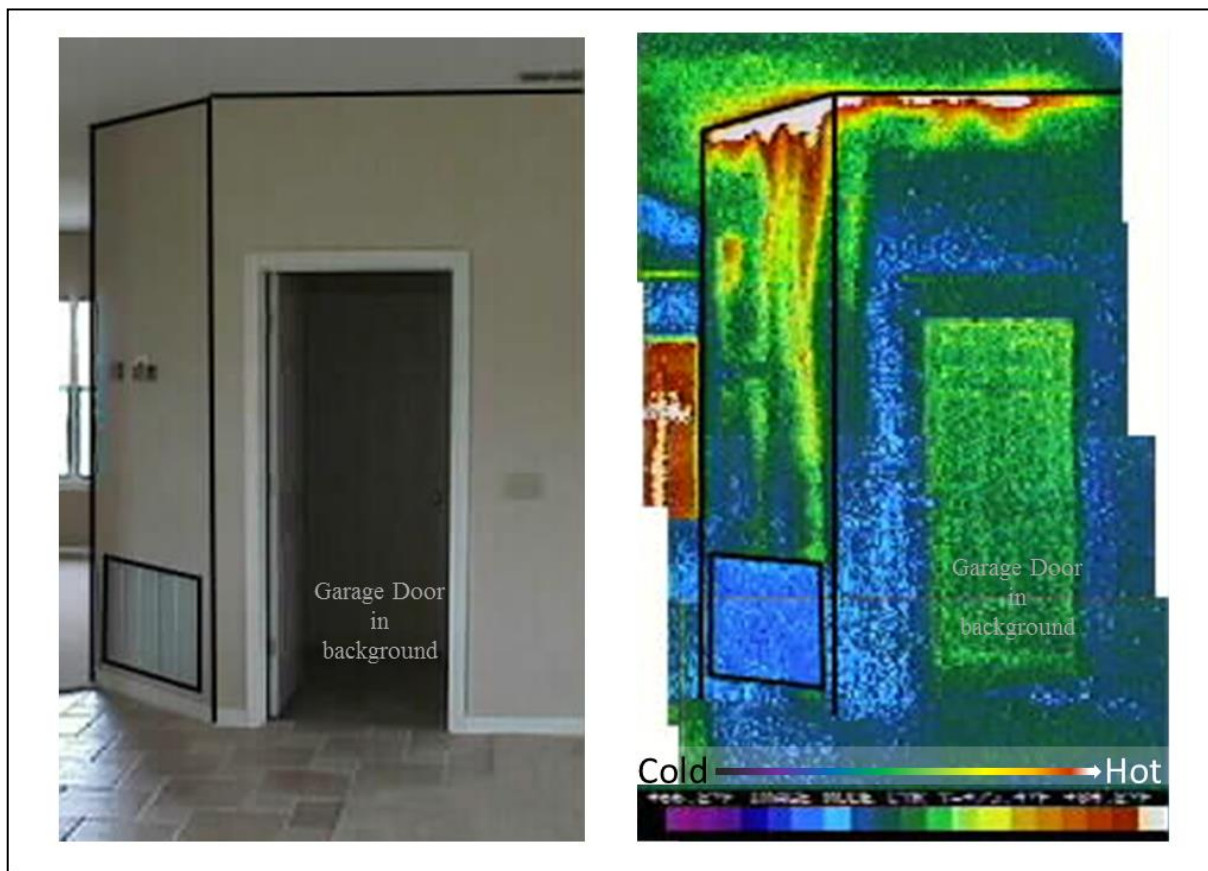


**Investigation of Potential Benefits of Revising Exception 1 under FLORIDA BUILDING CODE, ENERGY CONSERVATION, 101.4.7.1.1 Duct Sealing upon Equipment Replacement (see full code section text included at end of proposal)**

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**Research Purpose and Goal:** This research proposes to quantify the extent of need, benefit, and cost of sealing building cavities used as return air pathways that are formed by all or part of an air handler closet located in the conditioned space. These are arguably excluded from the sealing requirement of the referenced code section under Exception 1 by virtue of appearing to be “in conditioned space” when they usually are connected to unconditioned space. This connection creates an unintended airflow path from adjacent attic or floor cavities (Figure 1).



*Figure 1. Left: A return plenum formed by unfinished framing under an air handler support platform is on the other side of this wall mounted return air grille in a utility room. Right: Infrared image showing hot attic air (see color scale at bottom of image) being pulled down the interior wall cavity during air handler run time.*

**Definition of the Problem:** This code section (101.4.7.1.1) requires HVAC contractors to seal accessible (a minimum of 30 inches clearance) joints and seams in the air distribution system when new equipment is installed. Exception #1 eliminates the requirement for ducts in conditioned space, and by doing so, effectively eliminates the requirement for building cavities used as air distribution paths. These building cavities are often not separated from unconditioned spaces by a complete air barrier.

Building cavities used for supply distribution are not likely to meet the accessibility criteria; and therefore would not be subject to the sealing requirement. However, building cavities used for central return air conveyance often are accessible. These are usually formed by open wall cavities of adjacent interior walls or by poorly sealed air handler closets. By modifying Exception 1 to apply clearly to ducted pathways and not building cavities, this pervasive and apparently large leakage path could be eliminated in 1,000's of existing homes, enhancing performance with very little extra effort or cost.

**Building Science Background:** Unsealed return plenums are under significantly greater pressure than other leakage points in the air distribution system because of proximity to the air handler fan. Return leakage from unconditioned spaces is likely to be at an extreme temperature and dusty. It often bypasses the filter, fouling equipment components, degrading equipment performance, eroding equipment life, comfort, and potentially indoor air quality.

**Magnitude of Opportunity:** In an FSEC field study conducted between 2009 and 2012, researchers observed a large number of unsealed return plenums and AHU closets in the conditioned space (McIlvaine, et al.). Interior air handler configurations were found in 40 out of 70 homes ranging in vintage from the 1950's to 2006 (Figure 2). These types of returns are often connected directly to adjacent wall cavities and attic spaces through missing or compromised air barriers.

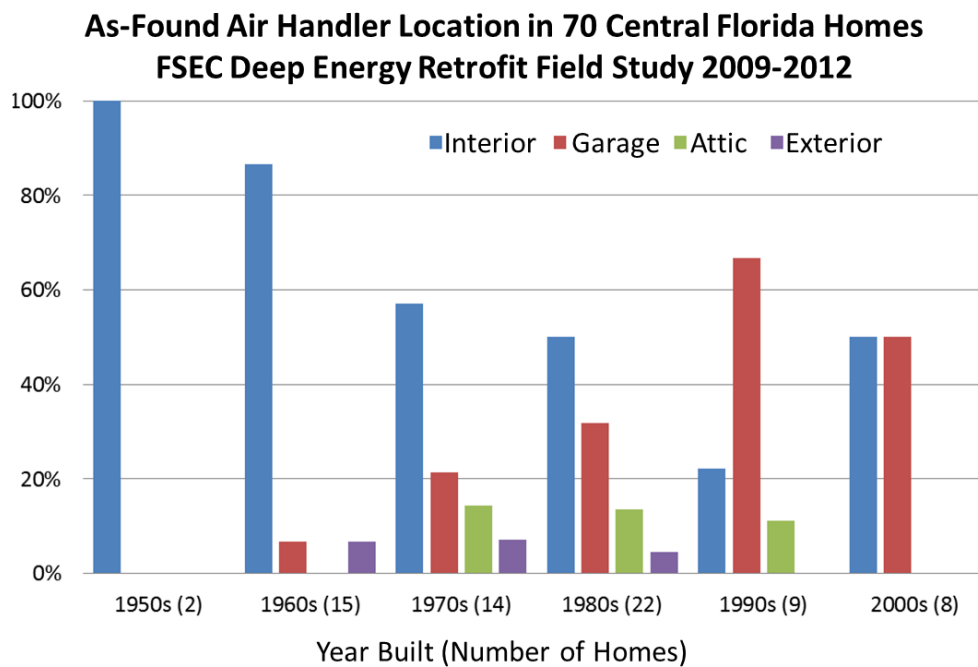


Figure 2. In a recent FSEC field study (McIlvaine, et al. 2012), 40 of the 70 homes had an interior air handler closet with a platform or full closet return plenum (blue).

These interior air handler closets generally manifested in the field study in two configurations: a framed platform supporting an up-flow air handler with through wall filter-back return grilles (Figure 3) or a metal or frame air handler stand where the closet functions as the return plenum with return air pathways through louvered doors or door mounted grilles (Figure 4).



Figure 3. This air handler in an interior closet (left, top) is served by a return air plenum directly beneath (left, bottom) formed by the open, unfinished framing of the closet walls.



Figure 4. Interior air handler closet with no dedicated return air pathway. The unfinished closet walls (and poorly sealed ceiling) function as a return plenum.

**Approach to the Research:** In the field study mentioned above and more recent research, FSEC builder partners and their mechanical contractors have achieved “substantially leak free” duct systems ( $Q_{n,out} \leq 0.03$ ) in 20 HVAC retrofits including many with the type of returns under discussion. The portion of leakage attributable to return side pre- and post-retrofit has not been assessed because this level of investigation was not covered in the funded scope of work. However, the FSEC research team proposes to leverage partnerships formed during the field study to identify and investigate 10 mechanical system retrofits involving return air plenums similar to those shown in Figures 3 and 4 above.

The technical approach, focused on open frame platform returns and whole closet return plenums located in the conditioned space, would consist of duct system testing in 10 homes as follows:

- Test leakage of as-found air distribution system including quantifying the portion attributable to return leakage and the degree of connection to unconditioned spaces

- HVAC contractor will replace AC equipment and seal accessible ducts as required by code section 101.4.7.1.1 using the contractor's standard approach with the addition of sealing the interior return plenum
- Re-test leakage of air distribution system including quantifying the portion attributable to return leakage and the degree of connection to unconditioned spaces
- Compare pre- and post-retrofit return side leakage to characterize the relative success of the contractor's sealing effort including the contribution of return side improvement to overall system improvement.

Test results will be used to model the impact of return sealing on heating and cooling annual energy use for several different levels of whole house efficiency.

**Expected Outcome and Impact on the Code:** The outcome of this research will be a report describing the impact of sealing return plenums formed by building cavities in the conditioned space and associated cost. From the results in this report, it is anticipated that the Florida Building Commission might consider modification of Exception 1 under section *101.4.7.1.1 Duct sealing upon equipment replacement* to limit applicability of Exception 1 to ducted pathways and not building cavities.

Budget: \$29,000

**Relevant Code Reference:**

2012 SUPPLEMENT TO THE FLORIDA BUILDING CODE, ENERGY CONSERVATION,

Chapter 1 – Administration, 101.4.7.1 Replacement HVAC equipment

101.4.7.1.1 Duct sealing upon equipment replacement (Mandatory). At the time of the total replacement of HVAC evaporators and condensing units for residential buildings, all accessible (a minimum of 30 inches clearance) joints and seams in the air distribution system shall be inspected and sealed where needed using reinforced mastic or code approved equivalent and shall include a signed certification by the contractor that is attached to the air handler unit stipulating that this work has been accomplished.

Exceptions:

1. Ducts in conditioned space.
2. Joints or seams that are already sealed with fabric and mastic.
3. If system is tested and repaired as necessary.