Residential Attic Performance Comparison Research

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## Research Question

This project is intended to compare the energy and moisture performance of three residential roofing systems in South and Central Florida:

* A traditional vented attic with ceiling insulation
* An unvented attic with sealed soffit and ridge vents and ceiling insulation (and no roof deck insulation)
* A sealed attic with sealed soffit and ridge vents and air impermeable insulation at the roof deck (and no ceiling insulation).

## Background and Code Relevance to Florida

Residential construction in Florida typically includes soffit and ridge or off-ridge vented attics with ceiling insulation. “Sealed attic” systems which have unvented attic spaces and typically foam insulation on the underside of the roof deck are also used in the state. Nationally, the use of foam insulation in residential applications has been forecast to rise 4.4% per year through 2022[[1]](#footnote-1). Another residential roofing system type is an unvented attic with insulation on the ceiling, and no insulation at the roof deck; this system is much less common and is not currently allowed by Florida Code[[2]](#footnote-2).

While previous simulation work has shown that unvented attics in Florida with insulation on the ceiling somewhat increase energy use and peak demand, since the attic is not vented to the outside, they also decrease the amount of moisture that is introduced into the attic[[3]](#footnote-3). Since the ceiling plane typically includes a number of penetrations for HVAC registers, can lighting and other fixtures, not venting the attic to the outside also reduces the amount of moisture that is introduced into conditioned space from the outdoors.

## Proposed Research

A lab and field research study is proposed to characterize the energy and moisture performance of residential attic sealing in Florida. Tasks will include:

* Lab Comparison: An FSEC lab home with insulation on the ceiling plane in Central Florida will be configured and monitored for two-week periods in each of four configurations:
  + Vented attic with ducts in attic
  + Unvented attic with ducts in attic
  + Vented attic with ducts in conditioned space
  + Unvented attic with ducts in conditioned space.

Monitoring will include space conditioning energy use, exterior conditions, ceiling heat flux measurement (to assess envelope load), supply plenum vs. supply register air temperature measurement (to assess duct heat gain) and moisture level measurement in the attic space, roof decking and ceiling. This monitoring will measure energy savings of the different configurations.

* Home Recruiting: For two Florida climate zones (South and Central), identify three homes in close proximity (the same neighborhood if possible) for comparison; these homes will have air distribution systems in the attic and be of as similar age and roof composition construction as possible, except:
  + The “vented attic home” will have a traditional vented attic with insulation at the ceiling plane
  + The “unvented attic home” will have soffit and ridge vents sealed, and have insulation at the ceiling plane (and no roof deck insulation)
  + The “sealed attic home” will have a sealed (unvented) attic with air impermeable insulation at the roof deck (and no ceiling insulation).

A Central Florida “unvented attic home” has been identified. It would represent a cool roof case as it has a white metal roof. A South Florida “unvented attic home” has also been identified; it has composition shingles on the roof.[[4]](#footnote-4)

* Home Performance Characterization: In each field study home the air leakage of the following will be tested using calibrated testing fan equipment
  + House to outside
  + Attic to outside
  + House to attic
  + Total duct leakage
  + Duct leakage to outside
* Home Monitoring: Each study home will have the following characteristics of the attic, duct and interior monitored each hour for a three month period
  + Roof deck % moisture content
  + Deck temperature
  + Mid height attic air temperature and relative humidity
  + Top of insulation attic air temperature and relative humidity
  + Bottom of insulation (also top of ceiling) attic air temperature and relative humidity
  + Top of ceiling drywall moisture content
  + Bottom of ceiling temperature
  + Bottom of ceiling moisture content
  + Interior of conditioned space air temperature and relative humidity
  + Supply duct air temperature after coil
  + Supply duct air temperature at register

This monitoring will help assess potential moisture issues and heat gain across the ceiling and through the ductwork. Due to the non-lab (no control case) set-up there is no direct energy measurement.

* Data Analysis to include collecting all data and comparing the three cases to one another in each climate.
* Conclusions and Recommendations: Study conclusions and, if applicable, code recommendations will be provided based on study results.

A search for candidate homes will begin in October 2018. While it would be ideal to conduct the lab and home testing over the summer, the DBPR funding cycle will not allow summer data collection. Lab and field testing will begin in winter and continue to mid-May.

## Expected Outcome and Impact on the Code

The outcome of this research will be a report summarizing project activities, findings and recommendations. Based on project results, recommendations will be made regarding code attic sealing requirements. Note that results will not apply to North Florida since colder outdoor temperatures in this part of the state and potential for moisture issues in unvented attics may be greater in North Florida than in other locations. The project does not include a North Florida home[[5]](#footnote-5). North Florida would need to be addressed via a separate, follow-on project.

Deliverables

The deliverables for this project are an interim progress report, a final report and work hours breakdown:

* The interim report will be delivered by February 15, 2019 and provide a summary of progress to date including instrumentation completed to date. In addition, the interim report will be presented to the Commission’s Energy Technical Advisory Committee at a time agreed to by the Contractor and Department’s Project Manager.
* The final report will be delivered by June 15, 2019 and include a summary of project activities including home recruitment, testing and monitoring results, discussion and any recommendations. In addition, the final report will be presented to the Commission’s Energy Technical Advisory Committee at a time agreed to by the Contractor and Department’s Project Manager.
* 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 will be provided. The Contractor agrees to provide any additional documentation requested by the Department to satisfy audit requirements.

## Budget

The budget for completion of the project is $110,000.

## Period of Performance

10/01/2018 – 6/30/2019

## References

*Florida Building Code, Building, 6th Edition (2017)*. (2017). Country Club Hills, IL: International Code Council, Inc.

1. <https://sprayfoam.com/foam-news/foamed-plastic-insulation-demand-to-grow-44-annually-through-2022/3308> [↑](#footnote-ref-1)
2. See [Section 1203 of the 2017 Florida Building Code, Building Volume](https://codes.iccsafe.org/public/document/FBC2017/chapter-12-interior-environment) [↑](#footnote-ref-2)
3. <https://buildingscience.com/documents/reports/rr-9801-vented-and-sealed-attics-in-hot-climates/view> [↑](#footnote-ref-3)
4. The most difficult attic type to locate of the three being studied is the “unvented attic home” with no soffit or ridge venting and insulation on the ceiling, as this type of construction is not specifically covered by the Florida building code and would typically be a retrofit. [↑](#footnote-ref-4)
5. The most difficult attic type to locate of the three being studied is the “unvented attic home” with no soffit or ridge venting and insulation on the ceiling. FSEC has identified South and Central Florida unvented attic homes, but is not aware of one in North Florida; adding the cost of identifying or preparing such a North Florida home would likely be prohibitive for this funding cycle. [↑](#footnote-ref-5)