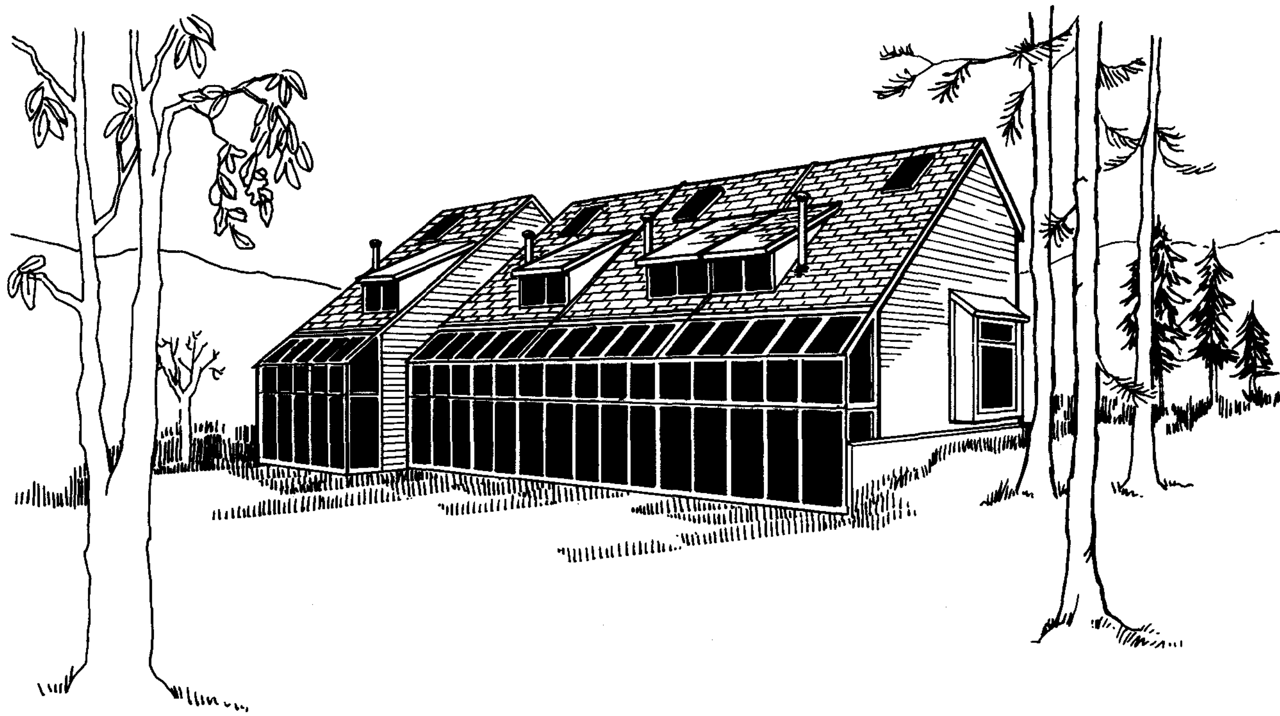
Cambridge, MA



Builder: Urban Development and Investment Corporation, Cambridge, MA

Designer: Brook/Elton Partnership, Cambridge, MA

Solar Designer: Brook/Elton Partnership Price:

$65,000

Net Heated Area: 1498 ft^2

Heat Load: 55.6 x 10^6 BTU/yr

Degree Days: 5634

Solar Fraction: 66%

Auxiliary Heat: 2.16 BTU/DD/ft^2

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

Recognition Factors: Collector(s): South-facing windows, greenhouse glazing, 416ft^2 **Absorber(s):** Concrete block wall, concrete floor slab **Storage:** Concrete block wall, concrete floor slab**-capacity:** 10,844 BTU/F **Distribution:**
Radiation, natural and forced convection **Controls:** Vents, dampers, thermostats, jalousie

Back-up: Water-to-air heat exchanger, wood stove

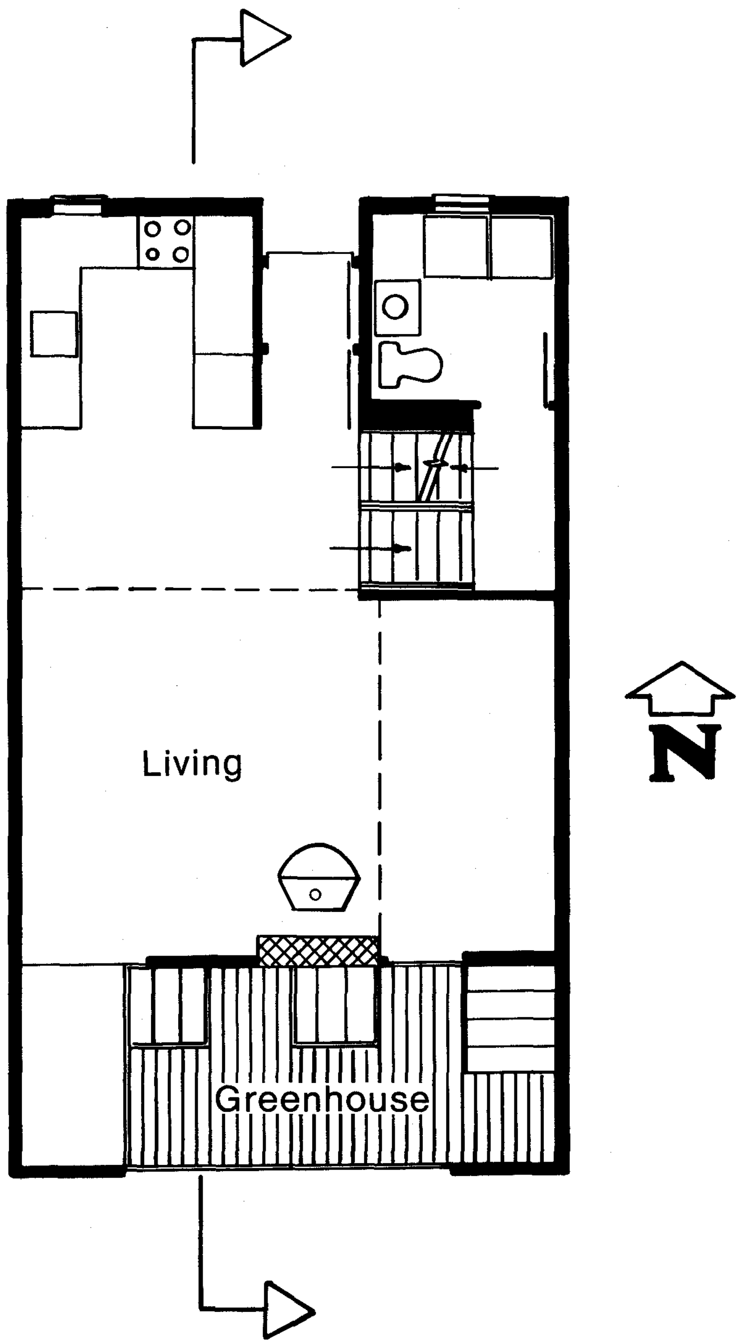
Located near Boston, a city known for its elegant townhouses, this and other homes in its development take the idea of the townhouse and update it for the solar future.

Tall pine trees covered the 14 acres of land that is now the site of the development. Except where they have been cleared to prevent shading of solar collectors or to allow the construction, the trees were retained.

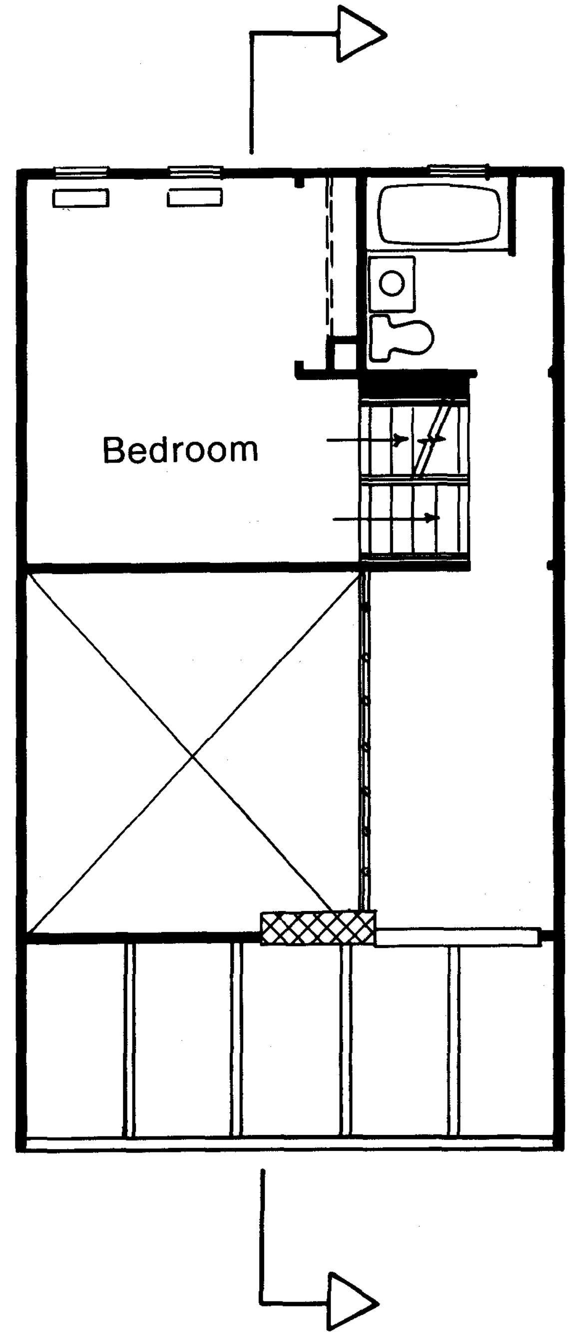
The townhouse design evolved in an era when saving building heat was important. Homes that share a common wall are intrinsically energy conserving because they have less surface area exposed to the elements. This townhouse also benefits from modern insulation technology: the north wall has a value of R-19 and the roof, R-35. All windows are triple- or quadruple glazed.

The large pines shield the house from cold winter winds. Both the north and south entrances have vestibules to limit the volume of heated air lost to the outside when a door is opened. The north wall of the home is bermed with earth to reduce the difference in the temperatures between the two sides of the wall. Summertime cooling is achieved by cross-ventilation through the open layout of the home and by the shade provided by the pines.

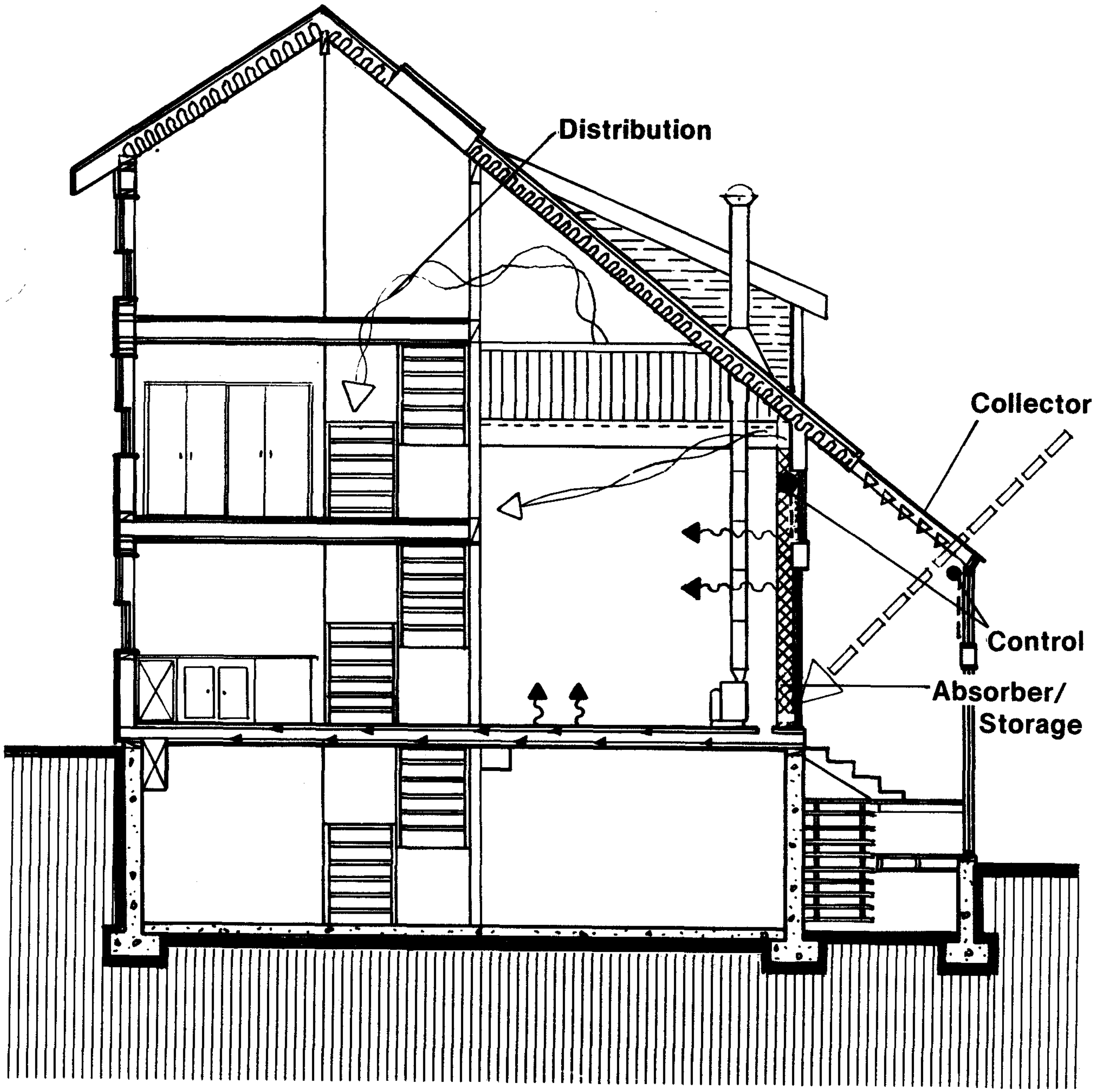
This home uses solar heat in three ways. The first occurs when sunlight is admitted through the house's 35 square feet of south-facing windows. When the sunlight strikes the interior of the home, it turns into heat, which "tempers" the inside temperature. This method is an incomplete solar energy system because there is no way to



Main Floor Plan



Second Floor Plan



control the heat gain or to store it. However, by providing some daytime heating, it allows the other two systems to store a larger amount of heat for nighttime use.

The second system collects sunlight through the glazing of the greenhouse. Some of the sunlight which passes through the glazing strikes a dark-colored concrete block wall where it is absorbed and turned into heat. Much of this heat passes into the concrete block wall where it is stored. At night, when the air temperature in the house falls below the storage wall temperature, heat is distributed from the wall by radiation and convection.

Not all the heat from the absorber surface of the wall is stored in the wall directly. Some of this heat warms the air in the greenhouse. This warm air may be carried by convection through vents in the concrete wall into the living space.

When the living space becomes hot enough, an automatic control opens a damper to a fan-driven duct system which pulls the greenhouse air through cavities in the concrete block wall into the living room, and then through the hollow Flexicore™ concrete floor slab. There the air heats the concrete. At night, the heat is distributed as it radiates from the wall and floor into the living space.

The blower system is also used to even out the temperatures in the home. It does this by drawing hot air from the ridge of the home and distributing it throughout the living space.

This entire system is controlled by a differential thermostat that monitors greenhouse temperatures and operates the motorized damper. Conventional thermostats control the fan and back-up system.

The designers chose to include little heat storage in the greenhouse itself. Although this design tradeoff allows the nighttime greenhouse temperatures to drop to near the outside temperature, it also allows more of the daytime greenhouse heat to be stored for use in the home's living space. At night, the greenhouse functions as a buffer zone by cutting down convection and radiation losses from the living space.

The home's third solar system also makes use of the greenhouse. Solar energy is **collected** through the roof of the greenhouse, and then through triple-glazed windows between the greenhouse and the living space. It is **absorbed** by the surface of the Flexicore™ concrete floor. The heat is **stored** in the floor until the living space cools down; the heat is **distributed** as it radiates into the room. This system is **controlled** by a jalousie on the roof of the greenhouse that provides summertime shading.

In an effort to eliminate the infiltration associated with combustion, the designers specified an electric back-up system. When the thermal storage mass falls below a specified temperature, water from a standard 85-gallon electric domestic hot water tank is circulated through a heat exchanger placed in front of the air circulation fan. The forced air in the duct system picks up heat from the heat exchanger and carries it to the living space.

This townhouse is also equipped with a Franklin stove to supplement the electric back-up system.

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.