

Ezell-Morgan Construction's New ENERGY STAR[®] Homes



For a home to qualify for an ENERGY STAR rating it must meet or exceed strict requirements of indoor air quality and be at least 15% more efficient than a new home that conforms to the 2006 International Energy Conservation Code (IECC). Adherence to the standards must be verified through inspection and testing by a licensed Home Energy Rating System (HERS) inspector. Ezell-Morgan Construction's new homes at 610 Wren Drive and 727 Wild Plum Court have easily exceeded this requirement. These homes are 45% more efficient than the 2006 IECC baseline. This rating also qualifies

the home for the maximum \$2,000 tax credit under the Energy Policy Act of 2005 (EPACT).

Some features that have been included in the home to achieve these results are outlined below:

Spray Foam Insulation

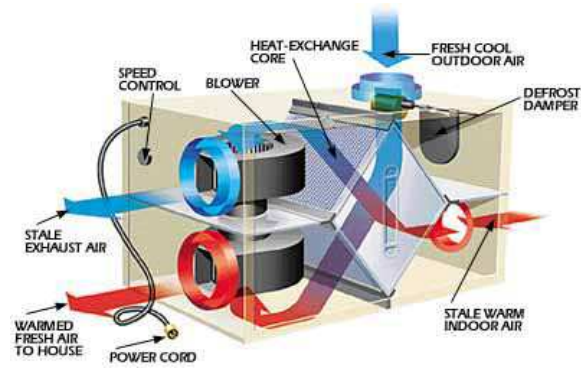


Spray foam insulation is sprayed into wall cavities, rims and the attic. It bonds to adjacent surfaces and expands to fill voids to form an exceptionally tight seal to reduce air infiltration. Air infiltration is normally the number one contributor to unwanted heat transfer in today's well-insulated homes. It can account for 40% of the energy loss in a new home. A home insulated with fiberglass batts that is well sealed and caulked will typically have an air infiltration rate of 35-50% per hour. In

other words, 35-50% of the total volume of air in the home is exchanged with outside air each hour. With foam, it is possible to lower this costly infiltration to just 6%/hour. The HERS inspector uses a blower door test to depressurize the home to determine the average annual infiltration rate.

Whole House Forced Ventilation System

Since these homes are so tight, they require a whole house ventilation system to supply fresh air and ensure healthy indoor air quality. It may seem contradictory to go to the effort of sealing the home which then requires the addition of forced ventilation; however, the forced ventilation system combined with an airtight envelope allows nearly complete control over the supply of fresh air to the home under all climate conditions.



In contrast, normal homes will leak air at increasingly higher rates the more windy it is and the more extreme temperatures become. Under extreme conditions the infiltration rate may easily quadruple a home's average air exchange rate just when it will create the maximum discomfort and energy loss. When temperatures are moderate and wind speeds are low homes without forced ventilation get no fresh air at all.

The heart of the ventilation system is the Heat Recovery Ventilator (HRV). It uses a small variable speed fan (40-150 cfm) to bring in fresh air from outside and exhaust a balanced amount of stale indoor air outside. It does this in a controlled way by filtering the air it brings in and by using a heat exchanger to condition this air with the air it exhausts at an efficiency of 86%. The fan has five speeds and is set based on the following formula:

$$0.01 \text{ cfm} \times (\text{conditioned area}) + 7.5 \text{ cfm} \times (\# \text{ of occupants})$$

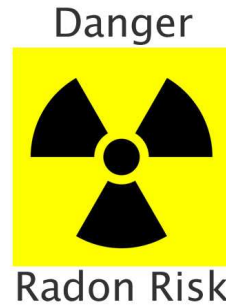
For this home with four occupants the amount of fresh air required is only about 60 cfm which equates to only 0.13 ACH, or about one third of the average ventilation of a well constructed new home. If several friends come over or if more fresh air is desired the setting may be temporarily increased.

Indoor Air Quality

Making the home nearly airtight and supplementing with a filtered supply of fresh air allows for an unprecedented level of indoor air quality. Outdoor contaminants like mold spores, pollen and dust are easily filtered out. However, one must also limit indoor sources of pollutants including exhaust from combustion appliances, Volatile Organic Compounds (VOCs), radon and humidity. Ezell-Morgan uses combustion appliances that are either direct-vent or are power-vented that will not contaminate indoor air. These include the fireplace, water heater and furnace. Carbon Monoxide alarms are installed outside each group of bedrooms to alert occupants of unsafe CO levels. Low-VOC paints and adhesives are used whenever possible and the carpeting carries the Carpet and Rug Institute's (CRI) Green Label to certify it as low-VOC.



Since Lawrence is located in a high radon concentration zone, Ezell-Morgan equips their homes with passive radon mitigation systems. Upon completion the homes are tested to ensure radon levels are below EPA acceptable levels. In the event testing reveals elevated levels of radon, Ezell-Morgan will install an active radon fan at no cost to the owner.



Many different methods of minimizing sources of humidity are employed not the least of which is simply the airtightness of the home. Special attention is also given to the exterior envelope to limit water as well as vapor intrusion. The framing contractors are meticulous about the proper installation of the Water Resistive Barrier (WRB) that works as a secondary drainage plane behind siding to route small leaks harmlessly away. A six mil vapor barrier is installed under the basement floor to prevent water vapor and radon from diffusing through the concrete floor. Interior sources of humidity are also controlled by the use of a continuous spot ventilation system that is coupled with the HRV. Finally, the advanced climate control system constantly monitors the humidity level to keep it in the optimum range.

High Performance Windows

The windows in these homes are ENERGY STAR rated and feature low infiltration rates and high performance glass that is Low-E (low emissivity). Argon gas is injected between the panes to further increase R-value and reduce sound transmission. This makes these windows twice as efficient as standard double-pane windows.

Advanced Framing Techniques



These techniques typically reduce the amount of lumber used in key areas of the home, while still meeting structural requirements. This is done in order to increase the amount of insulation in corners, window headers and wall connections to name a few. The photo shows the raised-heel trusses (RHT's) that are used to make more room at outside walls for a thicker application of insulation in this critical area. Typical homes have only four inches where the RHT offers over 16 inches with baffles installed

to prevent the insulation from spilling into the eaves. The eaves by the way are 24 inches instead of the commonly used 12 inches. This is one of the most effective things one can do to provide greater protection from the elements to the outside walls and reduce exterior maintenance.

Ezell-Morgan homes feature hot water recirculation for convenience and savings. The system saves water and energy while supplying hot water within five seconds to every faucet in the home. This type of system is so efficient it will be required by the 2012 energy code—but why wait.

100% Fluorescent Lighting



Compact Fluorescent Lights (CFL's) use less than 25% of the energy of standard incandescent bulbs and last up to 13 times longer. Standard 60W and 65W/750 hour incandescent bulbs are replaced with 13W/12,000 hour bulbs. These bulbs are so important for saving energy that the 2007 Energy Bill just passed by congress will effectively ban the manufacture of nearly all



incandescent bulbs by 2014. Other energy savings features in the home include the use of ENERGY STAR certified appliances, insulated basement walls, sealed basement floor, sealed ducts, insulated slab edge, and many more.

Heating and Cooling Equipment

These homes are heated and cooled with a super-high-efficiency Air Source Heat Pump. This is basically an air conditioner that can both heat and cool. It also has the ability to operate at two different levels of output. About 85% of the time the more economical low capacity output is all that's required, but when temperatures are extreme it will switch to high output. When winter temperatures drop below about 15 to 20 degrees, the heat pump will no longer be able to generate enough heat efficiently so the system includes a 95% efficient gas furnace for a still higher volume of heat. The furnace features a variable speed fan with an Electronically Commutated Motor (ECM) that lasts longer, is more efficient and much quieter than a standard furnace fan. By combining this variable output equipment with an advanced thermostat, the system can control humidity as well as temperature. When humidity becomes elevated the system will automatically run the heat pump on low stage with a low fan speed to maximize dehumidification.

All this equipment carries a 10-year factory warranty where standard equipment comes with only a 5-year warranty. Also, the extreme energy efficiency of the envelope means that smaller equipment is required.

Table 1 displays the results of the software simulation of 610 Wren Drive. It shows total yearly energy costs of about \$1,883/year compared to \$2,879/year for a home that meets the 2006 IECC required by the city of Lawrence. So the ENERGY STAR home will save its owner nearly \$1,000 per year and use less energy than an average car.

	Code Required	ENERGY STAR	% Savings
Heating	\$ 1252	\$ 603	52%
Cooling	\$ 206	\$ 99	52%
Water Heating	\$ 270	\$ 238	12%
Lighting	\$ 246	\$ 70	72%
Appliances	\$ 232	\$ 200	14%
Plug Loads	\$ 381	\$ 381	0%
Service Charges	\$ 292	\$ 292	0%
Total	\$ 2,879	\$ 1,883	45%

Table 1 - Energy Savings by Category
 *Electrical cost is based on \$0.085 per kWh

Note that plug loads refer to the average amount of energy used by appliances that are plugged in by the owners like TV's, computers, vacuum cleaners, blow dryers, etc.

What Does It Cost?

Obviously the improvements to obtain these dramatic results are not free. They add approximately \$6,000 to the cost of each of these homes. However, their efficiency earns them a \$2,000 tax credit making the total additional cost \$4,000. If this additional cost is amortized on a 30-year loan at 6% it translates to an increased monthly payment of about \$24/month, yet the monthly energy savings of \$83 more than triples this investment.

This simplistic calculation does not take into account the increased lifetime of the equipment and its reduced maintenance. Savings from the fast hot water system is also not included. Note also that while the amount of the house payment is fixed for next 30 years, fuel costs are most definitely not. Most energy experts assume an annual energy cost increase of 3.7%, though this figure may be too low when one considers the likely possibility of a carbon tax or cap and trade legislation that was supported by both candidates for president. In fact, just last year Westar increased the price of electricity by 24%. Rising fuel costs will simply increase the return on the investment.

Beyond the obvious economic advantages one must not forget the dramatic increase in comfort and the healthy, quiet environment that this home will provide to its owners as well as the reduction in fossil fuel consumption it represents.