The SunEarth House

A Minimal-Energy-Use Residence
HUD Award Winning Earth-Covered/Passive Solar Home

Designed by Paul Shippee

The SunEarth Home . . . Longmont, Colorado

Minimal-Energy-Use in buildings is successfully demonstrated in the SunEarth House. The house was designed, built and marketed by Colorado Sunworks in 1977-78. Performance is monitored by IBM computerized tracking of 90 energy sensors placed in the building during construction. The furnace was put to rest during its first winter because the pilot light was wasting natural gas. The result is extremely low fuel bills and comfortable living in an energy conscious house. 100% of the space heating demand is supplied by the passive solar system.

The design begins with concrete wall construction insulated on the exterior. Earth is bermed up over the walls and piled one foot deep on the flat roof to create an earth contact shelter. The South side exposes 300 sq ft of glass windows to the winter sun – this directly warms large barrels of water about 10 degrees F on a clear day. Atrium windows admit sun directly to light colored floor tiles which then reflect the light to interior concrete walls, storing, more energy for night time use. On winter nights moveable insulation (Beadwall®) converts large window areas to R20 heat loss barrier.

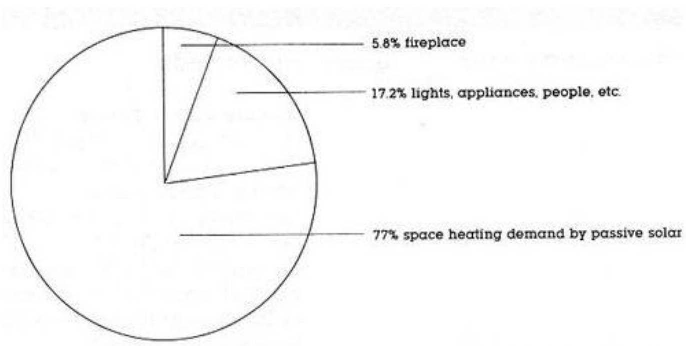
Other energy conserving features of the SunEarth include a garage buffer to the northwest, airlock entry, vertical skylights over the north wall, air tight construction, thermal envelope ceiling for natural heating and cooling, fireplace piped to outdoor air, summer shading devices and passive tank type water heaters.

Interior – Skylights bring light to the north concrete wall

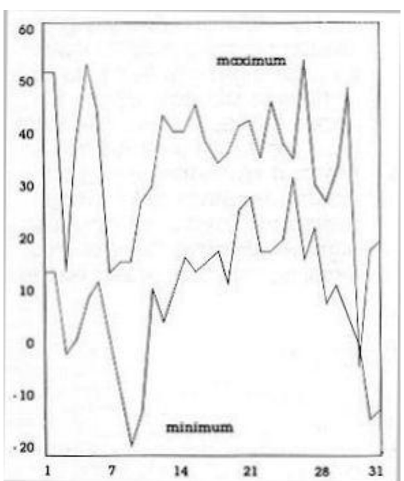
House interiors are pleasant and attractive. Rooms are arranged in a spacious manner around the great room. Bright and warm in winter, cool and shaded in summer - every element of the design works **with** the changing environment. Skylights and light floor tiles help bathe all walls with natural light while collecting solar energy. The centrally located interior garden is colorful and inviting. Plants supply fresh air and humidity year round.

House heating load
December 1979 =10 million BT

The circle diagram represents the total heat needed in January 1979 to maintain comfort levels in the house. All the space heating demand, after internal gains are counted, was supplied by the passive solar space heating system.



Outer temperature (F)

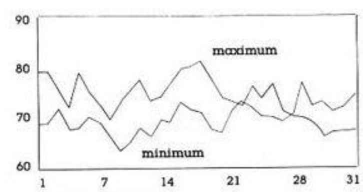


December 1978

Fluctuations in room air temperature are shown at right. The average daily temperature swing was 4F – 6F. This is achieved by massive and properly placed thermal storage materials - water in containers and structural concrete walls.

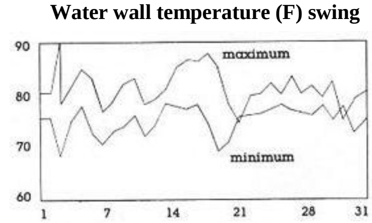
Temperatures of the water contained in the barrels, placed directly behind south windows, are shown in this chart. These temperatures ride about 10F degrees above room air temperatures and give off heat slowly as needed – by natural radiation and convection.

Room air temperature (F) swing



December 1978

Water wall temperature (F) swing



December 1978

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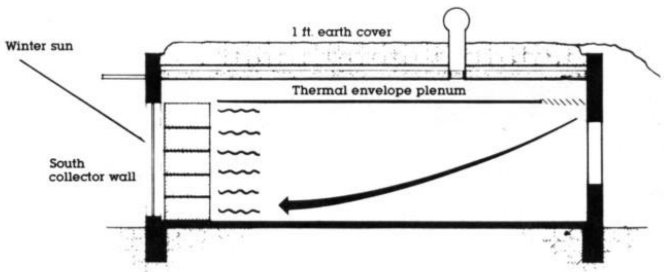
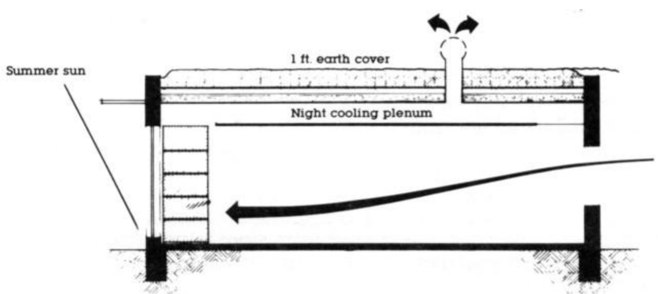
Natural lighting enhances indoor garden
– light color tiles absorb and reflect direct sunlight.

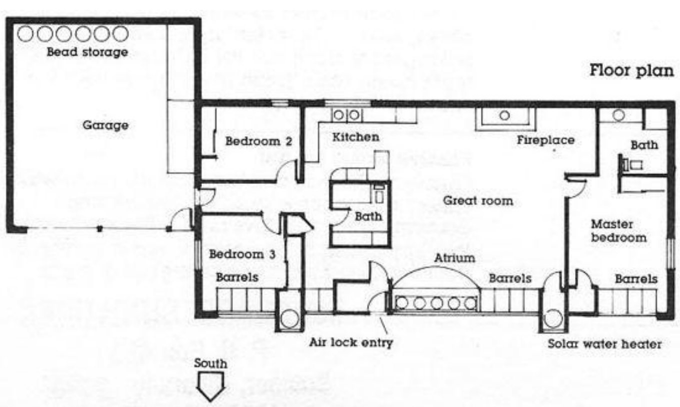
Blinds allow heat to flow from water barrels.



Winter Mode - Stored solar heat is released from the water containers as needed. Heat flows naturally by low temperature radiation and by warm air convection to the north side of the house, thus balancing comfort zones throughout the living space.

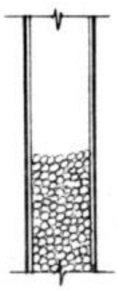


Summer Mode - Interior thermal mass is cooled down on summer nights by providing a natural air now path. Daily heat gains are rejected by this method through turbine roof ventilators. The cooled massive house is then closed up on hot summer days for comfortable living.

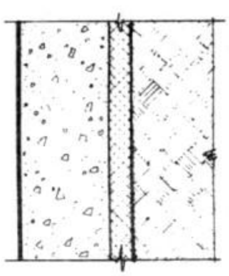


Floor plan emphasizes elongation of the south side of the building for good solar exposure. Rooms are laid out to aid natural heat flows. Note that the south collector/storage wall can "see" much of the north wall for effective distribution of heat.

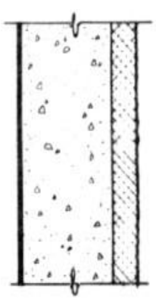
Technical details



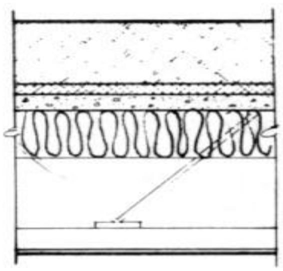
South glass wall
The south glass is vertical and functions as a solar collector. On winter nights the 5 ½ inch cavity between tempered glass panes automatically fills up with tiny styrofoam beads. The insulating value then becomes R20, keeping stored solar heat inside the house.



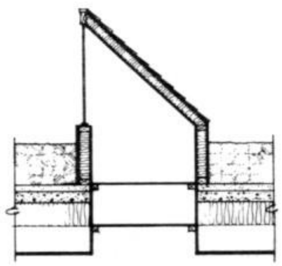
Underground wall
Concrete walls (secondary thermal mass) are equal in heat capacity to the south water wall. Wall temperatures rise 3F degrees on sunny winter days, then discharge heat to the rooms at night. Earth protects wall from outdoor temperatures, but must be insulated from the concrete.



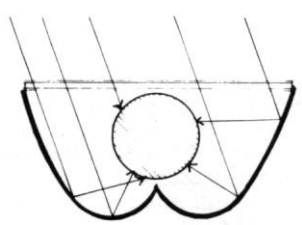
Exposed exterior wall
Parts of the surrounding concrete walls are exposed to air, especially near windows. Direct contact with outdoor temperature requires R20 insulation to be placed on the exterior. Tough styrofoam is glued to wall then plastered with mix of cement and glass fibres.



Roof section
One foot of earth cover provides patio, garden, and grassy areas on the roof thus increasing useable outdoor space. Effects of outdoor temperatures are dampened considerably. Ceiling is suspended from steel joists providing air flow plenum for natural cooling and heating.



Vertical skylight well
Maximum solar energy is admitted during winter, minimum in summer, by this vertical arrangement. The bright light wells diffuse strikingly pleasant natural lighting along interior north house wall. Triple glazing cuts heat loss to tolerable levels.



Passive water heater
Passive tank heaters inclined at the south wall collect solar energy used for pre-heating domestic hot water. The cusp reflector directs all the light falling on the glass to some portion of the tank. Beadwall® insulates the glass at night.

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