
Ducts in Conditioned Space...sort of?



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Session Description

Ducts in Conditioned Space...Sort Of? There is a significant push in the industry/codes to bring ductwork into the conditioned space. There are numerous methods to achieve this, but many require redesigning of the building. What options are available that are simply modifications/additions to typical practice? The Building America program has been researching options to better deal with ducts in vented attics. The history of this research as well as the advantages and disadvantages of these systems compared to alternative strategies will be provided.

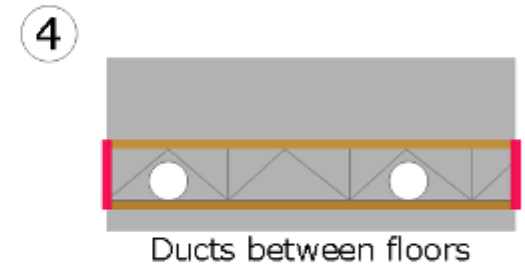
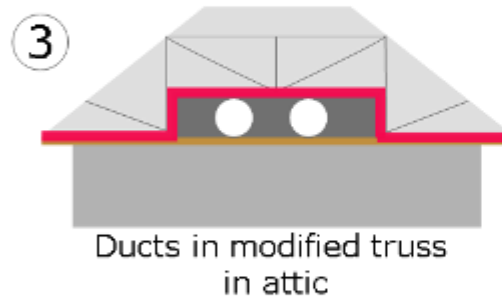
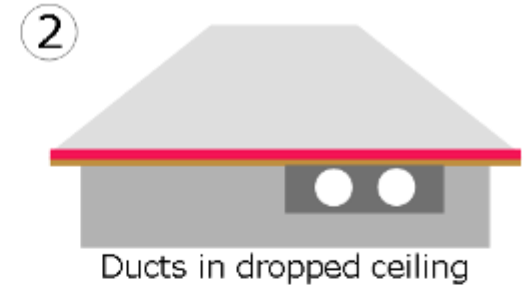
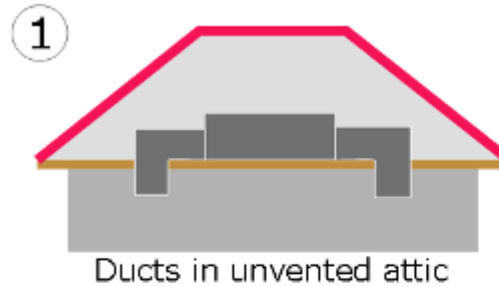
In addition, while the practice of burying ducts is not new everywhere, having prescriptive code language is. The 2018 IECC laid out a prescriptive path for the use of buried ducts with fibrous insulation in vented attics, for all climate zones. The code change has the potential to provide a vented attic design that is highly energy efficient but at lower cost than alternatives.

Learning objectives

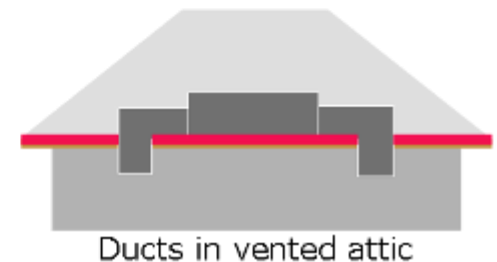
- An overview of past research done on bringing ductworks into conditioned space.
- A detailed summary of the code changes. There are variants of buried duct approaches with different code, and energy modeling, implications.
- A description of how builders can use this practice today, even if their area is not yet on the 2018 IECC.
- An overview of the energy and cost benefits of this approach compared to traditional or unvented attic design.
- A synopsis of relevant field research proving out this practice by showing how it can be done effectively, and safely, in all climates.

Why Buried Ducts?

- Ductwork thermal losses can range from 10-45%
- Interior ducts current solution, but may be impractical, expensive, or increase envelope loads



— Insulation & Air Barrier



Ducts in Unvented Attic



- HVAC design flexibility
- Minimal design integration
- Usually more expensive
- May increase enclosure loads

2015 IRC Sections R806.5 Unvented Attic Assemblies, and R316 FOAM PLASTIC control these assemblies

Ducts in Dropped Soffit



- Low-cost in simple plans

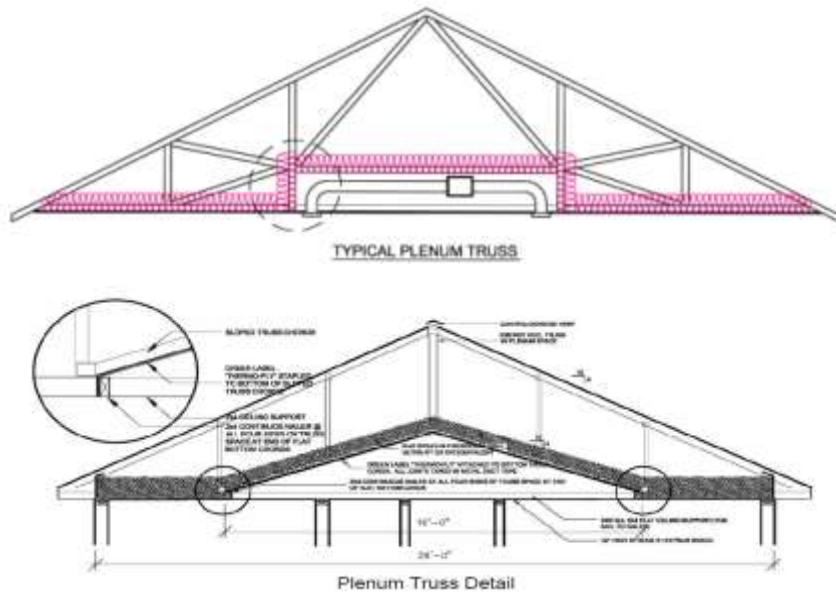
- Longer “throws” may be required based on plan.
- Requires high-level of architectural integration

Floor Truss Integrated Ducts



- Offers simple installation and design flexibility
- Very cost-effective
- Conducive to floor registers which don't work as well for cooling
- High wall registers increase performance, cost, and complexity

Ducts in Modified Truss



- Works well in narrow plans
- Moderate cost-increase
- Sealing the air-barrier is critical
- Design integration required

Research Timeline

SWA: insulation enhanced ducts

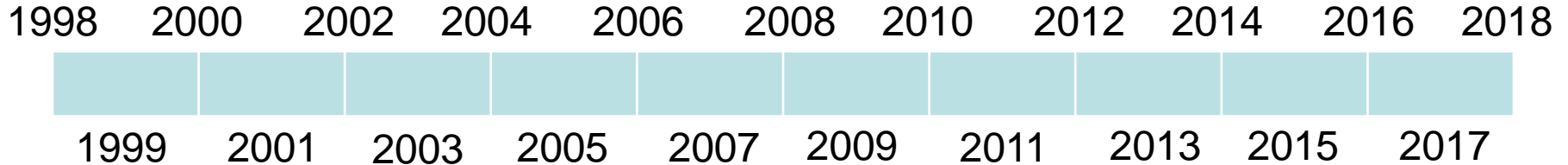
- R-30 attic suspended ducts
- Phoenix, AZ

SWA: buried ducts

- Southern CA
- Beazer Homes

SWA: Buried Duct Research

- Finite element analysis model was developed
- SWA ASHRAE paper: effective R-value of buried ducts and defining partial, fully, & deeply buried



2005 revisions to Title 24 Alternative Compliance Path incorporates buried ducts

SWA: buried ducts

- Sacramento, CA
- Beazer Homes
- Sought to do drop hallway ceilings, but architect was not interested.
- The science of buried ducts began

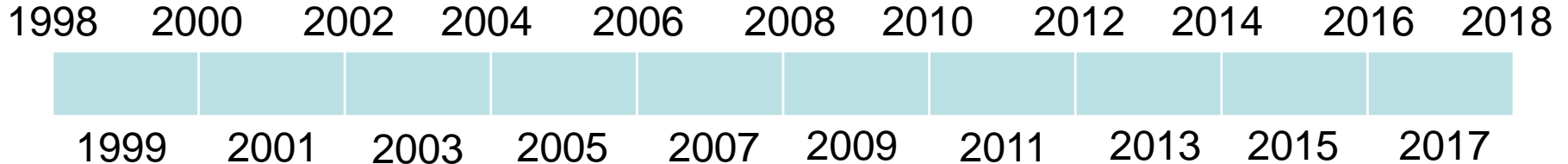
Research Timeline

SWA: hot/humid climate

- Knew buried duct would condense.
- Modeling suggested it would condense on side of duct @ ~11am. Monitoring confirmed this.
- Melbourne, FL

SWA: retrofit

- Foamed over suspended ducts
- Foamed, buried ducts
- Effective, but required significant oversight during installation.
- Jacksonville, FL



SWA: new construction

- Outlook Construction
- Working on technique of foamed over, buried ducts
- Cartersville, GA



2009 IRC prescriptively allows foamed ducts

Research Timeline

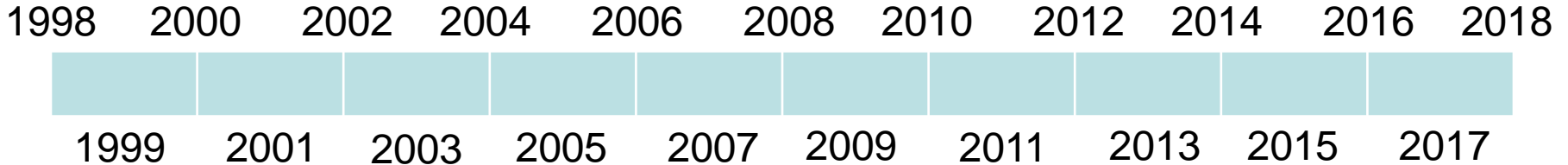
Owens Corning Science & Tech Center

- ASHRAE paper: thermal and moisture performance of buried ducts

2018 IECC prescriptive language for buried ducts

HIRL: MD case study

- Double R-8 branch ducts with ~2" insulation mounded over the ducts.



HIRL: NJ case study

- R-8 ducts with R-30 mounded over the ducts

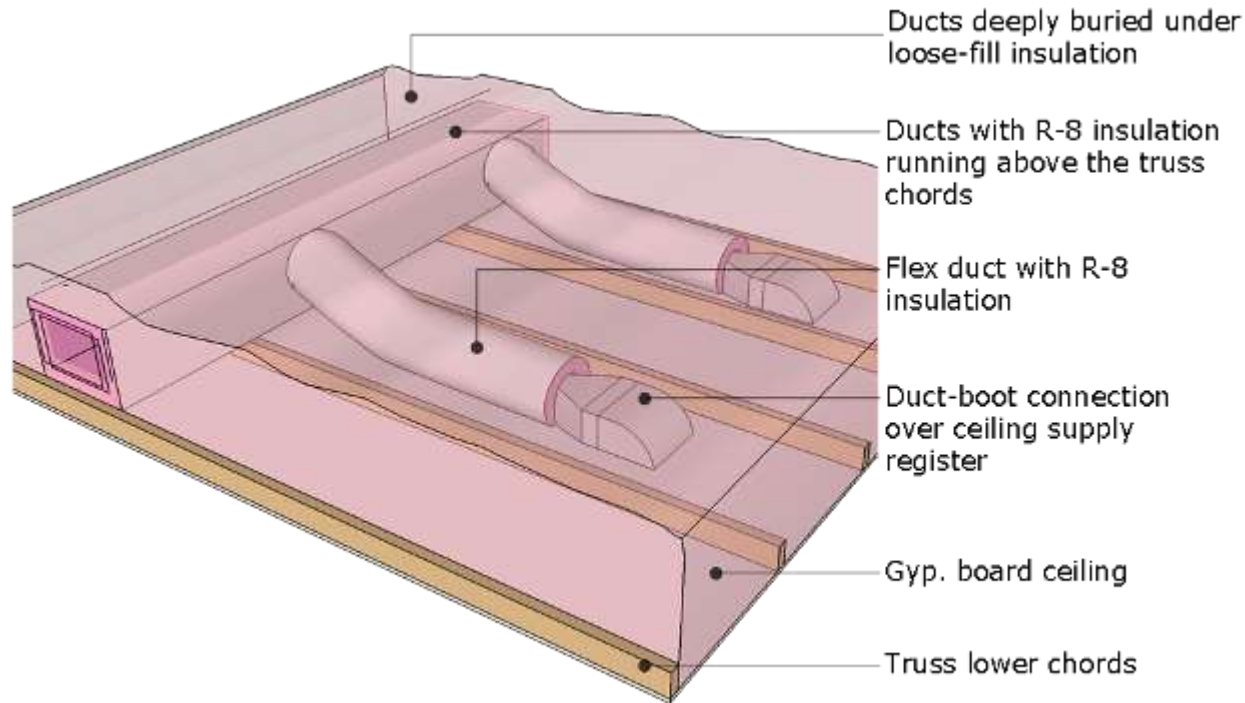
FSEC: hot/humid climate

- Buried ducts
- Condensation during mid-summer
- Cocoa, FL

HIRL: humid climate

- R-8 ducts with R-30 mounded over the ducts
- Effective, but needs quality control
- Lady's Island, SC

What Are Buried Ducts?



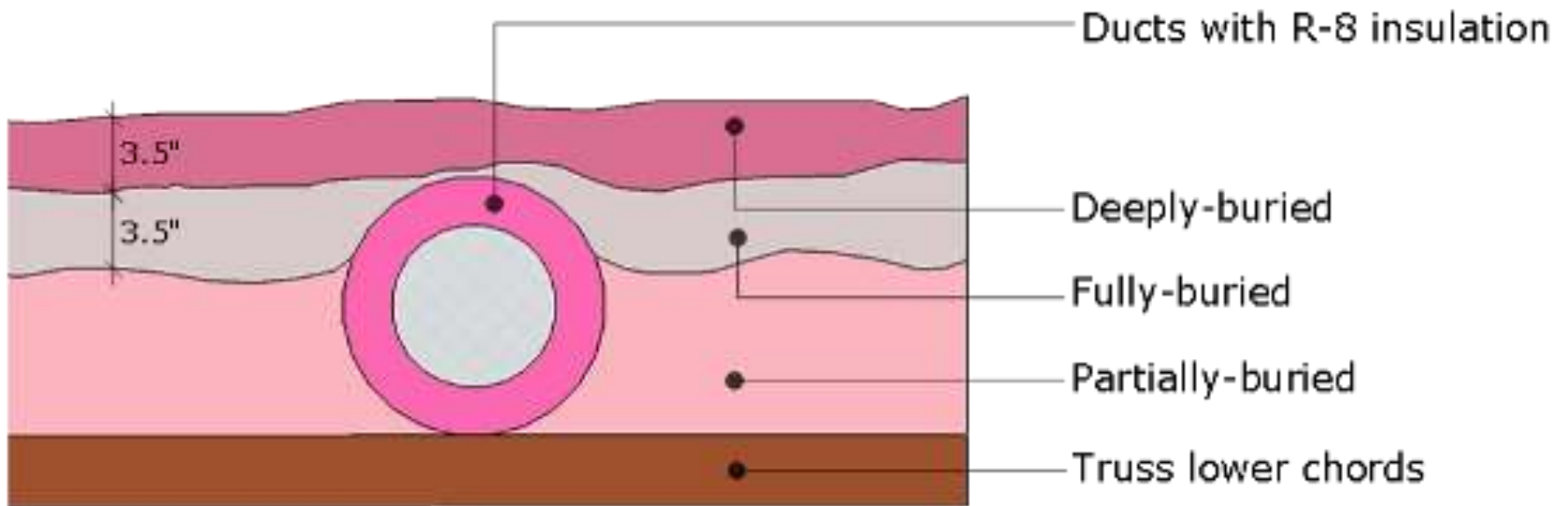
- Low cost, high-performance duct strategy
- Very high R-values

Buried/Encapsulated Duct Categories

- Buried Ducts
- Buried and Encapsulated Ducts
- Encapsulated Ducts

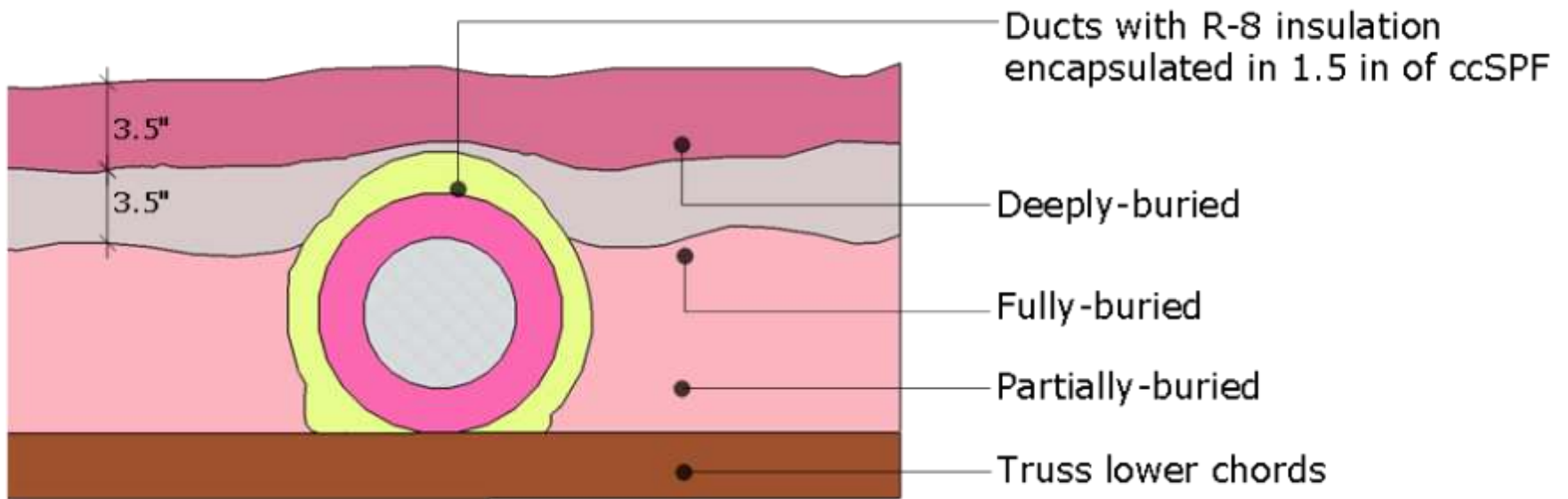


Buried Duct Classification



Buried Duct Schematic

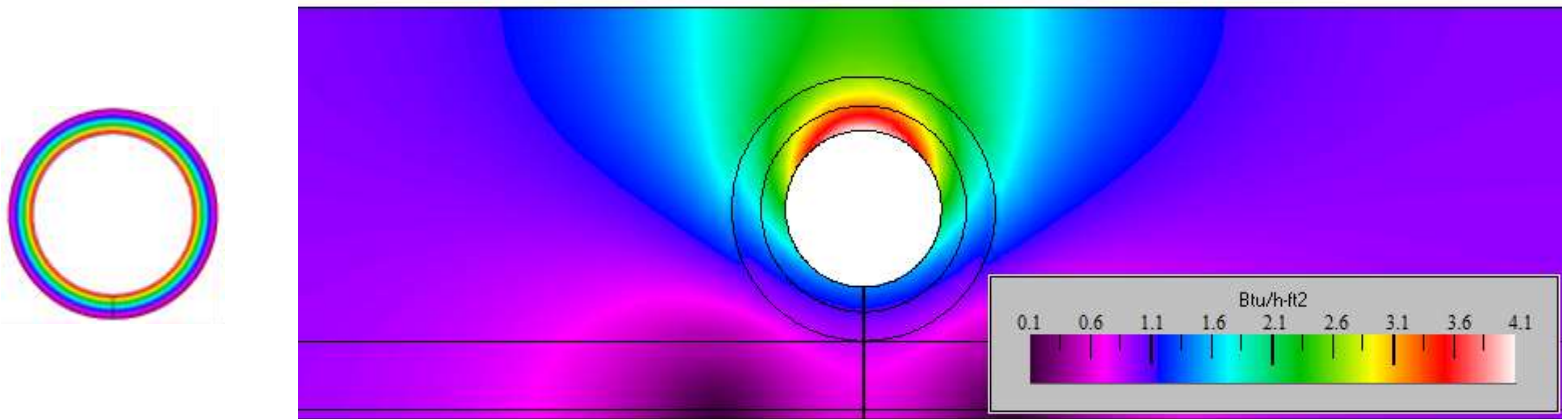
Buried Duct Classification



Buried & Encapsulated Duct Schematic

Effective R-values

- R-value metrics:
 - Nominal – listed values for duct insulation
 - Effective – heat loss/gain from duct to attic
- Buried duct effective R-values calculated using FEA

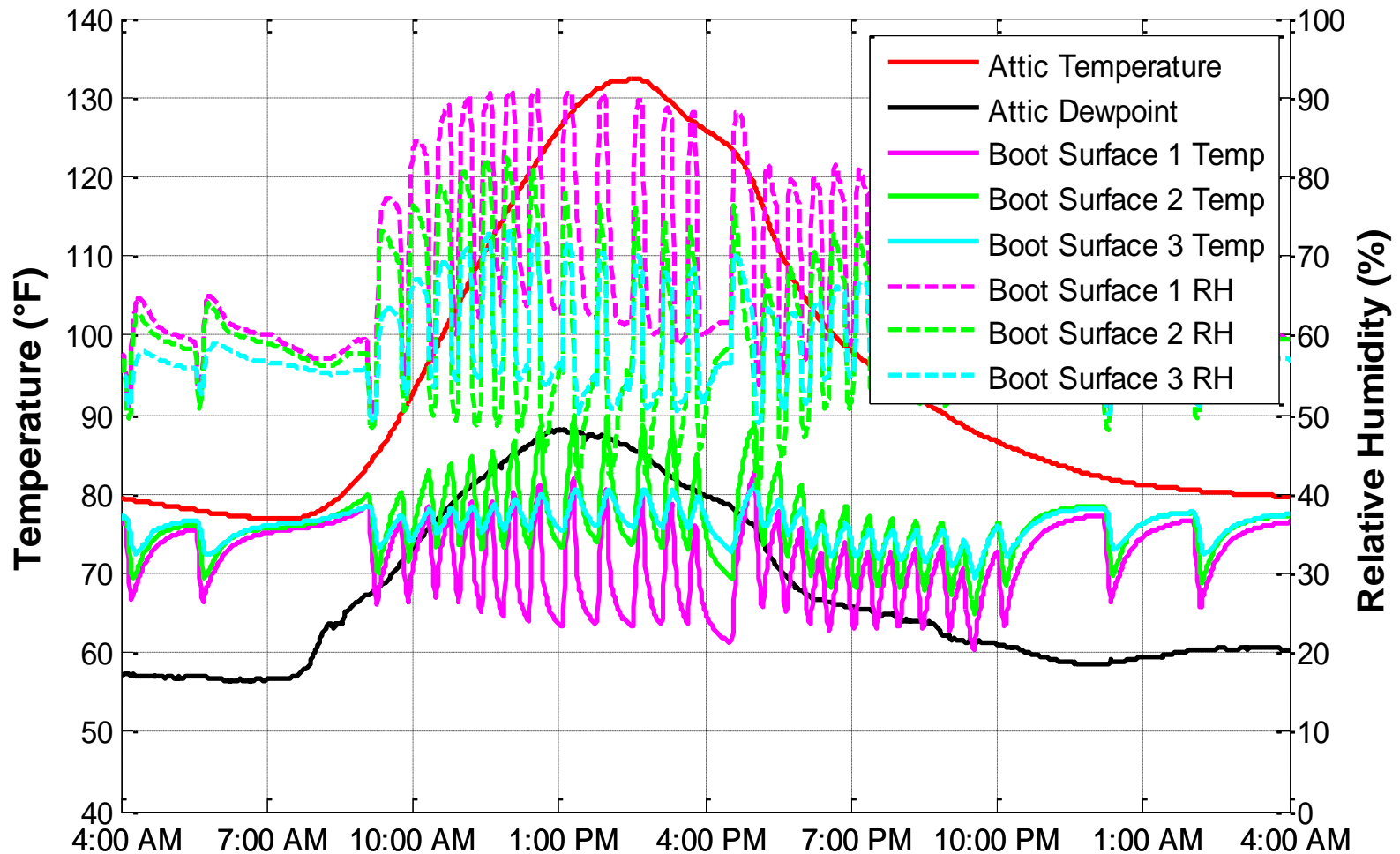


Heat flux magnitude through a hung duct, and an encapsulated and fully-buried 8-in diameter duct

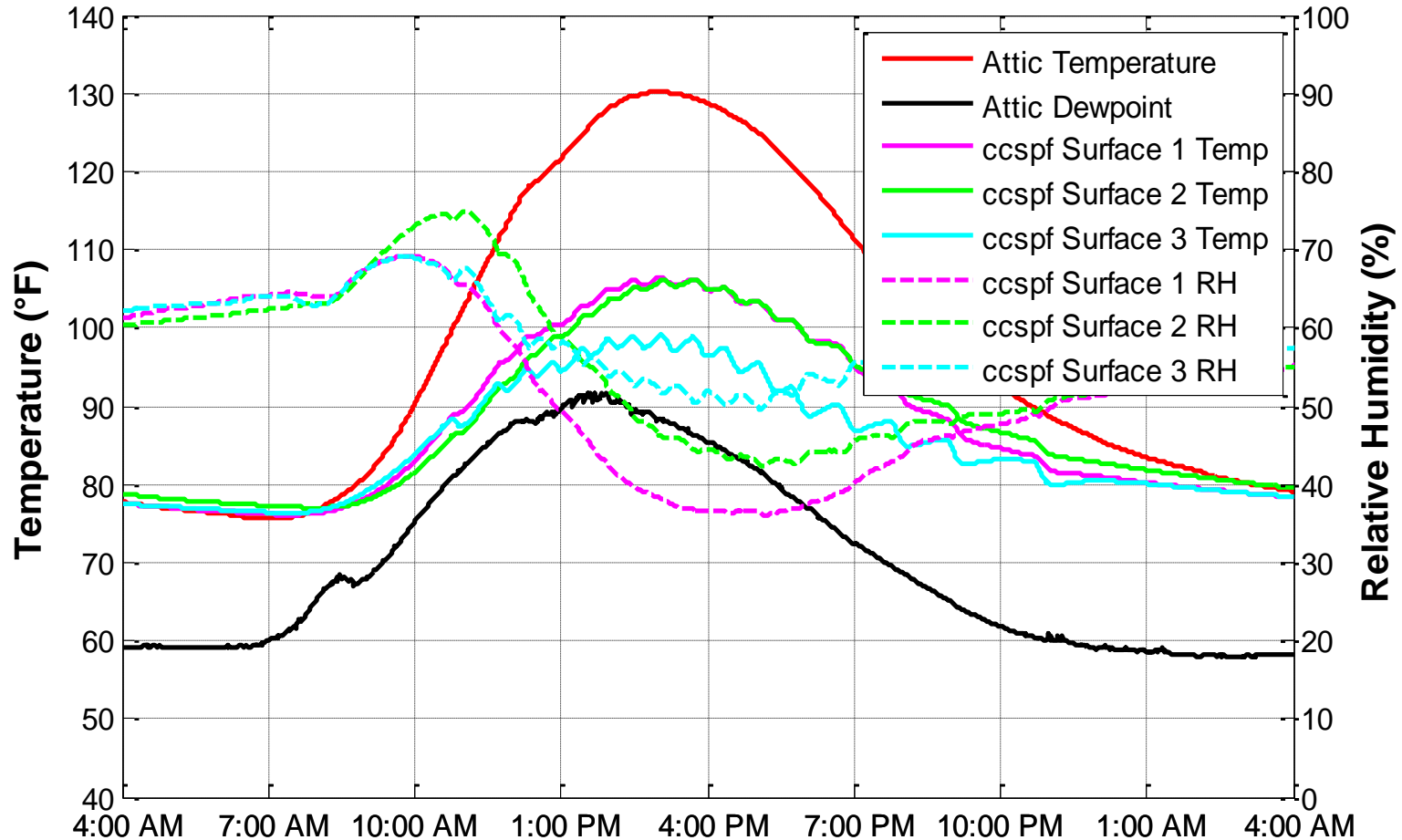
Effective R-values

Duct Configuration	R-4.2 Ducts	R-6 Ducts	R-8 Ducts
Traditional hung ducts	4.6	5.9	7.2
Hung ducts encapsulated in 1.5" of ccSPF	11.3	12.0	12.7
Partially-buried	8.1	10.2	12.3
Fully-buried	12.0	14.1	16.2
Deeply-buried	20.7	22.1	23.5
Encapsulated in 1.5" of ccSPF and partially-buried	18.4	19.7	21.0
Encapsulated in 1.5" of ccSPF and fully-buried	22.6	23.8	25.0
Encapsulated in 1.5" of ccSPF and deeply-buried	29.6	30.3	31.1

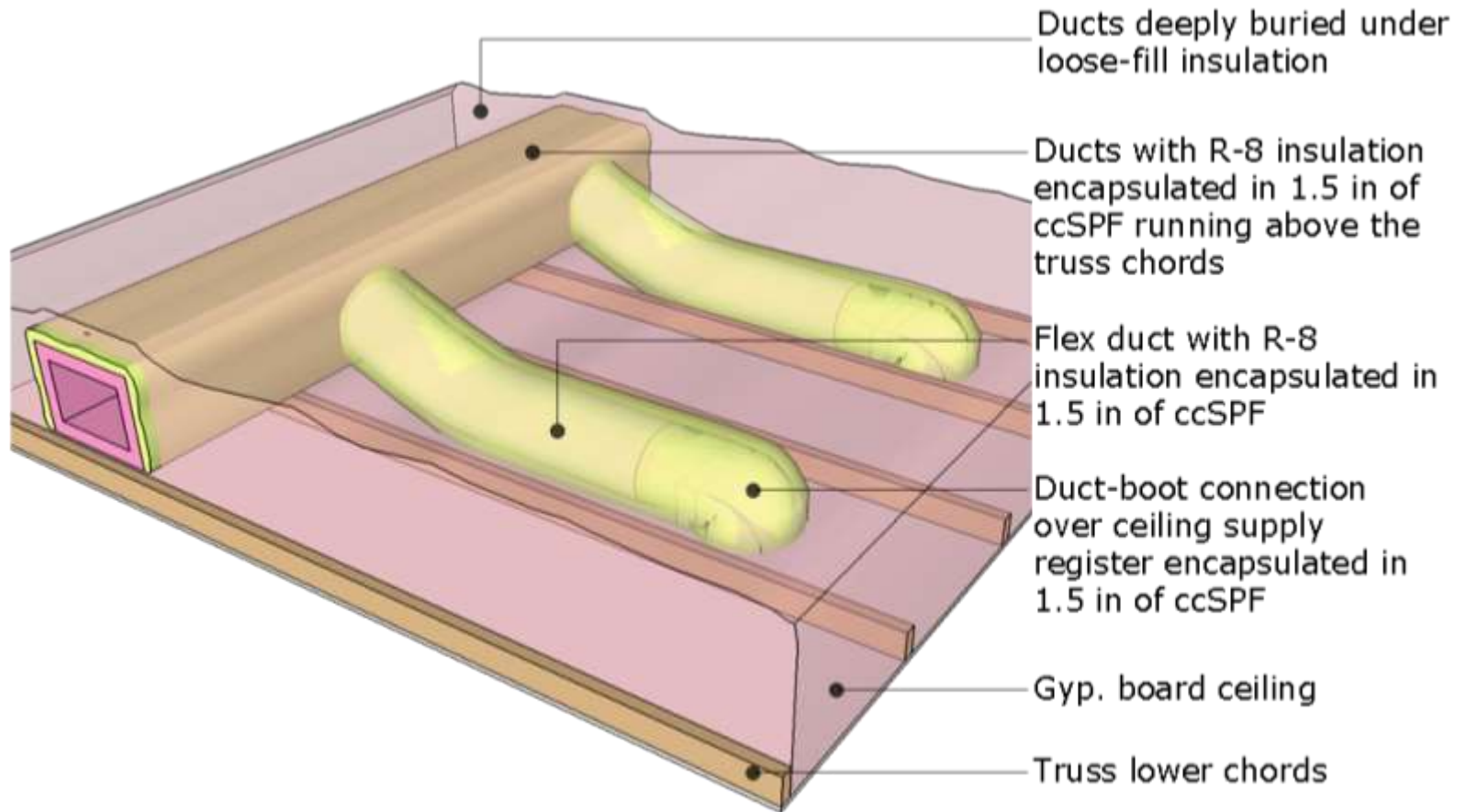
Condensation Potential (Before)



Condensation Potential



BEDs Implementation



Install Low-Profile, Compact Design



- Before ceiling drywall



- After ceiling drywall

Mastic seal ducts, and test



- **Test total duct leakage** to assure performance levels are met (total leakage ≤ 3 cfm25 per 100 ft² of conditioned space)

Apply 1.5" minimum ccSPF



- ccSPF applied prior to ceiling gypsum board

Apply 1.5" minimum ccSPF



- ccSPF applied after ceiling gypsum board

Quality Control Issues - Retrofit



Exposed
underside of
duct jacket



Well-sealed ductwork

Install Loose-fill insulation



- Insulation must be ASTM classified as “mineral-fiber”, and must cover the ccSPF by a minimum of 1.5” (cellulose doesn’t qualify)
- Some foams are exempt from this requirement (more in a moment)

Code Compliance

- 2015 IRC requires that spray foam insulation applied to the exterior of ductwork (Section M1601.3) in attics (Section R316.5.3) meet several requirements
 - Flame spread index less than 25
 - Smoke-developed index less than 450
 - No attic storage or occupancy
 - Spray foam protected by ignition barrier (1.5" mineral fiber)
 - Or meets R316.6 (no ignition barrier required)



Bringing Housing Innovations to Market



Implementing Buried Ducts



Layout ducts with the understanding that they will need to be buried.



Buried Duct Done Right



Pulled back blown insulation to show that a duct is really there.

Getting it Right... mostly



Buried Ducts?





Thank you!
Any Questions?



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