5. SUMMARY AND RECOMMENDATIONS

5.1 General

A short-term research project has been conducted to develop a rating system for the hurricane wind resistance of single family homes in Florida. The requirements for this project are given in Chapter 2006-12, Section 39 of the Laws of Florida. Basically, the requirements indicate that the OIR, in consultation with a designated Advisory Board, shall develop a program that will provide an objective rating system that will allow homeowners to evaluate the relative ability of Florida properties to withstand the wind load from a sustained severe tropical storm or hurricane. The rating system should be designed in a manner that is easy to understand for the property owner, based on proven readily verifiable mitigation techniques and devices, and able to be implemented based on a visual inspection program.

This project uses research performed in 2001 and 2002 on loss relativities of single family homes (1,2,3) to provide the foundation for the Home Structure Rating System (HSRS). Minor updates to the data have been undertaken in this report and have been discussed with the Advisory Board.

The following sections summarize the key results of the work. Implementation recommendations and the need for new research to improve the HSRS are given in Sections and

5.2 Home Rating Factors

The primary wind resistive building features considered in the HSRS and the number of levels for each factor include:

1. Roof Shape (Hip and Other)
2. Secondary Water Resistance (Yes or No)
3. Roof Cover (post FBC 2001 or not)
4. Roof Deck Attachment (Three levels of attachment strength)
5. Roof-Wall Connection (Four levels of connection strength)
6. Opening Protection (Three levels of protection for wind-borne debris)
7. Number of Stories (Two levels, one story and two or more stories)
8. Roof Covering Type (Tile and non-tile)

Eleven secondary factors are also considered:

1. Dimensional Lumber Deck
2. Masonry Walls
3. Reinforced Masonry Walls
4. Opening Coverage
5. Unbraced Gable End

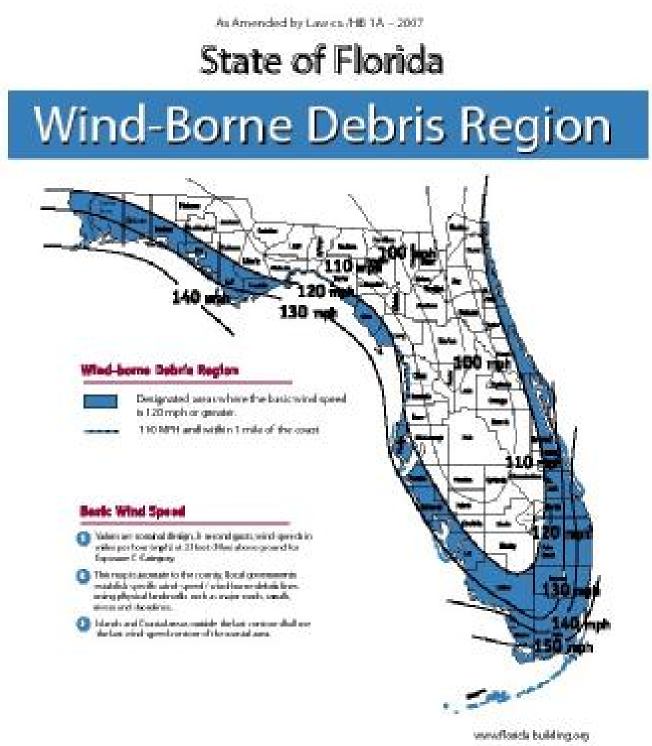
6. Foundation Restraint
7. Reinforced Concrete Roof Deck Integral with Reinforced Concrete or Reinforced Masonry Walls
8. Enhanced Roof Deck
9. Soffits
10. Vinyl Siding
11. Window, Door, and Skylight Water Leak Potential

These rating factors are used to determine the loss relativity, which is a single measure of the relative ability of the house to withstand hurricane wind effects as an integrated structural system. The loss relativity is determined from tables that have been normalized by the highest loss cost of the weakest house. A low loss relativity means that a house is expected to have relatively low loss costs from hurricane winds and a high loss relativity corresponds to a house with expected high loss costs. The basic loss relativity tables are based on 0% deductible and reflect a minor adjustment on the Secondary Water Resistance Factor. The tables are based on research done in 2001 and 2002.

The basic rating tables include a total of 3,200 loss relativities (1,600 for Terrain B locations and 1,600 for Terrain C locations). The secondary factors are applied in a sequential multiplicative fashion to adjust the basic house relativity. The final adjusted relativity is the fundamental input measure that determines the HSRS score for each wind zone and terrain.

5.3 Home Structure Rating System

This initial HSRS has been developed to provide an objective measure of the relative ability of a Florida home to withstand wind effects from sustained severe tropical windstorms and hurricanes. This rating system is based on an inspection procedure that uses readily verifiable (visual) methods to determine the building's construction and wind mitigation features.



The rating system produces a score between 1 and 100, with 1 being the score for a very weak structure and 100 the score for a very strong, code-plus structure. The system was designed to allow room in the top portion of the scale for building code improvements over time and for implementation of code-plus mitigation techniques. The scale produces the greatest relative change in score for code and code-plus construction.

Objective Measures. The system includes the following measures to determine the score:

1. A set of basic construction and wind damage mitigation features;
2. The home's location in Florida, as determined by its Florida Building Code wind zone location;
3. A set of wind resistive features relative to a Florida Building Code (2001 version, adopted 3-1-2002) home, built in that specific wind zone location; and
4. A simplified terrain exposure of the home, which considers coastal locations (Terrain C) and inland suburban locations (Terrain B).

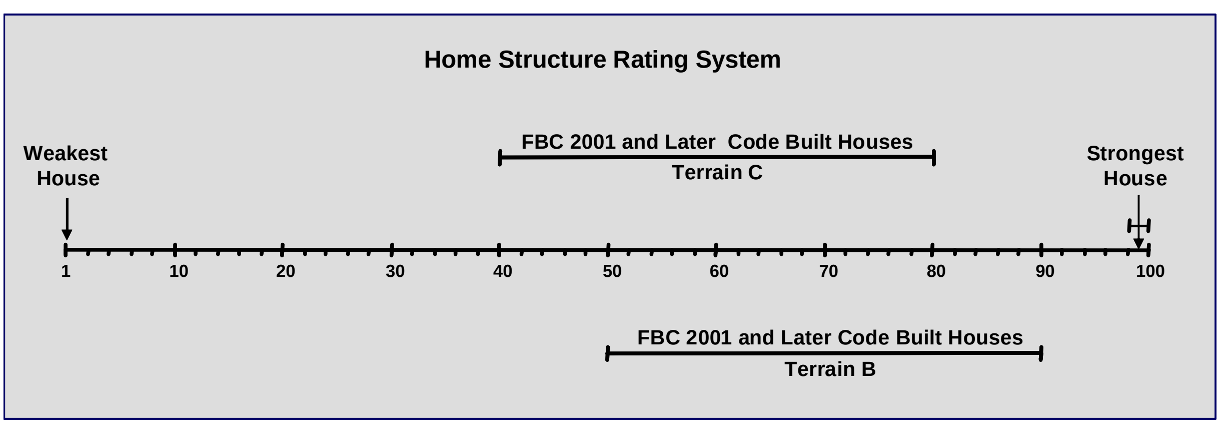
The score within each of Florida's "wind zones" is based on eight primary and eleven secondary inputs from these four groups of measures. The score does not reflect structures that may be attached to the home, such as screen enclosures or carports.

Score Interpretation. The HSRS score is founded in loss cost relativities. It measures the home's relative ability to withstand hurricane wind effects as an integrated structural system, including: roof covering, roof shape, roof deck, roof-to-wall, wall, wall-to-foundation, openings, and other components. A weakness in one or more of these building envelope components has a measurable affect on the score.

The HSRS was designed to be interpreted in a reasonably consistent manner throughout the State:

1. Within each of the wind zones in the State, the score for a FBC 2001 (and later) code-built home lies within a scoring range of 40 to 90.
2. FBC 2001 and later code construction with one or more code-plus improvements will always produce a score within or greater than the design range.
3. Effective loss mitigation improvements to a house, from among the 19 primary and secondary features, always produce higher scores.
4. A house in a Terrain B wind zone location scores higher than the same house in a Terrain C location within the same wind zone.

The range of score for FBC 2001 and later code-built homes is illustrated in the following figure.



Hence, a house with a score of 50 can be interpreted consistently, regardless of the wind zone location. In more severe wind zones (such as 120 mph and above), a house will need to have stronger construction features to achieve a good score than the same house in a milder wind zone (such as 100 mph).

The HSRS rating is not intended to be used or interpreted as a simplified stand-alone insurance rating measure. The HSRS scale was developed using loss relativities with a nonlinear risk-averse scoring function to promote wind mitigation of homes. While insurance rate differentials are determined from the same home inspection information as the HSRS rating, the determination of insurance rate differentials for wind mitigation features is more complicated than can be represented by a two-digit score. As the HSRS and insurance rate differentials further evolve, and as long as the HSRS is founded in loss cost relativities, there the rating score and insurance rate differentials should be reasonably correlated.

5.4 Testing of the HSRS

Testing of the HSRS was performed at three levels: Basic, Unit, and System. The Basic Testing involved producing HSRS scores for 1,088 combinations of different houses, wind zones, and terrains. These results produced reasonable scores and showed improved scores for mitigated houses. The scores behave consistently across wind zones and reflect the building code requirements within each zone.

The Unit Test involved testing the HSRS in the DBDDS for the same 1,088 cases analyzed in the basic tests. These tests confirmed that the programmed version of HSRS in the DBDDS performed consistently with the developmental FORTRAN code used to both develop the HSRS and to produce the Basic scores.

The System Testing involved testing the HSRS DBDDS against actual house inspection data from the MSFH pilot program. A total of 13,462 house inspections were used to produce HSRS scores for the existing house and the mitigation improvement plans. In addition, the MSFH pilot program HRR DBDDS version was run against these same houses (in order to compare HRR and HSRS scores). The HSRS scores are generally lower than the HRR scores, but result in a higher range of scores for code and code-plus construction. The HSRS scores consistently produce scores for FBC 2001 and later code-built houses in Terrain B between 50 and 90 and between 40 and 80 for Terrain C locations.

The testing confirms that the HSRS scores are performing in a reasonable manner and provide a consistent range of scores across wind zones, based on the home’s construction and wind damage mitigation features. The HSRS scores increase monotonically with increasing mitigation of the building.

5.5 Limitations

While this initial HSRS has many desirable features, it also has many limitations. It is based largely on research done in the 2001-2002 period for single-family, site-built houses. The current HSRS rating system should not be applied to manufactured housing or multifamily structures. While the methodology is based on significant prior research, the relative scores are limited by our basic knowledge, estimation methods, and numerous uncertainties. Care must be taken to ensure that the score is interpreted as a relative, best-estimate measure that is subject to further refinement and improvement. Much additional data exists now to improve the estimation of building performance and to validate the relative differences in construction and damage mitigation features, including new-code construction. The HSRS scale will need to evolve with improved methodologies and recognize further improvements in the building code. The ratings of homes will therefore need periodic updating to best reflect the structure's ability to withstand hurricane wind effects. A rough guess on the accuracy of a house's relative position on the HSRS scale is about ±10 points.

5.6 Implementation Recommendations

The implementation of the HSRS into the MSFH production mode requires:

1. Integration of the ARA modified DBDDS into the DFS DBDDS.
2. Testing of the integrated DBDDS on the DFS computer system to ensure that it produces the same scores as the testing performed under this project.
3. Finalizing the slight modifications suggested herein to the homeowner report to change the wording describing the interpretation of the rating scale.
4. Updating the MSFH website and other materials regarding the discussion of the home rating.

Draft wording changes to the homeowner report are given in Section 4.5.1 and have been implemented in the HSRS DBDDS.

This work has lead to several additional ideas to potentially improve the Pilot Program homeowner report and the mitigation recommendations being made in the homeowner report. These ideas include updating the DBDDS methodology for ordering the recommendations, coupled with the packaging of the individual improvements being recommended. The packaging idea consists of ordering the improvement plans in a progressive manner that also identifies potential code-level improvements and code-plus improvements. This concept would enable the homeowner to see a sequence of improvements from a good first step to a comprehensive set of improvements that produces the highest level of mitigation. Clearly, the development of the details of such potential improvements and the timing of any such improvements must be carefully orchestrated with the many other external requirements and budget limitations of the program and the production schedule. Improvements to the inspection form also need to be considered, but this is another area requiring careful implementation coordination.

Finally, there is a critical need to improve the loss relativity foundation for the HSRS rating scale. Updating the loss relativities to reflect improvements in hurricane effects modeling, new field data from Florida hurricanes, new wind tunnel and full-scale tests, and new laboratory data will produce better estimates of relative performance for both insurance rate differentials and the HSRS.