Its improving home energy efficiency construction essay

Introduction

The typical home today has an unquenchable thirst for energy and there are many steps homeowners can take to help lower their demand for energy. The main source for today's energy is fossil fuels. The burning of these fossil fuels releases CO2 and CO2 is a major contributor to global warming. It is important that we take a more sustainable approach towards our energy usage. Sustainable energy usage benefits the environment and results in lower energy costs to the consumer.

Building Shell

The exterior surfaces of a building are called the building shell; this may include the roof, walls, doors, and windows. It is the effectiveness or ineffectiveness rather, of this shell that determines the level of energy demand a building will have. It is the heat exchange through the buildings shell that places the largest demands on energy consumption of the home.

Let's take a minute to focus on the walls and structure with respects towards the building shell. A common trend in architecture today is to have many extrusions and intrusions in the walls of a home. This is more aesthetically pleasing to today's homeowner. However, these extrusions require extra framing which results in decreased insulation in corners and potential air leakage. Most single family residential homes are wood framed and any irregularities in the building shell are weak points when it comes to heat loss. Mobile homes are framed with metal studs, generally speaking. The increased metal presence combined with thinner walls and joints between modular sections all create potential weak spots that allow greater thermal

conductivity. Multi-family housing units suffer from some of the same design flaws; much of their structural support comes from metal components, larger air handling units, and elevator shafts create weak points, thermally speaking. However from an energy usage point it is better to have an apartment that is surrounded by other apartments, the temperature change from one side of your wall/ceiling will be almost zero, this equates to lower heating and cooling costs. Later I will discuss air leakage and insulation more in-depth, for now just knows that when it comes to the exterior design of a building, simpler is better.

Air Leakage

What represents 5-40% of building conditioning costs also known as energy consumption, air leakage does. Air leakage is the exchange of air from the exterior to interior, or vice versa, of a building. Air leakage control can increase comfort, reduce damage to intra-wall components, prevent pest infestation, and save energy. While ventilation is needed for the building and human health, the goal is to control that ventilation and have it happen when we deem it necessary. Ultimately this exchange in air is a result of pressure difference from the inside to outside of a structure. The pressure difference is caused by the density difference in warm and cold air. This concept is also known as the second law of thermodynamics that is that warm will always move to cooler areas (when unassisted) until equilibrium is met. Unchecked airflow will seek equilibrium inside and outside by the most direct path. Examples of this process at work during winter months would be warm air exiting the structure through leaks in the upper regions of the building and cool air entering through the lower regions, thus creating a

cycle that seeks equilibrium. Residents can prevent/reduce air leakage by ensuring that the building shell is properly sealed, air tight. This task can be accomplished by using spray foam around window and door frames as well as checking that the weather-stripping is in proper condition, not worn out. Also, windows and doors must be latched in order to be air tight, it is not uncommon for a window to closed but not latched. Other building practices that should be avoided include duct work, electrical fixtures, and plumbing components being placed in exterior surfaces. This could cause air leakage as well as reduced insulation where these components are present.

Insulation

Insulation prevents heat transmission through the building shell. In some winter months heat transmission poses a greater threat than air leakage. Insulation is placed in voids/cavities in the building structure to reduce heat transmission. Insulation accomplishes this goal by two means. It forces heat to transfer in the form of a gas, gasses are naturally poor conductors. Second its presence reduces heat convection and radiation. Insulation comes in many forms; it could be foam, fiberglass, wool, cellulose (shredded newspapers), and even straw bales in some construction. Every type of insulation has its own pros and cons. Foam is by far the most effective, it has very high R-values and if sprayed will expand to fill air leaks, on the down side it can be expensive, is not very fire resistant, and does not break down quickly in a land fill (eventually this is where it will end up). Fiber glass is probably the most prevalent form of insulation; it has good R-values, but until the wall is sealed can release particles into the air that are harmful if consumed. Wool/cotton is probably a more sustainable way to insulate a

structure, generally it is made out of recycled jeans, can achieve comparable R-values, but due to its unpopularity can be significantly more expensive than more common insulations. Cellulose ranks about the same as wool, it is recycled content, but is blown in place and often will settle over time; this leaves a small section of the cavity insulated once it settles. Straw-bale insulation is a controversial issue, its density makes it a good insulator, and however there is much debate about how long it will last. Each insulation is designated a specific R-value and is labeled as such. The R-value is a measure of how well the material resists heat transmission. The important thing to know about R-values is the higher the better, less heat transfer equals less energy consumption. The inverse of the R-value is the U-value. U-values are used to rate windows and doors for their efficiency.

Windows & Doors

Windows and doors are the complete opposite of insulation. So much so, that we do not rate them by their ability to resist thermal conductivity, but by their ability to conduct thermal heat transfer. The way we identify windows and doors also known as fenestration is with a U-value. The National Fenestration Rating Council is the private/public group tasked with testing and assigning a U rating to fenestrations. Windows are made up of four basic parts; the glass, sash, frame, and the rough opening, all of these contribute to a windows inefficiency regarding energy. Windows can have several different types of glass including; Low-e, tinted bronze, reflective bronze, and clear glass. The best option for energy savings is to install an insulated, Low-e window. The insulative property is provided by a gas, usually co2 and argon. The gas is injected between the window panes and sealed in place;

the use of a gas reduces the rate of convection between panes. The low-e is a coating placed on one pane of glass, usually inside the window, that reflects radiation. This coating is installed on the interior pane for cooler climates and on the exterior pane for warmer climates. The sash/frame is typically made of similar material, being; plastic, metal, or wood. With relation to energy consumption the plastic construction is the way to go. When made of plastic the sash/frame is extruded through a mold and often can be filled with foam insulation. The rough opening refers to the space between the window frame and the structural frame of the opening in the rough framing (the actual opening in the wall). The rough opening is often larger than the frame of the window to allow the builder to make adjustments during installation. Once installed, this space should be filled with insulation; the best to use for this situation is minimal expanding foam spray. Door construction is very similar. Doors can have glazing/fenestration within the door. They too, are given a U-value. When discussing the U-value of doors/windows the most important for a consumer to know is that the lower the U-value, the better. Lower U-values result in greater energy savings when heating and cooling a building.

Heating

In North America the heating demands of our homes require a huge amount of energy. This energy comes from mostly from fossil fuels that have been refined, mined, and converted to meet our needs. The residential heating fuels that are used today can be broken down into four major categories; natural gas 53%, electricity 29%, oil 9%, and other types make up the remaining 9%. Huge natural gas reserves have been found in North America

and it is considered to be the most environmentally friendly of the fossil fuels. It is the increased availability and societies concern for the environment that has led to exponential growth most recently in the natural gas industry. Electricity is considered to be 100% efficient once harvested. It is the methods by which we harvest electricity that cause environmental damage. The most environmentally degrading method of harvesting electricity is by coal power plants; however more sustainable methods such as harnessing wind and solar power production are being developed and implemented. Some electrical providers allow their customers to select the source/means of their power. Oil, once a major source of energy used to heat our homes is becoming quickly outdated as consumers become aware of more efficient and environmentally friendly ways to heat their homes. The other category refers to heat sources such as wood and coal, aside from the environmental impacts these sources are unpopular because they require more work by the consumer. A heating system should be designed to provide the home with heat at approximately the same rate that it is being lost in worst case scenarios. Each fuel type has a distribution system. These systems are given an efficiency rating. This rating measures how well the system operates and can be expressed as; Efficiency = Output Input. The resultant will be a percentage ranging from 35-95% efficient. The efficiency of a system is directly proportionate to the amount of fuel the system consumes. Therefore, the more efficient a system is, the less energy it will consume. High efficiency systems are considered to be any system with an 80-97% efficiency rating.

Cooling

Second to heating demands are the cooling demands, generally speaking, of a building. There are passive and active methods of cooling a structure. Depending on the designers knowledge and foresight of these methods energy required to cool the structure could vary greatly. Passive methods require no mechanical operations; the result is zero energy consumption. Active methods require the assistance of mechanical operations, although the level of energy consumption is defendant upon the system that is installed. Often it is a combination of these methods that provides the most comfort to the inhabitants of the home. One common passive method of cooling a structure is through the use of landscaping. The use of trees to shade a home is the most cost effective method of cooling. The trees must be deciduous so that they allow the sun to warm the building during winter months. Another passive method is ventilation through windows and other openings. A proper building design can create a chimney affect, pulling cooler air in at lower portions of the home and releasing warm air in upper portions of the home. Often this chimney affect can be assisted by proper placement of ceiling fans, an example of a combination of passive and active systems. The use of fans to ventilate a home is the most energy efficient way to cool the building. Moving air is more comfortable to the inhabitants and can give the perception of a 4-8 degree temperature change. Window/Room air conditioners are the least energy efficient. The constant start up and shut down process consumes large amounts of energy. They are subject to significant accumulations of dirt, unchecked over time, this causes greater inefficiency and eventual failure of the unit. The use of central air conditioning is another active method to cool a residence. Central air

conditioning can provide the most comfort; higher efficiency models reduce energy consumption. Central air conditioning systems are run by a thermostat and slowly cool a building. This prevents the constant start up and shut down process that occurs with a window unit. Regardless of the system and methods used to cool a building the inhabitants have control over how much energy is used. The warmer the environment the residents can willingly tolerate the less energy will be consumed to cool the structure. Due to the fact that most people do are not present during the construction and design process of their home perhaps the most applicable way to save energy is to perform regular maintenance and select the proper lighting and appliances.

Lighting

Lighting has a huge effect on a home’s energy consumption. There are many different light fixtures and bulbs a one could install in a home. Just as anything else thus far they vary in efficiency. The consumer must read labels to ensure they are actually purchasing the most sustainable, energy efficient light. Often more lighting than what is required is used, different activities require different levels of illumination, be sure to size fixtures adequately. Consumers must monitor their energy use by controlling when lights are on or off. If an area is not being utilized for a period of time the lights should be turned off to conserve energy. Also, residents should clean the globes or covers around the light bulbs, clean fixtures provide more optimal lighting. When purchasing new appliances consumers should purchase energy star rated appliances. Energy Star guidelines are set by the EPA and provide the consumer with a means of determining the efficiency of appliances such as

dish washers, TVs, clothes washers, and dryers. To help with the cost of these more efficient options some state governments offer a tax rebate to those who purchase high efficiency appliances.

Conclusion

In conclusion, even with the unquenchable thirst for energy, the consumer has more power than they realize to reduce the energy consumption of the buildings they reside in. With reference to the buildings shell basic is better; irregularities tend to be thermal weak spots. Air leakage can happen anywhere the building shell is penetrated, stopping the unregulated air flow through a buildings shell will result in increased energy savings. The proper insulation is key, to providing comfort and energy efficiency. Windows and doors also known as fenestration create weak points in a buildings shell and must be sealed and properly installed to promote energy efficiency. Heating systems are produced by a wide variety of manufactures, it is crucial that the consumer is well informed with the potential energy consumption of the system before purchasing and installing. Cooling can be accomplished through passive and active means, often the most effective is a combination of both. Lighting fixtures must be sized and installed properly to promote energy efficiency. Consumers should purchase high efficiency Energy Star appliances to conserve and reduce their homes energy consumption.