

Perceptions on the Natural Disaster Resilience of Homes in the Southeastern United States

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Abstract

Natural disasters such as hurricanes, floods, and earthquakes can cause millions/billions of dollars in economic damages in the southeastern United States (US) and result in extended recovery times for communities and homeowners. In an effort to capture public perception on the resilience of housing to natural disasters in the southeastern US – and to reduce future economic losses – a survey was conducted. The survey was distributed to key stakeholders, and the questions in it were designed to determine the educational and research need perceptions required to make homes better survive hurricanes, floods, and earthquakes. More than 350 surveys were collected and analyzed. The most significant finding was that 91% of the respondents thought that homeowners need to be better educated with respect to the natural disaster resilience of housing. Regarding information on recovery and rebuilding, most respondents turned to government agencies for assistance and found the received information helpful. Finally, with regards to perceptions on the survivability of various housing elements in natural disaster situations, most respondents correctly understand the most vulnerable features of a home in earthquake and hurricane events. However, they incorrectly perceive that insulation is the most susceptible part of a home in a flood.

Introduction

The economic recovery from the effects of a natural disaster is a resource consuming process that affects both the impacted community and the national economy. For example, after Hurricane Hugo, overall insurance claims were approximately 60,000 and reached \$2.6 million dollars (Huang, Rosowsky, and Sparks 2001). Similarly, following Hurricane Katrina, the unemployment rate for New Orleans was 20% and the average wage loss was around \$2.9 billion dollars (Dolfman, Wasser, and Bergman 2007). The national economy suffered from this catastrophe as well via increased gas prices from the temporarily shutdown crude oil and natural gas production in the Gulf of Mexico (Townsend 2006). Other natural disasters such as earthquakes are not prevalent in the Southeastern United States, but it is worthwhile to mention that they can result in severe damage as well. For example, the historic earthquake in Charleston, SC in 1886 damaged most of the buildings and resulted in \$5-6 million in property damage (Stover, Coffman, and Scott 1993). Countless additional examples exist on the negative economic effects of natural disasters on the southeastern United States (US) Li and Ellingwood (2006) and Townsend (2006).

Natural disasters in the southeastern US significantly affect housing, and the negative economic impact is increasing because the population and the number of housing units in the Atlantic, Gulf of Mexico and Pacific have more than doubled in the last five decades (US Census Bureau 2010). Hurricanes, for example, cause one billion dollars annually of wind-related damage to homes (Li and Ellingwood 2006; van de Lindt et al. 2007). In general, during a hurricane event, the most vulnerable part of the home is the building envelope, such as the roof, windows, and doors (Li and Ellingwood 2006) and, unfortunately, once the building envelope is

penetrated, water and wind effects cause more severe damage inside the structure (van de Lindt et al. 2007; Reinhold 2008).

Unfortunately, people living in high risk areas such as the southeastern US are not aware of the potential danger that they and their homes face from natural disasters (Kunreuther 1976). For example, a Mason-Dixon Poll in 2009 showed that coastal residents did not think that they were vulnerable to hurricanes/tropical storms and approximately 80% of the respondents did not use any mitigation techniques to make their homes more disaster resilient (Mendez 2009). This result is interesting to note in light of the fact that visible mitigation techniques (e.g., storm shutters) increase the selling price of homes by 5% (Simmons, Kruse, and Smith 2002).

It is clear that, in order to reduce the economic losses caused by natural disasters, it is crucial to encourage homeowners to build their homes in a more natural disaster resilient fashion. However, in order to target both assistance and information to them, it is important to understand their basic knowledge of resilient housing as well as their concerns and needs. Thus, the goal of this study was to determine the perceptions of the natural disaster resilience of homes in the southeastern US. To accomplish this goal, a survey was designed and distributed to key stakeholders concerning various aspects of natural disaster resilience in housing. Specifically, the questions in this survey were designed to determine the educational and research need perceptions required to make homes better survive hurricanes, floods, and earthquakes.

Methodology and Survey Design

A 17-question survey was developed to collect information about research and education needs related to resilient housing. The questions were designed to gather general information on the respondents, their experience with natural disasters, and discover the primary sources for their information. In addition, the survey included some specific questions such as the

survivability of residential construction elements in different natural disaster scenarios including hurricanes, floods and earthquakes.

The survey was designed in early 2008 and tested by distributing it to a small segment of the target population. Based on the feedback, revisions were made and the final version was distributed during the summer of 2008. The survey was written in Survey Monkey and was distributed at building conferences and workshops throughout the southeastern US and on-line and by mail to housing-related organizations (such as the Extension Disaster Education Network, the American Institute of Architects, state homebuilding organizations in the southeastern US, state and federal government agencies, etc.). Descriptive statistics and chi-square tests were used to analyze the results of the survey using SAS software (SAS Institute 2006).

Results and Discussion

Demographics

A total of 385 responses were collected; however only 367 surveys were useable due to missing values from skipped questions. The population that was targeted for this survey was from the southeastern US, primarily Alabama (AL), Florida (FL), North Carolina (NC), South Carolina (SC), Georgia (GA), Virginia (VA), Kentucky (KY), Mississippi (MS), and Tennessee (TN). Overall, 89% of the responses were from these states with the highest response rates coming from NC, FL, and AL (Figure 1). The stratified sample from the target audience included builders, homeowners, extension agents, architects, engineers, government officials, manufacturers, and other housing-related professionals.

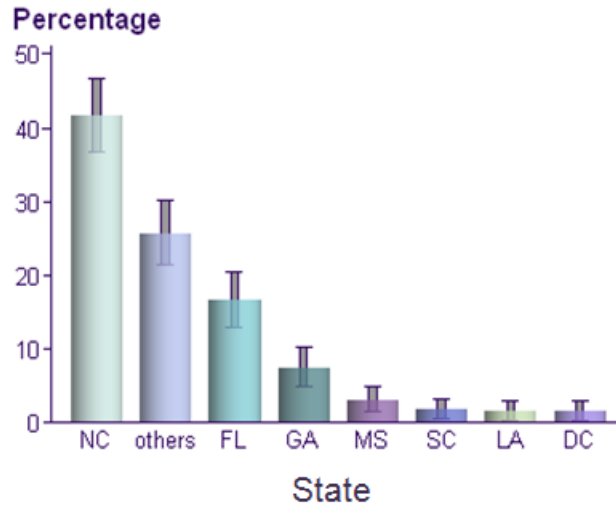


Figure 1. Distribution of the survey respondents by state

More than 90% of the respondents were homeowners (Figure 2), and the majority experienced natural disasters (Figure 3). For example, more than 65% of the respondents experienced hurricanes and approximately 25% experienced floods (Figure 4).

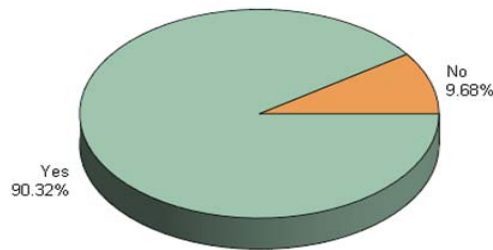


Figure 2. Homeownership of survey respondents

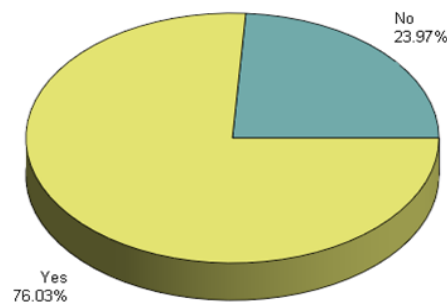


Figure 3. Natural disaster experience of respondents

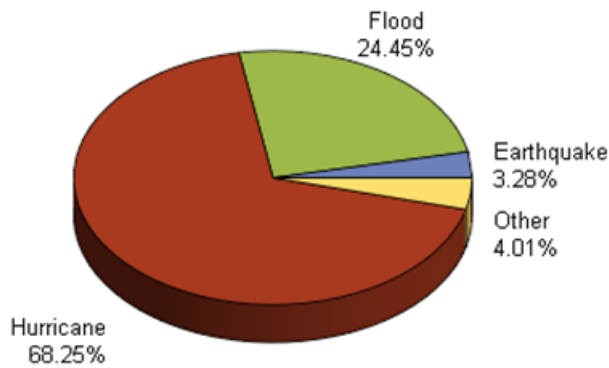


Figure 4. Types of experienced natural disasters

Those who experienced natural disasters indicated whether they had minimal, moderate, or extensive damage (Figure 5). From among those who experienced hurricanes, the reported damage was minimal (Figure 6). On the other hand, those who experienced floods reported their damage was moderate (Figure 7).

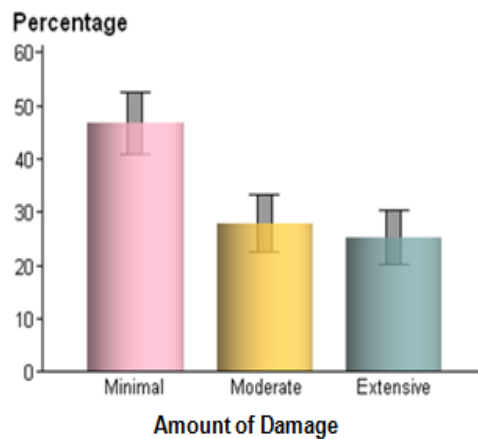


Figure 5. Reported damage after natural disasters

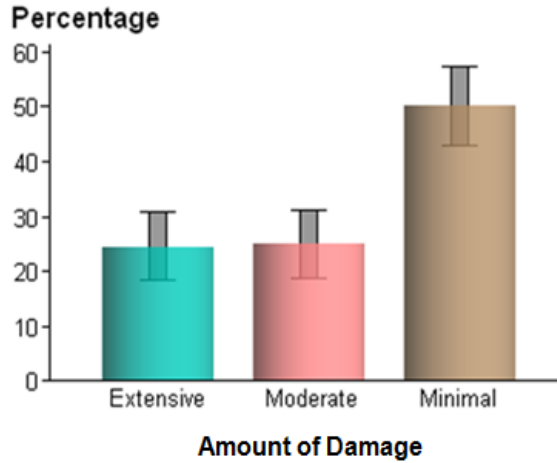


Figure 6. Reported damage after hurricane event

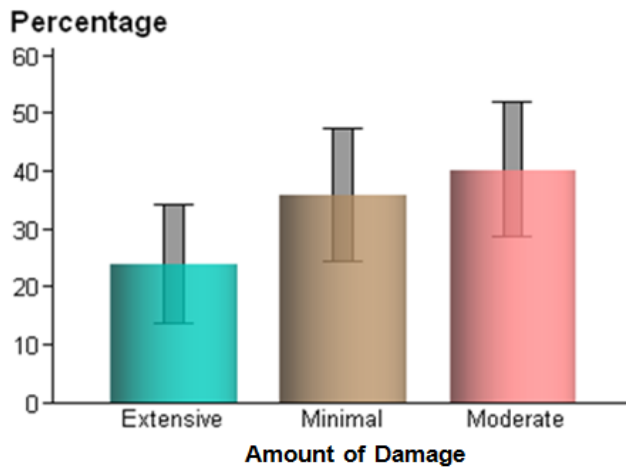


Figure 7. Reported damage after flood event

Sources of Information

The majority of the respondents to the survey turned to government officials, media (e.g., television, radio and newspapers), insurance agents, and builders to look for information concerning recovery and rebuilding following a natural disaster (Figure 8). Regardless of the primary source of information concerning recovery and rebuilding, however, most respondents were satisfied with the received information (Figure 9). To measure how efficient this received information was, the association between the primary source of information and the quality of

the received information was determined by performing a chi-square analysis. The chi-square test resulted in a p-value of 0.0007 indicating a significant relationship between the source of information and the quality of the information. In other words, those people who turned to government agencies for information tended to be more satisfied with the received information than those who turned to other sources. However, the relationship was weak between the two variables (Spearman's correlation of 0.09).

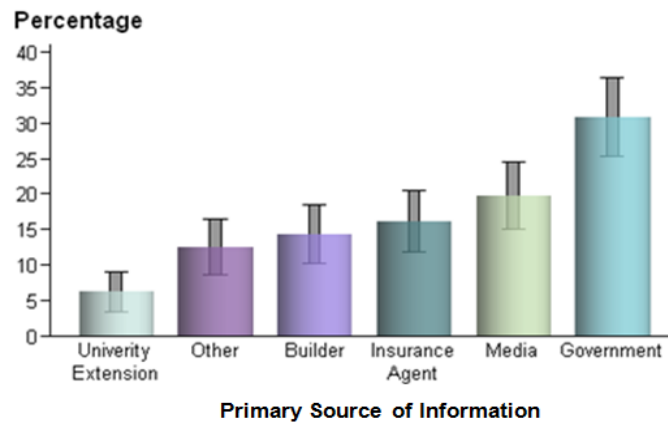


Figure 8. Primary source of information after a natural disaster

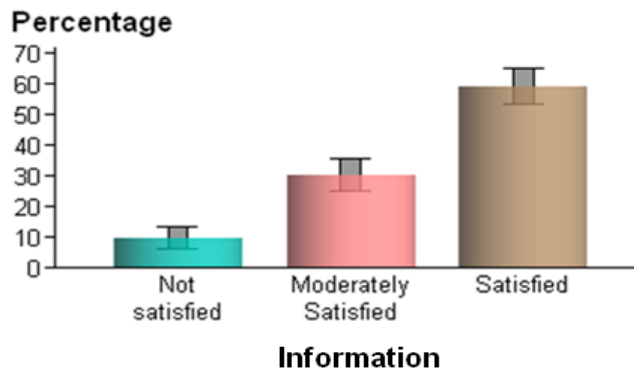


Figure 9. Satisfaction with the received information after a natural disaster

Needs of Homeowners

The majority of respondents (56%) felt that new building materials or construction practices should be developed to make homes more resilient to natural disasters. To investigate whether any correlations exist between either the disaster-experienced group and the disaster-inexperienced group with respect to new construction technologies, chi-square statistics were calculated on the collected data. The p-value (0.07) obtained from the test showed a marginally significant relationship between the two variables. This result suggests that, for people who experienced a natural disaster, it is more important to develop new construction technologies in order to be better prepared to and recover from a natural disaster.

A significant portion of the respondents (90%) indicated that homeowners need to be better educated about the natural disaster resilience of homes. A study conducted in 2006 supports this result by stating that people need to be better educated about the risks that are associated with the location of their homes (Hauser, Elmes, and Swartz 2006). A Mason-Dixon poll (2009) was conducted in the Gulf and Atlantic coasts and showed that a significant portion (approximately 90%) of the respondents did not reinforce their home to better prepare for the 2009 Hurricane Season (Mendez 2009). This attitude did not seem to change by 2010 either, unfortunately, as the Mason-Dixon poll (2010) showed that approximately 74% of the respondents did not apply any reinforcement techniques on their homes once again (The National Hurricane Survival Initiative 2010). In addition, the results of this poll support the need for better education of homeowners about the vulnerable parts of their homes towards different natural disasters. For example, approximately 95% of the respondents did not know that garage doors are vulnerable structural parts of homes during hurricanes. Moreover, 33% of the respondents thought that the basement is the safest place of the home to ride through hurricanes despite the

fact that the most interior part of the home is the preferred place (The National Hurricane Survival Initiative 2010).


Since a significant portion of our respondents wanted to see more education for homeowners on the natural disaster resilience of homes, the relationship between disaster experience and the need for homeowner education was compared using chi-square statistics. The p-value (0.2118) of the chi-square test showed no association between the two groups. Regardless of disaster experience, however, the need for a better education was equally important for both groups.

Perceptions of Housing Survivability

The respondents to our survey were asked to rank various housing elements with regards to their survivability to different natural disasters, i.e., hurricanes, floods, and earthquakes. The results of responses to this question are shown in Table 1 and, based upon them, the following three major conclusions can be drawn:

- There is a clear perception that different portions of the house will survive to lesser and/or greater extents for different disaster scenarios.
- In hurricanes, the roof system seems to be the most vulnerable part.
- During flood events, the insulation seems to be the weakest link.

Table 1. Summary of responses to the residential construction survivability question “Which of the following items in residential construction have the most problems surviving natural disasters? (Check all that apply!)” by natural disaster types.

	Hurricanes	% of responses	Floods	% of responses	Earthquakes	% of responses
Least survivable	Roof	99.3	Insulation	86.1	Foundation	76.1
	Construction Practices	91.4	Electrical System	83.5	Plumbing	70.8
	Framing Practices	88.5	HVAC	82.0	Framing Practices	66.3
	Materials for Wall Construction	83.9	Materials for Wall Construction	74.2	Construction Practices	63.8
	Insulation	66.9	Construction Practices	62.6	Materials for Wall Construction	56.3
	Electrical System	61.6	Foundation	56.4	Electrical System	39.7
	HVAC	59	Plumbing	49.4	HVAC	32.6
	Plumbing	43.3	Framing Practices	44.4	Roofing	25.6
Most survivable	Foundation	25.4	Roofing	17.8	Insulation	11.7

Note: Margin of Error: 6.4%

Similar as in other studies, the respondents of our survey identified the roof and foundation as the most vulnerable part of a home during hurricanes and earthquakes, respectively (Sparks, Schiff, and Reinhold 1994; NAHB 1994). Interestingly, with regards to flood events, our respondents identified the insulation as the perceived most vulnerable component of the house. (FEMA 2009) reports that the foundation and flooring systems are the most vulnerable parts of homes during flood events. Given this discrepancy, it is clear that better education and outreach materials are needed with regards to the vulnerable parts of homes during flood events.

Factors in Disaster Preparedness and Recovery

The relationship between different attributes such as cost, energy efficiency etc. were analyzed to explore what the important factors are regarding disaster preparedness and recovery before and after natural disasters strike. Chi-square statistics were used to test the independence of one or more the attributes, and the tests (Table 2) showed significant relationships at the 0.05 significance level. Spearman's correlation was used to measure the strength of these relationships, and all comparisons showed them to be moderately strong. The strongest one was found for sustainability ($\rho=0.74$) and the weakest for cost ($\rho=0.23$) and speed of installation ($\rho=0.24$).

Table 2. Chi-square and Spearman's correlation summary table

Comparison (before-after)	Chi-Square	P-value (exact)	Spearman Correlation (ρ)	Confidence Interval
Cost	33.80	1.046E-04	0.2304	0.0935 – 0.3673
Speed of Installation	17.05	3.742E-04	0.2470	0.1231 – 0.3709
Simplicity of Installation	52.5247	7.773E-11	0.4074	0.2794 – 0.5354
Sustainability	223.3469	1.425E-44	0.7380	0.6729 – 0.8031
Energy Efficiency	140.9155	1.920E-28	0.5639	0.4734 – 0.6545
Do it yourself	146.5924	3.984E-19	0.5957	0.4957 – 0.6957

Those who have experienced disasters should rank certain attributes differently than those who have not. For example, individuals who have experienced a flood might find that the speed of the installation of materials and their costs are the most important factors in disaster recovery. To test this hypothesis (that is, that different responses can be expected between those who have

experienced natural disaster and those who have not), chi-square statistics were used to detect any relationship for these attributes. Interestingly, based on these tests, none of the comparisons were significant at the 0.05 significant level. This result implies that, in spite of their disaster experience, the two groups ranked the attributes similarly.

Summary and Conclusions

This research project was conducted to explore the opinions of homeowners, builders, and others concerning various aspects of housing and natural disaster resilience. Results show that the majority of the respondents think that homeowners need to be better educated regardless of their disaster experience on issues relative to preparedness and resilience of homes. Therefore, more educational materials should be developed and distributed by different agencies such as state and federal government, builder associations, local communities, and electronic media.

In general, respondents expect the development of new construction practices and materials to improve the natural disaster resilience of homes. Those who experienced disasters are more interested in developing new construction practices as indicated by the marginal relationship between the need for new technologies and the disaster experience. Those who received information after a natural disaster from governmental agencies were satisfied with the received information.

Based on our results, future surveys regarding the natural disaster resilience of homes should involve the collection of additional demographic data such as age, income, social status, and level of education. This information will be useful to identify the different target audiences in order to target specific educational materials for maximum effectiveness.

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