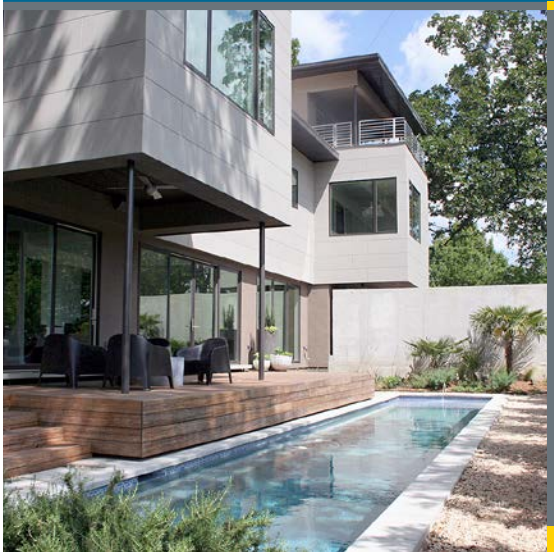

Building America Case Study

Ground Source Heat Pump Research, TaC Studios Residence

Atlanta, Georgia

PROJECT INFORMATION

Construction: New Home

Type: Single-family

Builder: TaC Studios, *tacstudios.com*

Size: 3,570 ft^2

Price Range: about $750,000

Date completed: 2011

Climate zone: Mixed-humid

PERFORMANCE DATA

HERS index: 66

Builder standard practice = 75

Case study house 3,570 ft^2

Projected annual energy cost savings: $493

Incremental cost of energy efficiency measures: $51,036

Incremental annual mortgage: $1,449

Annual cash flow: –$1,119

Billing data: Not yet available

Accounting for all energy uses when modeling a home during design and carefully sizing expensive systems such as ground source heat pumps (GSHPs) will result in a closer correlation between modeled and actual energy use. TaC Studios, an Atlanta-based architecture firm, learned these lessons during design and construction of the owners' new home in Atlanta, Georgia.

The firm worked with Southface through the U.S. Department of Energy Building America team National Association of Home Builders (NAHB) Home Innovation Research Labs Industry Partnership for High Performing Homes. The home serves as a residence and home office for the owners, as well as a demonstration of their design approach for potential clients.

> *"We practice what we preach! After developing 'Green' strategies for clients over the years, we wanted to apply many of the techniques, systems and products within the design of our own new home and studio."*
>
> – Cara Cummins, Partner
> TaC Studios

The home demonstrates current best practices for the mixed-humid climate, including a building envelope featuring advanced air sealing details and low density spray foam insulation, glazing that exceeds ENERGY STAR® requirements, and a high performance GSHP. As a Building America test home, it was evaluated to detail whole-house energy use, end use loads, and the efficiency and operation of the GSHP and associated systems. The home includes many nontypical end use loads, including a home office, a pool, a landscape water feature, and other luxury features not accounted for in Building America modeling tools. These end uses were monitored separately to determine their impacts on overall energy consumption.

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Key Energy Efficiency Measures

HVAC

- GSHP (Heating: coefficient of performance 3.9; Cooling: EER 18)
- 50% of ducts in conditioned space; 50% in sealed crawlspace. Duct leakage to outside = 128 cfm @ 25 Pa; 3.6% duct loss to outside
- Central fan integrated supply ventilation, 100% ASHRAE 62.2
- Kitchen and bath fans vented to outside

ENVELOPE:

- R-20 grade-1 open cell spray foam insulation in cathedral attic
- R-13 grade-1 open cell spray foam insulation in exterior 2 × 6 frame walls;
- Zip Systems exterior sheathing with pre-applied weather resistant barrier
- Exterior walls factory built offsite
- Double-pane low-e windows

  U-0.34, solar heat gain coefficient (SHGC)-0.26 max to

  U-0.28, SHGC-0.19 min
- Tight sealed house, ACH50 = 2.15

LIGHTING, APPLIANCES, AND WATER HEATING

- Advanced lighting controls
- ENERGY STAR appliances and induction cooktop
- 0.92 energy factor, electric storage tank with desuperheater from GSHP, and hot water plumbing with R-4 insulation

For more information, see the Building America report, *Measured Whole-House Performance of TaC Studios Test Home,* at *buildingamerica.gov*

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

This photo shows the TaC home from the driveway.

Lessons Learned

- This home's energy use exceeded projections from energy modeling tools. This disparity can largely be attributed to nontypical loads (home office, pool, landscape water feature), which accounted for 48% of total energy consumption during the monitored period. Although not included in many modeling tools, the impact of these types of loads should be carefully considered in a project's planning stages.
- The research results measured an average cooling efficiency of 14.3 Btuh/W for the monitoring period.
  - During extended runtimes, the home's ground loop had inadequate capacity to dissipate heat from the system. This may be due to rule-of-thumb loop sizing.
  - Southface found that GSHPs have considerable cachet value in the local residential market. Research findings, however, do not show an increase in efficiency far above that of high efficiency air source heat pump systems, making the recommendation of GSHPs a hard sell on cost effectiveness alone.
- Spray foam insulation, an engineered sheathing system, and careful attention to air sealing details following the ENERGY STAR Thermal Bypass checklist resulted in the project beating its infiltration goal of 2.5 air changes per hour at 50 Pascals (ACH50).

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For more information, visit:
buildingamerica.gov

The U.S. Department of Energy's Building America program is engineering the American home for energy perfomance, durability, quality, affordability, and comfort.

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