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Hurricane Hugo and Historic Charleston: Damage Recordation and Retrieval

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ABSTRACT: Despite a history of natural disasters, most preservationists in Charleston, South Carolina, discovered, as Hurricane Hugo approached, that they were without a cultural resource, disaster-preparedness plan. Each cultural organization in the city took basic protective measures prior to the storm's onslaught, but few were prepared for the magnitude of the outcome. Immediately afterward, preservationists organized an emergency stabilization task force at the request of the city. With a phone bank and a battery of volunteers, expert and amateur, a multilevel effort was commenced, consisting of architectural salvage, survey, technical information dissemination, contractor database, and recordation of damage. After months of recovery efforts, the final phase of recordation and survey led to the input of information and the development of a computer-automated graphics and database marriage program. The database has provided quick access to important information such as roofing and chimney failures and losses of building features. The Foundation's database offers the opportunity for future expansion. Its experience with Hugo has helped set forth new standards for damage recordation after a natural disaster.

KEYWORDS: disaster preparedness, damage survey, emergency stabilization, assessment, database program, building failures, disaster mitigation, preservation, rehabilitation, standards, building technology, buildings, evaluation

On 21 September 1989, as Hurricane Hugo seemed unswervingly fixed on a direct route toward the historic coastal city of Charleston, South Carolina, the city's well-spoken mayor, Joseph P. Riley, Jr., warned a populace accustomed to recent, milder storms, "There will be more flooding as a result of this storm than any Charlestonian has ever experienced. It will boggle the mind and it is going to be extraordinary" [*1*]. In a young preservation community that had not previously developed major disaster preparedness skills or experienced the aftermath of severe devastation, the fierce hurricane indeed initially boggled the minds of those responsible for Charleston's patrimony before and immediately after the storm. However, on the third day after Hugo, following a meeting with the mayor in a roofless City Hall, Historic Charleston rallied the rest of the preservation community including the Preservation Society and the Southern Regional Office of the National Trust to begin an Emergency Stabilization and Restoration Task Force. As assistance began to arrive from federal and state agencies and college/university preservation programs, partially conceived ideas for developing and disseminating emergency repair information, providing conservation assessments, and recordation of damage to historic sites, coalesced into fully developed programs. What follows is a narrative of what happened in preservation's front lines, a description of how the information gleaned after the disaster continues to be analyzed and refined for future use, and basic guidelines for completing a damage survey after a natural disaster.

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Charleston: A Common Thread of Disaster

Hurricanes are a relatively common threat to Charleston, striking the city many times since its settlement in 1670. This is a city planned in London on a baroque grid, yet sited on a peninsula with interspersing levels of high ground, pierced by marshes and creeks. A map of the peninsula (Fig. 1) reflects almost to the last detail the areas most threatened by surge (a sudden wave or rise in water resulting from the force of wind) in any hurricane. Severe storms of all degrees bore down on the fledgling municipality from its earliest days. One of the most severe, the Hurricane of 1752, struck suddenly on high tide one September day, flooding the town, toppling houses, breaking up wharves and drowning citizens who could not ascend staircases to upper floors quickly enough. Every vessel in the harbor save one came ashore, and a pilot boat dashed against the Governor's House, knocking a hole in the front brick wall on line with the second story windows [*2,3*]. The *South Carolina Gazette* described the damage in a manner all too familiar to Hugo victims, pointing out that an "abundance of roofs, chimneys, etc. almost all the tiled or slated houses were uncovered" [*4*]. A second, though milder, hurricane struck only two weeks later. Nearly 50 years passed before the next wind of 1804 damaged James Island and Sullivan's Island. Other significant storms included the cyclone of 1811 that lifted off roofs in Charleston; the hurricane of 1822 that drowned hundreds of planters and slaves as a surge stormed up the rice delta of the Santee River; and the hurricane of 1854 that again wrecked Sullivan's Island. The cyclone of 1885, with winds of 195 km/h (121 mph), killed more than 20 persons on the Charleston peninsula and was followed a year later by one of the eight largest earthquakes to ever strike the United States [*4–6*]. Excepting the earthquake, no systematic recordation of architectural damage was undertaken after these disasters, although contemporary newspaper accounts provide brief information on harm to certain structures. Charlestonians generally shored up affected buildings and repaired them as best they could.

The 1893 hurricane drowned 2000 people in its course between Hilton Head and Charleston County and was followed by five hurricanes in the following two decades. The trend culminated in the storm of 1911 that caused a large tidal surge in downtown streets. Owing to changed weather patterns, however, hurricanes of the twentieth century were fewer and generally less severe for the Charleston area, excepting perhaps Hurricane Gracie that struck to the southward on 29 September 1959, with winds nearly equal to Hurricane Hugo [*7*].

Hurricane Hugo: Disaster Preparation and Landfall

An enveloping calm of almost exactly 30 years promoted a diffidence toward preparedness: Charlestonians forgot their traditional expectations of certain disaster. Charleston's hurricanes usually originate as thunderstorms moving off the west coast of Africa to the Cape Verde Islands and depend on weather patterns on that continent. Tropical Depression 11 became a Hurricane with the name Hugo on 13 September 1989, peaking at 260 km/h (161 mph) before striking Antigua, Guadaloupe, Montserrat, the Virgin Islands, and Puerto Rico. Charlestonians focused on the reality of a strike on 20 September when computer predictive models served to inform local emergency and governmental officials. Taking a nod from the U. S. Navy, which prepared to dispatch most of its vessels to open sea, the historic City Hall and other municipal structures were the first to be boarded. The Charleston Museum, as the only cultural institution with a written policy for preparedness, began its safeguards on 20 September. Historic Charleston Foundation (HCF) conducted its time-honored steps (unwritten policy) for such events early in the morning of the twenty-first, moving furniture to the second floors of its two house museums, the Nathaniel Russell House and the Edmonston-Alston House, closing the interior shutters at the first level, and tying the exterior shutters closed at the second with stout twine. With short manpower, no additional protective measures could be taken at the Foundation's

FIG. 1—*Map of Charleston; darkened areas show former marshland likely to flood; from* This is Charleston, *Carolina Art Association (not to scale).*

revolving fund properties, which were already boarded awaiting rehabilitation. Windows at all other HCF shop and office locations were taped or boarded and important records secured by midday. Although some departed (evacuation was not required on the peninsula), most Foundation staff remained behind attending to last minute preparations. As the highways clogged with fleeing motorists, largely reflecting the mandatory evacuations of the adjacent sea islands, shelters filled up and the remaining residents stayed in their houses [*8*].

Hugo made landfall just north of Charleston Harbor with hurricane force winds spreading out more than 226 km (140 miles) in diameter from the eye and moving northwest at 41 km/h (25 mph) striking directly at Mount Pleasant, Bull's Bay, and Sullivan's Island at 11 p.m. The winds reminded some of the description from Dubose Heyward's 1925 novel, *Porgy*, "There was something utterly terrifying about the studied manner in which the hurricane proceeded about its business. . . . It was Destiny working nakedly for the eyes of men to see" [*9*].

When the hurricane "eye" itself came over at midnight, the eerie lull of 10 to 20 min gave some the chance to muse on the broken windows and cautiously peer out for the first glimpse of uprooted trees and the rising surge. Two hours more of winds in a reverse direction followed the eye, resulting in even worse devastation. By the early morning hours Hugo had moved northwest, passing over the warm waters of Lakes Marion and Moultrie, thus rebuilding its strength for hits on Sumter, Columbia, Charlotte, and other Carolina cities before moving northwards. Most of the eight casualties in the Charleston area included those who had moved boats up the Cooper or Wando Rivers, not expecting to feel the severity of the storm away from the coastline. One Charleston man, however, died a short time after being rescued from his collapsed nineteenth century house on Charleston's West Side [*10*]. For an excellent, non-local account of the hurricane aftermath see Ref *11*.

Disaster Response

On 22 September, morning dawned with bright sunshine, clear air, and high visibility, and residents began to walk the streets to view the damage—the roof of the Old Market lying in the street, the twisted weather vane and distinct lean of the steeple of St. Michael's Episcopal Church, the fallen steeple of Emmanuel AME Church (Fig. 2), the uprooted trees that crashed through dwellings such as the eighteenth century Daniel Ravenel House, and entirely collapsed buildings, such as a group of unrestored antebellum warehouses on Hayne Street. All power and water services were out for an indefinite period. By 9:00 a.m., as National Guard details moved into the streets to assist in reestablishing order, most residents worried about finding temporary roof coverings for houses and locating food, water, and ice. Historic Charleston staff immediately began cleanup and temporary protection measures for the Nathaniel Russell House. Its third floor windows had blown out, with water intrusion damaging important art objects and furnishings, and flood waters had risen to fill the basement. With more than five additional inches of rain a few days later, damages to all historic buildings and their contents were greatly exacerbated by water and humidity, necessitating the city and preservation community to act (Fig. 3).

The day after the Sunday meeting with the mayor, Jonathan Poston, Lawrence Walker, and the city's former historic preservation officer, Charles Chase, gathered at the Foundation's Frances Edmunds Center, awaiting power to be restored and special telephone equipment to be installed. Within hours, a bank of phones were on line with as many as ten volunteers beginning to coordinate homeowner needs with registering local and out-of-town contractors. A database for these needs and corresponding skills proved useful in the following days. At regular, early morning meetings, preservationists discussed various technical issues and introduced newly-arriving helpers from various out-of-town institutions who were prepared to assist in damage survey and provide conservation advice. More than five "emergency teams" were

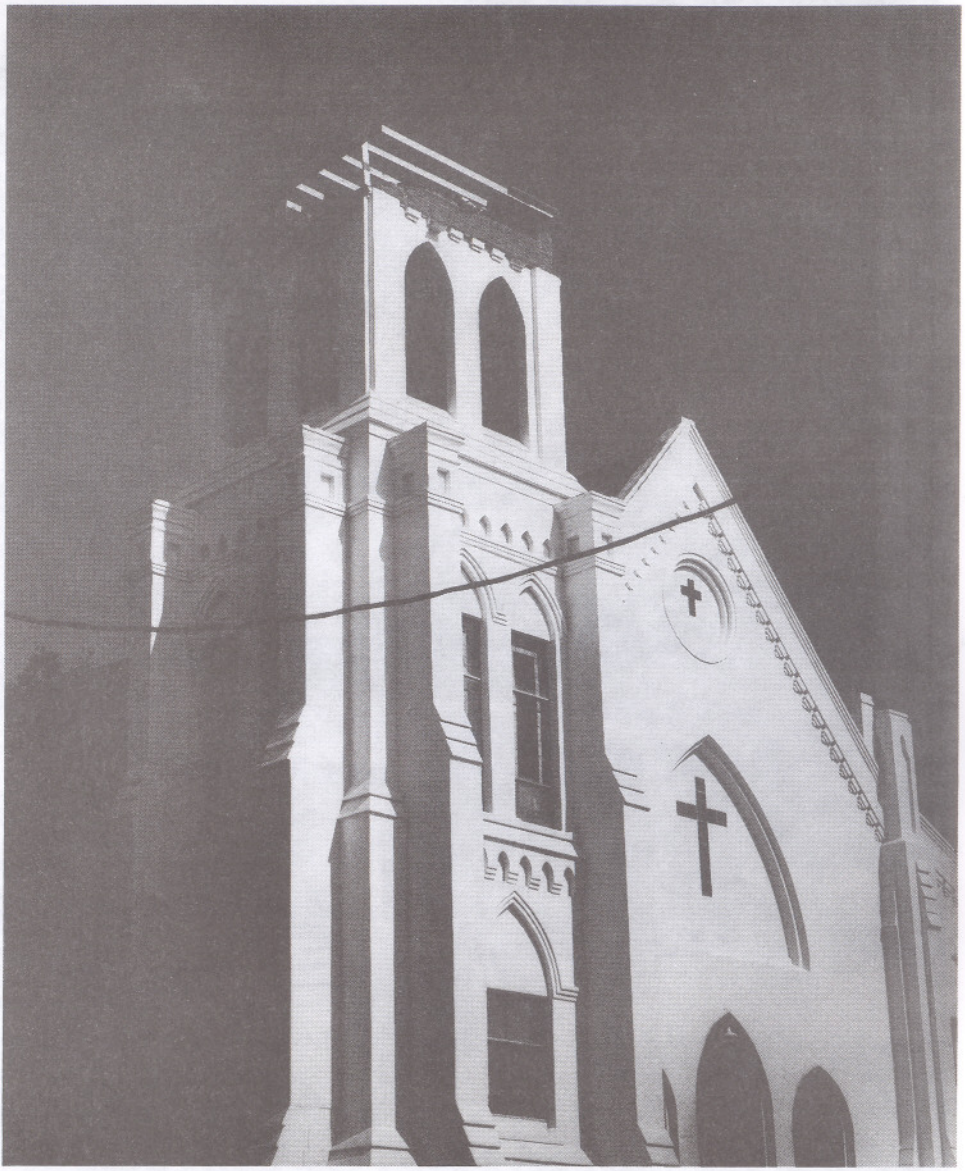

FIG. 2—*Emmanuel AME Church, Hugo damage to steeple (Jack Boucher, HABS photograph).*

immediately dispatched to examine HCF easement and covenant properties, to measure water damage, and to assist in stabilization at the Nathaniel Russell House, while high school student volunteers were organized to work with preservation consultant John Laurens in retrieving architectural details lying in the public rights of way before they were taken by city clean-up details. These elements, such as metal cornices and wood brackets, were cataloged and stored in a warehouse for safekeeping until restoration could begin.

FIG. 3—*St. Stephen's Episcopal Church, damage to interior following Hugo and subsequent rains (Jack Boucher, HABS photograph).*

FIG. 4—*Collapsed house on Rutledge Avenue, examination by National Park Service Disaster Team (Jack Boucher, HABS photograph).*

The National Park Service (NPS) initially dispatched four preservation architects under the direction of Blaine Cliver, who was then chief of the North Atlantic Regional Office in Boston. Most members of this and succeeding Park Service teams had not yet experienced a disaster of this magnitude. They surveyed damage to more than 130 Category One-rated buildings in the city including rough, Class C estimates of repair (Fig. 4), turned out specifications and guidelines for emergency stabilization, and presented the first seminars for technical advice to property owners and contractors [*12*].[2] They also worked with NPS properties including Fort Sumter, flooded by rising seas and described as the "world's biggest bathtub," and assisted the National Trust in evaluating its nearby Drayton Hall Plantation where the house was largely

[2] " 'Category One-rated buildings' refers to those structures so designated by the rating system of the official historical survey of Charleston as 'Exceptional.' Of highest architectural quality. . . . To be preserved and protected in situ at all costs."

unscathed but nearly two thirds of the trees were uprooted or topped off [*13*].[3] The Park Service's initial team rotated, with more than six other NPS architects following in succession, until the end of October. Even though the South Carolina Department of Archives and History had statewide devastation to handle, they dispatched architects from other State Historic Preservation (SHPO) offices in North Carolina, Georgia, Virginia, and Pennsylvania to the Charleston area to assist in technical advising. Private preservation consultants and architects such as George Fore, Ricardo Viera, Missy Dierickx, Hank Browne, and Ward Buchner arrived as volunteers at the behest of local preservationists, examining roofs and walls, and, in the case of Fore, providing condition assessments on buildings on the city's condemned list [*14*].[4]

The Hugo Damage Survey

Mary Washington College's initial student team under the direction of W. Brown Morton and Gary Stanton, and assisted by Colonial Williamsburg architect Willie Graham and Virginia Department of Historic Resources Architectural Historian, Calder Loth, set the pattern for the survey of the rest of the "Old City District" of Charleston. Stanton and Morton first worked with HCF in developing a survey form (Fig. 5). This assessment form, to be accompanied by color slides and black and white prints, was arranged to identify the elements of each building and follow with a record of the degree and percentage of damage for various elements. Nine historic preservation and architectural programs at colleges and universities sent teams, including Roger Williams College, Clemson University, and the Universities of Vermont, Delaware, Virginia, South Carolina, and Florida. Plenty of cameras and occasional video equipment and large format cameras from these groups, as well as photography by Jack Boucher from the Historic American Buildings Survey (HABS), augmented the recordation of the post-hurricane condition of Charleston and its environs. The realization of the inadequacy of current architectural surveys, especially those for the area south of Calhoun Street (not reexamined since completion in 1972), and the comparative lack of measured drawings, made the hurricane assessment and recovery more difficult [*15,16*].

The ongoing damage survey, responses to requests for technical advice from countless homeowners, and the audience comments and questions at various, hastily publicized seminars with the experts on slate and metal roofing, plaster, historic furnishing, and basic weathering-in and stabilization, eventually coalesced into patterns of damage and property owner needs. These responses in turn provided preservationists and the community with information to assist with insurers and particularly at meetings with representatives of the Federal Emergency Management Agency (FEMA). The preservation community became proactive, seeking stockpiles of roll roofing and plywood (for immediate stabilization) and later, terne metal roofing and slate. Consultants working with city building officials provided advice to prevent the emergency demolition of buildings on the official "hit" list of heavily damaged structures. Although the chancel of the Episcopal Cathedral of St. Luke and St. Paul was devastated by the collapse of the stone parapets, experts showed building officials that it could be restored (as it indeed was). Yet at least five structures, such as the old 1850s Roper Hospital (Fig. 6), were the subjects of emergency demolition after the storm. (Perhaps not coincidentally, this building lost its wings in the Earthquake of 1886.) Technical advice and strong preservation presence at public hearings combined with city support to ensure that the city's Board of Architectural Review helped

[3] Connie Wyrick, director of Public Relations for HCF, provided the description of Fort Sumter to the press. For a description of the aftermath at Drayton Hall, see Ref *13*.

[4] On 29 September, the city released a list of more than 15 historic buildings declared unsafe and possibly in need of emergency demolition, see Ref *14*.

maintain a strict policy of requiring in-kind replacement of damaged roofs and some missing elements. Reviewing more than 1400 applications, mostly at the staff level, the city's strong stance actually assisted in the effectiveness of the insurance process [*17*].

The damage survey was nearly 60% complete by 1 January 1990, but it continued through the summer of 1990 with teams of interns paid for by funds raised in the Historic Charleston Disaster Fund. These funds, along with an Architectural Monuments Fund raised by Friends in behalf of the Foundation, also supplied grants for institutional buildings and sites that were underinsured.[5] On 5 December 1989, the Disaster Fund commissioned Preservation Consultants, Inc., of Charleston to survey the damage to historic sites in Charleston County, Mount Pleasant, and Sullivan's Island. This survey was completed by early spring and a report completed by May 1990. Condition assessment forms for this effort differed slightly from those for the downtown damage analysis and contained background information gleaned from recent historical surveys of many of the areas. Owner questionnaires and building permit information were also utilized to provide a complete picture of post-Hugo conditions.

The Survey Database

In late 1989, a plan was suggested by Fred Phillips of the Charleston/Berkeley/Dorchester Council of Governments office (COG) to utilize post-Hugo information from official governmental reports and the Historic Charleston Damage Survey. What developed is a computer-automated graphics and database marriage program designed to offer quick access to a wide range of property-specific information (including building description, historic information, and zoning ratings and regulations). In 1993, after initial development of the program and transfer of basic damage survey information, Phillips began to work with Louis Nelson, the programs assistant in the Preservation Division of the Historic Charleston Foundation, on programs offered by Macintosh, utilizing Filevision[6] and operational on a desktop [*18*]. This final work is only now nearing completion.

The first factor in the creation of this program was the organization of the data collected in the Damage Survey on more than 2700 downtown properties, including the structural features and physical description of the building and the damage incurred by Hurricane Hugo. Once this information was transferred to the computer, Microsoft Excel® provided a spreadsheet format from which complex assessments and damage percentages could be gleaned [*19*]. This data also provided descriptive information about the various historic properties. Each field description from the damage database ultimately became a property identification field in the project. Other databases were utilized to complete the peninsula-wide project, fully housed in 4000 record spreadsheets in Microsoft Excel. The major secondary source was a database from the City of Charleston, which, in addition to new property records, also provided much of the historic inventory ratings and regulations data for those fields in each record. The final fields of information added were from the book, *Information for Guides of Historic Charleston, South Carolina*. This 576-page document has important historic and architectural information for a majority of the historic buildings on Charleston's peninsula. The entire book was scanned onto disk in Microsoft Word, then edited and each entry painstakingly transferred to the appropriate record.

The second aspect of the project has been the development of the graphic, or maps. This

[5] The Disaster Fund drive spearheaded by Connie Wyrick raised more than $150 000 for the Task Force while the Foundation's own Architectural and Monuments Fund Appeal netted about $175 000 in funds for restoration of uninsured or underinsured landmarks such as the Confederate Home, The Aiken-Rhett House, and the Morris Street AME Church.

[6] Registered trademark of TSP Software, Irvine, CA.

HISTORIC CHARLESTON FOUNDATION

HURRICANE HUGO DAMAGE ASSESSMENT FORM

Date of Survey:

Video: Reel/Frame
Camera:

Survey Team:
Members:

Slides: [ ]
B.& W.: [ ]

Name of Property: (if any)

Street Address:

Tax Map Number:

Current Owner:

DESCRIPTION

Principal Building [ ] Dependency [ ] Other [ ]

No. of Stories: Basement [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ]
Attic or Half Story [ ]

Material:

Structure: Brick [ ] Wood Frame [ ] Stone [ ] Metal [ ]
Other [ ]:

Surface Covering: Stucco [ ] Wood Siding [ ] Other [ ]:

Roof Covering: Slate [ ] Metal [ ] Tile [ ] Asphalt [ ]
Other [ ]:

Piazza: Foundation: Brick [ ] Stone [ ] Wood [ ]
Other [ ]:

Main Piazza: Brick [ ] Wood [ ] Other [ ]

Roof Covering (if different from main building):

Chimneys: Brick [ ] Brick & Stucco [ ] Stone [ ] Other [ ]

Comments:

FIG. 5—*Historic Charleston Foundation, Hurricane Hugo Damage Assessment Form.*

Address: Tax Map No.: Page 2

Damage Assessment	None	Minor	Major	%
Exterior Features				
Walls: Foundation/Basement	[ ]	[ ]	[ ]	
1st Floor	[ ]	[ ]	[ ]	
2nd Floor	[ ]	[ ]	[ ]	
3rd Floor	[ ]	[ ]	[ ]	
4th Floor	[ ]	[ ]	[ ]	
Attic	[ ]	[ ]	[ ]	
Doors	[ ]	[ ]	[ ]	
Windows	[ ]	[ ]	[ ]	
Shutters				
Piazza/Portico	[ ]	[ ]	[ ]	
Downspouts	[ ]	[ ]	[ ]	
Gutters	[ ]	[ ]	[ ]	
Cornice	[ ]	[ ]	[ ]	
Parapet	[ ]	[ ]	[ ]	
Roof Covering	[ ]	[ ]	[ ]	
Dormers (Number:)	[ ]	[ ]	[ ]	
Chimneys (Number:)	[ ]	[ ]	[ ]	
Other Visible Damage				
Garden Walls/Fences	[ ]	[ ]	[ ]	
Gates	[ ]	[ ]	[ ]	
Walkways/Paving	[ ]	[ ]	[ ]	
Sidewalks	[ ]	[ ]	[ ]	
Trees	[ ]	[ ]	[ ]	
Mechanical	[ ]	[ ]	[ ]	

FIG. 5—*Continued.*

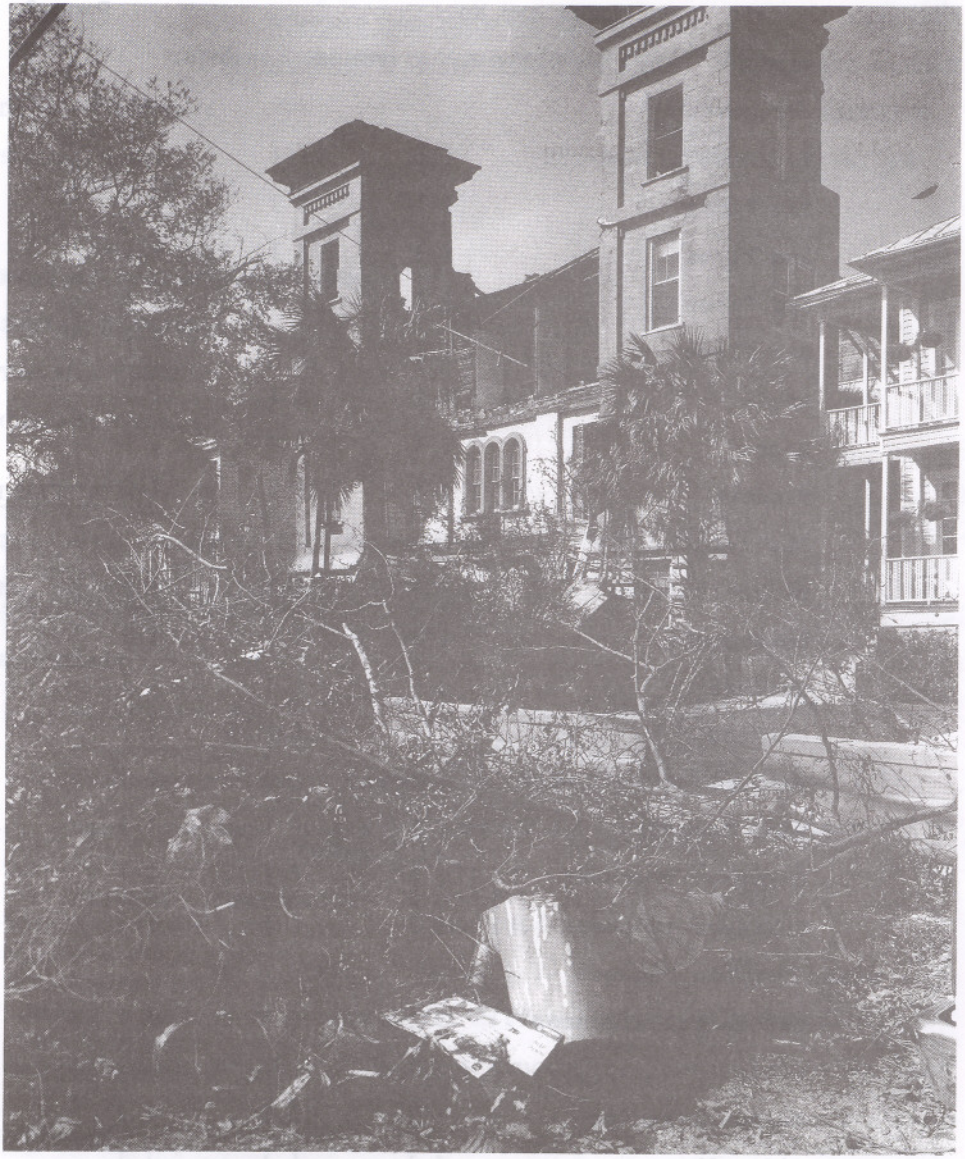

FIG. 6—*Old Roper Hospital, Queen Street, c. 1850; in a severe state of disrepair before Hugo, it was damaged and demolished pursuant to city order after the storm (Jack Boucher, HABS photograph).*

was accomplished by scanning each tax map for the peninsula onto disk in Canvas®, a Microsoft graphics program [*20*]. Each map was edited, street labels were typed in, blocks identified, and properties marked. The historic peninsula city is divided into four bands, each band divided into sections, and each section into specific maps (Figs. 7 and 8). Thus, a complete property reference might read, "Band 2, Section 3, Map 1, Block A, Lot 7."

Filevision is the master program used to handle both the data and the graphics. Filevision has the capability of linking a specific property to a record displayed on a HCF/COG Property Data Sheet (with all the appropriate historic, zoning, and descriptive information) to an icon on a map. Upon entering this program, one is presented with a map of the Charleston peninsula. After a short series of regional maps, the operator can then call up the property information for a specific lot (Fig. 9). Another capability allows searches by field, that is, responding to a specific query such as, "List all two story wood buildings built before 1820 with an inventory rating of three and lying within a single family residential zoning district." One can also search by region or distance on a particular map from any given point. Data from part of the Sullivan's Island portion of the larger county survey is partially programmed in the same way but operates as a separate database.

The Extent of Hurricane Damage

With the database and the separate calculations made from the report of the larger county survey, it is now possible to obtain some definitive numbers on the extent of Hugo losses to the historic environment, yet these two surveys have not been integrated as of yet. Although the database does not indicate the number of buildings destroyed, estimates from the Charleston building inspection division showed 89 city buildings suffered total collapse in the high winds, with approximately 30 of these being major downtown structures. Another 278 suffered severe structural damage (that is, foundations, framing, etc). Only 18 of these buildings, though, were classified as historic [*21*]. The city's original report of 80% roof damage can be compared, however, with the calculations from the database now available for the downtown Old and Historic District: 754 properties (or 27.93%) received minor damage, 756 properties (or 28%) received major damage, and 1190 (or 44.07%) received no roof damage [*22*]. The largest share of other losses were to gutters (nearly 43% of buildings experienced major or minor damage), to first floors or ground floors from wind-driven water or flooding (nearly 25% each), and to attics from leaking roofs (nearly the same amount). Chimney destruction or disfigurement was relatively widespread with 523 structures (or 19.37%) receiving minor damage and 215 buildings (or 7.96%) experiencing major damage or collapse.

In Charleston County, including the historic districts of Sullivan's Island and Mount Pleasant, 652 sites were evaluated and 56 were lost as of 30 April 1990. Thus, nearly 10% of Charleston County's historic resources were totally destroyed as a result of Hurricane Hugo. These figures, according to Preservation Consultants, Inc., do not include resources such as vernacular tenant houses or agricultural buildings, churches, or landscape features that, unfortunately, were largely unsurveyed before the storm [*7*]. The Francis Marion National Forest lost nearly 70% of the trees measuring more than 10 in. in diameter. This was only a component of the destruction of more than 4.4 million acres (1.78 million hectares) statewide [*7,23*]. City sites also had a high percentage of trees uprooted or overhead branch canopies destroyed, including a near 50% loss in the Olmstead-designed Hampton Park. At Middleton Place, many of America's earliest camellias survived but the nation's oldest documented red cedar was toppled by Hugo.

The damage survey and a partial analysis completed by Cornell graduate student Christa Ellis with Fred Phillips repeats the general conclusion: "Buildings on the peninsula performed remarkably well in spite of the fact that some were subjected to sea surge, flooding, high winds,

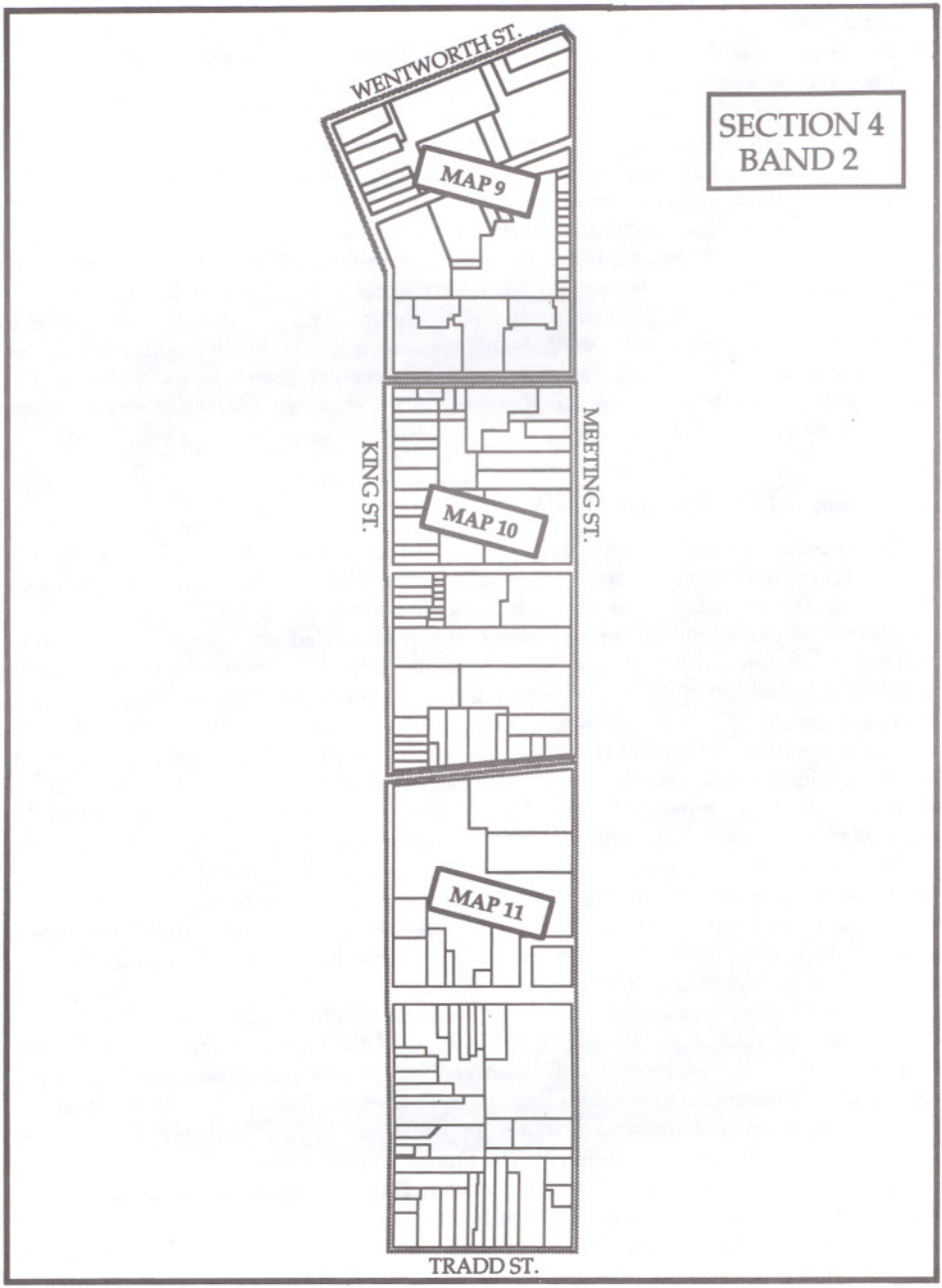

FIG. 7—*Typical Section Map: HCF/COG Damage Survey Program (not to scale).*

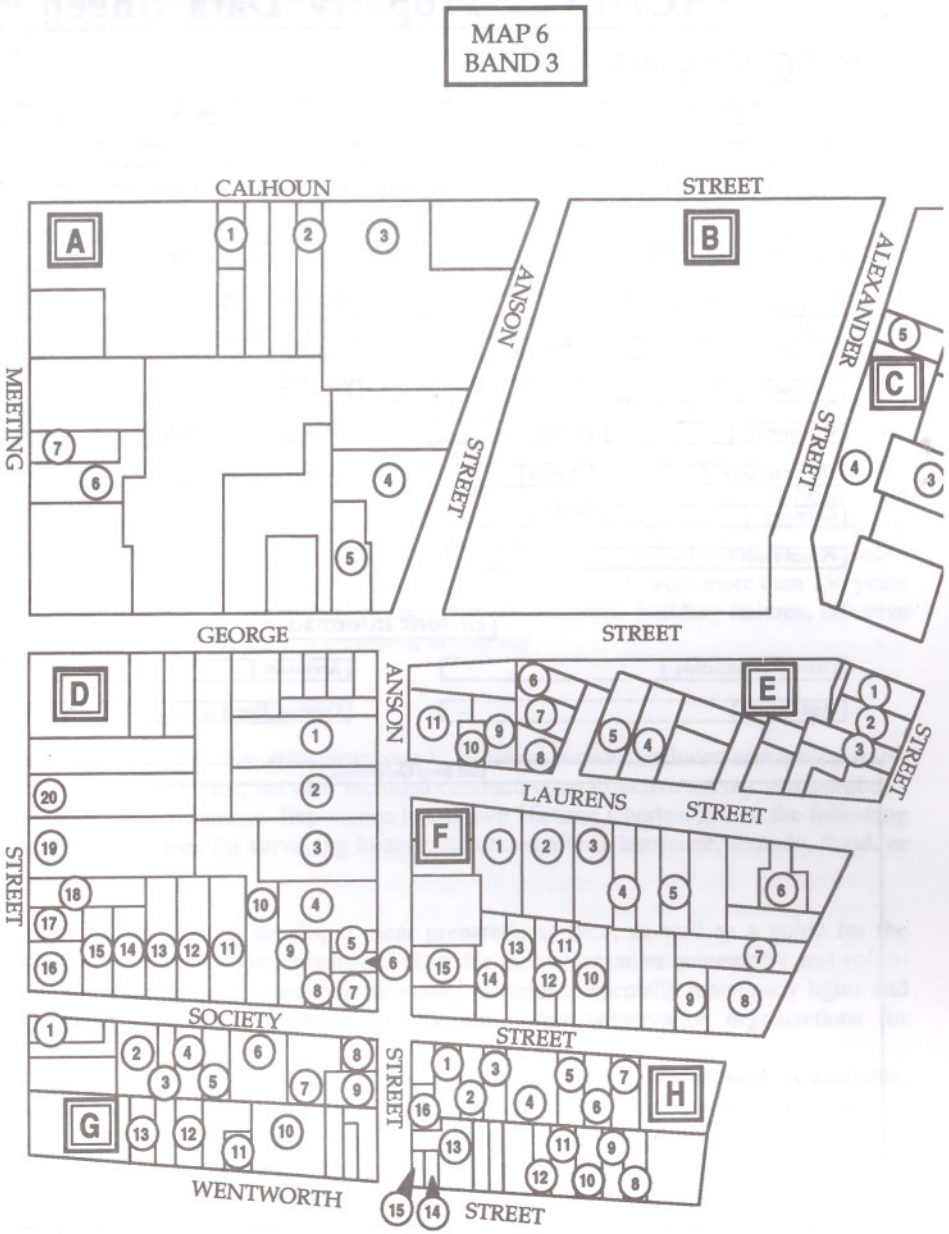

FIG. 8—*Typical Property Map; HCF/COG Damage Survey Program (not to scale).*

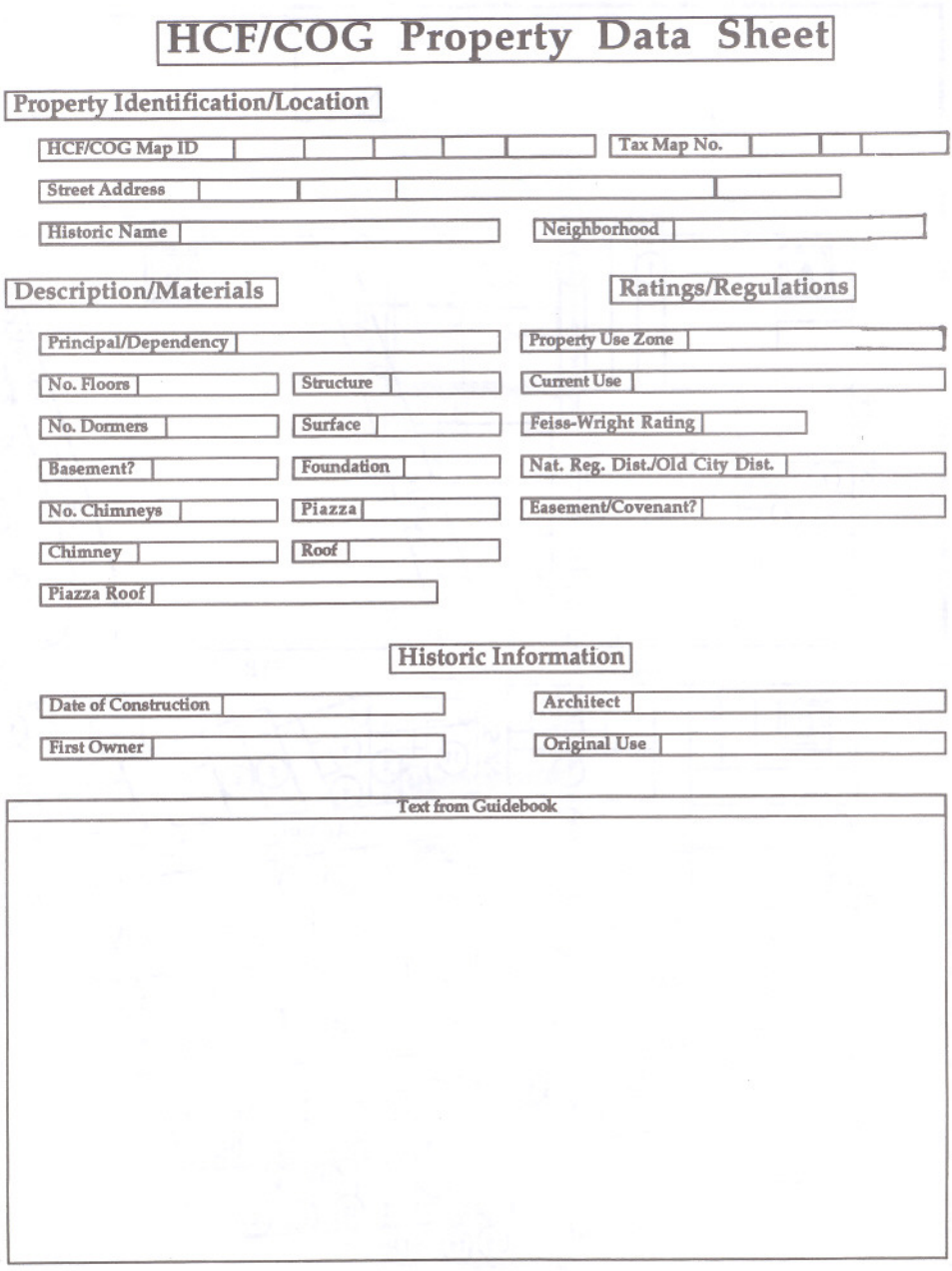

FIG. 9—*Property Data Sheet; HCF/COG Damage Survey Program.*

and battering by wind borne tree limbs and trunks and building fragments'' [*17*]. Ellis' study, looking at earlier correlations with the damage survey, concluded that wood and masonry buildings of some age withstood the stresses effectively without substantial statistical difference. Roofing materials had little difference in performance and only slight changes were noted in figures for chimney collapse between wood and brick buildings. Windows often taped or protected by shutters were relatively protected, and porches and shutters seem to have generally been tied in well enough to have a high percentage of survival [*17*]. Perhaps the most significant difference noted by the preservation community in shutter damage was between older, more substantial handmade shutters and the new, manufactured or thinly constructed types, but this was not quantified by the damage survey. Old shutters, if still fully operable, came through the storm, and true to their purpose, protected windows from harm.

The National Park Service's official trip report, produced by its architectural teams, best analyzed the reasons for the losses of standing-seam metal roofs and slate roofs. While metal roofs were generally in good condition before the storm, failure occurred with fastenings: ''Corrosion of iron nails reduced the mechanical adhesion between sheathing and metal skin allowing the metal skin to peel off during the storm conditions.'' The NPS basically concluded that standing-seam metal roofs were not connected properly at the eave line, adding, ''Where they were installed over deteriorated wood shingles, there was no proper adhesion for the fastenings.'' They further determined with slate roofs, ''Storm damage appeared to be in direct correlation to proper maintenance of the roofs.'' The presence of poor repairs with asbestos or asphalt shingles and various cements, delaminated materials, and widened nail holes evidenced roofs that were at the end of service life [*24*]. Some Charleston roofs were more than 150 years old. In general, it is fair to say, with roofs and with most historic building failures, effective maintenance was the key factor in the amount of damage.

A Guide for an Effective Survey

As illustrated, the most important responses to a natural disaster included emergency stabilization and technical advice, but also included conducting an effective survey and keeping a thorough record of the damage. Experience has shown Historic Charleston that the following could serve as guidelines for surveying historic structures after a hurricane, tornado, flood, or earthquake:

1. Before disaster strikes, develop a clear preparedness plan, as well as a guide for the aftermath, including an organizational chart for the preservation community and volunteers and quick training. Stockpile necessary materials, especially emergency lights and generators. Establish a regional network with other preservation organizations for assistance.
2. After the event, clearly divide duties according to the chart and those workers available, dividing technical information, survey, publicity and fundraising, and other functions, but keeping all integrated to ensure maximum effectiveness.
3. Develop the damage form relative to the results of the disaster, mindful of questions that will need to be answered later and the need for including any information likely to be lost. Also consider computer capabilities and the coordination of data.
4. Develop survey forms and team approaches to other lost or disturbed resources: landscape, graveyards, and archaeological resources (often brought up with uprooted trees), being cautious of preservation guidelines and considerations for native American artifacts.
5. Set clear standards of photography—seek black and white, color slide, and video recordation of all damage.

6. Orient damage recordation crews to the form and the resources to be encountered, as well as to helping property owners seek technical assistance.
7. As recordation is completed, develop a clear system of organization of the hard copies and photography. Keep up-to-date maps of areas completed and those yet to be examined.
8. Develop a computer program for inputting all information.
9. Seek final correlation of data collected, analyze the information, and publish record copies of the results of the survey.

Conclusion

By October of 1993, most storm repair has already been completed, but some major historic structures such as St. Michael's and St. Philip's Churchs are only now competing restoration. Larger restorations, such as returning the Charleston County Court House to its 1792 appearance, are being planned pursuant to lengthy but careful studies. With $2.1 billion in claims paid in South Carolina by private insurers and more than $250 million in FEMA awards, most insurance matters have been settled, although some litigation and controversy continues. Recordation of fragile historic structures continues with several drawing and photogrammetry projects between the Historic American Building Survey and HCF. Building conservation practices have improved and the Foundation has developed new programs utilizing federal Jobs Training Partnership Act Funds to employ youth at risk as apprentices in historic masonry and carpentry. As to the Filevision program, current property records fill only one twelfth of the record capacity. With expanded memory, each record will eventually retain Hugo damage information, historic photographs, zoning and Board of Architectural review application files, title searches, and more.

Historic Charleston has been working with the Citadel on a larger study for disaster mitigation including storm and earthquake stresses and guidelines for strengthening. The most interesting correlation of all may be the input of an exhaustive 1886 building-by-building survey of earthquake damage to Charleston. The correlations between these two disasters and the knowledge about historic building stress will certainly by of interest to ASTM members and all preservationists in the future. Future work with building codes may be possible with a greater understanding of sensitive procedures for strengthening historic construction. Owing also to the many hazards that have beset Charleston over three centuries, Hurricane Hugo records will doubtless be correlated later with the results of yet another disaster, an event that will add to the patina of the historic city.

References

[1] Riley, J. P., Jr., television interview, WCBD Television 21 Sept. 1989.
[2] Ravenel, S. J., *Charleston, The Place and the People*, MacMillan Company, New York, 1912, p. 134.
[3] Rogers, G. C., Jr., *Charleston in the Age of the Pinckneys*, University of South Carolina Press, Columbia, 1980, pp. 28–29.
[4] Ludlum, D. M., *Early American Hurricanes, 1492–1870*, American Meteorological Society, Boston, 1963, pp. 44–47 and 112–135.
[5] Calhoun, J., *The Scourging Wrath of God: Early Hurricanes in Charleston 1700–1804*, The Charleston, South Carolina, Museum Leaflet Series, 1983.
[6] *Earthquake Hazards, Risk, and Mitigation in South Carolina and Southeastern United States*, C. Lindbergh, Ed., The South Carolina Seismic Safety Consortium, Charleston, SC, 1986.
[7] *The Impact of Hurricane Hugo on Historic Resources, Charleston County, South Carolina*, report to Historic Charleston Disaster Fund, Preservation Consultants, Inc., Charleston, SC, 1990, pp. 2–3, 5, 6.
[8] *The News and Courier*, Charleston, SC, 22 Sept. 1989.

[9] Heyward, D., *Porgy*, Doran, New York, 1925.
[10] *The Evening Post*, Charleston, SC, 22 Sept. 1989.
[11] *The Florida Times-Union*, Jacksonville, FL, 23 Sept. 1989.
[12] Memorandum to associate director, Cultural Resources, Charleston Hurricane Assistance Team, National Park Service, Charleston, Nov. 1989.
[13] Nelson, C. L., *Protecting the Past From Natural Disasters*, National Trust for Historic Preservation, Washington, DC, 1991.
[14] "City-Wide Damage Assessment Survey," Department of Building Inspection, City of Charleston, Charleston, SC, 27 Oct. 1989.
[15] *News and Courier*, Charleston, SC, 11 Oct. 1989.
[16] Vitanza, T. A., "NPS Surveys Yield Data on Effects of Hurricane Hugo," *CRM Bulletin*, Vol. 13, No. 1, 1990, p. 13.
[17] Ellis, K. C., "*Disasters and Cultural Property*," Masters thesis, Cornell University, Ithaca, NY, pp. 58, 80.
[18] "Filevision IV," TSP Software, Irvine, CA.
[19] Excel 4.0, Microsoft Corporation, Redmond, WA, 1985–1992.
[20] Canvas 2.0, Deneba Software, Inc., Miami, FL, 1988.
[21] Department of Building Inspection, City of Charleston, Charleston, SC, 27 Oct. 1989.
[22] "Damage Survey Database," Historic Charleston Foundation/Council of Governments, Charleston, SC, 1992.
[23] Smothers, R., "Old and New Help Clear Hurricane-Felled Trees," *New York Times*, New York, 22 Jan. 1990.
[24] Memorandum, Charleston Hurricane Assistance Team, National Park Service, Charleston, SC, Nov. 1989.