



A Resource of the State of Florida

**HURRICANE LOSS REDUCTION
FOR
HOUSING IN FLORIDA**

**A Research Project Funded by
The State of Florida Department of Community Affairs
Through Contract 03-RC-11-13-00-05-012**

QUARTERLY REPORT No. 3

For Quarter Ended March 31, 2003

Reporting Requirement # 5

DUE BY April 15, 2003

PREPARED BY
THE INTERNATIONAL HURRICANE CENTER
FLORIDA INTERNATIONAL UNIVERSITY

HURRICANE LOSS REDUCTION FOR HOUSING IN FLORIDA
A RESEARCH PROJECT UNDERTAKEN BY
THE INTERNATIONAL HURRICANE CENTER
At Florida International University

QUARTERLY REPORT FOR THE PERIOD ENDED MARCH 31, 2003

SUMMARY

This report summarizes the activities of the International Hurricane Center (IHC), at Florida International University (FIU), and its research team related to the project designated as *Hurricane Loss Reduction for Housing in Florida* (hereinafter Project) being funded by the Florida Department of Community Affairs (DCA) under contract # 03-RC-11-13-00-05-012 executed on August 6, 2002.

This quarterly report covers activities of the IHC research team from January 1, 2003 through March 31, 2003. This quarterly report is submitted in compliance with Reporting Requirement #5 of above referenced contract. There are no problems or circumstances currently affecting the completion date, milestones, scope of work, and cost of the project.

Ricardo A. Alvarez, Deputy Director at the IHC, is Principal Investigator (PI) and Project Director. Carolyn Anderson, Research Associate at the IHC, is responsible for project coordination.

Major activities during the period covered by this report include:

1. January 10, 2003: a working meeting of the IHC Project Team was held at the FIU Management and Advanced Research Center.
2. January 15, 2003: Second quarterly report, covering activities from October 1, 2002 through December 31, 2002 was completed and delivered to DCA on schedule.
3. January 22, 2003: Harvey Ryland of the Institute for Business and Home Safety (IBHS) visited FIU and met with Ricardo Alvarez to discuss our research current

agenda for the HLMP project including various roof sheathing nailing schedules, and the resulting improvement in roof performance under hurricane conditions.

4. February 20, 2003: A meeting was held with FIU, Texas A&M University, FLASH and DCA to discuss and incorporate input from these institutions into the Statewide Survey instrument.
5. February 26, 2003: A meeting was held with National Instruments to finalize the purchase of computer and data acquisition/software systems for the Flat Roof Instrumentation testing.
6. Demolition of the three single-wide mobile home units was carried out and completed commencing during the week of March 17, 2003. A double-wide unit was delivered at our testing area on the CEAS campus for demolition. These activities are part of the mobile home “recycling” component of our current research agenda.
7. Testing for the roof sheathing nailing schedules began during the week of March 31, 2002. Two types of nails are being compared, 8d common nails currently prescribed by the Florida Building Code and 8d ring shank nails.
8. The Statewide survey commenced in March 2003. Analysis on the data will be conducted during the last quarter.

ORGANIZATIONAL/ADMINISTRATIVE ACTIVITIES

During this quarter, the final research team was assembled at both the IHC and participating universities. The assembled research team is as follows:

Principal Investigator: Ricardo Alvarez FIU/IHC

Project Manager: Carolyn Anderson FIU/IHC

Principal Researchers:

Syed Ahmed	FIU	Construction Management
Ronald Baier	FIU	Construction Management
Amaury Caballero	FIU	Construction Management
Jaime Canaves	FIU	Architecture
Jason Chandler	FIU	Architecture
Nicole Dash	UNT	Sociology
Jack Dye	FIU	Construction Management

Eugene Farmer	FIU	Construction Management
Hugh Gladwin	FIU	IPOR
T. Trent Green	USF	Architecture
Martha Gutierrez	FIU	High Performance Database Research Center
Alex Ratensky	USF	Architecture
Alfredo Ravinet	FIU	HCET
Timothy Reinhold	Clemson	Civil Engineering
James Rivers	FIU	Lab. For behavioral & Social Research
Walt Peacock	TAMU	Landscape Architecture & Urban Planning
Edgar Polo	FIU	HCET
Stephen Schreiber	USF	Architecture
Kang Yen	FIU	Construction Management

Research Assistants:

Christien Acosta	FIU	Construction Management
Michael DeLoach	Clemson	Civil Engineering
Carlos Escuti	FIU	Architecture
Ernesto Iona	FIU	Construction Management
Kevin Nickorick	USF	Architecture
Mary Phillips	Clemson	Civil Engineering
Scott Robinett	Clemson	Civil Engineering
Swapnali Salunkhe	USF	Architecture
George Torrente	FIU	Architecture

Undergraduate Students:

Victor Campos	FIU	Architecture
Brian Dick	Clemson	Civil Engineering
Cos Gardner	Clemson	Civil Engineering
Kyle Hardee	Clemson	Civil Engineering
Jon Lamb	Clemson	Civil Engineering
Brie Losego	FIU	Architecture

*** Other research assistants will include a minimum of 5 graduate and under graduate students located at four universities.**

Support Staff:

Kyle Campbell	USF	FCCDR
Maria Cano	FIU	IHC
Scott Caput	FIU	IHC

Zusana Havlacoca	FIU	IHC
Regnier Jurado	FIU	IHC
Ana Rouco	FIU	IHC
Jennifer Sandford	USF	FCCDR

ACTIVITIES BY RESEARCH TOPIC

Eliminating State and Local Barriers to Upgrading Existing Mobile Homes and Communities

I. RESEARCH ACTIVITIES

1. The IHC team continues to look at existing mobile home parks in Hillsborough, Pinellas and Polk counties that are marginal, with a view to their redevelopment. The IHC research team has had difficulties in obtaining information relative to mobile home parks that may have shut down in recent times, and which could be used as case studies for purposes of this research. Request for information have been made to representatives of the federation of Mobile Homeowners, the Florida Manufactured Housing association and others with whom the IHC team had met late in 2002, but no specific information had been received by the end of the first quarter of 2003. The IHC team also contacted several individuals in the City of Largo, including Richard P. Goss, Director, Community Development Dept, and Richard D. Cannone, Program Planner within the same department, seeking relevant information for this research topic, but without much success..

2. Accordingly, the IHC research team has been working with publicly available information including tax assessor data, to begin our portion of the study. The team has visited, explored where allowed, and photographed six parks. To date the following parks have been examined, all in Pinellas County: Louis Palms, Rainbow Court, Belleair Village, Whispering Pines, Sunpiper Trailer Park and Keystone.

3. The IHC team has looked for general patterns of land use to ascertain whether any conclusions we reach could be generalized. Initial findings are that the layouts of these parks are very similar, and that patterns of re-use should be generalized. It has been ascertained that the City of Largo has decided not to allow re-use of existing mobile home parks at the same densities. What we have noticed in our studies of land use patterns in the above parks is that the densities on adjacent or nearby blocks are only moderately less. Once we get a response from city officials we will explore with them what densities may be allowed in order to compare those to those of adjacent blocks. On the basis of land use patterns alone it seems probable that affordable re-use of marginal mobile home

parks after re-platting to meet codes could be feasible. However, there are other considerations we have begun to study. These include: land tenure, regulatory and infrastructure.

4. The IHC research team has developed a three-prong approach to understand the specific pressures that have played a role on closed (or closing) mobile home parks, the reason why the park was closed or abandoned.
 - i. The team has contacted the office of the Mobile Home Relocation Trust, a statewide program intended to financially help mobile home park residents, in re-zoned parks, move. The staff has agreed to send the team a database of people who have benefited from the trust.
 - ii. The team is studying two specific recently closed parks: one is Pinellas and the other in Hillsborough. Lake Seminole Campsite closed to make room for a Home Depot) and Sunnydale closed to make room for an apartment complex. The team is analyzing city directories from prior to the closings to develop a list of residents. It is then using current directories in an attempt to locate where the residents have moved.
 - iii. The team is using other information from public records and the media to determine circumstances of mobile home relocation.

II. Preliminary Findings

1. The process of tracking mobile home park residents during a relocation period has proven to be quite difficult.

Development of a Replacement Program for Existing Older Mobile Homes

I. Research activities

1. Current research appears to indicate a comprehensive mobile home replacement program may be too difficult to implement, not because of technical reasons, but due to social and economic issues. Based on these findings the IHC team is exploring the re-focusing of research under this topic. Input from the Florida Manufactured Housing Association and Florida Mobile Home Owners organization is being taken into account for these purposes.
2. A new focus of the research may be the federally mandated wind zone requirements that affect both the manufacturing and the location of manufactured housing units in Florida. There are three wind zones in Florida (Figure 1).
 - i. For those counties in the highest wind zone (Zone 3), any replacement of existing mobile homes with new mobile homes must meet the strictest wind requirement.

- ii. Mobile homes that meet the strictest wind zones are mainly manufactured to order and are more expensive than those manufactured for zones 1 and 2. Very few, if any, exist on the pre-owned market.
- iii. However, there are affordable Zone 2 mobile homes available on the pre-owned market that offer a much improved design and structural performance over pre-1976 mobile homes that may be currently installed in Zone 3.
- iv. Statute doesn't allow these Zone 2 Mobile homes to be brought into Zone 3 locations
- v. A new focus of this research would be to investigate the feasibility of temporarily modifying current statutes to allow Zone 2 Mobile Homes to replace pre-1976 units now located in Zone 3 Counties.

The axiom for the new focus is as follows: although units manufactured to Zone 2 requirements may be less wind resistant than those manufactured for zone 3, these Zone 2 units may be considerably better, in performance under extreme winds, than those older pre-1976 units manufactured before there were any national standards. The IHC team is carefully considering including this specific focus of research in the research agenda for the 2003/2004 period that will be submitted to DCA in the near future.

- 3. The IHC team has found some serious interest in the idea of rehabilitating (rehabbing) older mobile homes as a method of extending the life of the unit, strengthening it to some degree, and also to contribute to the financial viability of mobile home parks where older, poorly maintained and deteriorating units may be causing problems for the overall viability of the place. Preliminary information shows rehabilitation may cost between \$500 and \$10,000. Older mobile homes tend to leak, and these leaks can cause significant problems with flooring, roofing, ceilings and interior finishes in general. While there is no evidence that rehabbing will contribute to improving the structural performance of older mobile homes, it is an important area of research. The IHC team is considering the benefits of including this research topic in the 2003/2004 period research agenda.
- 4. Advanced Industrial Hygiene Services, Inc., was given a contract for asbestos and lead inspection on the doublewide mobile home unit at Rexmere Village Mobile Home Park. Both inspections were carried out in February, 2003.
- 5. The demolition of 3 single-wide mobile home units at our test facility was carried out on 3rd week of March. Blanchard's Mobile Home Removals & Transport, Inc., was given the contract for this demolition process. Since the floor and ceiling of

mobile homes were found to contain asbestos, wet-demolition process was used to prevent the dispersion of any airborne fibers that can release during the demolition. A hose with a nozzle capable of producing mist was employed for this purpose. Mobile home units were torn into segments using a backhoe with a grapple fork attached (figure 2, 3 and 4). All three mobile homes were demolished at the same time.

6. Different materials, waste, recyclable, and salvageable materials, from the three mobile homes demolished, were arranged into individual piles and later weighed. Following is the list of materials arranged:
 - Wood debris and chips
 - Combination steel (steel from roof, floor, house hold items, pipes etc.)
 - Insulation (Fiber glass and thermo insulation)
 - Plastic pipes
 - Wires
 - Aluminum
 - Copper
 - Carpet and padding
 - Steel frames and axles
7. The University Waste Management Center, located at the FIU Park Campus, was given the contract for disposing off the waste materials that resulted from demolition. Eight 20-yd³ dumpsters were used to collect the demolition debris. The weight of each category of materials obtained from these mobile home units was recorded.
8. All the waste materials, other than recyclable metals were transferred to the dumpsters. The Waste Management Center charged to FIU at a cost of \$85.41 for dropping off each dumpster and additional \$ 40 for each ton of waste material. These charges compare favorably with those billed by private waste management facilities in this area. The asbestos contained floor and ceiling were packed in separate double plastic covers and handed to FIU Waste Management Center.

II. PRELIMINARY FINDINGS

1. Currently 14 counties in Florida are designated Wind Zone 3 counties. For those counties in Wind Zone 3, mobile homes need to be built to withstand stronger wind loads. In Florida, the other 53 counties are designated Wind Zone 2. The map shows the geographic distribution of wind zone 3 counties in Florida. There is no wind zone 1 in Florida.

2. Analysis of Census Data allows us to better understand the distribution of generation 1 mobile home through Florida.
 - i. Of the 14 Zone III counties, Pinellas County, with 25,271, has the most occupied generation 1 mobile homes. Even more significant is that of all the occupied mobile home in Pinellas, 72% were built before 1980.
 - ii. Six other Zone III counties have more than 60% of all occupied mobile homes built before 1980. These counties are: Broward, Manatee, Martin, Monroe, Palm Beach, and Sarasota.
 - iii. Of all the Zone II counties, Polk County has the most generation I mobile homes with 13, 860. Significantly important, however, is that this only represents 30% of all mobile homes in Polk.
 - iv. No county in the Zone II area has more than half its mobile homes from generation 1. On the other hand, 7 out of 14 counties in Zone III have half or more of their mobile homes from the earliest, most vulnerable generation.
 - v. Overall, 58% of all occupied mobile homes in Zone III are from generation 1, while 35% of all occupied mobile homes in Zone II are the most vulnerable.
 - vi. See appendix 1 and 2 for county details.
3. Comparisons of Wind Zone 3 data and Wind Zone 2 data shows that those counties in Wind Zone 3 have a proportionately bigger problem. At the same time, their designation as a Wind Zone 3 county makes it clear that these mobile homes are likewise the most vulnerable. When comparing renters in both zones, renters in Zone 3 are more likely than renters in Zone 2 to be living in the most vulnerable mobile homes. Owners in Zone 3 are more likely than owners in Zone 2 to be living in the most vulnerable mobile homes. Clearly a significant problem exists for Zone 3 Counties – they are the most vulnerable to high winds and have the highest proportion of generation 1 mobile homes.
4. Since 1994, data indicates that the prices of mobile homes in Florida have significantly increased. According to Census economic data, a double-wide mobile home in 1994 cost about \$39,100. In 2000, the price had jumped to close to \$53,000. With prices at such levels, it is questionable whether mobile homes will remain an affordable housing option. What is clear is that older mobile homes continue to be in circulation, in part, because the cost of replacement is prohibitively high in general. The expectation is that the price in Zone 3 will be even higher.

5. The asbestos inspection carried out during the second quarter of this project for the 3 single-wide mobile homes, which was conducted by ATC Associates Inc. (ATC), was found to contain non-friable asbestos in the floor and ceilings of mobile home 2 and 3. Non-Friable Asbestos-Containing Material (NF-ACM) is any material containing more than 1 percent asbestos as determined using Polarized Light Microscopy (PLM) that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. In the asbestos survey, of the fifty-three samples analyzed, three were documented to contain ACM with a PLM analysis between 3 and 10% of asbestos. Since the report confirmed the presence of asbestos and, even though the asbestos found were non-friable, we made plans to use wet-demolition technique during the demolition process, providing constant misting of water during all disturbance activities, to avoid airborne fibers that could be emitted during the demolition.
6. The results of a total of 70 samples tested in this inspection indicated that no lead in amounts greater than or equal to 1.0 mg/cm² in paint was found on any building components. Hence the doublewide unit mobile home was considered free of lead-based paints according to 40 CFR, part 745 of EPA guidelines.
7. The recyclable materials from these mobile home units (aluminum, copper and steel axles) were separated and given to Blanchard's Transport Inc. The current values for this recycling material are: Aluminum at \$ 0.30 per lb, copper at \$ 0.60 per lb and steel axles at \$ 0.25 per lb. It was found out that most of the recycling companies were not willing to buy materials such as wood, combination steel, insulation and plastics. However they are more interested in metals particularly copper and aluminum.

Research and Development on Hurricane Loss Reduction Devices and Techniques for Site-built Housing

I. Research activities

1. The IHC research team has tested three hurricane house models at Clemson University's wind tunnel (figure 5) under supervision from team member Dr. Timothy Reinhold. The models tested are the FIU Base model, FIU Base model with extra features and FIU base model with 20' Cubic addition. Team member Jason Chandler, from FIU School of Architecture, received the test data and has begun mapping the most extreme positive and negative conditions.
2. The IHC team is in the process of building two additional models for wind tunnel testing. These models are known as the FIU Breezway model and the FIU Sheds model and are currently 70% complete.
3. The IHC team completed 55 tests to examine the role of various fasteners and fastening schedules in the performance of connection of roof sheathing panels to their supporting structure under hurricane wind conditions. (figure 6).

Undergraduate students at FIU continue to construct 40 additional roof-sheathing panels to continue the testing.

4. Tim Reinhold, a member of the IHC research team, developed, based on work under this project, a paper for the International Wind Engineering Conference in Lubbock Texas on design of roof sheathing fastener schedules for high wind areas.
5. Sixteen sensors have been built and calibrated to instrument flat roof housing units to gather empirical data on wind pressure stresses induced by hurricane conditions (figure 7). Coordination has been made with the Facility Management Dept. at FIU for the installation of these sensors on the roof of the Engineering building (EAS) and with the Computer Lab. at EAS for the cable installation from the roof to the Lab. It is anticipated that the installation will be completed by the end of April.
6. A roof specimen conditioning chamber has been fabricated. This chamber uses a forced air heating system. Procurement of all the materials for fabrication of the stainless-steel water generator component of the roofing wind tunnel the IHC team will use to run water penetration test under hurricane conditions is now in progress. Concurrently with this fabrication is proceeding on the roof sample test frame to be used with the roofing wind tunnel.
7. The IHC team is now evaluating bids to complete the installation of high voltage/amperage (460 volts/3-phase/250 amps) electrical supply to run the roofing wind tunnel once it is installed in the IHC Laboratory for Structural Mitigation.. The electrical installation is expected to be completed by May 12, 2003.
8. The IHC research team constructed 22 reinforced masonry walls (figure 8) test samples at Clemson University under supervision of Dr. Timothy Reinhold. Eleven have a conventional u-shaped bond beam at the top and follow typical construction of the bond beam for areas outside Dade, Broward and Palm Beach Counties. The other 11 walls include an 8-inch by 12-inch poured reinforced bond beam. Four different types of straps have been used in the construction of the 22 walls. The walls have now cured and are ready for testing in the 4th quarter. Testing will include individual loading of walls and roofs to create out-of plane bending of walls, shear between the roof and the walls that acts along the axis of the walls, uplift on the roof-to-wall connection and then various combinations of uplift, shear and out of plane loading. Conducted tests of mortar and grout used in the walls.
9. The IHC team hosted a meeting on February 21, 2003 with DCA, and FLASH to receive input to be used in finalizing the statewide survey instrument. The IPOR (Institute of Public Opinion Research at FIU) team and interviewers carried out statewide survey data collection throughout the remaining days of February and

through March. A total of 1261 interviews were completed which should yield a margin of error of +/- 2.8 percentage points (assuming a 95% confidence interval). Data analysis will commence during the last quarter.

10. On April 7, 2003 we conducted a debriefing with interviewers that carried out the survey. Useful information has been obtained that may be helpful in improving future survey instruments. Initial findings indicate several poll-type rather than survey questions that were added at the request of DCA and FLASH, may have caused increased frustration for interviewees leading to a potential increase in mid-term refusals (when individuals want to stop the interview). Fortunately, the skilled interviewers conducting the survey managed to minimize this problem.
11. The instrument for the targeted survey is substantially ready, with a few minor modifications being undertaken at the writing of this report. A good deal of effort was spent on developing the sample frame for this survey. The sample frame is the list of all possible respondents to this survey. Lists were obtained from BASF who was contracted by DCA to contact building professionals about the need to take a training course on the statewide survey. The total frame consists 81,712 architects, contractors, and professional engineers. A stratified non-proportional random sampling technique will be used to obtain a sample of approximately 1000 interviews.
12. A training session for the interviewers that will undertake the sampling for the targeted survey was conducted on April 7, 2003. Data collection will be conducted during the week of April 14, 2003

II. PRELIMINARY FINDINGS

1. Preliminary finding for the wind tunnel testing of various house models indicates that while the addition of architectural features that complicate a roof geometry also complicate the pressure distributions. The more complex roof geometry did not promote higher localized positive or negative pressures than those observed in critical areas of the base roof. The distributions just became more complex.

Figure 1: Map of Florida Counties by Wind Zone

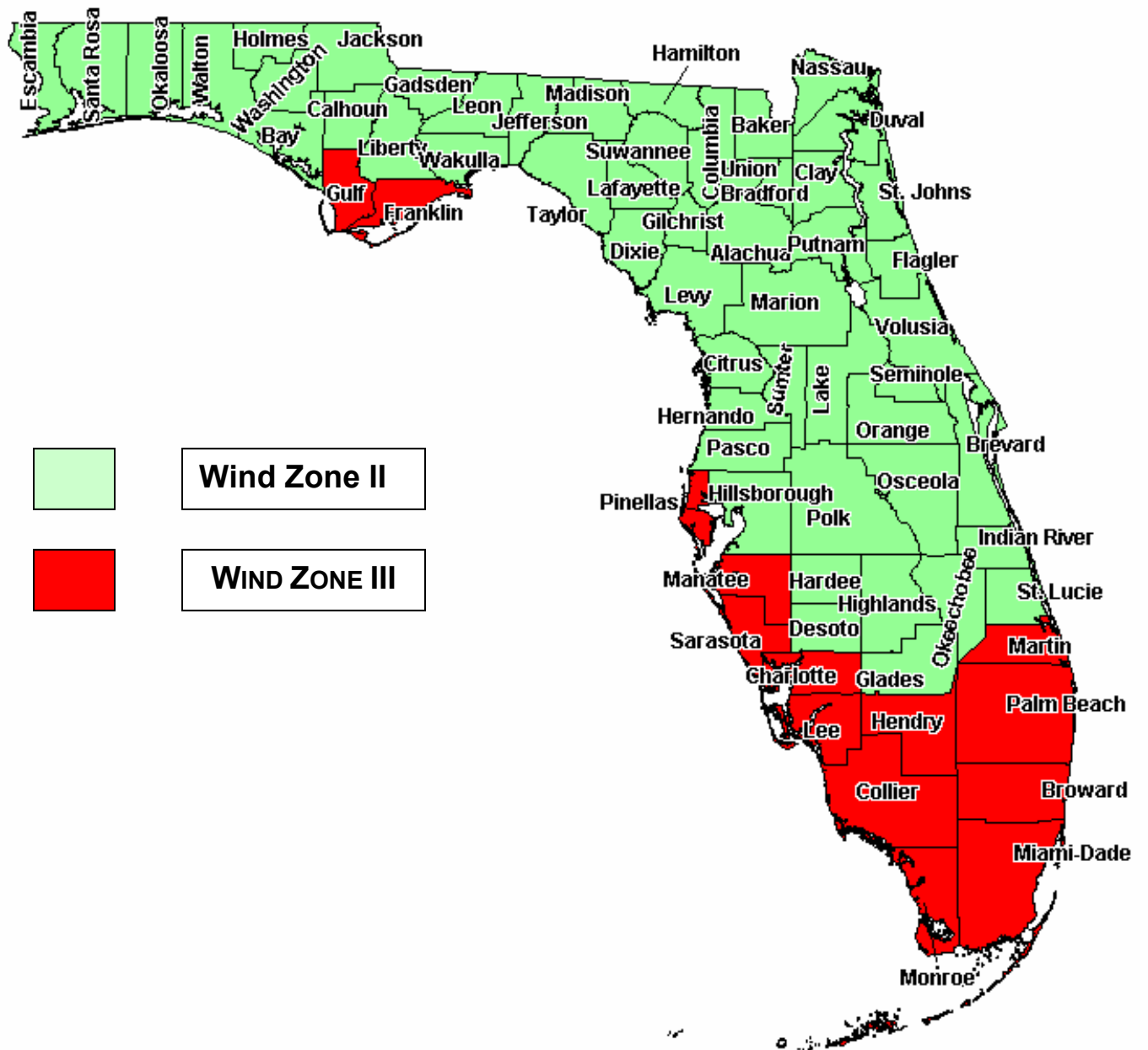




Figure 2. Aluminum pieces are weighed in the scale



Figure 3. Backhoe demolishes one mobile home



Figure 4 Wet demolition is in process using mist-controlling nozzle

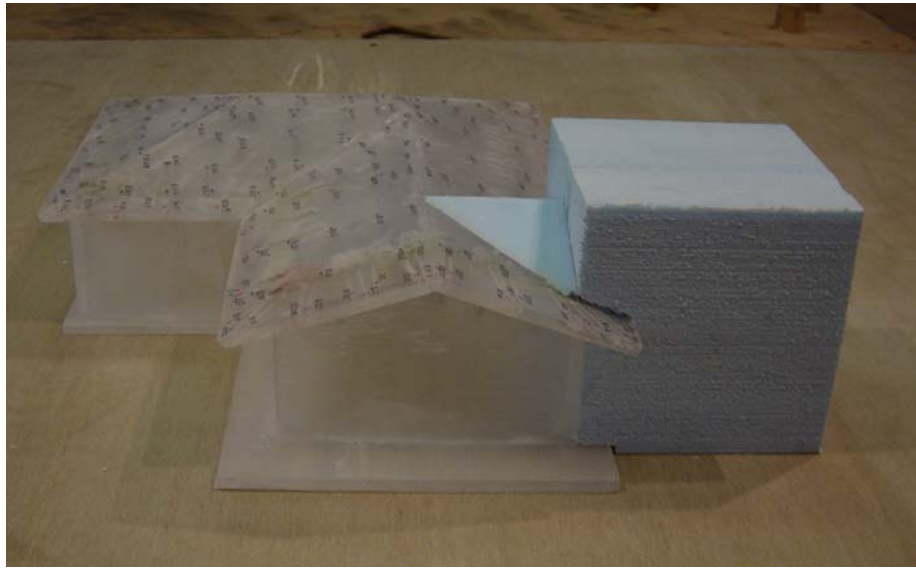


Figure 5. Hurricane House Model.

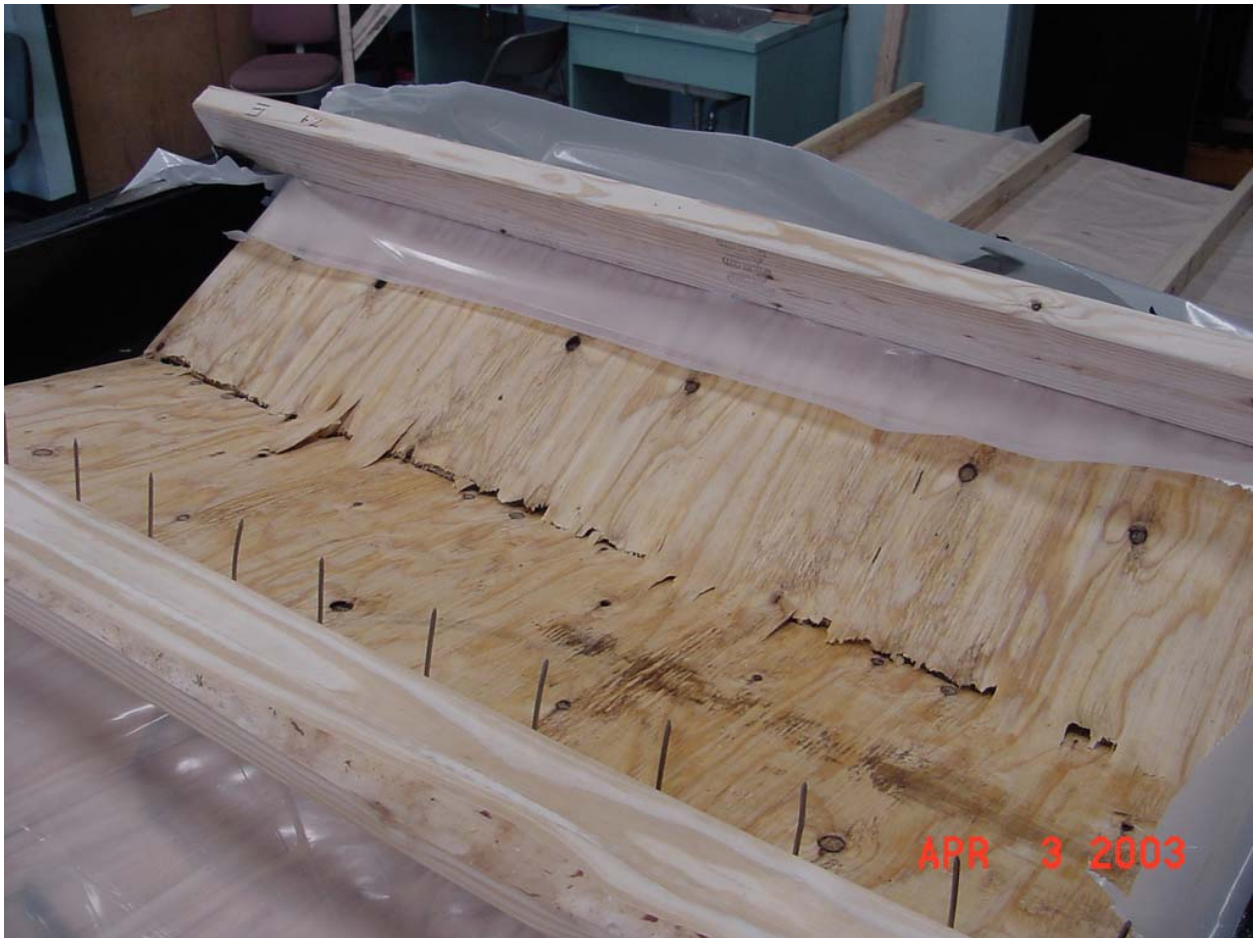


Figure 6. Roof Sheathing Tests.



Figure 7. Flat Roof Instrumentation Sensors.



Figure 8. Masonry Walls