Proposal to Further Investigate Energy and Performance Impact of Whole-House Dehumidifier Duct Configurations

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Introduction

This proposed work provides additional investigation to a 2018 FBC funded research project (Withers et al. 2018) to cover two test configurations that did not fit within the previous funded scope. One test configuration was originally proposed last year, but had to be dropped due to limited budget. A second test was identified as a common configuration used in Florida during the June 18, 2018 Energy TAC meeting. Energy Technical Advisory Committee member, Oscar Calleja, indicated it would be beneficial to know how this second test configuration compared to the other three tested configurations of the 2018 completed FBC study. Because the lab is still configured from the previous study, funding this year will save some set-up related costs.

Research Questions:

Which whole-house ducted dehumidifier (DHU) duct configurations are likely to provide best performance? Should the code mandate rules or allow penalties/credits based on DHU duct configuration in performance code while limiting options in prescriptive?

Code and Background Relevant to Florida:

The Florida Code accounts for energy impacts of ducts and air handler locations due to the high energy differences. As an example, Cummings et al. 2002 found that air handlers located in south Florida attics would have about 17% increase in cooling conditioning energy and 10% increase in heating energy compared to air handlers located in conditioned space. Air handlers located in north Florida would use about 15% more cooling energy and 19% more heating energy than air handlers in conditioned space. There is currently no code provision for DHU duct configuration or duct location.

Simple DHU distribution pulls air from a room and supplies conditioned air back into conditioned space. Other methods involve ducted distribution to and from the central ducted heating and cooling system or ducted outdoor ventilation air into a DHU. Variability in entering air conditions affect performance of the dehumidifier and central system depending upon how DHU ducting is configured.

A recently completed FBC project by Withers, Nigusse and Vieira 2018 found that a DHU ducted to a central cooling system return adversely impacted central cooling performance. Predicted annual cooling and DHU energy increased by 12% with DHU ducted to central return compared to DHU ducted to room. Steady-state testing also measured a 28% decrease in central latent cooling performance with DHU ducted to return. DHU Ducted to a central supply had very little impact on space conditioning energy and no negligible impact on cooling or DHU performance. DHU latent performance varied significantly based upon entering conditions as evaluated by three different steady-state tests.

Two other common DHU duct configurations were not able to be evaluated during this project which we propose to further investigate. They were:
1) DHU entering air (DHU return) from conditioned space and DHU supply air into central heat/cool supply duct
2) DHU entering air from outdoors (mechanical ventilation) mixed with some indoor air

Based upon previous work, using a DHU to provide mechanical ventilation will have variable impacts upon DHU performance. This proposed project would be able to further evaluate the range in DHU performance impacts.

Scope of Work:

1. In a laboratory, alternate method of dehumidifier air distribution for specified test cases. Testing will occur in the same lab as previous DHU configuration testing (Withers et al. 2018).

The dehumidifier air distribution will be configured in the following ways:

   a. DHU entering air (DHU return) from conditioned space and DHU supply air ducted into central heat/cool supply duct
   b. DHU entering air from outdoors (ASHRAE mechanical ventilation) and indoors
      70 cfm OA (ASHRAE 62.1-2013) with about 90 cfm balance of DHU entering air from indoors; wall hung dehumidistat controls DHU to meet indoor RH target.

2. Write a final report with results, combine with previous Withers et al. 2018 study results, and offer additional recommendations if warranted.
   a. Results will include a predicted annual DHU and space cooling energy use based on energy monitoring that can be compared to previous withers 2018 results.
   b. Results will include an evaluation of duct configuration upon DHU performance.
   c. Update Withers et al. 2018 report summary with new findings in final report.

Deliverable:

A final report will be prepared that explains the purpose, methods, and results of the research. The final report will provide a summary of test findings. Recommendations for Florida code changes will be provided if the authors feel it is warranted.

Budget:

Budget total is estimated at $31,500 and covers all costs for labor, materials, and overhead.

References

Cummings, J., C. Withers, Dr. L. Gu, J. McIlvaine, J. Sonne, P. Fairey, and M. Lombardi. 2002. "Field Testing and Computer Modeling to Characterize the Energy Impacts of Air Handler Leakage". FSEC-CR-1357-02. Cocoa, FL.: Florida Solar Energy Center. Submitted to Florida Department of Community Affairs September 23, 2002.

Vieira, R., and D. Beal. 2017. "Residential Performance Code Methodology for Crediting Dehumidification and Smart Vent Applications Final Report," FSEC-CR-2067-17, June 1, 2017.

Withers, C., Dr. B. Nigusse, and R. Vieira. 2018. "Investigation of Energy Impacts of Ducted Dehumidifier Duct Configurations and Location" FSEC-CR-2038-18, June 1, 2018.