DRAFT

Feasibility Study for In-Home Storm Shelters in Florida Residential Homes

Presented to the

Florida Building Commission
State of Florida Department of Business and Professional Regulation
by

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1. Issues

FBC Staff raised the following issues about in-home shelters

Problem Definition: D*evelop guidelines for strengthening a room or an area within an existing home necessary to achieve an acceptable level of protection from a severe windstorm".*

2. Introduction

When severe windstorm events are imminent, Florida's residents must decide whether to evacuate or to shelter-in-place. In storm-surge zones, evacuation is the only option, but beyond those zones, a family may choose to stay in their homes and ride out the storm. This latter option is contingent on the family having confidence in the structural integrity of their house and its ability to protect them.

Severe windstorms in Florida are produced by hurricanes (from June through November) and by thunderstorms and tornadoes that can occur throughout the year. The number of tornadoes per square mile in Florida is the second highest of all states, (Oklahoma is the highest per capita) but fortunately, very few Florida tornadoes are extremely violent (EF-4 or EF-5) events.

Hurricane forecasting can provide 72-hour or more notification windows of impending landfall. In past storms, sufficient time was available for affected Florida residents to evacuate, which has substantially reduced loss of life in hurricanes. However, large-scale evacuation has its inherent risks as tens of thousands of vehicles head away from a predicted landfall location onto limited evacuation routes (highways). The benefit to the state from reduced evacuation traffic volume due to a shelter-in-place/hardened room policy is a worthwhile consideration.

Tornadoes continue to cause structural damage to houses and injury to residents in Florida. From a national perspective, the wind damage from tornadoes over the past twelve years accounts for about 20% of economic losses from hurricanes over the same period. The University of Florida personnel surveyed damage from two tornadoes that struck Central Florida in 2012. Tornado warnings are very short, usually less than 20 – 40 minutes, giving very limited time for occupants to head for cover. Most Florida homes do not have basements, so shelter must be within the living space of the house

The notion of installing storm shelters or strengthening a room in single-family homes in Florida should be discussed in terms of the specific design considerations for protection against hurricanes, tornadoes or both. Hurricanes and tornadoes produce distinct and complex load distributions on structures and their overall impacts differ in terms of their size, strength, duration, and amount of warning given to residents to prepare. Fully 80% of Florida's inventory of single-family homes was built before important wind load provisions were introduced to Florida's building code in 1994. In these pre-1994 homes, roof fasteners may be inadequate or

roof-to-wall and wall-to-floor connections in the framing may be inadequate to resist design wind loads. Structural hardening of existing structures (retrofitting) is a worthwhile goal but studies are needed to establish the level of such retrofitting that is appropriate. Once design guides are established, testing and verification of the specific retrofit methods will also be required

The provision of residential structures with hardened areas for protection of lives and property would also produce a secondary benefit of mitigating hurricane damage through hardened structures within Florida's residential inventory that is conservatively valued at $1.5 Trillion dollars.

A two-phased approach is proposed. The main goal of this first phase is to propose appropriate target performance-criteria for in-home shelters and hardened spaces for existing single-family residential homes for the state of Florida. A Phase I deliverable will be the scope of work and proposed budget and schedule for Phase II – Testing and Economic Costs/Benefits.

3. Statement of Work – Phase 1

- Review available design guides, reports and recommended practice on storm shelters, and methods for retrofitting of existing houses.
- Summarize shelter-in-place options, retrofit solutions and present their advantages and disadvantages.
- Synthesize knowledge and develop selection criteria for suitability of a house to have shelter-in-place hardened areas within existing light-framed wood and masonry residential structures.
- Summarize and present recent knowledge on geographical variations of severe windstorm risks (hurricanes and tornadoes) in Florida, and develop an in-home shelter load model.
- Recommend in-home shelter design options, including schematic renderings for an existing residential structure considering the cost, size and practicality of design and impact of Florida's mixed (hurricane and tornado) climatology.
- Develop outline scope of work for Phase II – Detailed Engineering and Testing of Structural Components for a Hardened Shelter-in-place Room in an Existing House.

4. Points of Contact

- To Be Determined

5. Budget

Table 1. Budget

Budget	**Amount**
Salaries	$30,388
Fringe Benefits	$15,434
Misc. (M&S, Tuition)	$15,328
Indirect cost/overhead	$5,162
TOTAL	$66,312

Research personnel time and will be reported and certified using a "loaded" rate computed from the following table. Note that the indirect cost shown in Table 1 is computed from the indirect cost in Table 2 + the indirect cost associated with the travel and miscellaneous categories.

Miscellaneous costs:

- Travel: Florida survey and select existing house layouts, meeting with FLASH, National Storm Shelter Association, and IBHS, Manufacturer's laboratory, and data gathering visit at ASCE Structures Congress in Boston, MA in April 2014): $4,000
- Materials and Supplies: materials to construct structural mock-ups of in-home shelter components: $1,800
- Tuition: Graduate student tuition support: $9,528

Table 2. Breakdown of the hourly compensation rate

Person	Hours	Hourly Rate	Fringe Benefits	Tuition	IDC	Total
F. Masters	20	$70.07	$18.43	$0.00	$8.85	$97.35
D. Prevatt	180	$61.32	$16.13	$0.00	$7.74	$85.19
K. Gurley	20	$63.70	$16.75	$0.00	$8.05	$88.50
Lab Manager	0	$25.38	$8.45	$0.00	$3.54	$37.21
Admin Asst	30	$22.51	$10.24	$0.00	$3.38	$36.03
Graduate Students (2)	800	$20.00	$14.40	$11.91	$3.28	$49.75
Undergraduate Students (0)	0	$10.00	$0.16	$0.00	$1.02	$11.18

6. Deliverables

- A summary report will be submitted to the Program Manager by June 15, 2014
- A breakdown of the number of hours or partial hours, in increments of fifteen (15) minutes, of work performed and a brief description of the work performed. The Contractor agrees to provide any additional documentation requested by the Department to satisfy audit requirements