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Education Panel

Public Education Related to Coastal Hazards: Case Study - 113 Calhoun Street Project

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INTRODUCTION

Here along the southeastern coast hurricanes and other extra-tropical storms are an inevitability. Wind, flood and surge associated with these storms have caused the loss of hundreds, if not thousands, of lives and property loss in the billions of dollars throughout our history. However the years of the most rapid development of our coast, the 1960s through most of the 1980s, coincided with a lull in storm activity. Between 1954 (Hazel) and 1989 (Hugo) no major hurricanes struck the South Carolina coast. Hurricane Hugo with its \$5 billion in damage provided a wake-up call. Three years later after Hurricane Andrew, the need to find ways to strengthen homes was made even clearer.

In 1994, the Institute for Business and Home Safety (IBHS), an insurance industry group that seeks to reduce insured property loss, conducted a telephone survey of residents in six hurricane prone areas (Corpus Christi, TX; Biloxi, MS; Myrtle Beach, S.C.; and Tampa, Miami and Jacksonville, FL)¹. In that survey three of out ten residents said they would be willing to spend over \$2,000 on significant improvements to their home in order to increase the chances that it would survive a hurricane.

The problem was that no one really understood the most effective ways to make homes more resistant to hazard damage. Following Hurricane Hugo, S.C. Sea Grant supported research by Clemson University Department of Civil Engineering faculty to assess and characterize the damage done to homes along the South Carolina coast and its causes. Researchers found that most of the damage consisted of relatively minor, non-structural breaches to the building "envelope" (roofs, windows, doors). Those breaches allowed rain to enter the structure, damaging or destroying furnishings, fixtures, walls, floors and personal possessions. Often just a few thousand dollars in damage to the envelope resulted in a tenfold greater insurance claim.

¹ Homes and Hurricanes: Public Opinion Concerning Various Issues Relating to Home Builders, Building Codes and Damage Mitigation. 1994. Insurance Institute for Property Loss Reduction (now Institute for Business and Home Safety) 1408 Westshore Blvd., Tampa, FL 33607.

S.C. Sea Grant next began to support research at Clemson University's Wind Load Test Facility to develop and test low-cost, effective methods for making homes more resistant to wind and other hazard damage. S.C. Sea Grant was not alone in this activity. Other such efforts were underway elsewhere, for example in Florida, where the Department of Community Affairs has supported research to identify cost-effective home retrofit methods and materials.

Now we are in the process of moving the information developed in the research laboratory into the hands of people who can use it to protect their homes.

By demonstrating the many ways in which a home can be made more hazard resistant, the 113 Calhoun Street project is providing a bridge to help transfer research-based information on hazard loss reduction from the laboratory to individual homeowners, small contractors, home inspectors, local government and others.

113 CALHOUN STREET

113 Calhoun Street: A Center for Sustainable Living is a public, private, academic partnership to develop and conduct educational programs that address sustainability needs of communities to minimize threats to public health and safety and enhance conservation of natural resources. These strategies represent elements essential for long-term community economic development, resource enhancement and quality of life.

The Center's overall mission is accomplished by developing low-cost tools and techniques, educational activities, and technical assistance programs in three areas:

- Natural Hazards Mitigation
- Sustainable Building Practices
- Sustainable Living

The house at 113 Calhoun Street, in the historic district of downtown Charleston just a few blocks from here, was probably built sometime between 1875 and 1880. It is a variant of the traditional Charleston "single house" style. Over the years it survived the great Charleston earthquake of 1886 and numerous hurricanes, including the major hurricanes of 1893, 1940 and Hazel in 1954. They built houses to last in those days. There was no indication of structural repair in the building when work began on the project. By 1989 when Hurricane Hugo struck Charleston, the house had already been abandoned and left derelict for several years. Hugo tore off much of its roof and it was left to deteriorate in the elements for some six years. The house was near collapse when the City of Charleston donated it to the 113 Calhoun Street Foundation in 1996 as a center for "sustainable living."

The 113 Calhoun Street Foundation was formed in 1995 by the S.C. Sea Grant Consortium, the Clemson University Extension Service and the City of Charleston to renovate and retrofit the house for re-use as a center for community learning on issues of sustainability in urban coastal areas. A project manager, a local architect, Clemson University Civil Engineering faculty, local consulting engineers and a general contractor formed a team to undertake the design and construction of the project. The team's goal was to completely renovate and retrofit the house according to the principles of sustainable building and resistance to natural hazard damage, including that from wind, flood and earthquake.

Several S.C. Sea Grant-supported graduate students from the Clemson University Department of Civil Engineering have worked on or contributed to this project through their studies at

Clemson. The 113 Calhoun Street project provided two of them with the basis for their respective masters and doctoral degree research. One student, Ed Sutt, received an *Outstanding Wind Engineering Ph.D. Award* from the American Association for Wind Engineering in 2000 for his dissertation, *The Effect of Combined Shear and Uplift Forces on Roof Sheathing Panels*.

HAZARD RETROFIT

Following are examples of a few of the hazard retrofits performed on the house during the course of its renovation.² Several of these retrofits are commercially available and all have been tested in University laboratories or certified according to an accepted industry standard or code.

Window Protection

Traditional Wood Colonial Shutters

As mandated by rules governing the historic district, traditional wood shutters were used on the front of the house. For added resistance to debris impact penetration, hardened fiberglass backings have been installed. Because the panels are visible only when the shutters are closed, they may be acceptable for use in historic districts.

Aluminum Colonial Shutters

Aluminum shutters, designed to look like traditional wood shutters, provide much better protection against wind borne debris. These custom made shutters demonstrate that it is possible to manufacture window protection that is consistent with the need to maintain the historical “look” of the area.

Aluminum Window Coverings

Corrugated aluminum window panels are one of the most cost-effective options for homeowners outside the historic district. Aluminum “roll downs,” a more expensive option, are operated manually or electronically.

Polycarbonate “Bubbles”

Polycarbonate bubbles, the same material used in the canopies of F-16 fighter airplanes, will withstand impacts far in excess of any current standard. Because they are “see through” they can be installed at the beginning of hurricane season and left up, making them an attractive option for rental property and by absentee owners.

Impact Resistant Glass

This glass will withstand the impact of a 9-pound, 2”x4” board travelling at 34 miles per hour, which meets the old Miami-Dade building code standard. (It is still a very high standard). A high initial cost may be off-set by the convenience it offers.

² A full description of the hazard retrofits and other renovations can be found on the Center’s web site www.113calhoun.org.

Roof Retrofit

Adhesives

A variety of adhesives (AFG-01 rated) can be used as a retrofit to triple the capacity of a roof to resist uplift forces. A ¼-inch bead of adhesive is applied from the attic to each side of the roof rafters at the junction with the plywood roof decking. This can be done on a “do-it-yourself” basis by a homeowner.

Screws

Although adhesives work well and may be the best choice in certain circumstances, an even better long-term retrofit for an existing roof or for houses under construction is the use of screws to attach plywood roof decking to roof rafters or trusses. Clemson University laboratory research has shown that screws increase the capacity of a roof to withstand hurricane winds by up to a factor of five. Both the screw and adhesive roof retrofit methods are illustrated in two videotapes titled “Holding on to Your Roof, Parts 1 and 2.”

Foundation

The building’s original foundation was “brick on dirt”—non-reinforced brick laid on a compressed earth footing buried about three feet in the ground. Due to the extreme deterioration of the original foundation, it was completely replaced in the course of renovation.

The new foundation has a steel reinforced concrete footing with concrete block foundation walls. The block is filled with a cement grout into which threaded steel rods are anchored. The wooden house frame is bolted to the foundation. This retrofit provides greater resistance to shaking and twisting from earthquake and wind forces and provides the basis of a continuous load path from foundation to roof for vastly improved overall strength.

The original brick from the foundation was re-used as a veneer over the concrete block to preserve the building’s historic character.

In the course of re-building the foundation, the building was elevated by about one foot, producing a substantial flood protection benefit. Clemson University Civil Engineers calculated that raising the building a just a foot would reduce the probability of flood damage by about 60%.

FUNDING

Principal public funding for the construction and program development phases of the project has been provided by:

- Federal Emergency Management Agency (FEMA) through a series of hazard mitigation grants totaling \$350,000.
- The City of Charleston through the donation of the house and land valued at the time at \$110,000 and subsequently appraised at \$426,000.
- Charleston County through the donation of \$30,000 to support the renovation of the house.
- NOAA Coastal Services Center through grant funding totaling \$90,000 to support initial center operations and educational program development.
- The South Carolina Department of Insurance through a \$35,000 grant for hazard related interpretative exhibits and signage.
- South Carolina Energy Office through a \$25,000 “Re-Build America” energy conservation grant for educational exhibits and literature.

Additional support for the project has been provided by more than forty individuals, businesses and non-governmental organizations. Notable examples include BellSouth, Alcoa, Duron Paints, Simpson Strong-Tie, the Joanna Foundation, S.C.ANA Corporation and State Farm Insurance.³

Finally, the S.C. Sea Grant Consortium and the Clemson University Extension Service have each made significant contributions in grant and staff support during all phases of the project.

The construction phase of the project ended in October 2000, when the building was formally dedicated by Charleston Mayor Joseph P. Riley and opened to the public for tours and educational programs.

EDUCATIONAL PROGRAMMING

Today educational outreach programs are being developed and conducted under the auspices of 113 Calhoun Street. Exhibits and interpretative signage is being developed and installed, brochures and videos are being produced, classes offered and house tours are conducted. The Center is staffed by two extension educators - a S.C. Sea Grant Coastal Hazards Specialist and a Clemson University Extension Facility Coordinator, who offer on- and off-site outreach education programs to a variety of interested users. Examples of these programs include:

House Tours

In 2001, over 600 people toured the Center, including youngsters studying environmental issues at a summer youth camp; College of Charleston undergraduates studying historic restoration and design; and architects from a local Charleston firm interested in sustainable design. In addition, the Center receives walk-in visitors, residents and tourists, interested in learning about storm shutters or other features of the house.

Virtual House Tours

Because the Center has a mission beyond Charleston, extending anywhere wind, floods or earthquakes occur, it offers a virtual house tour on its web site www.113calhoun.org with photographs and text on the features on the house. In the last quarter of 2001, the site was visited 3025 times by Internet users.

Classes

The Center staff has also been involved in offering college level and continuing education classes. This winter an upper level undergraduate and graduate course, *Coastal Sustainability*, is being offered by the Clemson University Charleston Architecture Center at 113 Calhoun Street and being co-taught by 113 Calhoun Street staff. Last year, Center staff developed and had certified by the S.C. Real Estate Commission, a continuing education course for Realtors in hazard resistant construction.

Extension Videos

In collaboration with the Clemson University Wind Load Test Facility, two videos, "Holding Onto Your Roof I and II," were produced to help educate consumers and roofing contractors on how to install a more wind-resistant asphalt shingle roof.

³ A full listing of project supporters is appended to this document.

Community Service

Wind-Aid - The Center, in collaboration with the Charleston Area Project Impact, developed and conducted a pilot project, Wind-Aid to assist limited resource elderly residents of Folly Beach, S.C. Project volunteers, using donated materials, built plywood storm window coverings and made arrangements for them to be put-up and taken down in the event of a storm.

Loss Prevention Partnership - In addition, the Center has partnered with the Charleston Homeownership Center in the development and delivery of an educational program on hazard retrofit for low income home owners.

Regional Interactions

With funding from the Blue Sky Foundation of North Carolina, the S.C. Sea Grant Coastal hazard specialist and Clemson faculty created a consumer guide and technical field manual on coastal construction.

National Interactions

EDEN - The Center is an active member of the Extension Disaster Education Network (EDEN). A group of Cooperative Extension and Sea Grant Extension professionals nationwide who work in the field on issues related to disaster planning, response and recovery. The Center will co-host EDEN's national conference in Fall 2002.

HazNet – The Center's web site is linked to the Sea Grant network's hazard web site, HazNet www.haznet.org extending and expanding the reach of its programs and information to Sea Grant constituents in all areas of the country.

Networking – Center staff has identified 14 similar demonstration projects around the country and is organizing a networking for those projects meeting at the National Flood Proofing Conference to be held in Tampa, FL in March 2002.

Media

CBS Morning News – A few years ago, as Hurricane Dennis approached the Carolinas coast, the *CBS Morning News* featured a live network broadcast from 113 Calhoun Street. The national audience got a complete tour of the building and its hazard resistant construction elements.

Bob Villa's Home Again – The popular cable television program on home remodeling featured a tour of the building by Center staff that highlighted the hazard-related elements of the house.

CONCLUSION

Those of us involved in the 113 Calhoun Street project have learned the importance of partnership and collaboration. The contribution of each agency, institution, organization, business and individual has been critical to the success of our project. We would have failed without our partners. Federal policy should encourage, facilitate and nurture partnerships and collaborations among agencies of government, business and academia at all levels.

Extension education programs help to create a link between university and government research and communities. They encourage two-way communication between scientists and

the users of scientific information. Extension educators help identify problems within communities and among user groups that can be solved through scientific research. They help communicate those problems to scientists. They bring scientists and users together to help ensure that research leads to useful applications that help solve problems. Federal policy should place a high value on this form of education and devote sufficient resources to develop and expand it further.

Effective extension education programs rely on current research – basic and applied. While scientists and engineers have learned a great deal about the nature and effects of coastal natural hazards in recent years, there is still more to learn. A strong Federal commitment to hazards research is needed to continue addressing the problems of natural hazards with effective extension education programs.

The 113 Calhoun Street project has focused on home protection, but there are many other hazards-related issues that could be addressed through research and extension education programs. For example, even as the ability to better forecast hurricane landfall improves, coastal population growth is making effective evacuation of threatened populations more difficult. As growing coastal populations overwhelm the ability of transportation infrastructure to handle mass evacuations, the ability to target high-risk areas for evacuation and to safely enable more people to shelter in place has become apparent.

There is a critical role for Sea Grant scientists and extension educators in finding and communicating solutions to these and other coastal hazards problems.

113 Calhoun Street: A Center for Sustainable Living

Partners, Donors and Individual Contributors

Partners

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Charleston County
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George Rose
Mr. & Mrs. George F. von Kolnitz

Biography

Robert H. Bacon S.C. Sea Grant Extension Program

Since 1990, Robert Bacon has worked in the S.C. Sea Grant Extension Program, a collaborative outreach effort of the S.C. Sea Grant Consortium and the Clemson University Extension Service. Serving as Program Leader since 1992, Bacon works primarily on issues related to coastal recreation and tourism and coastal hazards.

In 1995, Bacon was appointed Project Manager for the 113 Calhoun Street project. He coordinated the activities of a team of architects, engineers and builders in the design, retrofit and renovation of a "Charleston single house" for use as a community learning center. The renovation was completed in October 2000 and Bacon continues to oversee the Center's hazard education programs. The 113 Calhoun Street project has won two national awards: The 1999 John R. Shaeffer Award for Excellence in Flood Proofing from the Association of State Flood Plain Managers and the Federal Emergency Management Agency's Project Impact 2000 Livability Award in Historic Preservation.

In addition, Bacon is currently collaborating with staff at the NOAA National Severe Storms Laboratory and the National Weather Service on a project that uses advanced weather radar technology and hydrological modeling in a web-based delivery system to improve flood warnings in coastal areas.

Bacon received a Bachelor of Arts degree (1972) in Anthropology from the George Washington University in Washington, D.C. and a Master of Arts degree (1979) in Recreational Resource Management from the University of Maryland in College Park, MD.

Bacon is serving a three year term on the Executive Committee of the Assembly of Sea Grant Extension Program Leaders and was its Chair in 2001.