



Building America Case Study Whole-House Solutions for New Homes

HVAC Design Strategy for a Hot-Humid Production Builder

Houston, Texas

PROJECT INFORMATION

Construction: New Home

Type: Single-family, production builder

Builder:

David Weekley Homes – Houston
www.davidweekleyhomes.com/new-homes/tx/houston

Size: 1,757 ft² to 4,169 ft²

Price Range: about \$260,000 to \$450,000

Date Completed: 2013

Climate Zone: Hot-humid

PERFORMANCE DATA

HERS index:

Builder standard practice = 66;
case study 1,757-ft² house = 54

Projected annual energy cost savings:
\$375

Incremental cost of energy efficiency
measures: \$7,500

Incremental annual mortgage: \$372

Annual cash flow: \$3

Billing data: Not available

In this project, Building Science Corporation, a U.S. Department of Energy (DOE) Building America team, collaborated with David Weekley Homes in Houston to develop an economical method of locating the HVAC system within the conditioned space of three research homes. The goal of the research was twofold: to develop cost-effective and replicable designs for locating ducts in conditioned space; and to complete high performance technology packages that will comply with future code improvements.

Traditional methodologies have included either utilizing an extensive system of dropped ceilings and mechanical closets, or converting the vented attic to an unvented cathedralized attic with polyurethane spray foam installed at the roof plane. The builder sought an alternative that can avoid the aesthetic impact of widespread dropped ceilings and the cost impact of spray foam unvented cathedralized attics.

As a production builder, David Weekley Homes must make decisions about designs in the context of large volume production. The builder employs 2×6 walls at 24 in. o.c. with insulating sheathing along with high performance windows and high efficiency equipment. Relocating the HVAC systems to conditioned space represents the single most impactful residential building design improvement, with regard to energy efficiency.



Insulated attic coffered were utilized in key locations to allow for the placement of ductwork in conditioned space without dropping the ceiling. This maintained the indoor aesthetic in rooms such as kitchens, living and dining areas, and wide open spaces.

Key Energy Efficiency Measures

HVAC

- 96% AFUE gas furnace in conditioned space
- Ductwork 100% located in conditioned space. Duct leakage to outside less than 30 CFM 25.
- 16 SEER 2-stage air conditioner
- Central fan integrated supply whole-house ventilation system (fan cycling with outside air duct)
- Kitchen and bath fans vented to outside

ENVELOPE

- R-50 blown ceiling insulation in vented attic
- R-19 grade-1 batt insulation in 2×6 frame wall at 24 in. o.c.
- Double-pane, low-e, vinyl windows; U = 0.29, SHGC = 0.22
- Tightly sealed house, ACH50 = 3.5

LIGHTING, APPLIANCES, AND WATER HEATING

- 100% CFL
- ENERGY STAR® refrigerator
- Natural gas tank water heater

For more information, see the Building America report, *HVAC Design Strategy for a Hot-Humid Production Builder*, at www.buildingamerica.gov

Image credit: All images were created by the IBACOS team.



Mechanical closet in attic (left photo) and insulation “trough” installed over ceiling coffer (right photo) to ensure consistent levels of ceiling insulation over duct coffers

Lessons Learned

- Duct coffers and mechanical closets are best installed by the HVAC contractor to avoid separate visits from other trades.
- The builder expects to vastly improve its HVAC installation methods and save about 40%–50% in future installations.
- Moving the HVAC system to conditioned space reduces the HERS Index by about four points and saves 4%–5% in annual source energy use.
- This duct design methodology satisfies energy codes (e.g., the 2012 IECC) and energy efficiency program criteria (e.g., DOE Challenge Home).
- In future homes, the builder may choose to develop new floor plans that more seamlessly integrate the HVAC system in conditioned space, as opposed to retrofitting house plans. This could lead to additional cost savings and represents the most affordable duct design solution.

“This project helped us find unique ways to achieve cost-effective, production-oriented processes that enhance the energy-saving programs we include on our homes.”

– Mike Funk, Quality Coach
David Weekley Homes
On the value of this HVAC design research