

UNIVERSITY OF CENTRAL FLORIDA

Energy Efficient Building Technologies and Zero Energy Homes

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Description: The project consists of two elements: 1) the construction of two flexible research homes at FSEC to conduct research on advanced building energy efficiency technologies under controlled conditions; and 2) a staged, field retrofit study in a small number of unoccupied homes to measure and document the effectiveness of a series of retrofit measures that can be deployed using current technology. The project will also conduct an annual meeting where other FESC participants, other university members and utility, industry, the U.S. Department of Energy and other stake holders who will be briefed on plans and progress. Inputs from meeting participants will be sought.

Budget: \$879,322

Universities: UCF/FSEC

Progress Summary

1) Flexible research homes: Design was completed and documents put out for bid in April 2010.

The lowest bid for the UCF **Flexible Residential Test Structure** FI 10FSEC01 was from Jordan Development and construction LLC for just under \$300,000. The contract was signed in July. Construction was contracted and is to be complete in December, 2010.

Construction on the side-by-side label homes began in August. Utilities were run to the site. Each site was filled to the same height leveling the same dirt for both pads. The west site was lower than the east site but both were brought to the same height and the surrounding area will be graded accordingly. One oak and one pine tree were needed to be removed. Ground sensors were ordered and prepared for installation in September prior to pouring of the slab.

Ground instrumentation was installed in September. A well-digging company was brought in to help facilitate the ten-foot and twenty-foot holes. Water was reached at the eight-foot level the day of instrumenting the homes. All thermocouples were 22AWG type T, butt-welded and coated with thermal epoxy. They were attached to 3/8" PVC dowels for the ten and twenty foot length holes.

2) Field Retrofit Study: Below is shown a Sarasota County home before and after the retrofit. As of September 2010, 89 homes have been analyzed, 31 retrofits are complete, 20 are in progress, and 30 are starting.

2010 Annual Report

- A. **May 2010 status:** Technical assistance for government and non-profit residential retrofits in conjunction with Building America:
- a. Added new partners Volusia County, City of Palm Bay, Habitat Mobile, Habitat Lake Sumter
 - b. Conducted energy audits and analysis of 33 homes
 - i. Five homes have been retrofitted
 - ii. One Sarasota County home, of the five homes retrofitted, has met the Builders Challenge level for new homes with a HERS index of 66. Other homes have HERS indexes of 73, 79, 86, 87.
 - iii. Fifteen other homes in process of retrofits, others just beginning process



Sarasota County home before retrofit



...and after

September 2010 status:

- 89 Homes Analyzed
 - 31 Retrofits completed
 - 20 Retrofits in progress
 - 38 Retrofits starting soon
- Mostly: single family detached, concrete masonry unit or frame, single story, built 1954 - 2004, 780 – 2408 sf, split-system forced air mechanical systems are the norm.
- Figure 1 shows that age is not a good predictor of efficiency. Older homes with good renovations test-in well.
- Poor HERS results were largely related to duct leakage.
- Impressive scopes from many of our partners, many falling below the ICEE 2004 Hers Index of 100, approach goal of HERS 70 in some cases.

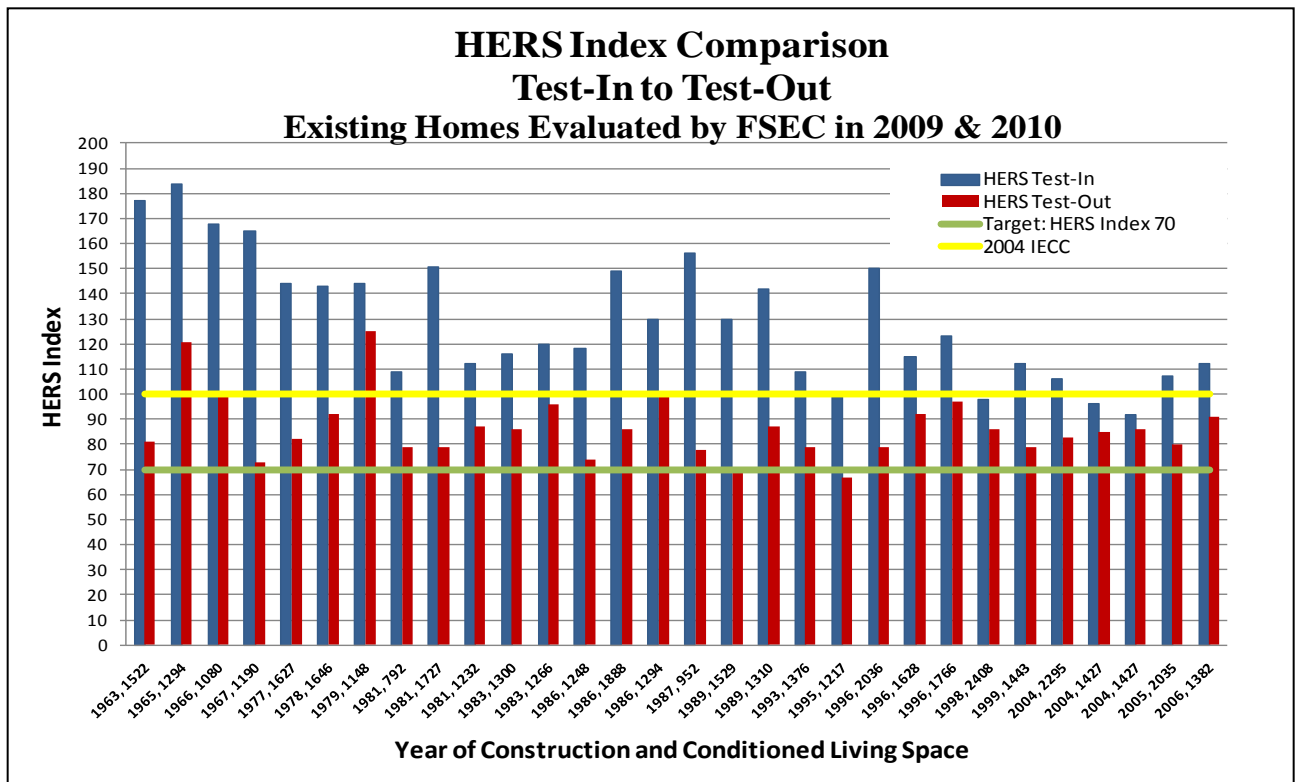


Figure 1. HERS index scores (the lower the better) for before and after retrofits by year of construction

B. May 2010 Status: Side-by-side residential test structures

- a. Designs of the test structures were completed. Decision was made to use concrete block construction and not make walls flexible as previously planned.
- b. Final site selection was made and the structures will sit next to one another with 60' between the structures. A shade analysis was completed indicating minimal shading at that distance.
- c. Documents were put out to bid in April 2010.
- d. Pre-bidders meeting were held.
- e. Three contractors submitted pre-qualification interest.
- f. Bids received in June. Construction expected to be completed by December 2010.

September 2010 Status:

Bids were submitted by four companies. Contractor bids for the construction funded under FESC funding, were opened on June 11, 2010. The lowest bid for the UCF **Flexible Residential Test Structure** FI 10FSEC01 was from Jordan Development and construction LLC for just under \$300,000. The contract was signed in July. Construction was contracted and is to be complete in December, 2010.

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Table 1. Under Slab Temperature Measurements

Type	Quantity	0'	1'	2'	5'	10'	20'	Moisture at 5'	Location
A	3	✓	✓	✓	✓	✓	✓	✓	Center of homes and midway between homes
B	6	✓	✓	✓	✓	✓	✓		Footer midway on east and west sides and two-feet out from home
C	12	✓	✓	✓	✓	✓			Corners of home and midway on North and South side footers
D	12	✓	✓	✓					Eight feet in from each corner in both directions and eight feet in from midway edge points on North and South sides



Figure 2. (above) Well is dug using water.



Figure 4. FSEC's John Sherwin measures for exact depth placement; yellow strings mark top of slab.



Figure 3. (above) PVC rod with thermocouples tied to it is lowered into hole.



Figure 5. (below) Rafters were placed on the East house by hand.



Figure 6. (right) Rafter design allows for a walkway above insulation level for easier attic walking for experiment changes.

FSEC led proposal effort for FESC for funding from four federal agencies for the amount of \$120+ million Energy Efficiency Hub Regional Innovation Cluster (E-RIC) proposal. Teamed with UF, FSU, USF, FIU, U of Illinois, GTI, American Council for an Energy-Efficient Economy, Lighting Science Group, and Sunovia. Also had economic co-applicants Seminole State College, Florida High Tech Corridor Council, Small Business Development Center, and the Florida Manufacturing Extension Partnership. With the help of the Florida MEP, reached partnership projects with a number of manufacturers in the region. Proposal was submitted May 5.

September Status: DOE announced that Penn State had won the E-RIC funding.



Figure 7. September 30 photos shows plywood sheathing near completion. Dutch hip roof design allows for overhang on all four sides while providing an attic ridge area as well.