Extra Insulation and Air Sealing Provides Helena Habitat Homeowner with Annual Heating Bill of $100

A common belief holds that all new Montana homes are energy efficient. The proof, however, lies in the home's energy bills and comfort level.

The Helena Area Habitat for Humanity built its first house in 1992 and these early homes were well built and met minimum energy code standards. Habitat for Humanity's philosophy at the time was that any dollar spent on above-code energy features would take a dollar away from future houses. In more recent years, however, the Habitat homes have become more efficient using higher levels of insulation, ENERGY STAR-certified windows and doors, and more tightly sealed and upgraded mechanical ventilation systems. These features ensure good indoor air quality and very low energy bills. The recently built home on Spencer Street should have an annual heating bill of $100.

The 800-square foot house was built in 2015 and became Helena's thirty second Habitat home. Construction of the house was primarily done by Youth Build students and volunteers. Youth Build is a national program that offers young students the opportunity to learn carpentry and home building skills while earning a small salary while working toward a high school diploma.

Building simple, decent, and affordable houses while keeping in mind the ability of families to afford utility bills is the model for Habitat affiliates. The home on Spencer Street was built on a shallow, frost protected slab-on-grade foundation, which requires less excavation— two feet compared to a conventional foundation requiring four feet. A two-foot horizontal wing of R-10 blue board foam prevents frost from getting under

the foundation and causing frost heave. DOW Chemical provides blue board free of cost to Habitat affiliates. The students cut DOW blue board to form the foundation walls and placed four inches of blue board (R-20) under the entire concrete floor.

The home's exterior walls were framed with 2X6 studs, sheathed, and the wall cavities filled with R-21 fiberglass batt. Two layers of two-inch foam board (R-20) was placed over the wall sheathing, providing a total insulation level of R-41. All the seams of the board were sealed with construction tape, providing a water-resistant barrier. Furring strips (1X4-inch) were placed over the exterior foam board to provide a nailing base for the siding. This provides a three-quarter inch air space, or vented rain screen, that allows any rain water to drain out the bottom vent strips. Wood blocking was attached around window openings to provide a solid nailing base for the window flanges. The windows are triple glazed ENERGY STAR-certified and rated U-.25. The attic received extensive air sealing and is insulated to R- 60 with blown-in fiberglass.

The house is heated with a sealed combustion 95 percent efficient furnace and has an electric water heater. A conventional open combustion gas furnace and/or gas water heater, would probably not vent properly in this home, particularly when either the kitchen exhaust fan or the clothes dryer is operating, and all windows and doors closed. Air being drawn out of the house by either the kitchen fan or clothes dryer might reverse the flow of a non-sealed combustion gas water heater or furnace causing dangerous combustion byproducts to enter the house. Fortunately, this is not a problem in the Spencer Street home.

Good indoor air quality is ensured with installation of a heat recovery ventilation system which draws stale air and moisture out of the bathroom and kitchen, while

transferring about 75 percent of the heat to the incoming air. Fresh air is delivered through dedicated registers located high on bedroom closet walls, allowing the cooler outside air to mix with warmer air, lessening any discomfort issues.

The home is rated by an independent third-party Home Energy Rating System (HERS) provider and received a score of 60. A HERS score of 100 would just meet code while a score of zero would show no annual utility bill. A score of 60 indicates the house is 40 percent more efficient than a house that meets minimum energy code.

The rater made several visits to the house, including a code-required blower door test to confirm that air sealing had been done correctly. The house tested at 2.3 air changes per hour (ACH at 50 Pascal pressure), surpassing the code requirement of 4 ACH/50. Results of this tests, along with inputs derived from the plan review, are used to generate the HERS Index score which predicted the $100 heating expense.

The proof of the home's energy efficiency is reflected in the heating bills and exceptional comfort of the home.

Helena Habitat house on Spencer Street in Helena, MT with $100 annual heating bills.

Foam Foundation – Youth Build Students cut 2-inch DOW boards for Lite Form inserts and placed and filled the forms with concrete.

2 layers of 2-inch DOW board (insulating value of R-20) was placed under the entire under floor.

2 feet horizontal layer of R-10 prevents frost from getting under the foundation.

Wall extension framing for windows, ready for 4 inches of DOW board (R-20) foam sheathing.

Exterior walls have R-21 fiberglass batt in the wall cavity and two layers of R-10 foam sheathing with seams taped on each layer for total wall of R-41.

1X4 furring strips were screwed to wall framing creating a ¾ inch space (vented rain screen) behind the siding. Note: The blue bugs screen at bottom of the siding. Foam foundation is protected with coil stock metal covering.

Long screws were used for attaching window and siding supports to the wall framing.

Foam seal used at top plate of interior and exterior walls. Note: The bathroom exterior wall has DOW board for cavity insulation.

Spray foam air sealing at electrical boxes in the attic.

Montana DEQ conducted several trainings at the house with a blower door and infrared camera. Here Youth Build students detect slight air leakage at an exterior wall electrical outlet.