Cincinnati, OH

Builder: Louis S. Ionna III & Associates, Inc., Cincinnati, OH

Designer: Fuller Moore, Architect, Oxford, OH

Solar Designer: Fuller Moore

Price: $82,500

Net Heated Area: 1600 ft^2

Heat Load: 45.5 x 10^6 BTU/yr

Degree Days: 4834

Solar Fraction: 82%

Auxiliary Heat: 1.04 BTU/DD/ft^2

Passive Heating System(s): Direct gain, isolated gain, indirect gain

Recognition Factors: Collector(s): Double-glazed, south-facing greenhouse windows, sliding glass doors, 521 ft^2 **Absorber(s):** Black aluminum in plenum area, water drum surfaces, darkened surface of water wall. **Storage:** 55-gallon water-filled drums, water wall—**capacity:** 6000 BTU/°F **Distribution:** Natural and forced convection, radiation **Controls:** Thermostat, damper, roll-down insulating shade

Back-up: 50,000 BTU/H woodburning stove, electric baseboard heaters

Domestic Hot Water: Preheating coil in the greenhouse and heat exchanger on woodburning stove

Passive Cooling Type: Earth pipes, ground cooling, natural and induced ventilation

This 3-bedroom house is designed to accommodate the local climate's wide range of seasonal temperatures (12°F winter and 92°F summer), as well as a normal daily fluctuation of about 27F. The rustic contemporary styling is typical of other custom homes in the area. The landscaping includes evergreens to the west for wind protection, with deciduous trees to the northwest and east. There are no significant solar obstructions.

Energy-conserving features are central to the success of this solar design. These include R-40 insulation in the attic and R-22 in the exterior stud walls. In addition, there is double glazing on all windows including the greenhouse. Particular attention was paid to caulking and weather-stripping in an effort to further reduce heat loss.

The primary solar **collector** in this house is a greenhouse that extends nearly the entire length and height of the south wall. Sunlight is also **collected** in a plenum area above the greenhouse that runs the entire length of the roofline. Both the plenum and the greenhouse are tilted at a 60-degree angle.

The sunlight **collected** by the greenhouse is **absorbed** and **stored** as heat in two ways: 1) by a series of 13 water-filled 55-gallon drums arranged along the south wall of the greenhouse, which is partially below grade; and 2) by a water wall that separates the greenhouse from the upper floor of the living area. The water wall is a series of 4-inch diameter water-filled tubes set between exposed studs and single glazed on both sides. Reflective surfaces on the end walls of the greenhouse reflect additional light onto the dark surface of the water wall.

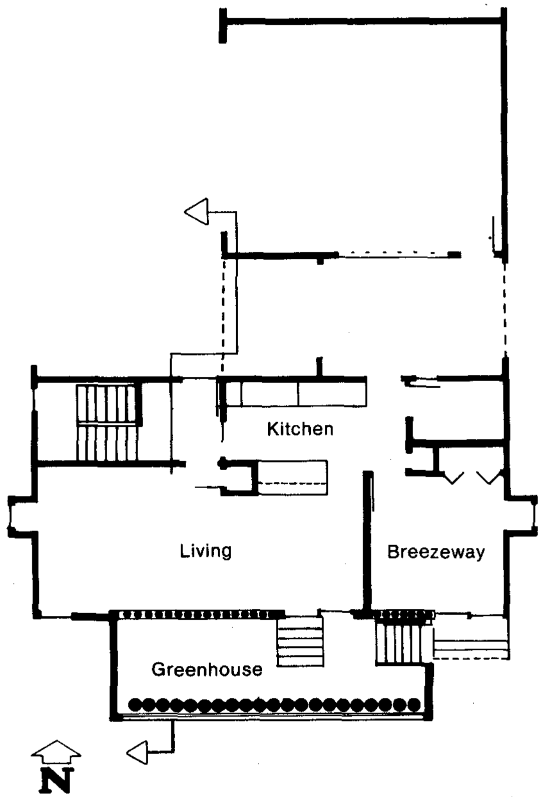
A natural convective **distribution** loop is formed during the day when heated air rises in the greenhouse and flows into the living room, which is on the upper floor. This heat flow is **controlled** by opening either or both of a pair of sliding glass doors (one on either side of the water wall) that connect the greenhouse and the upper floor. These doors also admit direct radiation that immediately heats the room air when the sun is shining. As the air reaches the north wall it becomes cooler, and therefore heavier. Losing buoyancy, it sinks down the rear stairwell into the sleeping areas and from there siphons back into the greenhouse, via bedroom windows, for reheating. In moderately cool weather, this convective loop plus radiant heat from the water wall are expected to be all that's needed to warm the house.

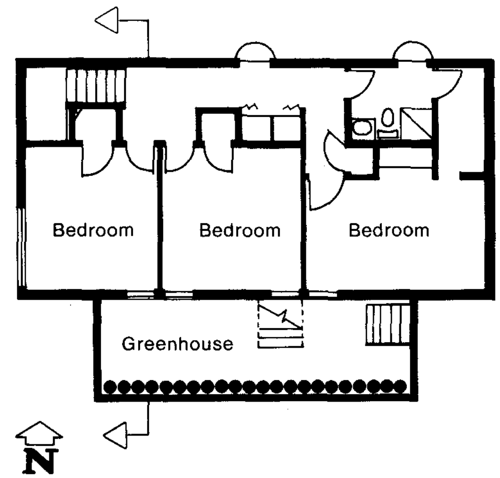
At night heat los$ from the greenhouse is controlled by a roll-down insulating shade with an R-value of 6.5.

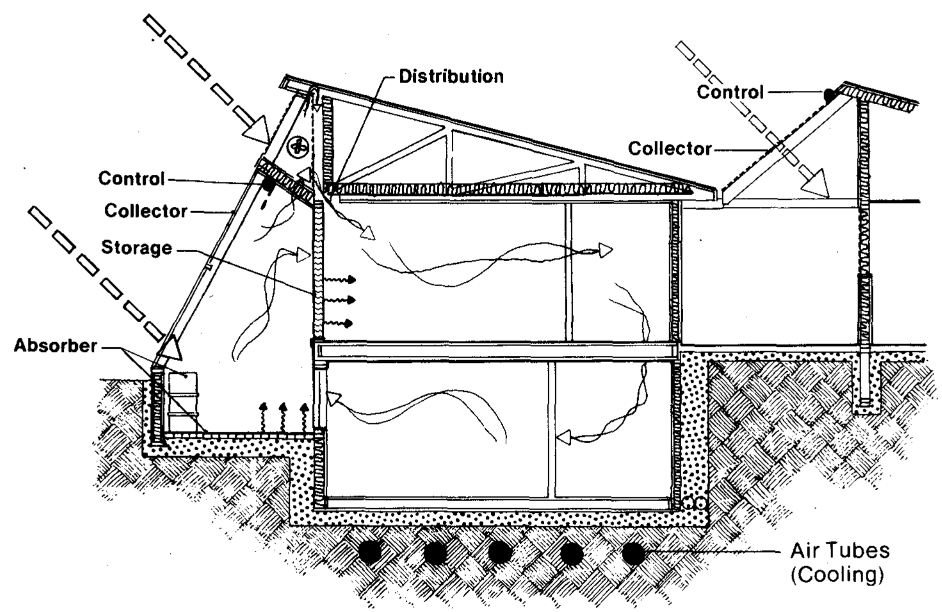
On colder winter days, the solar plenum above the greenhouse will be used to further heat the greenhouse air. The stove is also equipped with a heat exchanger used to preheat domestic water. In addition to the stove, there are "last resort" electric baseboard heaters on the south wall of the lower level.

The passive cooling mode is a matter of inducing convection by the chimney effect and allowing cross-ventilation by opening windows. For strictly passive cooling, the greenhouse is sealed off from the rest of the house, and the insulating shade is lowered to prevent the sun from heating the water wall or the barrels.

Essential to the cooling effect, though, is attaining the lowest possible temperature in the lower level. To this end, the designer has accented the effect of having the area below grade cooled by running four 6-inch diameter PVC corrugated air tubes approximately 6 feet underground near the foundation.







This plan is from the book
"Passive Solar Homes – 91 new award-winning, energy-conserving single-family homes",
The U.S. Department of Housing and Urban Development, **1982**

The solar homes designs in this book were the winners of HUD's fifth (and final) cycle of demonstration solar homes. The 91 winning home plans in the book were selected from 550 applications from builders.

This was a time of great interest and activity in the passive solar home designs – many of the winning homes show a level of innovation not found in most of today's passive solar designs.

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