Duct condensation risk in humid climates

Overview

Hot and humid climates have a risk for condensation on un-insulated duct surfaces, even in conditioned space. Condensation is a complex phenomenon, and pilot home investigation will be required before we can say with greater certainty what level of insulation would be recommended for Rheia ducts in very humid climates.

Discussion

If the temperature of a surface is below the dewpoint of the surrounding air there is the risk of condensation occurring. This is a risk for ducts carrying cold air in humid climates. Many factors influence this risk including system and environmental factors. Equipment factors include duct location, duct insulation, correct sizing, equipment supply air temperature and airflow. Environmental factors include construction quality, construction moisture, indoor sensible gains and climate. All of these factors interact in the real world restricting the ability to generally describe and predict humidity levels.

Once condensation has occurred, enough liquid water must accumulate before it will drip and cause a problem. This depends on how far below the dewpoint the surface is, the duration of the temperature excursion, and the surface texture. The only surefire way to eliminate risk is to make sure the duct surface temperature always remains above the dewpoint of the surrounding air.

Considering the two variables of duct temperature and dewpoint: We can understand the expected duct surface temperature through testing and calculations. However, it is much trickier to understand the dewpoint of the environment for every home in which the duct will be installed. One proxy for the duct chase environment is the dewpoint of the interior conditioned space. The following table summarizes data from a DOE study of the interior conditions in new southern homes:

	95th percentile dewpoint (F)	Avg dewpoint (F)
Tampa	60	55
Orlando	62	57
Houston	64	54
San Antonio	62	55

Preliminary testing of 3 inch ductwork showed the following surface temperatures. The uninsulated surface temperature is very near the observed 95th percentile dewpoint of the sample of humid climate homes.

Uninsulated: 62F duct surface temperature (Airflow temp of 52F)

Insulated R-4.2: 71F duct surface temperature (Airflow temp of 53F)

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In some situations, such as a slab-on-grade foundation, a six-inch drop ceiling (a RHEIA 'raceway') is used for routing RHEIA's small diameter ducts. These required drops have a minor architectural impact compared to the large bulkheads that would be needed using conventional ductwork. The alternatives are to condition the attic, or use inverted trusses to hold the ductwork. Both are costly alternatives.

Development testing

Lab testing can determine the expected duct surface temperature in a bundle of ducts in a chase. Field testing during the pilot phase will help the team better understand the environmental conditions in a drop ceiling chase.

As a reference, for a house at an interior temperature of 75F and a RH of 60%, the corresponding dewpoint is 60F. This would represent the typical maximum you would want to see in a house for extended periods, otherwise there would be general mold growth and durability concerns. Bringing the interior RH down to 55% lowers the dewpoint marginally to 58, which might be a more ideal target.

References

Data collected by FSEC in a test manufactured housing structure in FL showed interior dewpoints (possibly in a soffit) that averaged 49.7F. Below the coil supply air temperature which ranged between 50 – 60 F. Evaluation of the Performance of Houses With and Without Supplemental Dehumidification in a Hot-Humid Climate http://www.fsec.ucf.edu/en/publications/pdf/FSEC-PF-444-08.pdf

Data collected by BSC in post Katrina supplemental housing. Of 10 homes, on average the indoor DP was >60F for 7% of the time in homes with supplemental dehumidification and >60F for 9.6% of the year for homes without. Typically the indoor dewpoint for these homes was around 55F, with daily cycles between 60F and 50F. Homes without supplemental dehumidification had more frequent excursions beyond 60F. Evaluation of the Performance of Houses With and Without Supplemental Dehumidification in a Hot-Humid Climate https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/houses_supplemental_dehumidification.pdf

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