Designing Houses to be Environmentally Friendly

A house – your home, an office – any building, can be seen as a shelter, protecting an indoor space from the weather and external elements. Our shelters allow us to maintain a comfortable environment, free from the extremes of heat or cold outside.

In order to achieve this in our modern society, we employ sophisticated heating, ventilation, air conditioning systems, window louvres requiring increasing amounts of energy. This energy use, combined with in appropriate and mindless construction methods mean that huge amounts of energy are wasted daily.

A more sensible way of designing a building is to take the environment into consideration when designing the building in the first place. When we work with nature like this, the need for mechanical and artificial heating and cooling is reduced, with considerable savings in energy use. This saving is not just financial, but also environmental – with less harmful emissions being produced through ordinary energy use.

The principals of climate sensitive design

The principles applied in climate-sensitive design are based on the idea of using natural conditions to the best advantage. The principles of orientation, heat storage and cooling can be combined with specific building materials to achieve climate sensitive design.

Energy efficient housing design principles encompasses all the available techniques of creating a 'healthy' interaction between indoor and outdoor climate conditions in buildings. This would include the use of solar passive design strategies to build more energy efficient houses and simultaneously increase thermal comfort in houses as well as maximize water conservation, use of renewable energies, greening activities and the use of energy efficient stoves.

Solar passive design principles include design and orientation of the house, and the building material used (that is mass, glazing, insulation, use of daylight, ventilation and other systems which might be required).

Orientation of your property to maximize natural resources, and eliminate un-necessary heating & cooling

Understanding the path of the sun and it's angle in the sky at various times of year is key to working with nature in order to reduce energy costs.

The sun rises daily in the east and sets in the west. In summer in North America, it will pass almost directly over-head at noon, whilst in winter its path will be low in the southern sky. This is true for any location north of the equator, and the further north you go, the lower the sun will be in the southern sky – south of the equator the sun follows a path that is low in the northern sky.

Therefore, to let the sun inside the house in winter, most windows should be on the southern side. Windows on the east and west tend to lose more heat than they gain in winter and they can cause overheating in summer since they receive hot morning and afternoon sun. A roof overhang over southern windows shades the windows in summer while allowing sunshine in during winter, due to the lower position of the sun in the sky – the sun shines in under the overhang to heat the inside of the house.

Some practical advise….

- In the northern hemisphere (north of the equator) the house should be orientated east west, with the internal rooms planned in such a way that the most frequently used rooms face south

- To maximize light and available heat, the largest windows should be situated on the southern side
- The roof overhang on the southern side of the house should be calculated to be at an altitude angle equal to 90 degrees minus the latitude, as measured at the windowsill.

When it is not possible to make this calculation precisely, a good guideline to follow is that the overhang on the southern side of the house should at least be 16" to 24" in length;

- A roof overhang should ideally be combined with a strip of grass or vegetation to prevent the surface from warming up.

Heat Storage

If the sun is allowed to stream in through a window, the room will warm up. If there is a concrete floor or thick walls, they too will warm up and stay warm for a long time and release heat slowly into the room after the sun has gone down. The walls and floor act as thermal mass to store the heat gained. Stone, concrete, brick, adobe and rock chips are all good thermal storage materials, which can be incorporated in walls, floors and a fireplace.
Some practical advice….

- The floor slab should be constructed of a material that has a high thermal mass, e.g. brick or concrete to store heat during the day and release it at night. For this reason it is important that the floor slab is left uncovered by carpets;
- If you have curtains or blinds in front of the windows, it is important that they are open during the winter day to let the sunshine in and heat the floor. The curtains should be closed once the sun goes down to keep the heat inside the room
- Insulate the building perimeter and use doors and windows that shut tightly

Cooling a Building

Besides providing heat during winter, successful climate sensitive buildings are cool in summer. Sufficient overhang protects the south facing windows from the high summer sun while at night, the house must be well ventilated to cool the place down. Insulation and thermal storage that retain heat in winter will keep the building cool during hot days.

In very hot climates ventilation is important. For example, a front porch is used to cool the air before it circulates through the house via the windows, which open on the porch. Plants and trees are also cooling, preventing heat to be reflected off bare ground while deciduous creeper growing over a porch will shade it in summer and let the sun through in winter when the leaves fall.

Building Materials

The skin of a building is made up of various materials, which may reflect, absorb, store, transmit or resist heat. In winter, retarding heat loss is as important as admitting sunlight, so the roof needs insulation, normally in the form of a ceiling with additional bulk insulation on top.

A wide variety of commercial insulation materials are available on the market, or in low-income houses, a layer of crumpled newspaper is better than no insulation at all, but fire risks should be considered. The curtains help to insulate windows while in very cold climates people use double-glazing (two sheets of glass with a gap between them) to reduce heat loss through windows. Similarly, a double wall (a double brick wall with an air gap in between) can be used to prevent losses and gains through walls.

The shape of a building is also important from an energy point of view. A tall, slender building has a high surface area to volume ratio. Ideally a building should be compact, with a low surface area to volume ratio, since the building's surface is the element through which the heat transfer occurs.

Some practical advice….

- Ceiling / loft insulation will reduce the need for heating the home and could reduce energy

costs by 50%
- Plastering is an excellent method for insulating walls, as it improves the moisture resistance. Within walls, non conducting material such as polystyrene sheets can b used.
- Traditional building materials such as mud bricks, thatch roofs, clay walls and floors are all also excellent sources of insulation
- In North America, window and doorframes are now most often made of steel except in the coastal areas where rust is a problem and wood is the material of choice. Wood however, provides a better insulation than steel.

Climate sensitive design principles can be incorporated to various degrees in office buildings, social housing, private homes as well as apartment buildings and townhouses. Incorporating energy efficient design principles, especially in the delivery of low cost housing, would have numerous benefits to the poor families living in these houses. Low-cost houses may be cheap to build, but their running costs are astronomical. Because of the use of energy-inefficient materials, it is sometimes warmer outside the house than inside. The costs of keeping these houses heated come out of the earnings of the people who can least afford to pay them – heating can cost poor people up to 60% of their income.

Furthermore, poor families use dirty, dangerous fuels such as coal and paraffin to heat their homes. These fuels cause indoor and outdoor air pollution, respiratory diseases as well as being dangerous in terms of causing fires and burns.

Can it work for me?

For sure, if the principals outlined above are followed.

Simply orienting a new house appropriately, being sensitive to the angles of the sun and local conditions, you are sure to save energy and money in the long term.

For existing homeowners, considerable saving can be made by weatherizing homes or your building by retrofitting according to the principals outlined.

Some interventions are low to no cost (house orientation, positioning and size of windows, use of plants and color and good ventilation); some are medium cost (roof overhang, energy efficient appliances) and some are high cost (wall, roof and ceiling insulation; additional glazing and draft proofing around windows and doors).

Benefits of Energy Efficient Housing Design EEHD

There are tangible benefits through the use of EEHD principles such as:

- Reducing extremes of heat and cold within your home, improving quality of life
- Working more with nature, the health of people working or living within buildings improves
- Energy demand reduces due to less need for artificial heating , lighting and cooling
- Savings on energy costs (electricity and heating bills), therefore releasing funds for other basic essentials such as food, clothing and education
- Financial benefits through energy and subsequent monetary savings
- Environmental benefits through reduced air pollution; which is a result of less ‘dirty’ fuels being used
- Improved air quality reduces the cases of respiratory and associated illness
- Benefit to power suppliers through reduced/eliminated peak electricity demand

Bear in mind that although the upfront cost of insulting your roof for example, may seem high, think about the savings you will achieve over the life-span of your house. The avoided cost of heating your home or reducing your heating expense will pay off the investment in a short period of time.

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