

**DOE CHALLENGE HOME
CASE STUDY****Dwell
Development**

Seattle, WA

**BUILDER PROFILE****Dwell Development LLC**

Builder: Anthonny Maschmedt
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FEATURED HOME/DEVELOPMENT:**Project Data:**

- Name: Passive House #1 at Columbia Station
- Location: Seattle, WA
- Layout: 3 bedroom, 2.5 baths, 3 floors plus rooftop deck
- Conditioned Space: 2,000 ft²
- Completion: May 2013
- Climate Zone: IECC 4C

Performance Data:

- HERS Index without solar PV: 45
- HERS Index with solar PV: NA
- Projected annual utility costs (without solar): \$483

Anthony Maschmedt's first U.S. Department of Energy (DOE) Challenge Home is also his first Passive House, and, to his knowledge, the first Passive House built on speculation in the state of Washington.

If the home performs according to expectations, DOE's Challenge Home will become a target for future Dwell homes. Maschmedt also plans to build more Passive Houses with the goal of eventually building every home to Passive House standards.

Like most of the homes he's built, this one sold at the foundation stage. "Our buyers are looking for energy efficiency. We have a waiting list of people who keep an eye on our new homes," said Maschmedt. All of his homes are built on spec, which Maschmedt prefers over custom homes, because it gives him the freedom to build homes the way he likes them done, and the way he likes to build is to aim for the most energy-efficient home possible.

Maschmedt started out in 2002 working for his mom, an award-winning designer and general contractor of custom homes. In 2005 Maschmedt ventured out on his own and started Dwell Development with the idea of going modern and going green. He took the first Built Green class offered by Washington state's Master Builders Association and began building homes that achieved the 3-star rating from the Snohomish and King County Master Builder Association's Built Green program. By 2007 every home was achieving a 5-star Built Green rating as well as the Northwest ENERGY STAR certification. When the market crashed, Dwell Development's homes continued to sell at premium prices.

Maschmedt's company has grown to 6 employees (plus contractors) and he now builds about 25 homes a year, with 26 scheduled for 2013 and 27 slated for 2014.

The home in South Seattle is one of 42 homes by Dwell, in a micro-community of modern, efficient homes built on an urban gray-field site. One of the other homes in



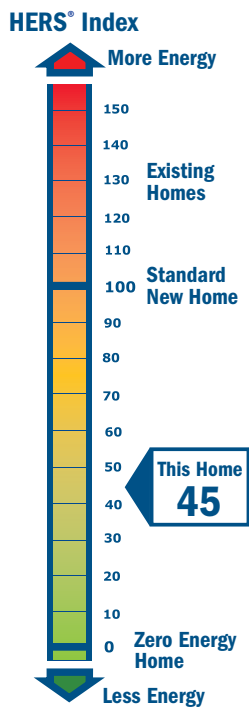
DOE Challenge Home builders are in the top 1% of builders in the country meeting the extraordinary levels of excellence and quality specified by the U.S. Department of Energy. Every DOE Challenge Home starts with ENERGY STAR for Homes Version 3 for an energy-efficient home built on a solid foundation of building science research. Then, even more advanced technologies are designed in for a home that goes above and beyond current code to give you the superior quality construction, HVAC, appliances, indoor air quality, safety, durability, comfort, and solar-ready components along with ultra-low or no utility bills. This provides homeowners with a quality home that will last for generations to come.

Induction cook tops only heat up when a pot is placed on them. Triple-pane windows; an ENERGY STAR-rated dishwasher, clothes washer, and refrigerator; a condensing dryer; and 100% CFL lighting are among the other energy-saving devices inside the home. All plumbing fixtures are EPA WaterSense-certified. Cabinets are formaldehyde-free and locally made.



CHALLENGE HOME CERTIFIED:

- 1 BASELINE**
certified ENERGY STAR for Homes Version 3.0
- 2 ENVELOPE**
meets or exceeds 2012 IECC levels
- 3 DUCT SYSTEM**
located with the home's thermal boundary
- 4 WATER EFFICIENCY**
meets or exceeds the EPA WaterSense Section 3.3 specs
- 5 LIGHTING AND APPLIANCES**
ENERGY STAR qualified
- 6 INDOOR AIR QUALITY**
meets or exceeds the EPA Indoor airPLUS Verification Checklist
- 7 RENEWABLE READY**
meets EPA Renewable Energy-Ready Home.



this community is part of a performance testing program conducted by DOE and the Northwest Energy Efficiency Alliance (NEEA), with energy monitoring by Washington State University's Energy Extension Office.

Meeting Challenge Home was not a difficult jump, according to Maschmedt. His company was already building a double-wall enclosure. To meet their project goals they just increased the overall cavity width from 10 to 14 inches. The double-wall consists of two 2x4 16-inch on-center framed walls. The framer built the exterior walls in his shop and brought them to the site ready to assemble.

The walls were spaced 8 inches apart, so the overall wall cavity was 14 inches wide from the OSB-sheathed outer wall to the interior surface of the inner wall, which was covered with netting to hold 14 inches (R-45) of blown cellulose. Instead of housewrap, a liquid air- and weather-resistant barrier was sprayed onto the OSB sheathing, then half-inch vertical battens were installed to provide an airspace and drainage plane behind the fiber cement siding. "Application of an exterior fluid-applied air barrier allows us to make the homes air and water tight after framing. Once the roof and windows are installed, we can work all winter long and the homes stay warm and dry inside even in the wet Northwest," said Maschmedt.

A fluid-applied weather-resistant barrier also covers the 3/4-inch OSB sheathing on the home's flat roof, making it water and air tight. The roof is then covered with a thermoplastic polyolefin (TPO) single-ply roofing membrane lapped 6 inches up the sides of the parapet walls. Two inches of closed-cell polyurethane foam is sprayed against the underside of the OSB and the cavities formed by the 18-inch roof trusses are further filled with 16 or more inches of blown cellulose for an R-60 insulation value.

The foundation slab was wrapped in a 10-mil vapor barrier. An 8-inch-thick (R-42) layer of XPS rigid foam extends under the entire slab and comes up on all sides to separate the slab edge from the footing wall.

Extensive air sealing was conducted throughout the home to achieve the Passive House standard of 0.6 ACH50.

Maschmedt had difficulty finding affordable windows that met the Passive House standard; he eventually bought triple-paned windows that were argon-filled with steel-insulated frames from a manufacturer in Lithuania. The windows' solar heat gain coefficient is tuned for window orientation and varies from 49% to 62% (SHGC = 0.49 to 0.62). Insulation values are U=0.17 for frames and U=0.11 at the center of the glass. Fixed shading covers the south-facing windows to block out overhead summer sun.



The Challenge Home is one of 42 homes in a micro-community of ultra-modern, energy-efficient homes built by Dwell Development on an urban gray-field site in South Seattle. Every home will achieve a 5-star Built Green rating from the regional master builders association and meet the criteria of the Northwest ENERGY STAR program which is more strict than the national ENERGY STAR criteria.

The home's one mini-split heat pump is almost overkill given the low heating load, estimated at 4.0 Btu/ft²hr or 7,580 Btu for the 1,882-square-foot home, a heating energy cost of about \$50/year. The air is circulated through the home by a heat recovery ventilator (HRV), which supplies fresh, filtered air throughout the main living areas and exhausts stale air from the bathrooms, laundry, and kitchen. The HRV uses a dedicated duct system with round metal ducts for maximum air flow efficiency.

The home is equipped with an on-demand gas hot water boiler, and an ENERGY STAR dishwasher, refrigerator, and clothes washer, as well as a highly efficient induction cook top and a condensing clothes dryer, which eliminates the need for an outside duct. High-efficiency fluorescent lighting adds to the energy savings.

No- and low-VOC products were used including zero VOC interior paints and very low VOC, formaldehyde-free locally made cabinets to ensure better indoor air quality.

Although solar photovoltaic panels were not installed, a 3.5-kW photovoltaic system could zero out the electrical consumption for conscientious homeowners. To make the house solar-ready, a net energy metering system was installed next to the electrical meter and conduit was installed from the electric panel to the roof. The home's flat roof will accommodate installation of solar panels at whatever direction and angle are optimum for solar gain. As more homes are purchased in the community, Maschmedt hopes to work with the neighborhood association to encourage participation in a volume purchase of solar panels.

All homes have electric car charging conduit installed in the garage.

The home has a roof-top deck to capture the territorial views, along with the option for roof-top gardens or living roofs. Other design features that enhance the home's energy efficiency include windows that were set in the middle of the wall to maximize thermal performance and massing that was kept relatively compact to reduce heat loss.

All of the construction debris from the site was recycled, a practice Dwell Development is committed to on all its projects.

To meet the rigorous standards of the Challenge Home and Passive House, Dwell held several project team meetings early on to establish the necessary approaches and appropriate design and materials to achieve its goals.

HOME CERTIFICATIONS:

DOE Challenge Home

Passive House

ENERGY STAR Version 3 (Northwest version)

Built Green - 5 Star

ENERGY STAR Version 3

EPA Indoor airPLUS



Every DOE Challenge Home combines building science specified by ENERGY STAR for Homes and advanced technologies and practices from DOE's Building America research program.

The home was heavily visited when it was opened during construction for the Northwest Ecobuilding Guild's Green Homes Tour, a regional opportunity to show green dwellings in and around Seattle and King County. Pamphlets, publications, and blog posts were created to advance awareness of the project and Passive House in general. The energy efficiency and performance of the home were also communicated through Dwell Development's website. Dwell has presented on this project and other homes at several industry events that have received press coverage and were covered on Dwell's blog and websites. Maschmedt also increases Dwell's visibility through community service. Maschmedt serves on the executive board of the King and Snohomish County Master Builders Association. The company released a parcel of land from this micro-community at cost to Habitat for Humanity.

In addition to using the Northwest Multiple Listing Service, realtor websites, press releases, and Dwell's own website, the company made extensive use of social media to market the home, including Facebook, Twitter, YouTube, Google+ and Pinterest. Several videos were shot during construction, explaining the energy-efficient features of the home. These videos have been promoted via multiple social media and public relations channels and published to Dwell's own YouTube channel (http://www.youtube.com/subscription_center?add_user=DwellDevelopment).

The first in a six-part video series was posted August 6, 2013, during YouTube's GeekWeek. Additional episodes will be posted every other Tuesday through October 15. These videos include a roundtable discussion featuring the construction team and the homeowners discussing the home's energy-efficiency features and performance (http://www.youtube.com/watch?v=suq8TfOFT0M&feature=player_embedded and EP#2 is <http://www.youtube.com/watch?v=je8xIaPKvTM>).

These marketing efforts have paid off. The home was highlighted in several episodes of Seattle NBC affiliate KING 5's *New Day Northwest* program (which airs weekdays at 11am PT). The story was picked up by several national and international media outlets.



The flat roofs provide an ideal location for roof-top decks and solar panels, supported by 18-inch roof trusses that provide space for a combination of 2 inches of closed-cell spray foam and more than 16 inches of blown cellulose delivering an R-60 insulation value. Double-stud 14-inch-thick walls allow for R-45 of blown cellulose.

For Maschmedt, profits aren't the goal, but the end result of building a great product. "Dwell Development's business metrics are simple... build the most energy-efficient home we can each and every time. Commit to learning new processes, technologies, and ways of improving what we do on every home we build. If we continue to build homes the right way, profits will follow."

KEY FEATURES

- **Path:** performance
- **Walls:** double-stud walls with 14 inches (R-45) blown cellulose. Liquid-applied air- and weather-resistant barrier applied to OSB, 0.5-inch vertical furring strips, fiber cement siding.
- **Roof:** unvented flat roof with 2 inches of closed-cell polyurethane foam sprayed against underside of ¾ inch OSB sheathing, plus 18 inches of blown cellulose in 18-inch roof truss cavity for R-60. Above-roof sheathing is liquid-applied weather-resistant barrier, topped by a thermoplastic polyolefin (TPO) single-ply roofing membrane lapped 6 inches up sides of parapet walls.
- **Foundation:** slab on grade, 8 inches (R-42) XPS rigid foam insulation under slab and at slab edge. 10-mil vapor barrier between slab and XPS.
- **Windows:** triple-pane, low-e, uPVC-framed, U=0.17 frames, U=0.11 center of glass, SHGC=0.49 to 0.62.
- **Air Sealing:** 0.6 ACH 50
- **Ventilation:** HRV with dedicated distribution of hard round metal ducts, with MERV 8 filter
- **HVAC:** 10.6 HSPF/23 SEER ductless minisplit heat pump with one inside unit
- **Hot Water:** 96% AFUE gas on-demand water heater with manifold plumbing distribution system
- **Lighting:** 100% CFL
- **Appliances:** ENERGY STAR-rated dishwasher, clothes washer, and refrigerator; condensing dryer, induction cook top
- **Solar:** solar ready with conduit to roof
- **Water Conservation:** drought-tolerant landscaping, rain barrels for irrigation.
- **EPA WaterSense:** all plumbing fixtures
- **Other:** no- and low-VOC cabinetry and finishes; within 1,000 feet of light rail; 100% construction debris recycling, use of locally sourced and recycled content materials