

efficient, sustainable building design. Mike Nicklas is a world leader in high performance design and has given seminars in Iowa.

Kent Boyum - state and federally funded Rebuild America coordinator for Vedic City, Fairfield, and Jefferson County.

Iowa Association of Municipal Utilities - www.iamu.org - High performance building located near Des Moines.

Thomas Brown, Architect - www.tombrownarchitect.com - Wisconsin based architect experienced in high performance design and energy efficient construction. Excellent web site with lots of references for the cold Midwest.

Larry Larson - 472-4953 - Earth tube and high performance building consultant

Earle Mason - Habitat for Humanity, Mason City Iowa - Earl is a leader in developing low cost, high performance housing for Habitat for Humanity. A free article about his Mason City, Iowa projects is at <http://www.nahn.com/iowa.htm>.

Energy 10 software and training seminars - <http://www.nrel.gov/buildings/energy10/> - Energy 10, an award-winning PC-based design tool, helps architects and building designers quickly identify the most cost-effective, energy-saving measures for small commercial and residential buildings. Energy 10 software and training seminars are heavily subsidized by the US Department of Energy and are available at amazingly reasonable prices. Attending an energy 10 design seminar will provide you with a complete education about high performance building.

Don Aitkin - www.donaldaitkenassociates.com – Nationally known consultant on high performance building.

Videos of presentations - There are lots of great videos of high performance design seminars that have taken place in Fairfield. Check with the Fairfield Public Library .

National Affordable Home Network - advocates of low cost high performance home designs. Lots of information, building details, and plans on this web site.

Sustainable Buildings Industry Council - <http://www.sbicouncil.org/> - Promoting a 'Whole Building' Approach to Achieve High Performance Buildings. They have an excellent program for designing high performance school buildings.

Innovative Design - <http://www.innovativedesign.net/> - Their mission : **To be the world's leading architectural firm in advancing energy-**

We have known how to build homes that require little or no fossil fuel to heat and cool them at least since the 1950's. In 1939 MIT built a 100 percent solar heated house that relied on the sun only to provide a constant 72 degree temperature during the cold and cloudy Boston winter. Bill Mollison, one of the originators of the permaculture design method, says that we have enough examples and experience that designing a high performance home is a "trivial exercise". When you see that buildings can perform like the examples above without cost penalties, you wonder why we ever build anything else.

We should all demand this kind of performance and comfort in all the buildings that we help finance (directly or indirectly through our tax dollars) including homes, civic centers, schools and workplaces.

Resources:

Author - Lawrence A. Gamble, P.E. 641-469-5240 lonniegamble@yahoo.com
Abundance Ecovillage - www.abundance-ecovillage.com - Solar and wind powered subdivision located in Fairfield, Iowa, under construction now, will eventually consist of 30 units. The author is one of the developers. This web site has lots of additional information and resources that wouldn't fit in this article, and will have all the articles in this series on-line.
Surya Nagar Farm - www.solarfarm.com - The author's web site with lots of additional information that wouldn't fit in this article, plus all the articles in this series on-line.
Home Power Magazine - www.homepower.com -
Iowa Renewable Energy Association - www.irenew.org - great resource for efficiency and renewables, they host an annual energy fair in September at Prairiewoods in Cedar Rapids..
Midwest Renewable Energy Association - www.the-mrea.org - they host one of the largest energy fairs in the country in June in Wisconsin.
Iowa Energy Center - www.energy.iastate.edu

a 45 degree partly cloudy day in early April, the air coming off my roof top collector is still over 90 degrees, and I have a tank full of 160 degree solar heated water for my shower. The water for my showers (and all other household uses) is collected from rain falling on the roof and is stored in a 12,000 gallon tank built as part of the basement. The whole home was built with and runs on solar and wind generated electricity. Simple greenhouse and cold frame structures allow me to harvest something fresh 12 months of the year just a few steps from my door.

We don't have space in this article to give the details of how to build a high performance building. Here are a few things to consider; See the web sites and references in the resources sidebar for more information. Here are a few things to consider:

1. Start early (get help early if you need it) and avoid type one errors - Amory Lovins of the Rocky Mountain Institute, one of the leaders in high performance design, states that more than 80 per cent of a buildings life time energy use is determined (fixed, set, cast,) in the first few hours of design. Typically, a building is optimized component by component, without regard to how the components interact. This kind of a design optimizes each component but often leads to suboptimization of the whole system.
2. Insulation levels - walls should be r-40 and ceilings r-60
3. Radiant Barriers
4. Window Placement
5. House Orientation and shape
6. Air Infiltration
7. Fresh Air
8. Earth Coupling
9. Windbreaks and landscaping

The constant temperature of the earth a few feet below the surface can be used for cooling air in the summer and tempering cold fresh air in the winter. In my home and in the homes in Abundance Ecovillage in Fairfield, air runs through tubes in the earth to provide home cooling at 1/20-1/50th the energy of conventional air conditioning. When the outside air temperature is 100 degrees, the temperature of the earth 8 feet below the surface is 55 degree. the outside air is a cool 70 degrees and the humidity is reduced after being pulled through earth tubes. Larry Larson of Fairfield is the Ecovillage consultant for earth tube design (see contact info at the end of this article).

People often don't realize that a major side benefit of high performance design can be greater comfort, beauty, and quiet (because the home has fewer and smaller mechanical systems) In the book "Natural Capitalism" , Amory Lovins, Hunter Lovins, and Paul Hawken detail the high performance design process and give the example of the Rocky Mountain Institute's headquarters building in Snowmass Colorado, built in 1983. The building is located at 7100 feet in a climate that occasionally gets as cold as -47 degrees F. It is a harsh climate - midwinter cloudy spells last as long as 39 days, and there is only a 52 day growing season between hard frosts. (Iowa has 160-180 days). The 4000 square foot building has no heating system aside from two small wood stoves, Yet its 99 percent space-heating savings made it cost less than normal to build in 1982-84, because its superinsulation, superwindows, and 92 percent efficient heat-recovering ventilators added less cost than was saved up front by eliminating the furnace and ductwork. The building features a central garden. Bougainvillea blooms over ponds in which frogs jump while turtles, carp, and catfish swirl below. You can come in out of a blizzard to the scent of nightblooming jasmine and the blur of a miniature hedgehog running silently about eating bugs. In December 1997, RMI harvested its twenty-sixth indoor banana crop, perhaps the world's altitude record for passive-solar bananas.

My own house is built of 19 inch thick straw bale, with beautiful earth plasters that also seal against air infiltration and provide thermal mass. The roof has r-60 insulation with radiant barriers. It is so well insulated that I can cool it in summer with air blown through tubes in the earth and in winter I get a significant amount of heat from a simple, low cost solar hot air collector built into the roof. As I write this at 4:30 in the afternoon on

design, it is easy to change the orientation and placement of windows at little or no cost. After the home is built, it is difficult and expensive to change window placement. These west facing windows then contribute to the peak demand of the electric company, forcing the electric company to build new power plants to keep up with the demand for energy to cool homes with improperly placed windows. The whole system becomes inefficient and wasteful because of early design errors. More energy would be available faster and at a lower price if we paid a premium to properly designed buildings, instead of building new power plants. (Iowa utilities are getting ready to spend \$1 billion dollars on new fossil fuel power plants in the next few years) High performance design can provide benefits and cost savings that extend beyond the home.

High Performance Integrated Design: A Vision of Possibilities

Earle Mason of Mason City, Iowa has won national awards for the low cost, high performance buildings that he helps Habitat for Humanity build. One project that he recently completed in the Mason City area is a 1600 sq foot, 3-bedroom, 2-bath home. A family of four lives in it. Superinsulation (r-40 walls, r-60 ceiling) and careful attention to detail during construction allow the home to be heated with the family's water heater. The heating and cooling bill for an entire year is less than \$175. The house has abundant fresh air without an energy penalty because the energy in the outgoing stale air is transferred to the incoming fresh air through an air-to-air heat exchanger. The savings on not having to install a furnace paid for the additional insulation, so the home was built for about the same cost as other similar sized Habitat for Humanity homes. "We're just putting some common sense to the way we build things," said Earle in article detailing the various awards his buildings have garnered. . Amory and Hunter Lovins, in the book *Natural Capitalism* call this synergistic design "tunneling through the cost barrier".

Another example comes from Chicago area builder Perry Bigelow. Since the 1980's he has used techniques similar to Earle Mason's to build thousands of homes. He guarantees less than \$200 per year annual heating bills. He hasn't paid out a dime in claims. He sponsored a contest for the lowest annual heating costs - the winner was \$24, with a \$26 runner up.

Living Wisely and Well Home Heating and Cooling

"Imagine a building like a tree - buildings that produce their own oxygen, distill water, accrue solar energy, change with the seasons, harbor microclimates for the mutual benefit of hundreds of other organisms, and produce no waste.... Consider how a building can be fecund, like a tree, accruing solar income to the benefit of living systems and absorbing water quickly and releasing it slowly in a healthy state. "

- William McDonough

Imagine a whole city of such buildings - cool and quiet like a forest. These buildings go beyond sustainability - these buildings, like a tree, accrue a surplus of solar energy and make this surplus available for the benefit of the surrounding environment. This is the vision that is emerging from the new field of high performance building design. In this article we will look at two aspects of high performance building design - home heating and cooling. You can save money and improve comfort with high performance building design, using practical, state-of-the-shelf technology.

Home Heating and Cooling

Last month, we saw how it is possible to radically reduce the amount of electricity used at home while providing as good or better services. The same kind of improvement is also possible in heating and cooling your home. It is easier to get high levels of performance when designing a new home than when retrofitting an existing home. Decisions made in the first few hours of design can drastically limit or make expensive radical efficiency in heating and cooling a home. Things like the orientation and placement of the home, placement of windows, and levels of insulation have dramatic effects on building performance, comfort, and lighting. There is a great deal of synergy that can take place in the early stages of design that can allow a high performance, high comfort building to be built without a premium price.

For example, placing lots of windows on a west-facing wall in south east Iowa makes it very difficult to cool a building, even with conventional air conditioning. The sun will shine in west facing windows during the hottest time of the day and the hottest time of the year. In the early stages of