Building America
U.S. Department of Energy
Research Toward Zero Energy Homes

Case Study

Colleyville Eco House Prototype

Colleyville, Texas

Overview

BSC collaborated with Greencraft Builders, LLC in Colleyville, TX on a 2009 prototype house called the Colleyville House. This house demonstrates the energy efficiency and durability upgrades that Greencraft currently promotes in all of their products. The Colleyville house is located in Colleyville, TX, about 25 miles North West of Dallas. The house was designed by William Peck and Associates, an award winning architect specializing in sustainable energy efficient architecture.

BSC has been collaborating with Greencraft homes since 2005 and have forged a valuable working relationship. BSC provided consulting services for Greencraft and recommended numerous efficiency and durability improvements. One of the main features that separate this home from previous projects is the inclusion of a high efficiency ground source heat pump. Other key upgrades include an unvented roof with low density spray foam insulation and supplemental dehumidification. Also included are LoE^3 next generation spectrally selective glazing treatment

U.S. Department of Energy
Energy Efficiency and Renewable Energy
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Project Profile

Project Team: Greencraft Builders, LLC, Building Science Corporation

Address: 1708 Oak Knoll Drive, Colleyville, Texas

Description:
4,886 ft^2 two-story single family home

Completion Date:
March, 2009

Estimated Annual Energy Savings:
Average 70.5% projected source energy savings relative to the 2008 Building America Benchmark

Project Website:
http://colleyvilleecohouse.com/

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Builder Profile

GreenCraft Builders L.L.C. is the culmination of more than 30 years of experience building and remodeling homes in the Dallas/ Fort Worth metroplex. Since 2004, Chris Miles, principal of GreenCraft, has been recognized as a leader in the North Texas green building industry, first as a producer and project manager, and now as a builder with his company, GreenCraft Builders L.L.C.

Participating Programs & Certifications

U.S. Department of Energy's Building America Program

U.S. Green Building Council LEED® for Homes- Gold

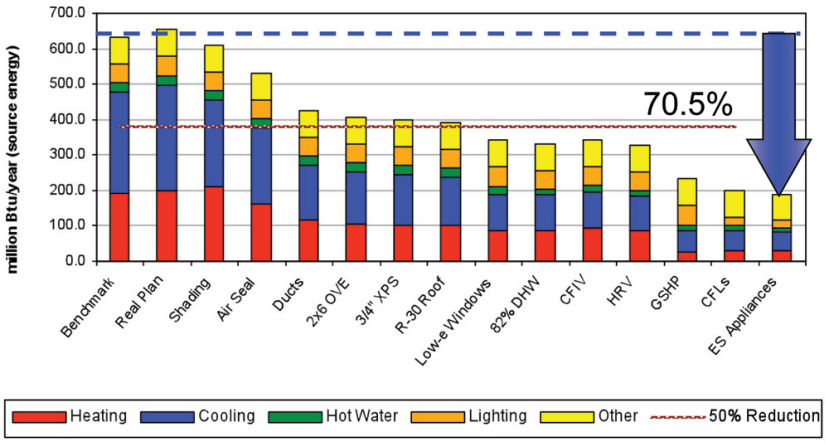
U.S. Environmental Protection Agency ENERGY STAR® Program

NAHB National Green Building Program™- Gold

GreenBuilt™ North Texas

Sole show house at the Sunbelt Builders Show

Parametric Study



Construction

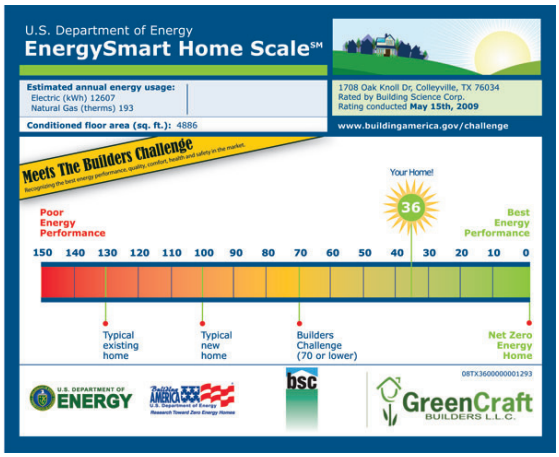
Greencraft constructs with full Advanced Framing in their walls, roof, and frame floor. This includes 2x6 studs at 24" o.c. plus two stud energy corners and single top plates. Greencraft employs stack framing so that wall and floor framing members are aligned to transfer loads efficiently through the structure.

The wall cavity is fully insulated with low density open cell spray foam to an R-20. The roof is an unvented cathedralized roof with R-30 low density open cell spray foam installed to the underside of the roof sheathing.

and very low enclosure infiltration. A full CFL lighting package plus Energy Star® appliances help to achieve a HERS Index of 36.

The Colleyville house was able to procure high quality fiberglass framed windows with state of the art LoE^3 spectrally selective glazing coating. This resulted in an NFRC full unit SHGC rating of 0.34 with a U-value of 0.29. This glazing coating, coupled with extensive overhangs in the floor plan, results in a greatly reduced cooling peak load and annual cooling energy use.

A high efficiency ground source heat pump (18.8 EER/4.1 COP) is installed along with a integrated supplemental dehumidification. All the equipment and ductwork is located in the unvented cathedralized attic to save living space. Jump ducts provide passive returns from the bedrooms. High efficiency exhaust ducts are installed at all the bathrooms and at the kitchen hood.



Enclosure Design

❶ **Roof Assembly:** Unvented roof with R-30 open cell spray foam and fully adhered waterproof membrane

❷ **Wall Assembly:** Fully advanced framed structure; R-24 wall with R-20 open cell spray foam and $^{3}/_{4}$" XPS sheathing

❸ **Window Specifications:** Vinyl framed double glazed windows: U=0.34, SHGC=0.29.

❹ **Air Sealing:** The design infiltration rate is 2.5 in^2 leakage area per 100 ft^2 of enclosure area. Low density open cell spray foam installed in wall and roof cavities. Low expanding open cell spray foam installed around windows and mechanical and electrical penetrations throughout the enclosure.

Foundation Assembly: Slab-on-grade foundation; ❺ uninsulated with Termimesh® termite mitigation system and sill seal ❻.

Mechanical Design

Heating and Cooling: 4.1 COP/18.8 EER ground source heat pump (see ❶ for piping).

Ventilation: Fantech energy recovery ventilator (ERV) ❷.

Supplemental Dehumidification: GeneralAire whole-house dehumidifier integrated with HVAC system ❸.

DHW: 0.82 EF instantaneous water heater with an add-on storage tank for hot water from ground source heat pump.

Lighting: ENERGY STAR® CFLs

Appliances: ENERGY STAR® dishwasher, refrigerator and clothes washer.

Ventilation

Greencraft Builders, LLC utilizes Central Fan Integrated Supply ventilation that draws outside air via a 6" flex duct to the return plenum of the HVAC system. This allows for the introduction of outside air to the living space whenever space conditioning is already operating. The GeneralAire whole house dehumidifier draws air from the main living space and supplies dehumidified air to the supply plenum of the HVAC system. An Aprilaire® Ventilation Control System 8126 communicates with the air handler to employ fan cycling. Fan cycling will turn on the fan at a 33% duty cycle (10 minutes on, 20 minutes off) in order to provide outside air during periods of no space conditioning. A 6" mechanical damper is installed on the 6" outside air duct. This is controlled by the fan cycler and will close off the outside air duct during periods of consistent space conditioning to prevent over ventilation of the living space.

Bathroom exhaust fans plus a kitchen hood are installed to provide spot ventilation when necessary. These are all routed to the outside and are not recirculating fans. One of the bathroom fans is rated to provide ASHRAE 62.2 ventilation so that the house can be operated at that rate if needed.

Quality Control

- Design follows BSC Building America criteria
- Manual J8 analysis ensures right sized mechanical systems and ductwork

Moving Forward

The open house period of the Colleyville house has ended and now Greencraft is ready to start design on the Net Zero Energy Lewisville Eco House. One of the major design upgrades for this house will be the installation of a heat pump with integrated supplemental dehumidification. AAON Inc. has designed a residential heat pump that integrates modulating gas reheat to allow for dehumidification separate from cooling. This technology has been implemented successfully in commercial buildings for years and now will provide supplemental dehumidification in residential buildings.

Design and Construction Challenges

The construction of the Colleyville house presented a number of challenges to the builder. First, there was a new framing crew on the site and they had significant difficulty constructing a fully advanced framed structure. Greencraft had to hire another framing contractor halfway through construction to remedy errors and finish the job to meet specifications.

Second, the homeowners requested a dark metal roof for aesthetic purposes. Greencraft had to work to find an Energy Star® rated dark metal roofing material in a short period of time.

Third, the homeowners also requested a higher roof pitch to match the 10:12 roofs in the neighborhood. A 10:12 roof pitch greatly reduces the overhang potential for shading purposes so Greencraft compromised by increasing the roof pitch from the original 4:12 to 6:12. A 6:12 pitch still allowed for the specified overhangs to be constructed.

Fourth, a considerable amount of select fill had to be obtained to prepare the ground surface properly. This was due to the fact that the previous home on this site had a pier and beam foundation. The existing foundation was fully removed and that left large cavities that needed to be filled. Then, the resulting ground had to be compacted 95% to meet the structural demands and this had to be tested and verified in the field.

This case study has been prepared by Building Science Corporation for the Department of Energy's Building America Program, a private/public partnership that develops energy solutions for new and existing homes. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

For more information about Building America go to www.buildingamerica.gov

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