for the archives room reference, and several copies with standard paper and ink for everyday use.

For example, the collections of brenograph and lantern slides (used by the projectionist during the annual summer film festival) are permanently stored in the collections room in an additionally secured, custom Rousseau modular drawer cabinet. When an organist prepares the song list for a performance, he/she simply searches through a slide catalog in the projection booth to choose the accompanying slides. The organist then gives a list to the archivist, who delivers the slides directly to the projection booth and returns them to the collections room after the performance.

Likewise, many of the architectural drawings of areas of the Theatre are either very old and delicate or are legally significant contract documents that should not be handled regularly. All of these drawings hang on plan racks in the archives room, but staff members may reference drawings easily and quickly through the computer database or in a catalog that contains an 11-by-17-inch reproduction of each drawing.

All of the photographs in the Fox's collection are stored in archivally secure envelopes in the freezer in the archives room. Cold storage guarantees both the chemical and physical stability of photographic materials, as the individual and grouped housings, in conjunction with the freezer itself, maintain a constant temperature and condition not affected by seasonal variations.[5] When the photograph catalog and database are complete, it will be possible to access both a paper and digital image of each photograph without disturbing the artifacts in the freezer.

Both the furniture and lighting collections are in constant use throughout the theater, and thus cannot be stored in the collections room. Efforts to mitigate the vulnerability of these collections include fireproof materials in new building construction and comprehensive catalogs of each collection.[6] Each entry in the furniture catalog includes an exhaustive description of the piece, including an analysis of its structural, surface, and upholstery conditions, as well as a service history and photograph. The catalog functions as a repair schedule as well as a comprehensive record of each piece in the collection. In the event of a future disaster, it is hoped that the detailed description and photograph in the catalog would provide instructions for an appropriate repair or reproduction.

Back-up Procedures

Since all of the Theatre's collections are documented with computer databases, it is necessary to ensure the permanence of these references. One way to do so is with the archival quality printed catalogs. Some of the collections (most notably photography and architectural drawings) grow every day, however, which dates printed catalogs quickly. To resolve this problem, the restoration staff makes regular updates of the collections databases.

Strict procedures for compact disc back up of each of the computer databases[7] have been developed, with careful consideration of the necessity of back-up intervals and storage. Back-up compact discs are stored both in the Theatre's archives and in off-site storage in case of extreme disaster.

Conclusion

The 1996 fire taught the owners and staff of the Fox the importance of security and proper handling of the artifacts in its collections. Fortunately, the Fox lost very little of its archival collections in the fire, but the experience necessitated a re-thinking of storage and handling methods in case of any other similar disaster. The result of the change in procedures and construction materials is a much more secure environment for the artifacts in the collection, as the new procedures considerably limit their vulnerability.

One of the most unique and appealing aspects of the Fox Theatre is that it continues to provide the public with beautiful, delicate, and historically significant pieces of its collection. The building itself, with its original restored hardware, plumbing fixtures, heating and cooling systems, and masonry details, is a testament to the Fox's effort to continue to include beauty and history in public spaces. The new post-fire procedures simply enhance and ensure the Fox's continued display and use of its notable collections.

Notes

1 This excludes the majority of furniture and lighting fixtures, which are located throughout the building's many lounges, lobbies, and ballrooms, as well as the projection equipment, which is stored in the auditorium projection booth.

2 Michele Schuff continues to organize and catalog each of the collections. In March 2000, the lantern slide, brenograph slide, architectural drawing and furniture catalogs are complete. Work on the photography catalog is in progress.

3 FileMaker Pro is made by the Claris Corporation. We use version 5.0 for both Macintosh and Windows.

4 The Fox Theatre uses 8 1/2-by-11-inch sheets of Permalife brand, 20-pound white acid-free bond paper made of 25% rag stock. This paper has a lifespan of 300 years when stored properly. Each page is printed on an Alps MD-2010 Micro-Dry Photo-Realistic Color Printer with Alps permanent, waterproof, fade-proof inks in cyan, yellow, magenta, and black.

5 Please see Douglas Nishimura, "Storage Guide for Color," Image Permanence Institute, 1997. Mr. Nishimura is a research scientist who was kind enough to help the Fox Theatre make determinations about the methods and materials they used in archiving their photography collection. It was his research into the effects of cold storage on photograph permanence that led the Fox to their purchase of a freezer for the new archives space.

6 The lighting collection has not yet been cataloged. This work is scheduled to begin next year, once the photography catalog is complete.

7 The Restoration computer databases include several that are not part of the archives. Each year the Restoration department completes nearly 100 architectural and restoration projects, each of which is carefully documented in a computer database. After five years, each project file and database is evaluated. Information that is deemed archivally or historically significant is then included in the archives.

Mary Catherine Martin, AIA, the Restoration Project Manager for the Fox Theatre, is a registered architect who oversees all restoration and construction projects in the theater and is responsible for a staff of 11 full-time restoration architects, painters, archivists, and craftsmen.

Lila King, the restoration assistant at the Fox Theatre, assists Mary Catherine and the restoration staff in documenting the restoration and construction projects in the theater.

Photos by John Reilly.

Paul Gleeson and A. Trinkle Jones

Cultural Resource Protection and Federal Fire Management Issues

In the aftermath of recent catastrophic fires in the West, notably the Cerro Grande fire near Los Alamos, New Mexico, federal wildland fire policy is under scrutiny. From the perspective of cultural resource protection, the existing policy has many strengths and places greater emphasis on resource protection than at any time in the past. However while the fire community is willing to fund appropriate cultural resource work, there has been a reasonable reluctance to fund basic inventory of large areas that is seen as each land manager's stewardship responsibility. Also at issue is the fact that survey and mitigation procedures and requirements seem to vary widely from park to park, between park and forests, between states, and between resource professionals. Many fire and cultural resource professionals seem to lack a clear understanding of the objectives and practices of both specialties and need to develop a mediation process. In many cases it has not been clear what the effects of fire are or what elements of a cultural resource are most important to protect. The following describes efforts to provide a common frame of reference for making fire management decisions that also provide a reasonable level of protection for cultural resources.

Ground fire in ponderosa pine, Grand Canyon National Park. Prescribed fire planning by fire and resource staff can avoid damage to known cultural resources and reduce hazardous fuels. Photo by Mark Oetzmann.

Wildland Fire Management Policy

After the loss of human life and resources and the costs of suppression that occurred in the 1994 fire season, it was apparent that agencies and the public must change their expectations that all wildfire can be controlled or suppressed. No organization, technology, or equipment can provide absolute protection when unusual fuel loads, extreme weather conditions, multiple ignitions, and extreme fire behavior come together to form a catastrophic event. A joint task force comprised of U.S. Forest Service (USFS), National Park Service (NPS), Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), and U.S. Fish and Wildlife Service (FWS) members participated in a program review that led to the current Federal Wildland Fire Management Policy (1995). The report had the following key points:

- Protection of human life is reaffirmed as the first priority in wildland fire management. Property and natural/cultural resources jointly become the second priority, with protection decisions based on values to be protected and other considerations.
- Wildland fire as a critical natural process must be reintroduced into the ecosystem. This must be accomplished across agency boundaries and will be based on the best available science.
- Where wildland fire cannot be safely reintroduced because of hazardous fuel build-ups, some form of pretreatment, particularly in wildland /urban interface areas must be considered.
- Every area with burnable vegetation will have an approved Fire Management Plan.
- Wildland fire management discussions are based on approved fire management and other land and resource management plans. The plans must provide the agency administrator flexibility to choose from the full spectrum of fire management actions – from prompt suppression to allowing fire to function in its natural ecological role.

On May 26, 2000, the Secretary of the Interior charged the National Academy for Public Administration with conducting a comprehensive review of the implementation of prescribed burning policies by the National Park Service. In addition, the Secretary will reconvene the interagency workgroup to recommend additional improvements to the 1995 policy.

Section 106 Programmatic Agreement

There is a need for overall guidance that is consistent with the National Historic Preservation Act (Section 106; 36 CFR 800) and agency policy. A programmatic agreement (PA) is being developed for the protection of historic properties under the Federal Wildland Fire Management Policy.

From experience with incidents such as the Exxon Valdez oil spill, it was recognized that pre-incident planning could protect resources. This approach was codified in a PA for oil and other hazardous material spills. The question is not will there be wildland fire, but when will a wildland area burn. Like oil spills, hurricanes, floods, and other unscheduled disasters, are we dealing with an event for which there is a preplanned response? With an unscheduled and unplanned response event, the result is chaos and unneeded resource loss, while with an unscheduled and planned response event, there is a managed response that results in a logical level of resource protection.

The National Interagency Fire Center (NIFC) convened an interdepartmental group of agency cultural resource specialists from NPS, BIA, FWS, BLM and USFS to draft a similar PA for the fire program that will address responsibilities, pre-incident planning (mechanical hazard fuel reduction and prescribed fire), emergency response, and post-fire rehabilitation. Initial discussion was undertaken with the National Conference of State Historic Preservation Officers (NCSHPO) and the Advisory Council on Historic Preservation (ACHP) representatives, who are supportive of this approach. The group developed a strategy paper for discussion with colleagues at the 1999 Society for American Archaeology meetings in Chicago. The PA will integrate a number of existing agreements, guidelines, and studies to provide a uniform process for considering the effect of actions on cultural resources resulting from the fire management policy. On the local level, the planning document will be the Fire Management Plan. A working draft of the PA is expected by fall 2000.

Training for Fire Management Officers and Cultural Resource Specialists

In the planning process for prescribed fire, it is apparent that few cultural resource specialists or fire management officers fully understand the objectives and needs of both the fire program and the cultural resource program. The goal of this class is to provide tools to evaluate fire effects on cultural resources and to aid in the cooperative rewriting of fire management plans. The course, sponsored by the Stephen T. Mather Training Center, was presented twice to a full house in January 1999 and 2000. A third class is scheduled for 2001.

The class has been integral in the development of the PA. The class members now generate a matrix of fire effects on cultural resources that can serve as the basis for protecting cultural resources and as the point of discussion for consultation with the SHPO under Section 106.

Rainbow Volume on Fire Effects on Cultural Resources

One of the most difficult issues has been the question of the effect of fire on cultural resources, especially those in the archeological record. Fortunately the USFS "Rainbow series" on fire effects is being updated, and a volume on cultural resources is being prepared for the first time. The overall objective of the project is to write, publish, and distribute a series of "state of the art" reviews of the effects of fire on fauna, flora, air, cultural resources, and soil and water. The USFS Missoula Fire Lab in partnership with the NPS Western Archeological and Conservation Center proposes to complete the cultural resources-archeology volume in 2000.

The cultural resources volume will emphasize archeological remains. Cultural landscape vegetation and archeological matrix issues are referred to the flora and soil volumes. A team of archeologists and fire scientists are reviewing the literature, including internal agency reports, on the effects of fire on materials covered under the National Historic Preservation Act of 1966, (NHPA) the Archaeological Resources Protection Act of 1979, and others. Much of the literature is anecdotal and qualitative. In many cases conclusions are drawn only from post-fire observations of select resources. Often little is known about the fire behavior characteristics that led to the resource damage. At times, it is uncertain if the observed damage can be attributed solely to the most recent fire. The team will identify known

and potential fire effects on cultural resources, develop a conceptual framework for assessing and predicting potential effects, and identify needed fire effects research.

Burned Area Emergency Rehabilitation Planning (BAER)

Each BAER team is an interdisciplinary group consisting of a watershed specialist, a vegetation specialist, wildlife specialist, certified silvaculturist (forester), cultural resource specialist, facility specialist, environmental protection specialist, and an operations specialist. A handbook guides BAER activities. BAER teams have prepared management plans for 20 large fires and have consulted on many other fire events. They provided management recommendations at Bandelier and Mesa Verde in 1996 and on the basis of experience with subsequent implementation, have been assigned to produce a strong plan for the Cerro Grande fire.

While the BAER program can do much to protect resources from further damage, the activities permitted are limited by law to specific fire effects and suppression related damages. The objectives of a BAER team are to provide guidance as to appropriate emergency treatments that are required immediately post-fire. Proposed treatments must prevent loss of life and/or property and reduce negative impacts to critical resources resulting from fire effects or activities related to the suppression of the fire.

BAER cultural resource protection objectives are as follows:

- All treatments to achieve the BAER objectives will be evaluated to assess potential effect on historic properties. Treatments may or may not have an effect.
  - Treatments have critical time frames for implementation to minimize threats and losses.
  - Efforts will be made to design the treatments to have *No Effect* or to undertake Section 106 consultation in an expeditious manner. *No Adverse Effect* treatments will be undertaken only after either the BAER CRM team member or agency representative have completed appropriate consultation with SHPO. All *Adverse Effect* actions will be referred to the agency NHPA coordinator for consultation.
- Known historic properties damaged by fire or fire suppression activities may be stabilized by specific treatments if such treatments will result in mitigation of further damage.
- Areas of fire-induced sediment instability may be evaluated and treatments may be taken that will reduce the potential for loss of historic properties.
- Survey and/or evaluation of all known historic properties are not required. Inventory of known historic properties and/or unstable areas will be limited to the effort needed to determine the appropriate treatments that will reduce the potential for loss of historic properties.
- Research is not an objective of this program; however, studies that provide effective post-fire protection of cultural resources will be supported on a limited basis.

At the Cerro Grande and nearby Viveash fires, BAER archeologists set priorities as follows: survey of dozer lines, a burned National Register district, and known architectural and historic sites within areas of high intensity burning. Following the above objectives, treatments were recommended and, in some cases, implemented immediately due to the threat of seasonal rains. However, calls for fireline-qualified professional archeologists on these and other fires often go unanswered. We have come a long way in raising awareness of the need for the fire community to protect our cultural resources. Now, other supervisors and we need to allow staff and seasonal archeologists to answer the call.

Conclusion

Management of cultural resources within the Federal Wildland Fire Management Program is a complex process. Responsive actions cannot be achieved with one guidebook, one research project, or one strategy. The current work done by the NPS, USFS, BIA, BLM, and FWS seeks to develop a management strategy that protects varied historic sites, structures, landscapes, and traditional cultural sites while achieving fire management objectives.

Paul Gleeson is Chief, Cultural Resource Division, Olympic National Park, Port Angeles, Washington. He has been a member of the Department of the Interior BAER team since its inception.

A. Trinkle Jones is Supervisary Archeologist, NPS Western Archeological and Conservation Center, Tucson, Arizona. She began working with fire staff on cultural resource protection in 1978 when she was Grand Canyon Park archeologist.

Douglass C. Reed

No Thanks to a Tornado

To Auntie Em, Dorothy, Toto, and the residents of America's heartland, the fury of a spring tornado is not to be underestimated. Those who reside in the mid-Atlantic region, however, are more apt to fear the spring floods and autumn hurricanes rather than the havoc wreaked by the unpredictable path of a twister. Yet, each year many buildings in the mid-Atlantic region, some historic, are damaged by the strong winds and pounding rains of the ominous funnel clouds that rip across the landscape.

Standing proud on the rise of a hill near Chambersburg in south central Pennsylvania, the historic Rocky Spring Presbyterian Church withstood the attack of a short-lived but vicious tornado late in the afternoon of May 11, 1996. Built in 1794, the 3,000-square-foot elegant brick church was pummeled by winds gusting up to 100 mph as the F-0* rated tornado struck from the south, causing the collapse of the brick gable and tearing away over one third of the roof. This article focuses of the careful restoration of this cherished landmark listed on the National Register of Historic Places.

Almost immediately after the tornado hit, the call for help went out. Many of the volunteers who had seen combat up close and personal likened the devastation to a bomb scene. Shattered trees with broken limbs made access to the church nearly impossible. Sections of the roof littered the churchyard. Once volunteers gained access to the interior, they were very depressed. Unchanged for over 200 years and actively used until 1921 when the local chapter of the Daughters of the American Revolution leased the building from the Carlisle Presbytery, this well-maintained church had been partially destroyed in a few moments of furious destruction.

Rocky Spring Presbyterian Church near Chambersburg, Pennsylvania, a few days after the F-0 rated tornado with 110 mph winds toppled the south gable and tore off 22 squares of roofing and rafters. Photo taken May 23, 1996.

The south gable brick wall, which measured 50 feet wide and a little over 20 feet tall from the ceiling to the peak, collapsed from the impact of the winds hitting head-on. As the winds passed over the building, a vacuum was created that lifted large sections of the 60-square (a square is 100 square feet in area) roof off the south end. A 12-square section of rafters, sheathing, and roofing shingles on the east slope lifted and sailed high up over the north end of the building to land on the cemetery fence some 50 yards away. A 10-square west slope section of the roof also sailed away to land harmlessly in the west yard some 20 yards from the church. Unfortunately, the damage was not limited to the gable wall and roof.

As the roof tore away, a series of king-post principal trusses that supported the roof remained in place. The collapsing gable brick wall cracked the first principal truss a few feet inside the south wall. Some 22 tons of brick and mortar were pushed into the king post truss before falling and breaking out several hundred square feet of the beautifully coved original plaster ceiling. Another ton of plaster, lath, and secondary framing cascaded to the sanctuary floor.

Inside the beautifully preserved sanctuary, the force of the tornado was equally evident. The pews and their paneled box walls were all original, hand planed and unpainted. The pew box doors retained the names of the families who occupied the pews. Four of these original pews and their boxes were crushed into splintered wood by the weight of the debris. Several of the surrounding boxes and pews were damaged.

Once the winds opened up the roof, the pressure between the interior and exterior equalized and the structural damage caused by the storm came to an abrupt halt. Unfortunately, the rains pounded down into the building for hours after the storm adding extensive water damage throughout the church interior. The wind-driven rain soaked the wood directly below the large

Twenty-two tons of brick, mortar, plaster, lath, and framing fell to the sanctuary floor crushing four box pews and two original deacon benches. The debris was carefully sifted for all salvageable materials. Photo taken May 23, 1996.

opening in the roof as well as the surrounding plaster of the ceiling. As the plaster became water logged, more of the ceiling and lath fell to the floor.

In spite of its condition, never a thought was given to the demolition of the church. Community residents rolled up their sleeves and went to work. The day after the storm, the author was called and went up and helped to guide the building cleanup efforts as the Boy Scouts from a local troop and other members of the community carefully sifted the debris for all salvageable brick pieces. Even the old mortar was salvaged for re-use as part of the new mortar. Work crews from Brechbill and Helman, Inc, a local contracting firm, temporarily built a frame over the gaping hole in the roof and covered it with tarps. Over the next several weeks a member of the board of trustees stopped by daily to open and close the windows so the dampened interior could dry out.

Fortunately, the church's insurance policy covered tornado damage. The insurance company as well as the board of trustees of the church contracted Preservation Associates, Inc., of Hagerstown, Maryland, to restore the destroyed portions of the church back to their original conditions. Before beginning restoration, the firm first determined the full extent of the damage, established the best course for restoring the building, and detailed the costs for repairing the damage.

The restoration plan outlined three major phases. First the exterior shell had to be rebuilt. Then the interior woodwork of the crushed and damaged pews, paneled pew box walls and doors, and deacons benches had to be carefully restored. Finally, the plaster ceiling had to be repaired, the damaged windowpanes replaced with older wavy glass, and paint coatings on the walls renewed.

The south gable was rebuilt using as many of the original bricks as possible and older bricks salvaged from a brick house (c. 1820) that was gutted by fire and slated for demolition. The original mortar used in the church was good quality sand, clay, and lime mixed with a visible small aggregate of streambed sediment. The new mortar was one part white mason's mortar that consisted of half stone dust and half lime, an additional one-quarter part of mason's hydrated lime and three parts of a local bank sand with a natural dark tan color. The final ingredient was one part of salvaged original mortar, which was finely ground and added to the new mix. By varying the sand color and using the older mortar reground and added to the new mortar, the firm managed to achieve an almost perfect color match to the historic mortar. After the mortar dried, it was very difficult to tell where the rebuilt section began and the older surviving section ended.

Experienced crews restored the damaged king-post truss to good strength by using epoxy consolidation methods to impregnate the damaged and cracked areas. Two metal straps running up the bottom of the king post near the damaged area of the post worked to our advantage; and, as

The pews were restored using the original materials. Less than 5% of the original wooden components was lost. Even the pieces deemed non-salvageable were cut into small pieces and used for dutchmen repairs. Replacement wood was taken from leftover scaffolding lumber left in the attic in 1794. Photo taken July 31, 1997.

The 1794 Rocky Spring Presbyterian church with the original bricks reset with a soft mortar, all the trim work restored, and the pent roof restored. Photo taken July 3, 1997.

a result, the beam required no additional reinforcement to prevent the reconsolidated area from cracking in the future.

All but two of the smaller intermediate rafters were salvaged. The craftsmen extracted dutchmen pieces from the two non-salvaged end rafters for repairing the other visible intermediate rafters. The intermediate rafters visible to the attic were all restored and set back in their original locations. New poplar rafters were sawn on a modern circular sawmill to the same dimensions as the originals. These pieces were dried at a local kiln and placed over the restored south gable wall where they cannot be seen from the interior of the attic. The rafters were marked with the date of their replacement for future researchers.

The original roof sheathing was carefully canvassed and salvaged where possible; however, much of it needed to be replaced. Where replacement sheathing was necessary, rough-sawn poplar replaced the original northeastern white pine, which today is hard to find in quantity and quality. All the boxing, pent-roof areas, cornices, and bargeboards were restored with very few pieces requiring replacement. All profiles were matched and the new pieces marked with the dates of their installations. The roof was covered with a 30-year fiberglass shingle.

On the interior, Preservation Associates, Inc. sifted the debris piles for all salvageable wooden components and staged them where they would dry. The crushed pews were carefully extracted from where they lay in a heap on the floor. Craftsmen experienced in restoration of damaged properties retrieved one piece of crushed wood at a time from the wreckage, identified its original location, and tagged it. The salvaged pieces were assembled like a giant jigsaw puzzle and analyzed for salvation and repair versus replacement. When the few non-salvageable pieces were set aside, the craftsmen identified how much good wood was in each badly damaged piece and what portions might be salvaged for use as dutchmen to repair nicks, holes, and splintered edges in the rest of the pew wood to be salvaged.

The dilemma facing the restoration team was that the pews were never painted. Any repairs would forever be very visible. Care was taken to salvage as much wood as possible since the original wood had the patina matching the rest of the original pews. Although some new edges were exposed, the restoration crew carefully matched grain structures, and decided to let the atmosphere form a patina on the new edges. Lacking enough wood to finish the job, a search of the market for salvage wood with the right grain and color took weeks. Eventually the author discovered in the attic a few remaining scaffolding boards left from the original construction. Only one large board was retrieved from the attic space for remanufacture into the replacement piece needed on one of the four crushed pews. The wood salvaged from the attic worked perfectly.

It took nearly 16 months to slowly and carefully restore the church from May 11, 1996 to August 24, 1997 when it was rededicated. Today, the 50-foot by 60-foot single room Rocky Spring Presbyterian Church stands as it did previous to the storm damage, a much beloved landmark on the local rural scene. The doors open once a year for a memorial service and occasionally for weddings. The patches in the pew woodwork stand out to say the building was lovingly restored and continues in use. The church was restored using every method available for salvaging the original components and replicating the components that were damaged beyond salvage. The church had a total restoration cost of $150,000 or $50 per square foot.

Note

* The scale is called the Fujita scale after Ted Fujita at the University of Chicago. An F-0 tornado is one that is not expected to cause much damage. An F-5 is one that will cause catastrophic damage.

Douglass C. Reed, founder of Preservation Associates, Inc., Hagerstown, Maryland, was the consultant for this project. While Mr. Reed has worked on brick, stone, and timber frame structures, his sub-specialty is log structures.

Martin E. Weaver

Conservation vs. Disasters

The Restoration of Kathrineberg

The restoration of Kathrineberg, the historic residence of the governor of the U.S. Virgin Islands, has been described by specialists as the most advanced project of its kind in the Caribbean.

Kathrineberg, built in 1830 in Charlotte Amalie on the island of St. Thomas as a grand residence for a Danish plantation owner Hans Henrik Berg, is one of the earliest and most important private residences in the Virgin Islands. Berg subsequently became governor of the Danish Virgin Islands in 1862. The house has a long and checkered history and was the residence of the Carpenter, Bregaro, and Delinois families between 1864 and 1913. In 1918 the house was substantially repaired and restored after a long period of neglect. The house was the official residence of the Danish consul general in 1958.

Inside the house in the central corridor immediately beneath the cracked and leaking gutter (see next photo) the wallpaper over a doorway was found to be peeling off the wall, with a massive fungal attack growing on the soaking wet wall paper paste and animal protein glues of early distemper paints.

Kathrineberg was subsequently damaged in hurricanes in 1979 and 1981, and was extensively redecorated in 1981 following water damage and associated termite attacks. Further water damage occurred from hurricanes Hugo in 1989 and Marilyn in 1995. By the mid-1990s, it was becoming increasingly apparent that there were many problems literally within the walls and that there was no easy solution to them. Typical warning signs included a strong smell of mold, extensive wallpaper failures, and paint failures inside and outside the building.

Early in 1998, the Virgin Islands historic preservation office (HPO) approached the owner, the West Indian Company Limited, concerning the possibility of making a preliminary condition assessment of Kathrineberg. The HPO recognized that if the historic mansion was going to serve as the governor's official residence it would need to be properly restored. The West Indian Company accepted the HPO's offer and the preliminary report was prepared by Claudette C. Lewis, now the assistant commissioner of the Department of Planning and Natural Resources; Myron D. Jackson, now the director and then senior planner; and Sean L. Krigger, architectural historian. This initial report contained a brief history of the site, a description of the building, an identification of some major problem areas, and offered recommendations for action.

After the HPO's assessment was made it was realized that the condition of Kathrineberg was so bad and so complex that a conservation specialist would be needed to prepare a conservation study on the mansion before it could be restored. HPO staff recommended the author, who was working with the Puerto Rico HPO on the conservation of the governor's residence in Old San Juan and who had also worked on the conservation and restoration of the governor's mansion in Antigua.

Accordingly, late in 1998, the West Indian Company commissioned the author to carry out preliminary studies on Kathrineberg to establish precisely the condition of the building with a

Painted many times, the corroded galvanized steel roof had many leaks. Here a gutter is cracked and leaking badly next to a critical rainwater outlet. The outlet was one half the size that it should have been. This causes overflowing and even worse leaks during tropical downpours.

view to developing a master plan for the preservation of this valuable historical resource.

The initial studies immediately confirmed that the officials of the West Indian Company had been correct in their suspicions that there was something seriously wrong at Kathrineberg. The author brought in forensic toxicologist Dr. Edward Montz from Pennsylvania, one of the leading specialists in toxic fungi and bacteria that can be found in buildings.

Scientific air and surface contamination studies, carried out early in 1999, identified a number of pathogenic species of bacteria and toxic fungi in the interior of Kathrineberg and in the water cistern under the house. Indications of a serious contamination problem included:

- The total indoor concentrations of organisms exceeded those outdoors (when concentrations indoors should be no greater than 50% of outdoor concentrations).
- Samples were predominated by hydrophilic species.
- Many of the species found are known toxic-forming species.
- Species were present indoors which were not found in outdoor samples (indicating that these species were reproducing in the building).

Having discovered that the new governor in residence was showing symptoms that could indicate reactions to these dangerous species, the experts immediately recommended that the building should be vacated. Governor Turnbull moved out in February 1999.

The process of conservation and restoration first involved the total replacement of a highly corroded and leaking galvanized steel sheet roofing of recent origin. It was replaced with a carefully detailed malleable stainless steel sheet roofing, a substitute material designed to last in this harsh maritime environment with its frequent tropical storms and hurricanes. Before the interior restoration had been finished, the new roof had already withstood Hurricane Floyd (1999) and a major tropical storm with torrential rains. Concurrently with the work on the roof, the project continued with the sealing-off of room after room of the interior and removal of damaged modern drywall so that the thick masses of fungal organisms could be sprayed with carefully selected chemicals by operatives working in hermetically-sealed protective suits and respirators. Infected material was carefully removed as biohazardous waste. Guidelines for removal of the waste generally followed those established by the New York City Department of Health and the American Industrial Hygiene Association.

The treated and now safe interior was then turned over to the author and his investigative team to carry out what turned out to be a major piece of detective work. Using microscopic evidence all of the original interior and exterior colors and finishes were rediscovered. The interior walls were originally finished by first stretching cotton canvas across the wall, then pasting on a lining paper and then finally applying a water-based distemper paint finish.

The beauty of this system was that it allowed water vapor to pass through it and thus allowed the thick masonry walls to dry out in the likely event that they got wet. In later re-decorations, contemporary newspapers were used

New stainless steel sheet roofing with complete cap flashings on all parapets and roof ornaments. Note new lighting protection system. All rainwater drains have been doubled in size.

instead of plain lining paper; and traces of these papers survived. Small fragments of newspaper from London, Göteborg in Sweden, Paris, Copenhagen, and the United States made it possible to date various restorations and re-decorations as far back as 1851.

Later in the 19th century, a pale-blue wallpaper with a fine gold pattern was used in the dining room. One tiny fragment actually had a tax stamp on the back from Paris. Subsequent research revealed that this same paper was used and still exists in the interior of the historic residence of the great French scientist Louis Pasteur in France.

In this century, unfortunately, multiple layers of impermeable plastic-based paints on both interior and exterior faces of the walls ensured that the interior walls never properly dried out. This eventually created an environment that caused and supported the growth of dangerous microorganisms hidden behind the painted finishes.

Having been able to ascertain the original decorative finishes and colors of the interior, the writer asked Robert Kelly, the leading North American wallpaper specialist, to join the Kathrineberg team.

Less than a year later, after the installation of new roofing, the interior is fully restored. The fine timber beams and flooring were restored using the same pitch pine that was originally used. The colors and distemper paint finishes are precise reproductions of the originals from the 1830s.

The original colors and the vapor permeable canvas and paper wall covering system have been carefully and accurately restored. Quite apart from the fact that such an important historic building should be seen in its former beauty, the restoration makes excellent sense for the very good scientific reason that when the roof was sound the original system worked and did not support the growth of microorganisms.

All modern air-conditioning units, which were contributing large quantities of condensation to the walls, were carefully and totally removed. The complete original system of through-ventilation with louvered jalousies was then restored. Kathrineberg is well sited on top of Denmark Hill and here the constant breezes are ideal for this traditional ventilation system. This restoration also makes excellent sense because it does away with the need and expense of constant air-conditioning.

Various specialists in the field have noted that Kathrineberg is extremely rare, if not unique, in the Caribbean for the accurate restoration of its original interior while at the same time it continues in its original function as an actual residence. It is also a rare example of the restoration of historic and traditional energy-conserving ventilation and cooling systems.

New ground has also been broken by the treatment of the dangerous microorganisms and termite infestations with the latest safe, environmentally-friendly pesticidal and preservative treatments. "Clearance samples" designed to verify that the abatement was successful showed that the contamination problems noted above were corrected. Total species concentrations were reduced to less than 50% of outdoor concentrations. Hydrophilic species were either eliminated or substantially reduced. Toxic species were substantially eliminated. Species profiles indoors were nearly identical to those outdoors at completion of the project. Based on these data, the team determined that it was acceptable to reoccupy the building and that the project was a success from a decontamination perspective.

The team was concerned about bacteria concentrations initially measured in water samples collected from the cistern system. Because most buildings in the Caribbean use rainwater from roof run-off and stored in cisterns, there is a distinct possibility of contamination by animals

Typical, accurately restored historic jalousie doors that provide natural cross ventilation.

and soil-borne microorganisms. The data showed that the cleanup of the cistern improved bacteria concentrations in the water, but the cleanup alone was not sufficient to render the water bacteria-free. Therefore, a permanent ultraviolet treatment system was recommended to improve the water quality in the cistern following chlorination of the cistern.

Taking another lesson from the building, the writer has restored the fine timber beams and flooring using the same top quality pitch pine that was used originally. It was noted that wherever the high quality pitch pine had not been used, the wood had usually been consumed by termites and hence the need for restorations.

All wood used in the restoration of both the structure and the fine joinery of the doors and jalousies has been carefully selected to match the original species, to be durable, and to come from renewable forest resources. Including accurate reproductions of missing original doors, paneling, trim, and jalousies, the fine joinery restorations have been superbly carried out by Eduardo Padron's firm from Charlotte Amalie.

As the careful removal of deteriorated modern finishes proceeded throughout the building it was found that in a hidden world concealed behind the surface, structural timbers had often been severely damaged or even totally destroyed by termites and fungal attacks. Hidden within the walls and floors, generations of electrical circuits were found to be corroded and in such poor condition that it was a miracle that there had been no fire. The entire electrical system has been tested and has largely been replaced by the expert firm of Kline Electrical Co. Inc. from Charlotte Amalie. The new installations have been carefully designed so that they do not disturb the historical appearance of the interior.

The restoration work has often involved extremely difficult repairs and replacements of parts of structural timbers in position in the building. The final products have often been so carefully and accurately made that even historic tool-marks have been accurately reproduced and only close examination would reveal that any work had in fact been done at all. Some of the restoration work has been rather like doing Chinese puzzles because of the need to keep as much as possible of the original timbers and working in very tight areas which are difficult to get at. This work has been carried out by Antillean Contractors and Developers Inc. under the site management of Mr. John Harding, PE.

The author has pointed out that Kathrineberg was incredibly well built. If it had not been, nothing would have survived its 169-year history of hurricanes, tropical storms, termites, and dangerous electrical circuits. With this intervention just in the nick of time, 1999-2000 has turned out to be a very appropriate year for the restoration of Kathrineberg extending its life for another hundred years. The U.S. Virgin Islands have regained one of their least known treasures and preserved it for future generations at a fraction of the cost of providing a new building of anything like the same quality.

Martin E. Weaver, an international conservation consultant whose practice is based in Canada and in New York, is the professor responsible for the conservation sector of Columbia University's Historic Preservation Program and is Director of the University's Center for Preservation Research. With over 39 years of experience in Europe, Asia, Africa, the Arctic, North and South America, Australia, and New Zealand, Prof. Weaver is a prolific lecturer and writer on conservation and is the author of the standard textbook Conserving Buildings: A Manual of Techniques and Materials.

Giorgio Croci

Emergency Stabilization of the Basilica of St. Francis of Assisi

This paper describes the damage caused by the 1997 earthquakes and aftershocks to the Basilica of St. Francis of Assisi and the urgent measures executed to stabilize the structure. The studies utilizing many mathematical models and analyses to design the seismic retrofit and restoration will be presented in a paper in a second disaster preparedness issue of *CRM* scheduled for publication next year.

History, Damage, and Collapse

Many earthquakes have shaken the Basilica of St. Francis since its construction in the 13th century. Major earthquakes occurred in 1279, 1328, 1703, 1747, 1781, 1799, 1832, 1859, 1917, and 1979. Yet none of these produced damage as great as that which hit central Italy during the night of September 26, 1999, as well as the second earthquake that struck the basilica at 11:42 a.m. Damage consisted of the destruction of the vaults close to the façade and those close to the transept and a portion of the left transept. The earthquake also caused large cracks and permanent deformation over all of the vaults of the basilica, leaving them in a very precarious and dangerous condition.

Besides the differing impact that the many historic earthquakes of different characteristics may have produced on the basilica, other factors have increased the vulnerability with respect to the past. Concerning the tympanum, constructed of a cavity wall with two faces and an inner fill, the cause of the partial collapse was the deterioration of the mortar which connects the stones of the external face with the inner fill (the first damage was produced on September 26, but it was the quake of October 7 which created a large hole in the wall). The reduced cohesion and bonding of the deteriorated mortar resulted in progressive failure of the wall stone by stone.

Damage in the tympanum on October 7, 1997.

Concerning the vaults, the collapse was produced by a large volume of fill which was mainly broken roofing tiles and other loose materials accumulated over centuries of roof repairs in the springer zones. During earthquakes, this non-cohesive fill alternatively acts only in one direction because there is no connection in the opposite direction. In addition, the loose fill follows the movement of the vaults, opposing their recovery and facilitating increasing permanent deformations. When the quake of September 26 hit the basilica, it is very likely that there was already some permanent deformation, reducing the curvature and, therefore, the bearing capacity as the result of previous earthquakes.

The fill accumulated through the centuries over the vaults.

The failure mechanism of the vaults close to the façade, filmed by Umbria Television, resulted from the progressive loss of curvature of the ribs, then a "hinge" was produced in the middle and finally the rib collapsed, drawing the vault down

Deformations of the vaults produced by the fill.

with it. A similar mechanism occurred in the zone close to the transept, where the second vault collapsed.

The collapses were concentrated in these specific zones because, as the direction of the seismic force was mainly perpendicular to the nave axis, the system of the vaults behaved globally like a "beam," where a kind of restraint at the ends was provided by the stiffness of the façade and the transept. This behaviour is clearly shown by the global mathematical model that will be presented in the next *CRM* issue on disaster preparedness.

Large cracks in the vaults with relative movements of around 25 cm.

Urgent Measures

Urgent measures (emergency stabilization) were required immediately after the earthquake to prevent the total collapse of the tympanum and the vaults.

The Vaults. The surviving vaults were damaged by large cracks distributed on both the intrados (interior face of the vault) and the extrados (exterior face of the vault). The curvature, as already said, was reduced in several areas.

The danger that the vaults might collapse, and the consequent risk to human life, precluded the possibility of supporting the vaults from the ground level. Rather, a platform was suspended from the roof above the vaults with the double function of inspecting and providing a base for working over the vaults.

The urgent measures taken in the first month after the main earthquake can be synthesized as follows:

- Removing the huge load of the fill in the springer zones of the vaults;
- Filling the cracks with a salt-free mortar to limit possible damage to the frescoes, first taking the precaution of inserting a strip of polyurethane in the larger cracks to prevent the mortar from flowing out;

Cracks and loss of curvature of the ribs.

- Applying bands of synthetic fibres over the cracks of the extrados;
- Suspending the vaults from the roof framing with a system of tie bars, having first inserted two springs to maintain the force at the design value, independent of thermal effects and minor vibrations; and
- Suspending the ribs from the roof with a system similar to the previous one after having placed a kind of steel cradle filled with soft rubber underneath in order not to damage the frescoes.

Suspension of the deformed kerbs (restraining straps) to the roof.

A crane in front of the convent lifts a second crane over the wall into the courtyard.

The Tympanum. The risk was that if the tympanum were to collapse it would destroy the roof of the chapel below, causing the loss of frescoes and works of art of inestimable value. After long reflection, it was decided to use a huge crane, 50 meters tall.

But such a crane could not pass through the narrow gate into the inner courtyard. This problem was solved using two cranes. The first crane located outside the basilica complex lifted the second crane over the roof of the building and deposited it in the inner courtyard.

Organizing this operation involved anchoring two cantilever steel trusses on the two walls of the transept. The trusses were designed to support a 4.5-ton steel-frame structure in the shape of the tympanum, a triangle 8 meters high and 17 meters wide at the base.

The following emergency stabilization work was completed between October 10-14, 1997. The steel structures were built; two cranes arrived on the square in front of the basilica; the first crane lifted the second one into the courtyard; the two cantilever steel trusses were lifted over the roof of the transept and were anchored to the lateral walls, ready to receive the steel frame.

After some attempts hindered by heavy rain and wind, the crane succeeded in lifting the steel tympanum over the brackets. The following day the empty spaces and larger holes were filled with polyurethane foam to provisionally stabilize the masonry.

Once the urgent measures were completed and the structure relatively stable to prevent additional damage from continuing aftershock, the damaged basilica was studied and analized using mathematical models and the seismic retrofit and restoration was designed and executed. The second part of this article will appear in a future issue of *CRM* on disaster preparedness.

Giorgio Croci is Professor Structural Restoration of Monuments and Historic Buildings, University of Rome "La Sapienza", and President of the ICOMOS Committee for analysis and restoration of structures of architectural heritage.

Lisa Usman

Mitigation—
Fact or Fiction?

Most of our knowledge relating to seismic activity has come about in the last 30 years. This is a fraction of time considering earthquakes have been a fact of life for man as long as history has been recorded. It is only since the late 1960s that the theory of plate tectonics was fully understood and recognised as being the most common cause of earthquakes. The question is, "Are we using this information to the best of our ability, or are we merely information gathering?"

While the cause of seismic activity may not have been known, attempts to construct buildings able to withstand the "shaking of the ground" have been discovered dating back to the Roman Empire. Excavations at the Greek towns of Sardis and Magnesia, almost totally destroyed in an earthquake and rebuilt with the assistance of Rome, revealed unusual foundations. Structures were found with a grid of wooden beams at the foundation level and archeologists believe this may be the first attempt to construct earthquake-resistant buildings.[1]

Understanding what causes earthquakes makes it possible to predict with considerable accuracy where they might occur, even if we are not able to ascertain when they might happen. We also have a clear idea of the type of building that probably will and will not withstand an earthquake. With this information it should be possible to substantially reduce vulnerability of both people and buildings. If an attempt is to be

made to achieve this, it is important to understand the nature of vulnerability.

For any natural event to be viewed as a disaster it must have a human impact. This will be most pronounced in areas where the population, for a number of reasons, lives in conditions of high risk. An area prone to seismic activity will not subject all people and buildings to the same amount of risk. Within a small area, it is possible for one group to be much more vulnerable to a hazard than another.

Vulnerability has its roots in physical, social, economical and political factors. Individual or group access to, or allocation of resources within a society will be dictated to by these factors. People may be marginalized due to race or social class. It is likely they will be allocated areas of poor quality land and poorly built homes. They may be urban squatters living on the edges of towns or cities, with a low government priority to deal with hazard mitigation. With both vulnerability and potential hazard present it is only a matter of time before a disaster occurs. While economic and political factors contribute to vulnerability, the built environment is the biggest single cause of death during an earthquake.[2]

Building regulations exist for areas prone to seismic activity, but the long return period and the added financial cost to the work act as deterrents in carrying these out. Consequently, building regulations sometimes get side-stepped or completely ignored. Work has also been carried out on the cost of retrofitting buildings versus the repair cost if no strengthening is undertaken prior to an earthquake. This report, summarised below, demonstrates how cost cutting is a false economy and carefully thought out hazard mitigation will considerably reduce both loss to life and heritage.

In 1997, D'Ayala attempted to produce a loss estimation technique to support decision making on the upgrading of masonry buildings in historic centres in Europe.[3] The Alfama district of Lisbon was chosen, having suffered earthquakes in the past and been altered and extended outward and upward, using local builders and conventional low-cost construction.

Two hundred buildings were assessed, estimating possible damage for a given ground motion. This information was then used to "define expected losses for a class of building as a function of a ground motion input."[4] The functions were verified with analysis from damage reports made after the 1755 earthquake in the area. Once the estimated loss for a given ground motion had been established, it was then possible to predict what the reduced loss might be if low cost, unobtrusive strengthening was used on masonry buildings. It was concluded that if this work were carried out the programme would reduce loss of life, rebuilding costs, and economic losses. It would also help preserve architectural heritage and reduce the cost of relief operations.

Conditions making a building unsafe are not usually visible. A survey carried out in the southern Italian town of Salvitelle highlighted how an earthquake will exploit inherent weaknesses in a building, brought about by either design or decay:

> Most of the buildings had been constructed on very variable ground, often re-using inadequate old foundations and built with poor materials and with poor construction detailing. Maintenance of the fabric had been normally inadequately carried out by the owner or done 'on the cheap' with materials found at hand. Alterations in the street layout and to buildings had firstly made them rely on each other for structural support and modernisation of the houses has often reduced their structural integrity.[5]

This repair work may have been the result of bad planning and management from previous earthquakes. It is also known that modern materials, used for repairs and alterations, can have different behavioural characteristics, placing excessive strain on a particular area.

The condition of the subsoil will also effect the performance of a building, by amplifying the effect of the earthquake. Damage will be greater on soft ground, being more responsive to long period motion from distant earthquakes. An example of this is Mexico City. Built on a deep deposit of soil, the city sustained greater damage in the last earthquake than areas closer to the epicentre.[6]

A building of considerable cultural and religious significance that suffered irreparable damage in an earthquake is the Basilica of St. Francis of Assisi in Italy (see Croci, page 30). Italy sits on the meeting of three tectonic plates, making the possibility of seismic activity a potential hazard for the majority of the country.

The town of Assisi is famous the world over for being the birthplace of St. Francis and the home of the Franciscan monks. In 1228, a basil-

ica was erected to honour St. Francis and provide a home for the monks. It consisted of an upper and lower church with entrances at right angles to each other. On September 26, 1997, at 2:33 am, an earthquake of the magnitude 5.5 on the Richter scale hit Umbria, central Italy, near the city of Foligno, and was followed by at least 20 aftershocks. The second jolt, nine hours later, brought down part of the vaulted ceiling in the upper basilica damaging 14th-century frescos ascribed to Giotto.

In the early 1990s, a detailed structural analysis and restoration project for St. Francis and two other local basilicas had been carried out using "accurate direct observation and some mathematical models."[7] With direct observation it was evident the pattern of cracks discovered had their origins in seismic action. All three showed more or less important separation of the facade and vertical cracks along lateral walls. More serious were vertical cracks in the side walls of the upper basilica that could pose a threat to the Giotto frescos. The results of the investigation showed "...a good global behaviour under seismic action as well as dead load. But in both cases it is possible to note important local effects."[8]

Italy is very aware of the danger it faces and periodically work has been carried out on the basilica. It was believed the basilica, having withstood many earlier earthquakes in its history, could survive others, but this was not the case. In hindsight it should be asked if the recent damage could have been prevented, given the detailed analysis carried out. If it could have been, perhaps the situation that exists in Umbria today might have been prevented.

The damage to the basilica attracted world attention and brought money flooding in for its restoration, but it was not the worst affected area. On the outskirts of Sellano, southeast of Assisi, the locals live in "container villages"— mobile homes made of corrugated iron. The town centre, now deserted, looks as it did the day the earthquake happened. Massa Martana, south of Assisi, suffered an earthquake earlier the same year. Initially, response was good, with mobile homes provided for those who needed them. After the earthquake in Assisi, Jane Kramer, a journalist who lived nearby, visited this village and found the locals, "...bewildered and not a little angry when devastation in Massa went largely ignored, while the world poured money and attention on Assisi."[9] Villages like these, in countries like Italy, are as much a part of our heritage as the basilica. Yet out of the public eye, they go unnoticed.

It is always easy to be wise after the event. Perhaps the weaknesses identified in the earlier survey on the basilica should have been reinforced, perhaps the damage would have occurred anyway. It is impossible to say. What can be said is the use of low cost, unobtrusive strengthening of masonry buildings in the area could have prevented extreme damage to historic villages and locals in Umbria might not be waiting on the basilica. Disaster preparedness does work. Yet time and time again, short-sighted government will trust to luck, hoping the disaster will occur in another party's term of office. For many people in the world today, disaster mitigation must come under the heading of fiction.

Notes

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3 D. D'Ayala, R. Spence, C. Oliveira, A. Pomonis. "Earthquake Loss Estimation of Europe's Historic Town Centres." *Earthquake Spectra*, Vol. 13, No. 4, November 1997.

4 ibid.

5 R.E. Hughes,"'Field survey techniques for estimating the normal performance of vernacular buildings prior to earthquakes." *Disaster Technology*, 1999, New York.

6 R. Spence, A.. Coburn, "Earthquake Protection - an international task for the 1990's." *The Structural Engineer* Vol. 65A, No. 8, August 1987.

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8 ibid.

9 J. Kramer, "Letters from Europe—The Shock of the Old." *The New Yorker* February 8, 1999.

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James McLane and Raphael Wüst

Flood Hazards and Protection Measures in the Valley of the Kings

The Valley of the Kings (VOK) contains 62 numbered tombs from the 18th, 19th, and 20th dynasties, the New Kingdom period of ancient Egypt that flourished during the 16th through the 11th centuries, B.C. Of these, 22 tombs show evidence of royal occupancy. The VOK is located on the west bank of the Nile in the region of ancient Thebes, which also comprises the present-day town of Luxor on the east bank. Hundreds of underground tombs built as the final resting places for kings, queens, and nobles are today preserved as part of the Theban Necropolis, which also includes temples and other ancient sacred structures interspersed with pastoral villages. The Supreme Council of Antiquities (SCA), Egypt's governmental agency in charge of these sites, must balance its preservation objectives with the heavy impacts of tourism.

The authors are members of a research team that is preparing a master plan in an attempt to mitigate the impact of flooding on the tombs in the VOK. The Valley of the Kings Research Group (VOKRG), which consists of American, Canadian, and Egyptian professionals from various disciplines, is sponsored by the California Academy of Sciences and is working in collaboration with the SCA.* The project, funded by the United States Agency for International Development (USAID), is carried out and administered by the American Research Center in Egypt (ARCE) under USAID Grant No. 263-G-00-93-00089-00, "Restoration and Preservation of Egyptian Antiquities Project."

General view of the Valley of the Kings looking south. The peak at upper left is the Gebel el-Qurn, the high point of the drainage area, 283 meters above the floor of the Valley. At lower right is the entrance to the tomb of Ramesses VI, labeled KV-9. Left of that tomb, a crowd of tourists is queued in the main walkway, entering the tomb of Ramesses III, KV-11. Photo by James McLane.

The Site and its Context

The VOK is a large *wadi* on the northern slope of a peak known as Gebel el-Qurn, with a drainage area of 0.46 sq. km. The tombs were cut out of the native marls that underlie the cliffs and slopes of the valley. They were decorated by painted plaster reliefs that illustrated liturgical scenes, and they are now some of Egypt's most highly valued antiquities. Historical records and physical evidence indicate that, since antiquity, there has been a succession of infrequent but heavy rains that have caused flooding of the tombs. Water drains from the upper catchment basin into the narrow gullies at the valley floor, which have been converted in modern times to the walkways used by tourists to access the tomb entrances. These have acted as the primary drainage channels in flood events, allowing water to drain into the tomb entrances. Flood water and sediment have stained and abraded the tomb decoration, caused migration of salts to the painted plaster surfaces, and damaged some tomb walls and pillars by causing the underlying shale to expand and thereby impose excessive stresses on the rock structure.

In October and November of 1994, two flood events occurred in the VOK, sending a warning to all heritage managers. In both cases, a local desert rainstorm occurred in the vicinity of the VOK. Storm-water runoff and sediment entered many of the tombs and caused erosion of gully floors. The SCA and ARCE responded by setting a project in place that would analyze the problems and implement a plan of action.

Scope of the Flood Protection Project

VOKRG worked under the careful supervision of ARCE to define the project's approach. The project scope of work is summarized as follows:

- Conduct a historical survey of documents pertaining to flooding in the valley, as well as information on topography, climate, and excavation activity.
- Conduct a field survey of the valley topography, geology, and existing surface structures; interior tomb surveys of geological conditions; and architectural documentation of the tombs (final products include topographic map, geological map, measured drawings of tombs, photographic documentation of valley topographic features, tomb entrances, and tomb interiors).
- Perform analysis of topography, geology, and hydrology.
- Prepare a master plan for the valley that specifies flood protection measures that apply to the entire valley as well as to local areas or individual tombs.
- Recommend a program for monitoring geological and climate data in designated tombs.
- Recommend and, if approved, construct two prototype flood protection measures.

Surveys: Topographic, Architectural, and Geological

VOKRG has made two field expeditions, one of four weeks, another of three weeks, for the purpose of surveying existing conditions.

The team studied ancient maps of the VOK in order to ascertain how over the centuries the valley has been altered by flood events and excavation activity. The most recent map of the valley, prepared by the Institut Geographic National (IGN) of France in 1962, was updated. An accurate survey using conventional methods but modern equipment produced a map which includes ground topography, tomb entrance structures, the existing walkway system, and other modern structures that accommodate tourism. Hydrological profiles were drawn from this survey data and used in the later analysis.

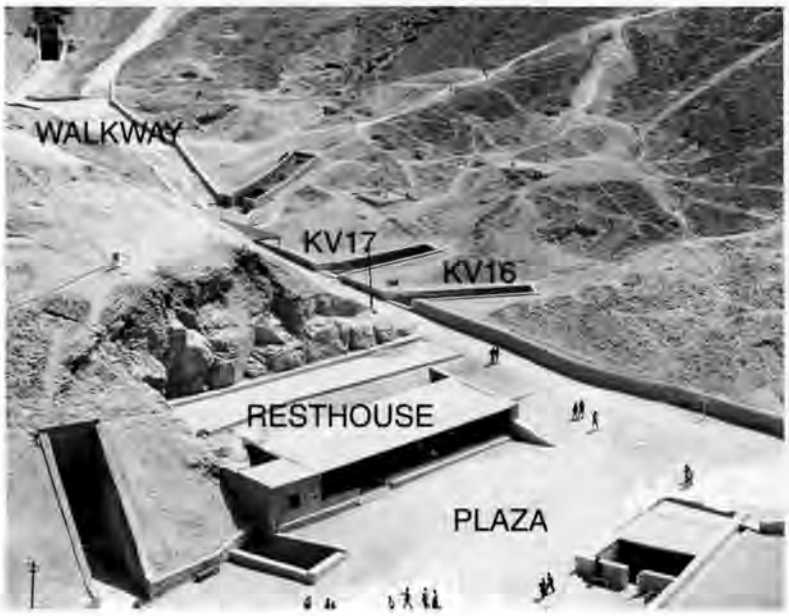
A team of architects worked in parallel on a survey of the tombs' interior chambers, producing a set of measured architectural drawings. The final product of both of these teams was a three-dimensional computer assisted design (CAD) map that shows surface topographic features as well as the subterranean architecture of the tombs. This document can serve as a base for future researchers to document the decoration in the tombs, and to implement further preservation measures.

A team of two geologists prepared a geological map that shows bedrock type, thickness of flood and excavation debris and, most importantly, catchment areas and flash flood flow patterns.

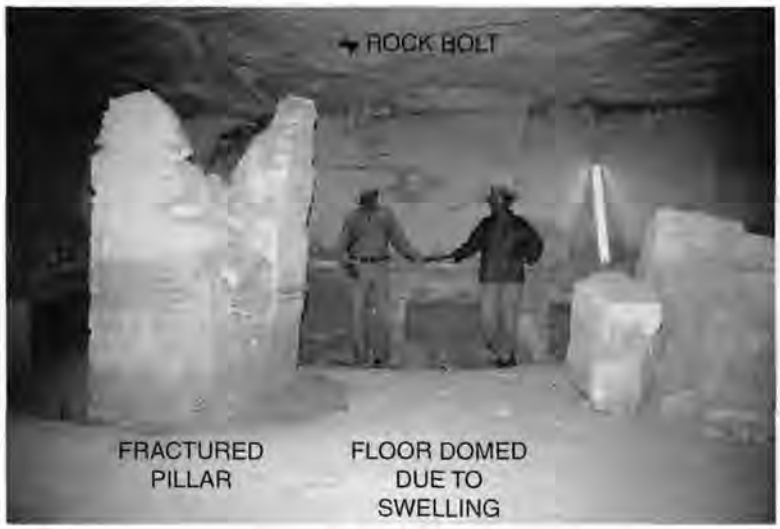
Analysis: Geology, Hydrology

The Thebes Mountains are composed of 350-meter-thick Eocene marls and limestones (Thebes Formation) overlying a 60-meter-thick Paleocene/Eocene shale (Esna Formation). Most tombs are built into the lowermost marl unit of the Thebes Formation, but some of them extend down into the Esna shale. During uplift of the Thebes Mountains, the brittle marls and limestones fractured and one of the Graben structures crosses the VOK. The displacement of rock units prior to the tomb excavation resulted in abundant rock joints, which can be re-activated during earthquakes or other rapid stress releases such as by swelling of the shales. When water enters the tombs, it comes into contact with the shale at the lower chambers, and causes swelling, cracking and structural failures in the floors, walls, and pillars.

Several tombs had been protected against floods by ancient Egyptian constructions. Unfortunately, most of them have been severely damaged during the past 3,000 years and are no longer effective. The researchers plotted floodwater flow paths and calculated the maximum amount of runoff for each tomb. With no local weather data available, the hydrologist based rainfall estimates on flash flood events in similar desert climate areas for which reliable data could be obtained. The hydrologic analysis sought to estimate the two major characteristics of the maximum flood event that may occur. The first and most basic characteristic is the maximum eleva-



Detail view of one of the main walkways, with resthouse and plaza. The walkways act as drainage channels during flood events. Walls about one meter high, made of dry-laid rubble with a concrete cap, line the walkways. Note the tomb entrances to KV-16 and KV–17, which are typical in that they are accessed by descending a stair from an adjacent walkway. Photo by Roy Eisenhardt.



Interior view of a lower chamber in the tomb of Ramesses II, KV-7, an example of the damage caused by successive flood events. Virtually all of the decorative plaster reliefs are lost, and the rock structure has been heavily impacted by swelling of the underlying shale. The floor obscures the two team members' feet because it has swelled in the center. There are two rock pillars on either side that have fractured and collapsed. At the top is a rock bolt installed by another project in a recent effort to forestall further spalling of the ceiling. Photo by James McLane.

tion, or depth, of the water surface of the flood as it passes the entrances of the tombs. If the elevation becomes higher than the top of the wall surrounding the entrance, flooding of the tomb results, as has been the problem for many tombs. The second characteristic is the velocity of the water stream during a flood event. The higher the velocity, the greater the energy in the water with a potential to cause scour, undermining walls or protective structures and ultimately creating a water path into the tombs.

By establishing the water depth in front of any tomb entrance during a flood event, structures can be designed to prevent the water from entering the tomb. The main variables that determine the water depth are the quantity of water being discharged, the width of the channel, the slope of the channel, and the roughness of the channel. By establishing the velocity of the water stream, an estimate of the size and quantity of sediment that will be transported can be made as well as an estimate of the energy and potential scour that could occur.

The calculated water surface elevations indicated that each tomb should have a protective wall at the entrance with a height of 0.25 to 1.00 meter above the adjacent walkway, depending on the location. Equally important is that the walkways provide an adequate channel to convey the water away downstream. No constrictions should occur moving downstream, or if there must be a constriction, it should be gradual and smooth. In addition, all of the walls that form walkways should be filled with cement and finished smooth both to provide strength during the turbulent water flow and to decrease the channel roughness and therefore convey more water at a lesser depth.

Recommendations

The team incorporated input from the SCA, workers in the valley, and eyewitnesses of the 1994 flood events. The recommendations had to consider every possible approach, yet work within the limitations of technology and financial resources. They are grouped in five categories, with the salient elements briefly noted:

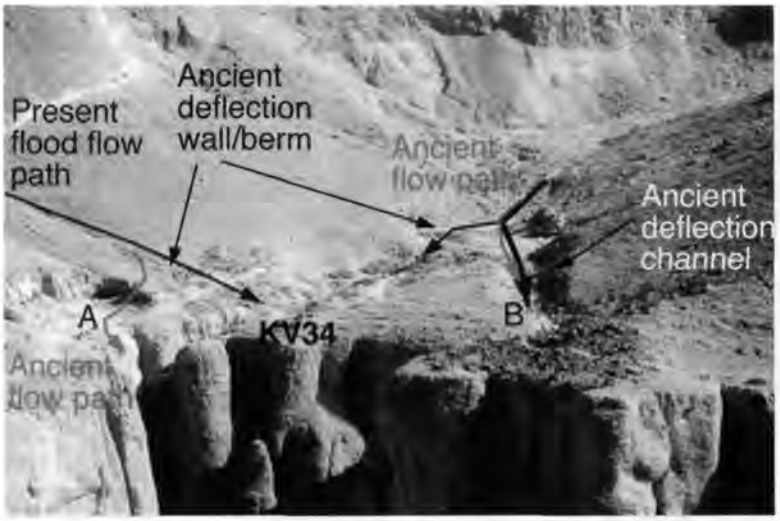
Long-Range Planning. The final report may serve as a database that can enable resource managers to control floodwater flow patterns. The survey maps show existing conditions, while the new map of proposed measures will show the work to be completed. The hydrological map will show how flow patterns will be re-directed by the proposed protection measures.

Emergency Response Plan. Analysis of the 1994 flood events revealed that a response plan would be an essential element of a preservation program. In addition to producing a training guide with base information about the flood hazards, it was proposed to put in place equipment such as a water pump, air dryer, hand tools, and a transport vehicle. This equipment could be used to avert or minimize damage by future flash floods.

Low-Cost/No-Cost Protection Measures. These measures involve minor changes and additions to existing procedures used by the dedicated staff in the VOK, who work with very limited resources to maintain a resource that is subject to intense impact by tourists who have little understanding of their difficult conditions. These include

- an improved program of monitoring tomb climate data collectors
- a related program of monitoring deterioration of the tombs' rock structure and their decorated surfaces
- the preparation of an as-built plan of the existing utility system
- implementing a plan to document the numerous minor repairs that are done to the tombs
- suggestions regarding limiting access by tourists.

Large-Scale Protection Measures. The core of the plan is the specific measures proposed to be constructed. The team will implement two of these measures as prototypes for the final stage of the project. One of the two prototypes will be to reconstruct an ancient rock berm that was built as a diversion structure above one of the oldest tombs (Tuthmosis III). The second prototype



View of the proposed restoration of the ancient deflection wall, which lies at the bottom of the upper drainage basin, directly above the tomb of Tuthmosis III, KV-34. Photo by Raphael Wüst.

will be construction of a new entrance walkway structure that will provide access to two tombs (Seti I and Ramesses I), while diverting floodwater in the adjacent walkways away from the tomb entrances.

The general measures include

- clearing the upper VOK basin of loose sediment and debris where future floods may sweep them into the tombs
- similar clearing in the areas directly above all tomb entrances
- widening and removing obstructions from the main walkways, which act as water channels during flood events
- reconstructing an ancient diversion structure in one part of the valley that would divert floodwater from a group of tombs with high preservation priority.

Protection Measures for Individual Tombs. The plan includes such detail as to provide an extensive list of recommendations for each tomb. Many of these measures have already been implemented by the SCA in isolated instances. They may be summarized as follows:

- Increase the height of and make waterproof the walls that surround the tomb entrances
- Construct watertight channels for diverting floodwater around the tomb entrance protection walls
- Seal open joints in the rock surface above the tombs in order to prevent leakage
- Build concrete roofs above tomb entrances that are exposed to falling water from overhanging cliffs
- Install steel doors at tomb entrances in order to prevent floodwater and debris from entering
- Install additional flooring, stairs, and glass screens in tombs that receive the highest influx of tourists, in order to minimize the damaging effects of abrasion and increased temperature and humidity
- Install air-conditioning systems and monitoring equipment in the highest priority tombs
- Seal the entrances with permanent doors (or by backfilling them permanently) for tombs that are seldom entered or are of low priority.

Note

* The Valley of the Kings Research Group (VOKRG) consisted of the authors and Lyla Pinch Brock and Ted Brock, Egyptologists; Charles Cecil, anthropologist; Garniss Curtis, geologist; Roy Eisenhardt, photographer and co-director; George Homsey, architect; Brad Porter, civil engineer; John Rutherford, civil engineer and project director; Dr. Abdul Fattah el-Sabahy, Egyptologist and project coordinator; Britt Stitt, construction consultant. Officers of the SCA (Mohamed Mohamed el-Saghir, Sabri Abdel-Aziz Khater, Mohamed El-Bialy, and Ibrahim Soliman) and many other unnamed employees at the VOK provided valuable assistance.

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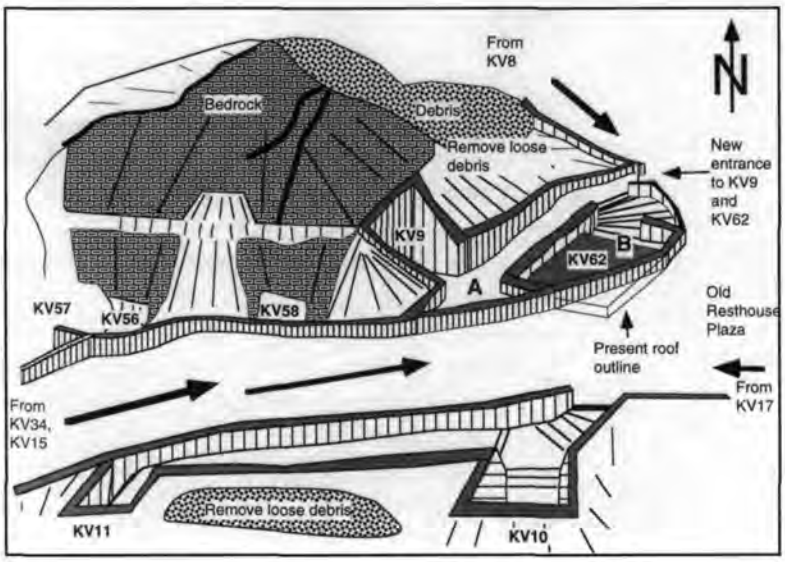
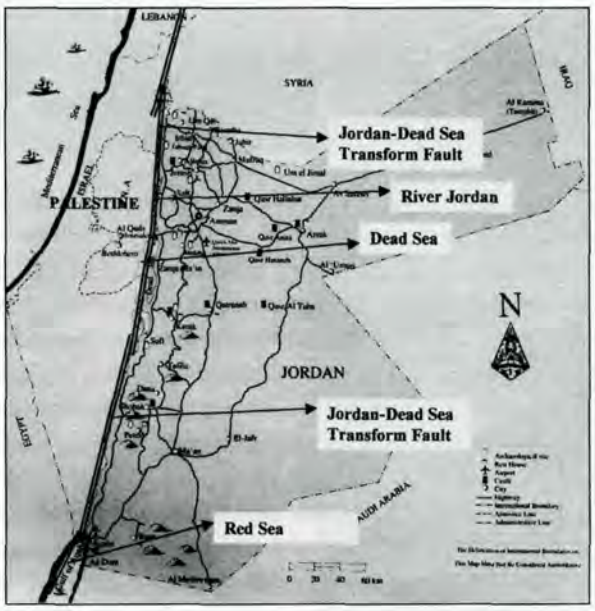


An example of flood protection measures as illustrated by Raphael Wüst. KV numbers refer to tombs. Newly configured walls along the walkways would direct the flow of floodwater away from the tombs with fewer obstructions or constrictions.

Sultan Z. Barakat and Rami F. Daher

The Cultural Heritage and the Nature of Disasters in Jordan and Palestine

The east Mediterranean region is the heart of many ancient and modern civilizations. The density and diversity of the historical and cultural resources in Jordan and Palestine are unprecedented and exceptional. Tens of thousands of sites date back not only to Neolithic and Chalcolithic periods, but also extends into Classical, Islamic, and even the 19th and 20th centuries. The cultural heritage incorporates religious, residential, and public buildings in addition to cultural landscapes encompassing historic cities and villages, streets, alleys, and neighborhoods. In addition, Jordan and Palestine are the homes for several World Heritage Sites designated by the International Council of Monuments and Sites (ICOMOS) such as Petra, Amra Palace, Dome of the Rock, Church of the Nativity, and parts of the Old City of Jerusalem.



Map of Jordan and Palestine showing the Jordan-Dead Sea Transform Fault. Courtesy the authors.

The east Mediterranean region in general and Jordan and Palestine in particular have been subjected to various disasters. Wars, political conflicts, and earthquakes are the primary disasters that have affected the area. They are major hazards with low probability but high adverse impacts. The Arab-Israeli wars of 1948 and of 1967 had an adverse impact on significant historical and cultural resources. The cultural heritage, especially religious buildings and significant monuments, is linked to national identity and pride and is usually targeted during wars and political conflicts (e.g., the Aqsa Mosque in Jerusalem and the Ibrahimi Mosque in Hebron).

The Jordan-Dead Sea transform fault, the major tectonic feature, was formed as a result of the breakup of Arabia from the African Plate.[1] The Jordan-Dead Sea fault connects with the Red Sea and the African fault to the south and the North Syrian and East Anatolian faults to the north. Strong and devastating earthquakes have struck the region in 336, 362, 551, 746, 765, 808, 1043, 1262, 1759, 1834, 1837, 1903, and 1927. The earthquake of 1927 is still important in living folklore and oral history to the extent that other events are dated in relation to it. Its effect amounted to hundreds of deaths and damaged houses and structures (e.g., the death toll in Salt alone, which is close to the earthquake epicenter, reached about 40 with almost 1,000 damaged houses).

Earthquakes tend to affect extensive regions making it possible to "chronologically articulate the depositional records of spatially discrete sites on the basis of comparative archeo-seismic evidence" (e.g., collapse orientation of columns and pilasters which tend to collapse in the opposite direction of the quake's epicenter).[2] Such archeo-seismic evidence can be collected from the entire length of the Jordan Rift Valley. A historiography of earthquakes in the region should be based not only on archeo-seismic and contemporary seismic data, but should also incorporate data from ancient historical and textual remains.

A Methodology for Disaster Preparedness and Mitigation Planning

In Jordan and Palestine, the heritage conservation movement is faced with several obstacles (e.g., lack of funding, absence of a clear methodology for heritage conservation and management, deterioration, exploitation, and misuse of many of the historical and cultural resources).[3] In addition, the protection and conservation of the cultural heritage in a post-disaster situation constitutes the lowest priority. Therefore, a conscious methodology for disaster mitigation and planning for the historic and cultural resources is important.

Disaster management is a cycle including actions before and after an event. While attention is often focussed on the immediate response to a disaster, preparedness and mitigation can prove to be more effective and far more important in mitigating the negative impacts of a disaster.[4] Therefore, the methodology will incorporate pre- and post-disaster mitigation strategies and be based on proactive rather than reactive mitigation measures. The methodology is composed of several stages.

Remains of the Shamiah Residential Quarter in Ma'an, southern Jordan, after the 1927 earthquake.

Development of a knowledge base on cultural heritage and nature of disasters. Accurate information and data about the nature of the different historical and cultural resources should be secured through identification, evaluation, and significance assessment of resources in an area. The definition of the cultural heritage is a continuous process during which new meaning and values are always being discovered. Consequently, different types of cultural resources are therefore incorporated into the realm of cultural heritage.[5] Significance assessment is the essence of heritage identification and evaluation because it affects the conservation strategies incorporated within a reconstruction or a disaster management plan.

Through a cultural resources management (CRM) project in the early 1990s, funded by the United States Agency for International Development (USAID), Jordan has established an inventory, the Jordan Antiquities Database and Information System (JADIS), of Jordan's archeological sites in an electronic format.[6] Even though the project provided a very valuable database on archeological sites, the project did not include heritage sites during the last 300 years. In addition, the project was not able to create, within the existing Jordanian economic planning structures, permanent mechanisms to coordinate public and private sector development that would protect and conserve antiquities sites and resources.[7]

After the peace treaty with Israel, the Palestinian Authority has started to address the issue of heritage conservation. The Ministry of Planning and International Cooperation (MOPIC) has launched an Emergency Natural Resources Protection Plan through which endangered cultural heritage sites in the West Bank are being inventoried. The objective is to protect and conserve such sites during future massive development in the West Bank and Ghazeh (Gaza).[8]

In a post-disaster situation, many historical and cultural resources are considered unsafe based on a very preliminary evaluation and are deemed for demolition regardless whether or not the resource is worth saving from a heritage conservation point of view.[9] In other circumstances, demolition of damaged buildings can be attributed to victims seeking retribution "to vent anger and to seek vengeance."[10] The public acknowledgement of the significance of such resources (e.g., even the ordinary cultural heritage beyond public monuments and religious buildings) can facilitate further evaluation of such resources. Such an evaluation can trigger other options

besides demolition such as structural stabilization, re-consolidation, and reconstruction. Understanding of earlier forms of construction and knowledge about historic building performances during earthquakes is very importance (e.g., for predicting the post-disaster behavior of a certain structure, carrying out reconstruction work).[11]

Risk assessment and defining levels of acceptable risk. Defining levels of acceptable risk can be achieved through vulnerability analysis, census and demographic data, hazards mapping, and a proper understanding of the cycles of disasters. The aim of this diagnostic process is to balance known risks against available resources.[12] First, risk assessment involves the production of hazard maps illustrating areas of potential seismic, volcanic, and flood activities. Local scientific analysis, historic archives, and archeo-seismic evidences can help in providing valuable information for the production of such maps using a Geographic Information System application. Second is the assessment of the vulnerability of persons and resources to the mapped hazards.

All information gathered from the previous stages should be passed on to decision makers to determine a course of action where different levels of acceptable risks are identified. The easy way out is to assume that no risk is acceptable and to demolish all affected heritage buildings. Acceptable risk needs to be carefully assessed.[13] Conservation of damaged historic structures needs to comply with building codes and regulations for historic buildings rather than building codes for new constructions. Different courses of action could be adopted such as risk reduction, upgrading infrastructure, and several other solutions based on the above collected and researched information.

Preparedness and mitigation planning and management. The main objective is to reduce the level of vulnerability of cultural resources and the impacts of disaster. This can be achieved through hazards reduction measures: protective infrastructure, preparedness measures emphasizing short-term activities (e.g., formation of disaster-management plans, development of warning systems, training of personnel, assessment of damage, and emergency repair), and longer-term mitigation measures (e.g., proactive building codes and regulations.)

Planners and policy makers can introduce the necessary measures to create a safer urban environment. Such mitigation measures include:

- Inclusion of safety elements in the curriculum of key professionals such as architects, planners, engineers, and housing officials;
- Establishment of a system of building codes and land-use planning controls to insure that future buildings and settlements contribute to resisting earthquakes;
- Incorporation of hazard impact analysis (HIA) in areas subject to seismic movement, landslides, and flooding;
- Incorporation of environmental impact assessment (EIA) prior to embarking on reconstruction projects where the stakeholders are identified, consulted, and engaged in the process of reconstruction.

HIAs and EIAs can play a significant role in assessing the impacts of various hazards on development projects.

Post-disaster mitigation measures involve the rehabilitation of the community and its cultural resources through several intervention tactics and techniques. This rehabilitation period is

The Hussieni Mosque in central Amman. The mosque has been renovated several times since the 1927 earthquake damaged it.

Exterior and interior views of the Zaidani Mosque of Tibneh in northern Jordan. The roof of the mosque has been severely damaged after the 1927 earthquake. The mosque, stands deserted, still waiting funding for its rehabilitation.

the most difficult for the victims physically and emotionally. Based on several reconstruction-after-disasters projects undertaken in Bosnia-Herzegovina, Iraq, Lebanon, and Afghanistan, the most productive type of aid during this period is cash and credit, job-producing activities, and projects where the local community is genuinely involved in the overall process of reconstruction.[14] A professional and knowledgeable team of heritage conservationists, civil defense officials, structural engineers, and other specialists must conduct a serious and through inspection of the impacts of the disaster on the cultural heritage. The recommendations of such a task force should inform decision making in terms of demolition, structural stabilization, and other significant decisions.[15]

Testing the methodology. Although simulation exercises or public drills can attempt to test the methodology, an actual disaster situation is the best test. The aftermath of a disaster is a busy time for disaster specialists to accurately assess the event in terms of deaths, injuries, damage to property, the needs of the affected populations and the character, scale, and nature of the assistance needed.

Incorporation of feedback from previous lessons. Feedback from previous disasters should be considered in the revision of disaster management and mitigation plans. In addition to incorporating feedback from previous disaster experiences, governmental bodies and universities are responsible for initiating special graduate courses in disaster mitigation and management. Such courses should target planners, enforcement officials, engineers, urban designers, and other segments of professionals. In addition, regular training courses (smaller modules) in disaster preparedness should target decision makers working in government agencies and non-governmental organizations.

Conclusion

UNESCO, and through ICOMOS and other international organizations, has initiated conventions, charters, and recommendations concerning the protection and conservation of cultural heritage. These include the Convention for the Protection of Cultural Property in the Event of Armed Conflict: the Hague Convention in 1954, and the International Charter for the Conservation and Restoration of Monuments and Sites: The Venice Charter of 1964.[16] Even though such international agreements aim at the protection of the cultural heritage, the widening gap between their glittering rhetoric and the dark reality of actual practices during war and political conflicts is increasing. One has only to take notice of what had happened in Bosnia-Herzegovina during the late ethnic cleansing which had an adverse effect not only on human beings, but on significant cultural resources as well. Such realities emphasize the ultimate necessity to seriously consider a disaster management and mitigation plan, especially in countries like Jordan and Palestine with high probabilities of wars, political conflicts, and earthquakes.

In Jordan and Palestine, specialists in disaster management call for the establishment of a governmental structure (a central coordinating body such as a National Disaster Co-ordination Council) to coordinate and implement disaster preparedness and mitigation strategies.[17] In Jordan, for example, the Jordanian Supreme Council for Civil Defense can be developed and upgraded through intensive human resources development and capacity building.

The recent earthquakes in the western part of Turkey in 1999, measuring 7.4 magnitude on

the Richter scale, shocked Golcuk and environs, causing about 15,000 deaths and damage to several monuments in Izmit, Iznik, Bursa, Istanbul, and many other cities.[18] This incident had adverse effects not only on human beings and buildings but on the economic and industrial infrastructures as well. It represents a clear indication that disasters can no longer be regarded as isolated events that have little or no relationship to the political or economic development of a country. As stated by disaster management specialists, "Disasters are major contributors to underdevelopment, in the same way as underdevelopment is one of the major contributors to disasters."[19]

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Photos courtesy Rami F. Daher.

Eva Osborne

Terrorist Attack

Disaster Response for the Oklahoma City Bombing

A truck bomb exploded outside the Alfred P. Murrah Federal Building in downtown Oklahoma City, at 9:02 a.m. on April 19, 1995. The explosion killed 168 people and injured many others. In addition to the immediate horrific impact, the rescue and recovery efforts inflicted additional deaths and untold injuries and emotional scars.

The intentional and unpredictable nature of this terrorist attack immediately and permanently changed the way Oklahomans and others across the nation view their personal security. This public perception has been expressed by changes to the built environment and has accelerated an introverted design philosophy as well as new security requirements for public spaces and new public structures, nationwide. This paper examines how Oklahoma City (City), the state historic preservation office (SHPO), and other government agencies responded to the threat of additional loss of historic fabric during the recovery process and during the creation of the Oklahoma City National Memorial. A discussion is included concerning how public programs were structured to encourage appropriate preservation practice.

The bombing caused damage to over 300 buildings. Seventy-three of these were buildings with recognized historical significance. Window damage was the most obvious and widespread damage with glass breakage reported over one mile from the blast. Many buildings were also structurally damaged within six blocks of the epicenter. Consequently, 14 buildings have been demolished including the targeted federal building, which was imploded on national television shortly after the devastating event. Plans for further demolition of adjacent structures continue to be announced, even after the fifth anniversary. Public opinion was leading the charge to remove all damaged fabric and replace it with symbols of artistic expression, economic strength, and the resilient character of the Midwest. The National Endowment for the Arts sponsored an open discussion and design charette, July 24-25, 1995, which produced a master plan for the damaged area of Oklahoma City's Central Business District. During preliminary discussions, citizens offered various descriptions of proposed cityscapes that would have required the razing of a majority of the surrounding historic buildings which were unattractive for retention because of neglect due to the economic conditions before the explosion. However, the design professionals produced a final report that focused on larger areas for zoning and encouraged re-use of the existing buildings.

The SHPO was located in the Journal Record Building, a historic building immediately north of the Murrah Building. This building would eventually become part of the Oklahoma City National Memorial site, housing the museum and archives, as well as the Memorial

The city center of Oklahoma City after the bombing. The Alfred P. Murrah Federal Building is located in the left foreground.

Institute for Prevention of Terrorism. The Journal Record Building was within the boundaries of a 12-block area that was declared a crime scene and seized by the Federal Bureau of Investigation (FBI). Similar to other state and private offices neighboring the federal building, the SHPO was relocated without access to National Register of Historic Places files and office equipment. Some members of the staff were hospitalized due to injuries sustained during the bombing. Despite these hurdles, SHPO served as host for preservation partners who came from across the United States. They rallied together with the common goal of working with the City to assist the property owners within the bomb-affected area by assessing the damage to each historic building and offering direction for the steps they could take to repair and preserve their properties.

Consultation occurred with the National Park Service (NPS), the National Trust for Historic Preservation, and the American Institute of Architects to assemble teams consisting of preservation experts, architects, and structural engineers. The teams worked on a volunteer basis to produce written reports for individual properties based on site visits during the week of May 15-19,1995. The Secretary of the Interior's *Standards for Rehabilitation* was the subject of consultation with property owners, which was required by Section 106 review and encouraged by the 20% tax credits for certified historic structures. Without these programs, implemented as key tools for assisting appropriate preservation, the City would have lost many of the remaining irreplaceable historic resources to redevelopment. Coincidentally, Oklahoma's Seventh Annual Statewide Preservation Conference had been scheduled 18 months in advance for the first week of May in Oklahoma City at a building a few blocks south of the Murrah Building. This forum was used as a gathering place for preservation partners who came to assist in planning efforts, to inform the public about the extent of the damage, and to introduce information and sources for information concerning appropriate preservation practice. Most importantly, preservationists were placed in the spotlight to explain the significance of the affected historic buildings and why they should remain as participants in an ever-changing built environment, part of the daily life of the community, as instructed by the National Historic Preservation Act of 1966, as amended.

Political promises concerning justice and healing came from top government officials who were onsite accompanied by national media. The terrorist attack was labeled a "historic event" the same day it occurred by those spokespersons. The bombing was described as the most destructive single act of violence on American soil. Ironically, the bombing was a calculated expression of protest against similar acts of violence, which it, itself, exemplifies.

Testimony of extraordinary heroism, compassion, and sacrifice associated with the rescue efforts immediately after the bombing have been covered by the media as the community attempted to come to grips with man's inhumanity to man and to renew confidence in the ideals of community. These interpretations silenced accurate communication of the crippling memories shared by rescue workers and survivors.

Much of the physical evidence of the site has been swept away in preparation for reconstruction to facilitate emotional rebirth of the City. For example, retention of the crater left in the street and preservation of the scarred buildings in the immediate area could have allowed the public the opportunity to re-interpret the event on site in relation to future occurrences and philosophies.

Efforts for museum purposes and plans to memorialize the event with a symbolic tribute began to clash with preservation efforts concerning retention of historic structures for their significance unrelated to the bombing event. Additionally, museum development and plans for constructing a memorial were competing conceptually with the idea of preserving physical evidence of the bombing by retaining damaged elements of buildings in place for future consideration. The Oklahoma City National Memorial, including the museum collections and the Institute for the Prevention of Terrorism, received $29.8 million in public funding and private donations.

These conflicting forces, each designed for educating the public concerning this event, collide on one site and are exemplified by the schizophrenic rehabilitation plans for the Journal Record Building. The north and east (front) facades will be rehabilitated with reference to the original building, the India Shrine Temple, designed by Solomon Andrew Layton who was a prominent architect in Oklahoma during a period of time shortly after statehood. The west

facade (back) was a common demising wall historically, and was relatively recently exposed by the demolition of the adjacent building. This non-historic facade will be embellished with new construction, as the new entry to the museum. The south facade faced the Murrah Building at the time of the bombing (now the Memorial site) and will be sealed to preserve evidence of the effect of the bombing on that structure. The interior was demolished by necessity, down to the structural concrete frame, and the marble that historically lined the lobbies and public corridors was stored for reinstallation. When cost estimates exceeded expectations, the SHPO (which was empowered by the Section 106 process) was able to negotiate reconsideration of the proposal to sell the historic marble that could potentially secure additional funding for the associated new construction. All the players in the memorial process, representing each respective discipline of history, argued passionately for the importance of acknowledging the past, which the public monetarily supported without recognition of any conflict in methodology. Of all the rehabilitation projects funded by the Murrah District Revitalization Program (which will be described below), the Journal Record Building has proven the most costly to repair because of its size and its close proximity to the bomb epicenter (half block separation). The City has facilitated $12,550,000 in federal grant funds to support adaptive re-use of this historic property. Just over $2 million of this was used to acquire the building and site. This step proved necessary when the former owners indicated no interest in retaining the building. It had been fully occupied at the time of the bombing.

The historic Young Mens' Christian Association (YMCA) building (c. 1950) housed a child-care facility and was a prominent building severely damaged by the bombing. The preservation community, represented by publicly respected historians, began a campaign early in the recovery efforts to focus attention on the fact that it remains the only example of International style architecture extant in the Oklahoma City Central Business District. Additionally, its physical proximity to the terrorist-targeted building serves to define the context of that event, which is symbolized in the Memorial on the site of the demolished Murrah Building. Preservationists continue to object to current plans by the private sector to demolish the YMCA and construct a multi-floor parking structure to serve adjacent businesses, visitors of the Oklahoma City National Memorial, and the new federal campus that will replace the Murrah Building. The private sector argues that Oklahoma City must retain an environment conducive to the commercial functions with a major focus on parking.

In addition to the allocation of funding for the Memorial, a separate pool of funds was established to assist the City in its recovery efforts. Congress appropriated $52.5 million to fund repairs to adjacent damaged buildings and to promote economic recovery of the affected Central Business District. The City established the Murrah District Revitalization Program to disburse the federal funds and to respond to requests for assistance in accordance with the appropriating legislation. To accommodate the unprecedented purposes of the program and the emergency nature of the requests, the federal regulations governing the procedures for each of the three federal funding sources were revised to specifically address the goals of the new program. For example, the requirements concerning low- to moderate-income families relevant to the Department of Housing and Urban Development were not relevant to the purposes of the revitalization program, and therefore they were not adopted or implemented. However, the City was responsible for compliance with federal wage laws (Davis-Bacon) and environmental laws, including those addressing historic preservation.

SHPO had enjoyed a productive relationship with the Planning Department, defined by the Certified Local Government (CLG) Program for more than 20 years, despite aggressive activities and the notorious success of the Urban Renewal Program perpetuated by a City Council focused solely on redevelopment. The downtown area had been surveyed and several buildings individually eligible for listing in the National Register of Historic Places (NRHP), and one potential historic district had been identified. The City had assisted the Federal Emergency Management Agency and the General Services Administration in identifying and securing damaged buildings during the period of occupation by the FBI. The resulting reports and City records concerning identified historic resources were critical to the success of the assessment program facilitated by SHPO. The Advisory Council on Historic Preservation, SHPO, and the City negotiated a programmatic agreement which

The Alfred P. Murrah Federal Building after the bombing on April 19, 1995.

authorized the City Planning Department to address specific types of repairs in accordance with the Secretary of the Interior's *Standards for Rehabilitation* to facilitate and expedite the National Historic Preservation Act (NHPA) Section 106 process. This partnership in the review process has continued for the past five years and has proven to be essential in the expediency required when safety issues associated with the damaged buildings were questionable.

Funds were disbursed in the form of grants to property owners in an effort to ensure that all buildings were returned to a condition equivalent to that present at the time of the bombing. Those buildings that had been boarded-up would be excluded from the program unless proposals were submitted to insure re-use. Because most buildings had been constructed prior to current building and life/safety code requirements, most damage repairs included some cost component targeted toward bringing the structure up to current code. In some cases, the costs related to code upgrades were more than the actual cost of direct bomb damage repairs. Building code officials worked closely with building owners to find creative solutions to life/safety issues when there was a sense of emergency associated with repairs. These discussions focused attention on potential stipulations that the City could address when re-adopting a national building code model. Preservation partners from various cities throughout the United States offered examples of modified language and recommendations based on their experience. Various groups associated with disaster preparedness were established and formed on-call teams to serve in future disasters. These groups have assumed a proactive role in building code legislation, which focuses on repair, retrofit and adaptive re-use, rather than demolition of damaged structures.

In addition to direct physical damages, the bombing also severely impacted the local economy. A number of businesses were forced to close, many had to scale back their operations during the first two-to-three years of recovery, and others simply moved out of the area. In an effort to reverse this downturn, the City established a loan program in partnership with three local banks to provide an incentive to business recovery in the affected area. The primary purpose of the loan program is to re-establish a level of economic activity in the affected area equivalent to that which existed prior to the bombing. Again, the City and the SHPO actively promoted understanding of Section 106 review and rehabilitation tax credits for historic buildings to encourage appropriate rehabilitation as businesses continue to improve their economic status. This was one of the first examples of private reinvestment in the area as the banks supplied 70% of the funding compared to the City's 30% contribution.

Some of the most notable historic buildings to receive assistance through the revitalization program include St. Paul's Cathedral, First Methodist Church, St. Joseph's Cathedral, and Calvary Baptist Church. The need to provide rehabilitation funds to these severely damaged and culturally prominent structures brought with it questions concerning the constitutionality of giving federal funds to religious institutions. In an effort to accommodate these special circumstances, the NPS awarded the SHPO a $40,000 matching grant from recaptured historic preservation funds. The SHPO offered the NRHP listed and eligible churches the opportunity to apply for assistance for development of restoration/rehabilitation plans. St. Paul's Cathedral and Calvary Baptist Church each requested and received a quarter of the pool of funds for planning. The other half was granted to the City through a special CLG sub-grant to complete inventory work in the downtown and to prepare

a NRHP nomination for Automobile Alley Historic District, as well as preservation plan and design guidelines. This new historic district was identified, placed on the NRHP and became an award winning Main Street Program. Murrah District Revitalization Program funding in the amount of $6.8 million, which included $1.6 million for streetscape improvements through the City Public Works Department, leveraged $20.5 million in private investment for a total of over $25 million in this district alone. Many of the property owners used tax incentives for historic structures and insisted that the new design guidelines be consistent with the Secretary of the Interior's *Standards for Rehabilitation* to insure consistency on the local level with established preservation programs. The public funds used for bomb-related damage and revitalization stimulated private sector investment throughout the downtown area. The federal funds coupled with renewed interest in the historic tax credit program have spurred private investment for rehabilitation and new construction that has been absent for 30 years. This investment and the prospect of a new federal campus have stimulated renewed interest in urban housing. An urban design review process has been established for the resulting future development.

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Photos courtesy Wil Moore, Ace Aerial.

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Call for Abstracts

This issue of *CRM* on disaster management for cultural properties has only scratched the surface. In fact, we have additional articles that could not fit into this issue. In 2001, there will be another issue of *CRM* on disasters focusing on disaster preparedness, planning, and mitigation. If you are interested in preparing an article (approximately 1,100 words and two illustrations) for the next disaster issue, please send a 50- to 150-word abstract to <David_W_Look@nps.gov> by November 1, 2000. Authors will be notified by December 1, 2000, if their abstracts have been accepted. Articles and illustrations will be due on April 1, 2001.

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