

CITIZEN-TIMES.com

GREEN BUILDING: Designing for energy efficiency results in savings

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SPECIAL TO THE CITIZEN-TIMES

October 29, 2006 12:15 am

The use and control of the sun's radiant heat will have a significant impact on the heating and cooling efficiency of your home. Heat energy from the sun is absorbed by darker colors and reflected by lighter ones. A black shirt on a sunny day is simple proof.

That is why you see dark-colored houses and barns in cold climates like Minnesota and light pastel colors in Florida. The simple selection of shingle color can dramatically affect your summer comfort.

Careful siting of the house can enhance the benefits of the sun, maximizing the advantages of slope, orientation, vegetation and house shape. Exposing as much of the house as possible to the south sun will raise the skin temperature of that wall, reducing the rate of conduction. It is equally important to shade out the opposite effect in the summer, using roof overhangs, operable awnings, and deciduous vegetation to shade as much of the house and surrounding ground as possible. This has the additional benefit of slowing the weather-related degradation of your siding.

When considering the use of the sun's radiant energy for passive solar heat, the three basic elements required for any passive system are:

- Collection, with windows facing south. This is easy for most people, especially if some of the views are in that direction.
- Distribution of the heat, which can occur completely by the natural means of radiation, conduction and convection.
- Storage, actually thermal storage, which is always the most difficult to include and usually accounts for most of the extra cost of a passive system. For those reasons, it is also the element that is usually left out.

We have all experienced a passive solar system without thermal mass when we open the door of our car that has been parked outside on a cold sunny day. The air inside is usually too warm, and it cools off very quickly. The sun's heat has been trapped but not stored. In summer, when you put those foldout sun shields inside the car, it stays cooler.

The same principles apply to your house. Summer shades and passive solar heat are a natural, efficient way to reduce your heating and cooling demands by 50 percent with very little additional cost.

One important lesson learned by trial and many errors over the last 30 years is the issue of indoor air quality. With extra efforts to tighten up the construction, you reduce the amount of fresh air exchanges that can naturally occur inside your house. Older homes had as many as five of these air changes per hour, or ach. Newer standard homes were reduced to maybe one to three ach.

A very efficient passive home can be as low as 0.1 to 0.5 ach. Whenever you get that low, it is important to give special consideration to mechanically induced ventilation.

These must have heat recovery ventilators so you can capture the heat from the exhausted air. These systems are usually combined with the bath/kitchen exhaust fans. Very low air exchange rates without induced ventilation, at the least, can cause offensive odors to build up.

Gases given off by carpeting, paints and solvent-based sealants can cause headaches and nausea. This has become known as sick-building syndrome. Using water-based paints and sealants and natural fiber carpet and pads will help. Houseplants are an attractive and easy way to clean the air and add oxygen. You can test the air exchange rate by having your mechanical contractor perform a blower door test.

When you use these natural energy flows, you are working with nature rather than fighting it with a bigger mechanical system and higher utility bills.

Building an energy-efficient home is not difficult. Most of the things you do are unseen and require very little maintenance. In fact, a well-designed, efficient passive solar home should be warmer in winter, cooler in summer, full of light year-round, and need less mechanical heating and cooling.

Any modest increases (maybe 1 to 3 percent) in initial construction costs will be offset over time by the energy savings. State and federal tax credits can also help, although because of their inherent uncertainty, they should not be the primary justification.

The N.C. Solar Center, located on the N.C. State University campus in Raleigh, is one of the best resources in the country for information on solar and energy-efficient design (www.ncsc.ncsu.edu).

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