

## Putting Energy Efficiency in Perspective

**Fox Blocks** stay-in-place insulating concrete forms (ICFs) are used in all types of residential and commercial applications. Fox ICF walls provide unparalleled energy efficiency, safety, durability and comfort.

### Heat Transfer and Increased Energy Costs

Energy efficiency becomes important when you realize that up to 70% of the energy purchased by a homeowner is used for heating and cooling living space. To understand how Fox Blockwalls achieve their energy efficiency, you first have to understand the two basic principles of heat transfer:

- ◀ Heat is in constant motion
- ◀ Hot air always flows to cold air until temperature balance is reached

Heat infiltration, or **convection**, is the movement of heat by the actual movement of heated air. When warm outside air leaks into a home through intended or unintended openings, conditioned air is replaced with unconditioned air and must be heated or cooled again. This process is often referred to as **air infiltration**. Preventing air infiltration is essential for achieving energy efficiency and maintaining a healthy environment.

Heat absorption, or **conduction**, is heat transfer by the direct contact of heated molecules with unheated ones. Heat moves directly from one molecule to another through contact, always moving from the hotter molecule to the cooler molecule. This is what happens when you grab a hot handle of a cast iron frying pan. A material's **R-value** measures the material's ability to resist heat absorption. It is important to remember the R-value is only one aspect of energy efficiency and is not the most important.

Heat **radiation** is the movement of heat away from an object by means of electromagnetic waves. A prime example of radiation is the transfer of heat from the sun to the earth. In your home, an example would be the sun shining through the window to heat the floor inside. Heat transfer depends on properties of the surface on which the waves strike.

### How to Stop Heat Transfer

There are three basic ways to stop heat transfer:

#### **Building Tightness – Inhibiting Air Infiltration**

- It is estimated that 20% to 40% of the heating and cooling load in U.S. houses compensates for air infiltration from the outside to the inside of the house, but not for heat conduction from the inside to the outside.
- Wood frame homes have a large number of gaps that allow air to pass through
- Air infiltration rates in new wood frame homes average approximately 0.35 per hour at naturally occurring air pressures.
- This rate of air infiltration means that the amount of air entering the building each hour equals half the amount contained in the building.
- Air infiltration rates for homes built with Fox Block ICFs can be as low as .04 - .09 per hour. Building the exterior envelope with Fox Block ICFs provides very air tight walls.



### R-Values—Inhibiting Heat Absorption

- R-value measures how well a material resists conduction of heat from one side to the other.
- Standard 2 x 4 wood frame construction with R-13 insulation, without finishes and of good construction has an R-value that can be as low as 8, but averages around 9.5.
- R-values for wood frame walls are lower than the R-values of their insulation because of conduction of heat through the lumber, which has low R-value and because of thermal gaps or bridges in construction.
- A Fox Block wall is a consistent, solid wall of EPS and concrete that provides an actual steady state R-value of 23 and effectively performs to a higher R-value due to thermal mass.

### Thermal Mass

Thermal mass reflects the principle that exterior walls made of heavy materials maintain more even interior temperatures and consume less heating and cooling energy than walls made of light materials and insulated to the same R-value. For example, in non-insulated adobe homes of the Southwest, the sun warms the adobe walls slowly during the day, and by the time the air cools off in the evening, the walls have become warm and pass this heat to the interior during the night. Thermal mass is most effective in climates with the greatest 24-hour temperature swings.

Although no scientific tests have been performed showing the combined effects of all the energy efficient factors on any wall system, studies show that the combined effects of R-value and thermal mass, and the wicking of the ground temperature result in a much greater degree of energy efficiency.

### The Bottom Line

Studies have shown that a standard wood frame house would need to be insulated to an R-32 or greater to equal the energy efficiency of typical ICF construction in some climates. Fox Block walls generally perform greater than R-23 when taking into consideration the walls, the tight envelope and the thermal mass. All other things being equal, Fox Block ICFs typically reduce heating and cooling costs up to 50%.

To sum up, the concrete in a Fox Block wall acts as an insulating thermal mass, the exterior polystyrene moderates the temperature of the concrete, and the interior polystyrene provides even more insulating power providing unparalleled energy efficiency.