Want an Energy-Saving New Home? Here's How

By Keith A. Suerdick

Efficiency is rapidly becoming the trend of today's housing design concepts, especially in the use of space, materials, and energy.

Escalating costs of construction now requires builders and designers to use the least amount of materials for the maximum amount of living space. New houses are being built with fewer interior walls, and more multi-use spaces. Home sizes are being reduced to meet today's needs, but with the capacity for future expansion.

The high cost of land and exterior building materials has caused increasing popularity in living units beging consolidated into one building envelope with little or no yards.

Advancement in cost- and space-efficient designs has been at a slow and constant rate. Design concepts for energy efficiency have developed at a much greater pace.

Only in recent years has energy efficiency been given any serious consideration in home design. Not long ago, energy costs were relatively cheap. The old theory was that any home could be heated or cooled with a mechanical system at a price almost anyone could afford. Today we are seeing a new awareness and insistence on energy efficiency.

Many design concepts for energy efficiency are not new, but rather new applications to ideas existing for decades and even centuries.

Homes using these concepts may look different, be constructed differently, and be located on a site unlike the average conventional home. Some designs are very subtle and unnoticeable, while others represent a major design feature that is easily recognized.

Concepts presented in this chapter range from ideas for selecting sites to devices for shading windows. The intent is to provide you with information on various ideas that may be appropriate for your own lifestyle, local building conditions, and weather patterns.

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You should consider ideas compatible with the surrounding area and suitable for your construction site. Public acceptance, code compliance, and site adaptability are important when selecting a design. Some designs are better suited for regions concerned primarily with heating systems, while others deal with cooling needs. There are also designs that support both needs.

Site selection is the first and one of the key decisions to make in building an energy-efficient home. Whenever possible sites having maximum protection from cold winter winds and minimum blockage of sunlight should be selected.

Land sloping to the south will provide the best opportunities for energy conservation. Sites protected with windbreaks such as large trees, hills, fences, or other buildings will also offer good energy-conserving opportunities.

Earth-covered Home Basics

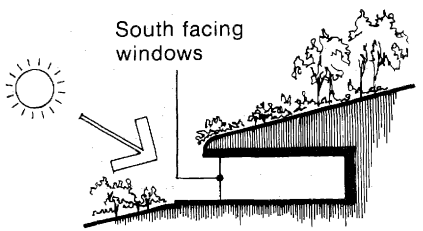
The site is even important for earth-covered home. Homes covered with earth, either totally or partially, are gaining wider acceptance. When properly used, earth is a strong, durable, and weather-resistant material which can be used to create an energy-efficient home.

The site's natural contours should be kept intact as much as possible and slope gently to the south. This allows any exposed windows to face the sun, and facilitates natural and controlled drainage of the roof.

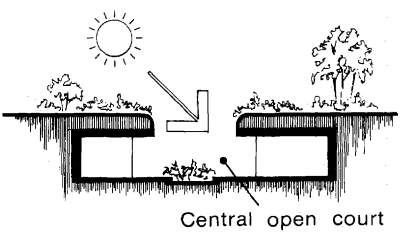
There are three basic concepts for earth-covered homes. The first is called "Elevational" and includes an exposed wall on the south side for the access and collection of sunlight. This concept is well suited for construction on sloping terrain and hillsides.

Another concept is called "Atrium" and has the earth-covered home surrounding a central open court-area or atrium. Sunlight and access are pro-

Elevational Earth-covered Home



Atrium Earth-covered Home



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vided through the central area. This idea is appropriate for a flat site or on the top of a hill or knoll.

A third idea is called "Penetrational" and totally covers the house with earth except for skylights and access doors punched through the roof.

The two most important considerations in an earth-covered home are structure and waterproofing. The structure must be very strong to hold the weight and pressure of the earth on the top and sides. It may be constructed with concrete, steel, and even wood. Definitely consult an engineer or architect in the design of the structure.

The earth-covered home must be properly waterproofed. Waterproofing and internal air circulation should be carefully determined by a professional designer.

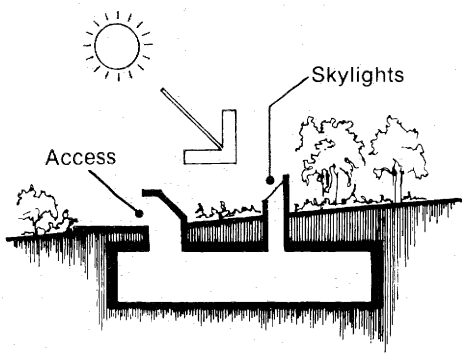
Earth-covered homes can provide a comfortable living environment with little energy consumption. This is possible by utilizing the heat of the surrounding soil and minimizing exposure to winds. Soil temperature below the frost line fluctuates very little during the year. Thus, the home requires a little additional heat in winter and little or no cooling in summer.

Additional heat needed in winter can easily and inexpensively be provided by the sun. The combination underground-solar design concept is an excellent approach to energy efficiency.

Heavy materials used for the structure of the home can also be used to store solar energy. Heat is absorbed in massive materials during the daytime and slowly released at night. This is one of the principles used in passive solar heating which will be re-emphasized later in this chapter.

Earth-covered homes may not be appropriate for

Penetrational Earth-covered Home



everyone, but they are indeed possible from both a technical and economic standpoint.

If you prefer living on top of the ground, many more energy-efficient ideas are available. One involves orientation of the house on the site.

Whenever possible, the home should be oriented with the long dimension placed in an east-west direction. This allows a maximum amount of wall and roof areas to be exposed to the sun for collecting natural energy as well as providing control of the sun during summer's hot season. The morning sun is usually desirable for heating a home in the early hours, but a late afternoon sun may be excessively warm and will require screening to control room temperatures.

The basic form of a house contributes to its energy efficiency. The amount of heat loss from a house is directly related to the amount of exterior surface area. Therefore, forms with the maximum amount of interior space within the least exterior surface area should be selected.

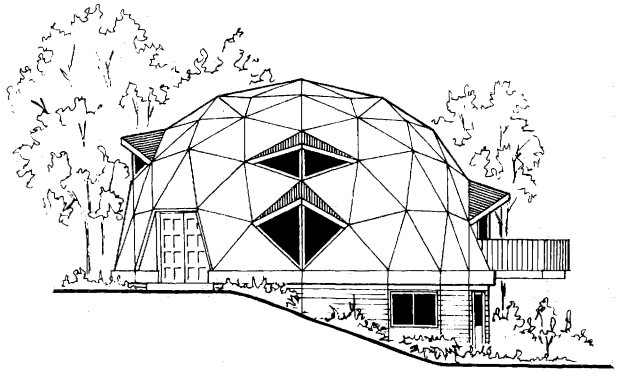
Dome Shapes

The form with the best volume/area ratio is the dome. Homes shaped like this have existed for centuries. The igloo is an excellent example of how the form contributes toward retaining sufficient heat to keep the interior temperature above the freezing point.

Domes can be circular or geodesic, which is a form with many flat polygon sides, usually triangles or hexagons. The dome home is slowly gaining public acceptance in today's society. The structures can be built very quickly with wood, metal, concrete, or plastic.

They are very strong structurally, and have an

Typical Geodesic Home



exterior shell much thinner than the shell of a flat-surfaced structure.

Geodesic domes are available in "Do it Yourself" kits that provide almost everything necessary for a complete home. These homes usually include a ground floor level with an upper loft area. Since the weight of the roof is carried down the exterior sides of the home, the interior walls can be located in almost any location.

Windows, skylights, and doors can be put just about anywhere in the structure. Orienting these openings for maximum energy efficiency can be easily accomplished. The exterior appearance of domes can be given variety with the addition of canopies, extensions, and dormers.

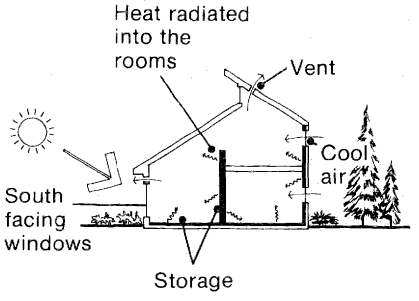
The contemporary dome concept can offer a surprising savings in both building and energy costs, and offer an interesting alternative to the conventional home. However, financing may be difficult.

A cube is another form that has a good volume/area ratio. Many new homes are returning to this basic form to conserve energy. A home shaped exactly like a cube may not be very attractive. So several design features can be added to improve the appearance while still retaining the basic cubical form. Good use of exterior materials, location of windows and doors, and interesting roof shapes will enliven the design.

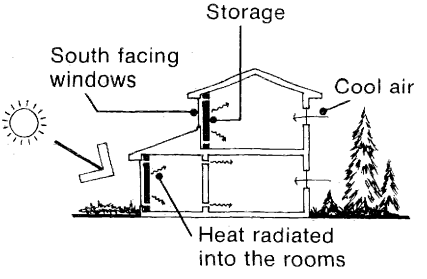
Passive Solar Structure

The total house structure can be designed as a large solar collector. Using the forces of nature rather than mechanical devices, a house can almost be energy self-sufficient. This concept is known as passive solar. Principles used in this concept have been known for years, but the importance of energy efficiency in today's society is causing a new recognition.

Direct Gain System



Indirect Gain System



The basic idea is for the house as a total unit to collect, store, distribute, and control solar energy. Several different methods can do this.

One is known as the "Direct Gain System." Sunlight enters the home through large south-facing windows and is absorbed in the floors and interior walls of the home.

To do this, the floors and walls must be constructed of a heavy dense material, such as concrete, stone, or masonry. The heat is then slowly released back into the rooms and circulated throughout the home by natural flow. Control is provided by vents to release excessive heat, and by shades on the south-facing windows to restrict heat gain in the daytime and heat loss at night.

Another method is the "Indirect Gain System." Sunlight again enters the south-facing windows but is then absorbed by a massive wall located only inches away. The heat is slowly radiated into the rooms.

Heat circulation and control are similar to the "Direct Gain System."

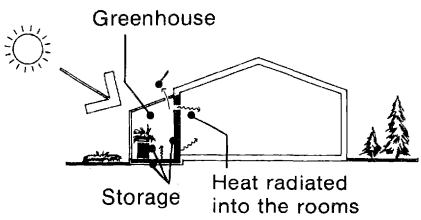
Another approach to the indirect gain method is to collect solar energy in water containers located on the roof. The heat is released slowly into the rooms through the ceiling. Insulated panels are moved over the top of these water containers at night to reduce heat loss.

This system can also provide cooling in summer by exposing the water containers to the cool night air, allowing heat from the home to be radiated back into the atmosphere.

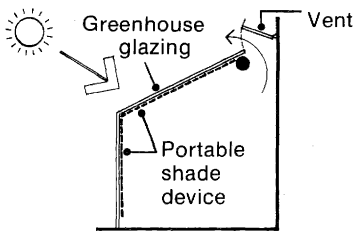
The "Isolated Gain System" collects solar heat in one specific space. The heat is then distributed into surrounding rooms of the house by simply opening windows and doors between these areas.

The isolated space for solar collection is often a

Isolated Gain System



Methods of Controlling Heat in a "Greenhouse"



"Greenhouse," which can provide oxygen, decorative foliage, food, and heat to the home.

Energy efficiency of the space can be increased by providing concrete or masonry floors and black barrels filled with water. Kits are available for constructing your own greenhouse. Control is accomplished with vents and portable shades under the greenhouse glazing.

Another method is the "Envelope System." The house is enclosed with double walls, double roof, and open space beneath the floor. Solar energy is first collected through south-facing windows and then distributed throughout the house in the wall and roof cavities by the natural flow of heat. Heat can be temporarily stored in rocks in the space beneath the floor. The system produces a continual flow of air in the cavities and creates comfortable room temperatures.

Various combinations of these basic types of systems are possible. Each combination will create a unique home design. Designs can be as numerous and unique as the people who will live in them.

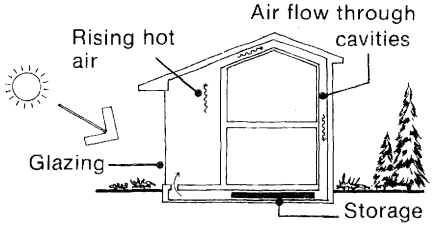
Active Solar Designs

An active solar heating system — in contrast to a passive system — involves using mechanical devices to move solar energy from an externally mounted collecting device into the house for either temporary storage or circulation to the rooms. Housing design concepts are being developed to include these collectors as an integral part of the design.

The collectors are mounted on south-facing walls or roofs. Large south-facing roofs are designed at special slope angles to accommodate the collectors. These slopes are usually much steeper than on the conventional home. Since sunlight must strike the confined area of the collector, obstructions such as trees or structures should be avoided or eliminated.

Active solar systems usually include a storage "battery," composed of rocks or a liquid solution,

Envelope System



Earth Berming

that must be included in overall design of the house. Distribution of heat is quite similar to a conventional home and usually does not have a significant effect on the basic design.

Today's concepts include special attention to landscaping. Trees, shrubs and ground cover are — among other reasons — selected for their individual beauty and for blending with the design of the home. These plants can also contribute towards energy efficiency.

Evergreen trees and shrubs planted on the north and windward sides of a home will perform as windbreaks and reduce heat loss. Deciduous trees and shrubs on the south side of the home will provide shading in the summer while in the winter, when the leaves are gone, they permit sunlight to pass through and into the home. Large trees surrounding a home can help moderate the extremes of both hot and cold temperatures.

Mounded earth, or berms, can be used to reduce the amount of exposed surface areas of a house, and thus, reduce heat loss. They can also direct winds in such a way as to cause snowdrifts to form away from the house and entrances.

Surface colors of walls and roofs can affect energy efficiency. Dark colors absorb more heat than light colors do. Materials for storing heat should have a dark-colored surface. Very light-colored surfaces and mirrors will reflect energy and should be used where heat is not wanted. The total design concept should include a color scheme that complements energy needs of the house.

Entrances and Doors

Entrances are a major concern for energy efficiency. Doors should be tightly sealed at the edges, and — whenever possible — located only on the south or east sides of the house.

One idea is to provide an airlock, two doors and an airspace in between. One door is usually closed before the other is opened. This greatly reduces the amount of interior heat loss to the outside. Other ideas include wing walls and plants at the entrance to divert cold winds away from the entrance.

Individual doors are available today in all sizes, colors, patterns, and new materials with very high insulation qualities.

Steel doors with insulation between the steel covers are becoming economical to use provided they have a thermal-break between the steel skins. Magnetic weatherstripping is also possible with the steel doors.

Sliding glass patio doors can waste a lot of

energy. Concepts for improving their efficiency are similar to those for windows.

Rooms of a house can be arranged to take advantage of the sun and the natural flow of heat. Spaces not often used — such as corridors, closets, and mechanical rooms — can be kept at lower temperatures and located between occupied rooms and the north exterior wall.

Areas such as laundry rooms, kitchens, and mechanical rooms will generate heat and should be located on the north or east sides so the heat can be easily vented to the exterior in summer, and used to heat the rooms in winter.

Living, family, and dining rooms should be located on the south side where heat gains and natural light would be available. Exterior entrances to these rooms on the south side would be functional and energy-efficient.

Windows can lose a great deal of energy. Windows are available with multiple layers of glass; between each glass layer is a dead air space which acts as an insulator.

One unique system that reduces heat loss includes particles of insulation beads blown into the air space between the layers of glass. The beads can be automatically removed during the daytime when natural light and solar gain are needed.

Heat loss can also be reduced with shutters, movable insulated panels and heavy insulated drapery.

Location of windows is very important. They should be placed to provide cross ventilation within the home and a pleasing arrangement of openings on the outside. Window sizes should be kept to a minimum on the north and east sides.

The skylight is another device to collect solar energy and create an interesting visual effect in the interior. Skylights should be constructed with multiple layers of glass and insulating panels to reduce heat loss.

Heat gained through a window can be just as important to control as heat loss. Windows with reflective glass can be located on the west or south sides to reduce the intense summer heat.

Shading Devices

External shading devices to control heat gain include large roof overhangs, sidewalls, awnings, recesses, and movable louvers, or screens. Internal devices such as insulated blinds, panels, and opaque drapery are also quite effective. Some of the devices can be automatically controlled.

Design and positioning of these devices require consideration of the sun's position in both summer

and winter. The shading device should allow the low winter sunshine through the window, while rays of the high summer sun would be blocked.

These and other design concepts are in the process of continuing development for improved efficiency.

The range of house designs available today is almost endless. You must decide what is best for your specific location and requirements. As new materials, construction methods, and technologies are developed selection of a house design should be a very exciting and rewarding experience.

R LLEWELLYN

A solar greenhouse and residence.

Further Reading:

A Treasury of Contemporary Houses, Architectural Record Book, McGraw-Hill Book Co., Princeton Road, Hightstown, NJ 08520. $18.95.

Design With Climate, Victory Olgyay, Princeton University Press, Book Order Department, Princeton, NJ 08540. $32.50.

Earth Sheltered Housing Design — Guidelines, Examples, and References, American Underground Space Assn., c/o TLH Associates, Suite 900, Minnesota Building, 4th & Cedar, St. Paul, MN 55101. $12.

Natural Solar Architecture — A Passive Primer, David Wright, Litton Educational Publications, 7625 Empire Drive, Florence, KY 41042. $8.95.

Planning and Building the Minimum Energy Dwelling, Burt, Hill, Kosar, Rittelman, Craftsman Book Co., 542 Stevens Avenue, Solana Beach, CA 92075. $10.

Sun/Earth, Richard L. Crowther, Charles Scribner's Sons Publishers, Attention: Customer Service, Vreeland Avenue, Totowa, NJ 07512. $8.95.

The Energy Issue, Progressive Architecture, April 1979.

The First Passive Solar Home Awards, #023-000-00571-4, U.S. Department of Housing and Urban Development, for sale from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. $5.50.