PREFACE

The Department of Housing and Urban Development and the Energy Research and Development Administration have joined in a comprehensive national effort to generate widespread use of solar energy. One of HUD's most important responsibilities in this effort is the demonstration of solar heating and cooling systems in residential structures.

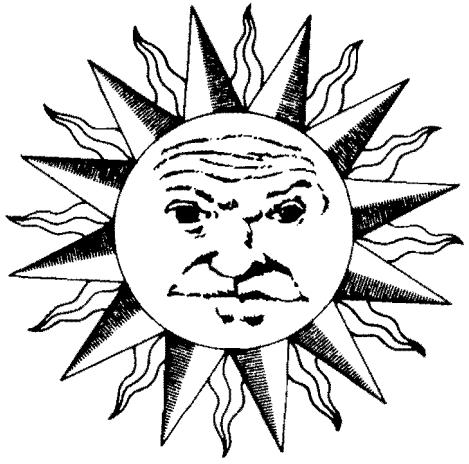
In September, 1975, HUD issued the first solicitation for demonstration projects involving single- or multi-family dwelling units which would incorporate solar energy systems for heating, cooling, or domestic hot water. This solicitation prompted 250 applications, which were evaluated by an inter-agency technical panel. Fifty-five projects were selected to receive grants. Shortly after selection, however, two projects were withdrawn. The remaining 53 projects are illustrated in this report.

Some additional projects may be dropped from this first demonstration cycle prior to the start of construction. However, in the interest of providing information on solar energy to the building industry and its customers, HUD has decided not to delay publication until all possible changes in the number of grants have taken place. Accordingly, it is possible that a few of these projects may be built without support by HUD. Before visiting any project, we recommend that you contact the project sponsor to determine its status.

This publication is designed to provide the public with a general look at the selected projects. Each project summary identifies the grantee and the location and size of the project, supplies a drawing of the unit, and describes the solar energy system.

We hope that this publication will add to the public's awareness of solar energy as an alternative energy source.

Charles J. Orlebeke, Assistant Secretary
Policy Development and Research
Department of Housing and Urban Development



Solar Heating and Cooling Demostration Program

HUD-005683

LIST OF PROJECTS

	BUILDER/DEVELOPER	PROJECT LOCATION	NUMBER/TYPE OF DWELLING		TYPE OF APPLICATION H	C/S	HW[4]
1	The Kelley-Fischer Co.	St. Louis, MO	1	SFD[1]	H		HW
2	Colburn Development Corp.	Stow, MA	1	SFD	H		HW
3	Jespa Enterprises	Old Bridge, NJ	1	SFD	H		HW
4	Crane Builders	Granby, CT	1	SFD	H	C	HW
5	Michael Green Co.	Moody, AL	1	SFD	H		HW
6	W.J. Faulk	Cleveland, TN	1	SFD	H		HW
7	Winford Lindsay	Dacula, GA	1	SFD	H		HW
8	Hooker/Barnes	Atlanta, GA	1	SFD	H		HW
9	Bldg. Ind. Assoc./Central, OH	Dublin, OH	1	SFD	H		HW
10	Korman Corporation	Blackwood, NJ	2	SFD	H		HW
11	University of Wisconsin	Milwaukee, WI	1	SFD	H		HW
12	Friedman, Rosen, Zien	Milwaukee, WI	1	SFD	H	S	HW
13	Vincent L. Oredson Co.	Ashland, OR	1	SFD	H		HW
14	Classic Development Corp.	Brea, CA	1	SFD	H		HW
15	Sir Galahad Co.	Virginia Beach, VA	1	SFD	H		HW
16	City of Santa Clara	Santa Clara, CA	5	SFD	H		HW
17	Creek National Hsg. Auth.	Tulsa, OK	5	SFD	H		HW
18	W. Brown Builders	Dallas, TX	2	SFD	H		HW
19	Solar Structures, Inc.	LaGrange Ville, NY	1	SFD	H		HW
20	Gordon Deering, Jr., Co.	Lubbock, TX	1	SFD	H		HW
21	Rust Construction Co.	Alexandria, VA	1	SFD	H		HW
22	Armstrong Development Co.	Claremont, CA	3	SFD	H		HW
23	The Blackfeet Tribe Hsg. Auth.	Browning, MT	5	SFD	H		HW
24	Solar Engineering Co.	Fort Collins, CO	1	SFD	H		HW
25	Marvin H. Anderson, Corp.	Bloomington, MN	1	SFD	H		HW

NOTES:

[1] SFD - Single Family Detached
[2] SFA - Single Family Attached
[3] MFLR - Multi-Family Low Rise (Garden Apartments)

[4] H - Heating
C - Cooling
HW - Hot Water
S - Storage Assisted Cooling

	BUILDER/DEVELOPER	PROJECT LOCATION	NUMBER/TYPE OF DWELLING		TYPE OF APPLICATION H	C/S	HW[4]
26	Church Community Corp.	Newport, RI	1	SFD[1]	H		HW
27	Waverly Homes	Westminster, CO	1	SFD	H		
28	Terracor-Utah	Salt Lake City, UT	1	SFD	H		
29	Daniel Brock Co.	Mesa, AZ	1	SFD	H	S	HW
30	Perl-Mack Enterprises	Denver, CO	1	SFD	H	C	HW
31	Ritter Buildings, Inc.	Berryville, VA	1	SFD	H	S	HW
32	ECO-ERA	Fort Collins, CO	2	SFD	H		HW
33	Lamar Savings Assoc.	Austin, TX	1	SFD	H	C	HW
34	Communico-Wayne Nichols, Co.	Sante Fe, NM	1	SFD	H	C	HW
35	Peachtree Homes	Shenandoah, GA	1	SFD	H	C	HW
36	Innovative Building Systems	Buffalo, NY	1	SFD	H	S	HW
37	Helio Thermics, Inc.	Greenville, SC	1	SFD	H	S	
38	Self-Help Enterprises	Selma, CA	5	SFD	H	C	
39	Grassy Brook Village, Inc.	Brookline, VT	10	SFA[2]	H		HW
40	San Antonio Ranch, Otd.	San Antonio, TX	3	SFD	H	C	HW
41	United Development Corp.	Vernon Hills, IL	4	SFA	H	S	HW
42	City of Colorado Springs	Colorado Springs, CO	12	MFLR[3]	H	S	HW
43	University of Pennsylvania	Philadelphia, PA	1	SFA	H		HW
44	Stonebraker Investments	Boulder, CO	8	MFLR	H		HW
45	Housing Auth. of Newark	Newark, NJ	6	SFA	H		HW
46	Cambridge Development Group	Columbia, SC	4	SFA	H		HW
47	City of St. Petersburg	St. Petersburg, FL	4	MFLR			HW
48	Puerto Rico Urban Renewal Corp.	Rio Piedras, RP	12	MFLR			HW
49	The Yeonas Co.	Vienna, VA	1	SFD			HW
50	Drexel University	Philadelphia, PA	5	MFLR			NW
51	The Babcock Co.	Coral Gables, FL	1	SFD			HW
52	The City of Pueblo	Pueblo, CO	5	SFD			HW
53	Leisure Tech. of CA, Inc.	Camarillo, CA	4	SFD			HW

INTRODUCTION

Solar energy. More and more these words are becoming a part of America's vocabulary. The continuing energy and environmental problems confronting the U.S. have been the primary catalyst to an increasing interest in energy from the sun. Its use for residential heating, cooling and domestic water heating has the potential for immediate benefits in energy savings and environmental improvements. Recognizing these benefits Congress has instructed HUD and other designated federal agencies to undertake an extensive research, development and demonstration program of solar heating and cooling systems in buildings.

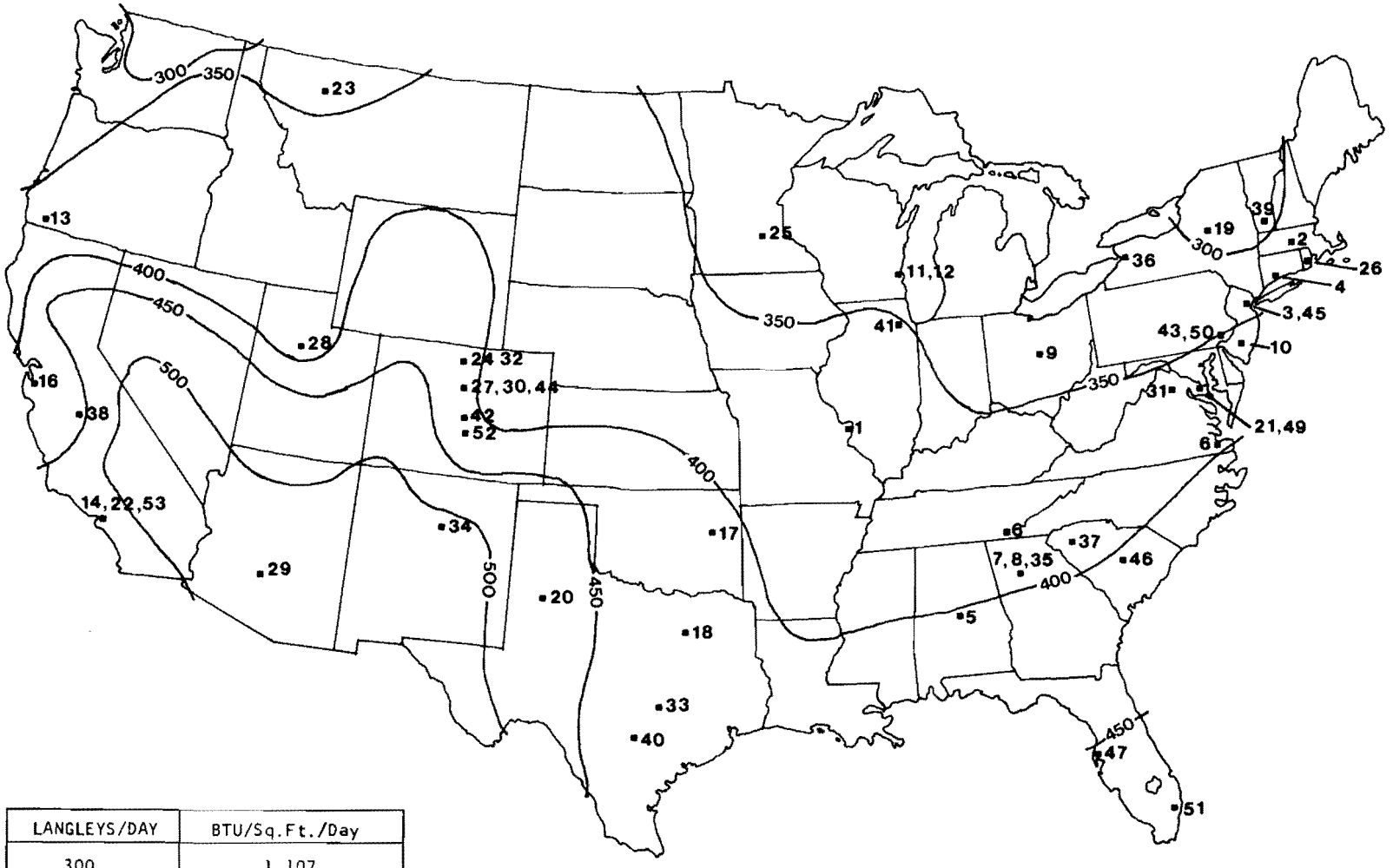
Solar heating and cooling is not as new as it sounds. For thousands of years man has intuitively made use of the sun's energy. To survive extremes in weather, he developed shelter designs responsive to the beneficial and detrimental effects of sun and climate. The intuitive approach to solar heating and cooling as evidenced by the pueblo structures of the southwest and the colonial houses of New England has laid the groundwork from which a scientific understanding of solar radiation and its corresponding climatic impact on buildings has recently developed.

Only since the 1930's has the United States experimented with buildings designed to collect, store and distribute solar energy as a principal heat source for human comfort. Less than 50 solar houses have been built between 1930 and 1970. These structures have provided the scientific and technical basis from which solar equipment designs and the solar dwelling designs are developing today. Since 1970, when the economic and environmental cost of conventional fuels focused attention on solar energy as an alternative energy source, the number of homes heated or cooled by solar energy has increased dramatically. Although for the most part, the houses being developed are custom or experimental homes, they nonetheless reaffirm the feasibility of solar heating and cooling with existing solar technology.

The present HUD Solar Demonstration Program is building upon these earlier efforts to establish solar energy as a viable energy alternative and to encourage the use of solar energy by the builder and the consumer in residential applications. The solar heated and/or cooled dwellings illustrated on the following pages represented the first series of projects selected under the HUD Program. A number of different solar heating, cooling and domestic hot water heating concepts are presented. In each case the solar concept has been combined or integrated with the building to form the total project. For the most part, the projects demonstrate the application of solar energy systems to newly constructed single family dwellings. There are, however, several projects where solar energy systems have been integrated with existing dwelling designs or with multi-family dwellings.

Information about the demonstration projects is organized into three areas: project information; building description; and solar energy systems. The purpose of the project summary is to provide a clear, concise description of the project. The descriptions do not provide a detailed discussion of solar system performance or dwelling design. General background and climatic data is presented in the project information section. A brief discussion of the dwelling's physical characteristics and energy conservation features occur in the building description section. And lastly, the components and relationship of components of the solar energy system are described.

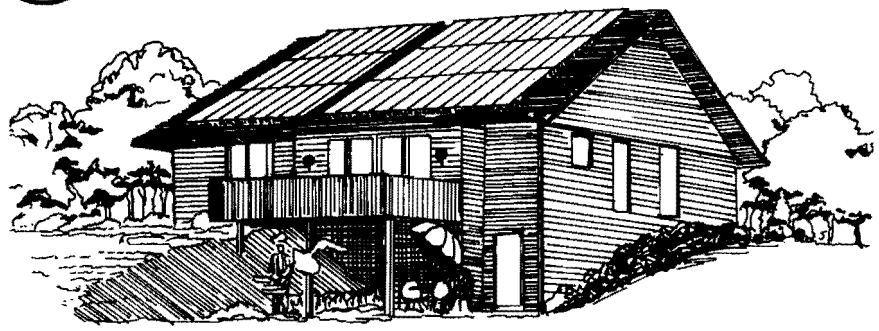
The map on the opposite page identifies the location of the solar demonstration projects. The numbers on the map correspond to the summary page number. The projects are organized by housing type and by solar application.

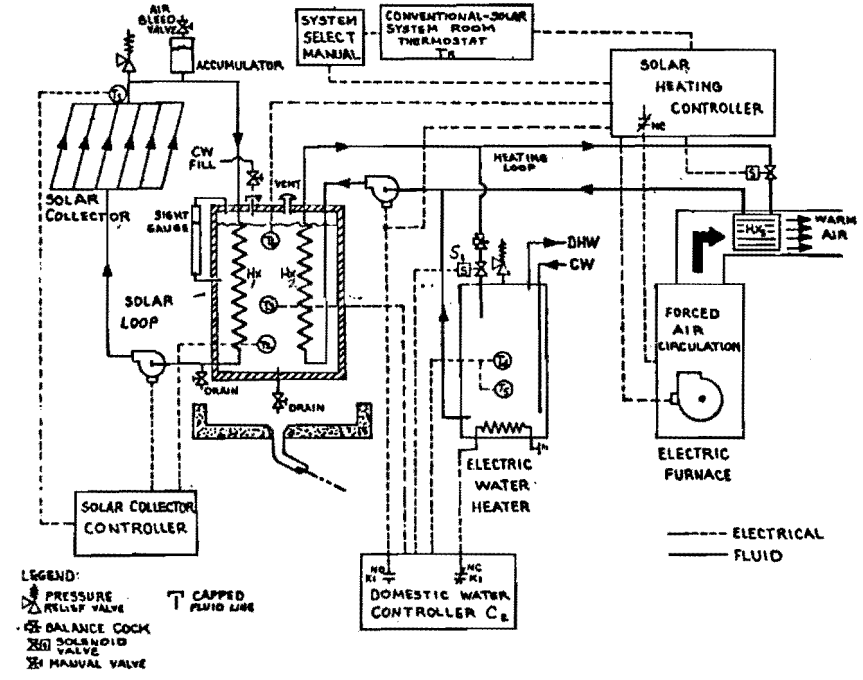


LANGLEYS/DAY	BTU/Sq.Ft./Day
300	1,107
350	1,291.5
400	1,476
450	1,660.5
500	1,845

LOCATION OF SOLAR DEMONSTRATION PROJECTS

Isopleths show annual average daily horizontal insolation in Langleys
1 Ly/day = 3.69 Btu/sq. ft./day





PROJECT INFORMATION

BUILDER: The Kelley-Fischer Company
DESIGNERS ARCHITECT: David Baumgartner
ENGINEER : Not Designated
LOCATION: St. Louis, Missouri Latitude 38°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,895 **COOLING** 1,150 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 170 **JUNE** 540 Ly.

BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with a contemporary split-level single family dwelling design. The wood house has 1,184 square feet of heated floor area under a gabled-type roof. The south sloping roof has sufficient area for solar collectors to provide a major percentage of the dwelling's heating requirement. Large south-facing windows allow additional solar radiation to heat the house during the winter months but an extended roof overhang blocks summer sun penetration.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 912 square foot liquid-cooled flat-plate manufactured by Revere Copper and Brass, Inc. The collectors are roof mounted and utilize a water-glycol solution for heat transfer and freeze protection.

STORAGE: 1,000 gallons of water within an insulated storage tank. Heat is transfered from the collectors to the tank by way of a water to water heat exchanger.

DISTRIBUTION: Forced air, natural radiation and convection. A heat transfer loop between the storage tank and a heat coil located in the primary supply duct provides heat for distribution by secondary supply ducts to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electric resistance furnace. Integrated with the solar distribution system, the furnace provides full or partial heating as required.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by running a heat transfer loop from storage to a heat exchanger located in the conventional water heater.

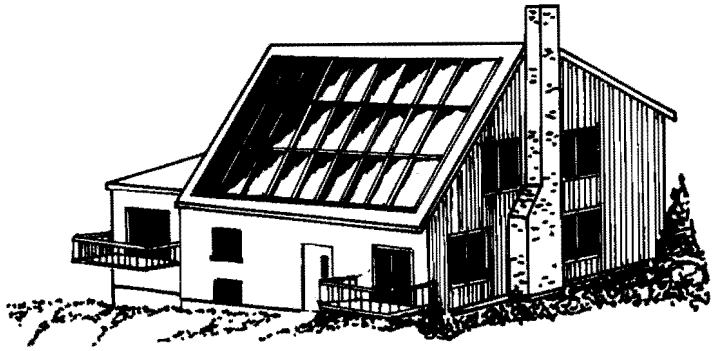
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Colburn Development Corporation
DESIGNERS **ARCHITECT:** Craig Parkhill
ENGINEER : William M. Bell
LOCATION: Stow, MA Latitude 42° 25'N.
HOUSING TYPE: Two Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,500 **COOLING** 400 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 500 Ly.

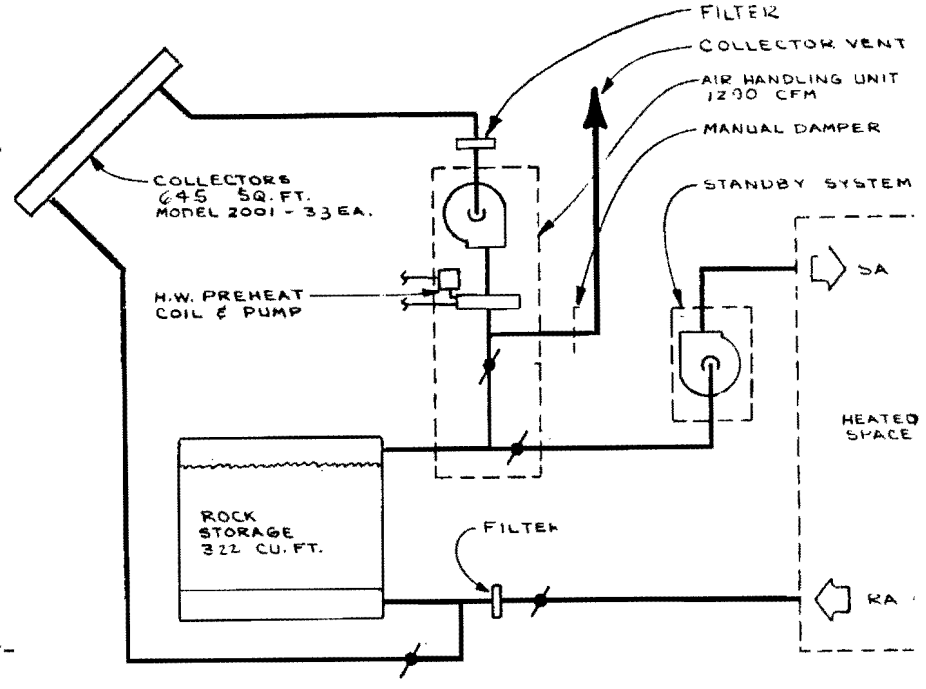
BUILDING DESCRIPTION

The project involves the application of a solar heating and domestic hot water preheating system to one single family detached dwelling. The dwelling totals 2,166 square feet of heated floor area within a compact two-story plan. Heat loss is reduced by the addition of extra insulation in the walls, floors and ceiling. The solar collectors are located on the steep south-sloping roof of each house.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 645.5 square feet air-cooled flat-plate manufactured by Solaron.



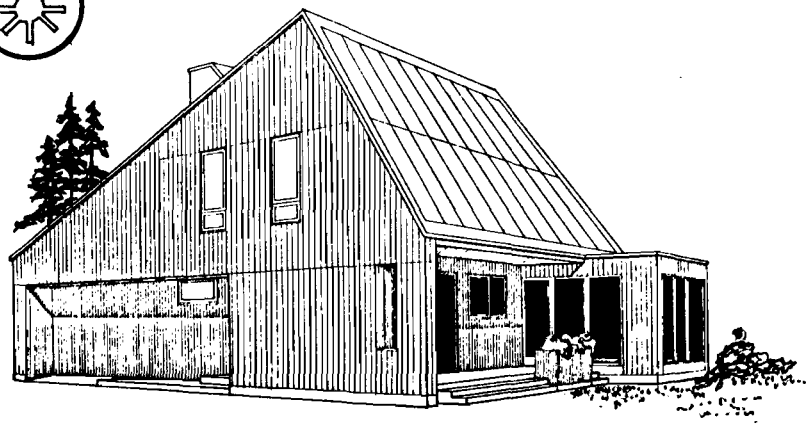
STORAGE: 322 cubic feet of 1½" diameter rock within an insulated 7'6"x7'6"x7' storage bin located in the basement. Air from the collectors is blown through the rock pile transferring captured heat.

DISTRIBUTION: Forced air. Air is circulated through the heated rocks in storage to ducts for distribution throughout the house.

AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace, arranged in-line between storage and the occupied spaces, provides total or supplemental heat as required.

DOMESTIC HOT WATER SYSTEM: Water is preheated by flowing through a finned coil heat exchanger in the air handling module of the solar distribution system before entering an 80 gallon conventional storage tank.

COOLING: Natural ventilation.



PROJECT INFORMATION

BUILDER: Jespa Enterprises

DESIGNERS **ARCHITECT:** Donald & Marja Watson
ENGINEER : T. Grayson & E. Barber

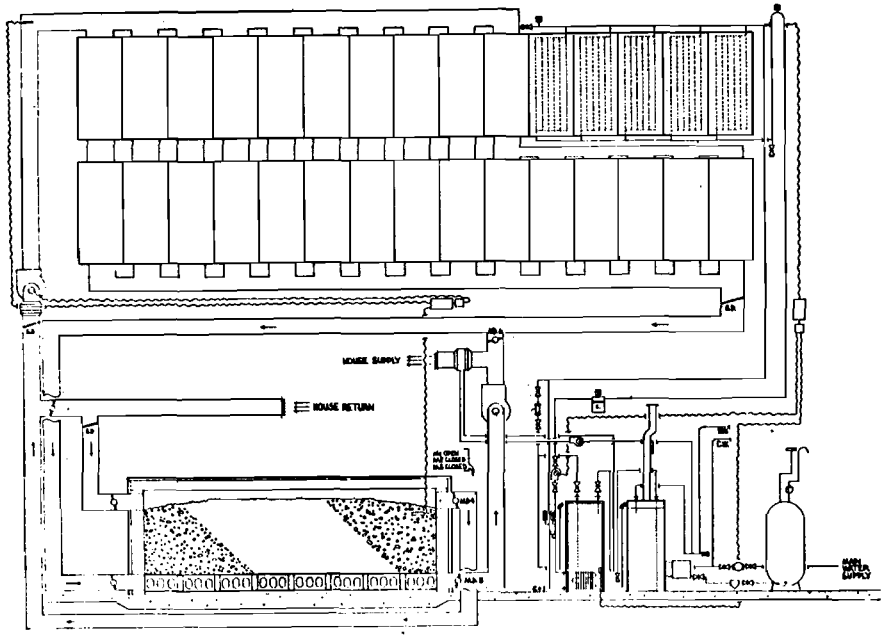
LOCATION: Old Bridge, New Jersey Latitude 40° 25' N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,980 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70
HORIZ. INSOLATION **JAN.** 150 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The contemporary single family dwelling fits 1,704 square feet of heated floor area into a compact two story plan. The dwelling's compactness as well as increased wall, floor, and ceiling insulation and a sun room greatly improve the building's thermal characteristics. Heating and domestic hot water preheating are provided by a warm-air solar system.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 368.8 square feet air-cooled flate-plate manufactured by Sunworks. A separate 74.2 square feet of liquid-cooled flat-plate collectors are used for domestic hot water preheating.

STORAGE: 840 cubic feet of 2" to 4" rock within a storage bin located beneath the first floor. Domestic hot water storage is separate.

DISTRIBUTION: Forced air. Air is blown through heated rock storage directly to the living space through supply ducts.

AUXILIARY ENERGY SYSTEM: Oil-fired water heater. Water to air heat exchange coil located in primary supply duct provides full or partial energy boost.

DOMESTIC HOT WATER SYSTEM: A copper immersion coil in a closed loop from collectors preheats the domestic water supply in an 80 gallon tank. Water from preheat tank passes through a conventional water heater prior to distribution.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Crane Builders

DESIGNERS **ARCHITECT:** Donald Watson

ENGINEER : Everett M. Barber

LOCATION: Granby, Connecticut Latitude 41° N

HOUSING TYPE: Single Family Detached

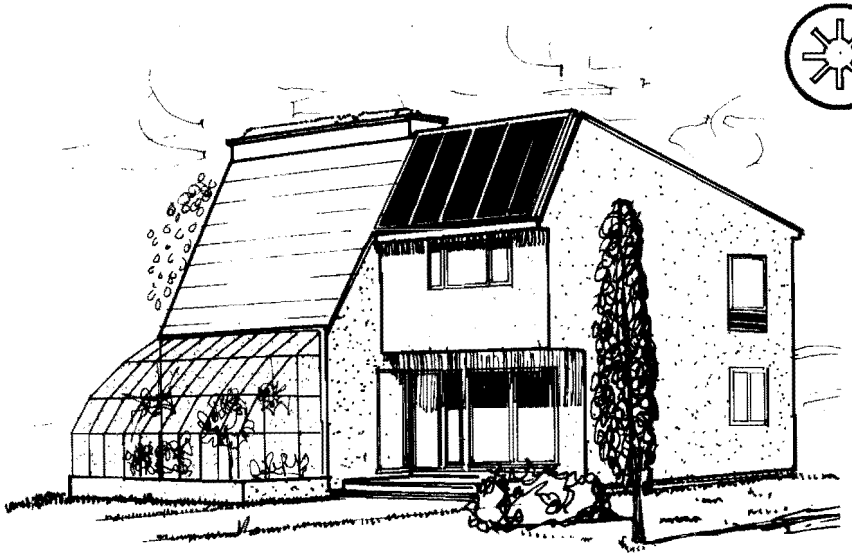
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,100 **COOLING** 50 D.D.

AVE. TEMP. **WINTER** 25 **SUMMER** 65°F.

HORIZ. INSOLATION **JAN.** 150 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project incorporates a number of solar energy and energy conservation features. A greenhouse/solarium acts as a passive solar collector, transferring heat to rock storage beneath the greenhouse. Above the sunroom a ventilating roof monitor with insulating panels lets hot air escape from the cathedral ceiling of the sunroom. Reflective insulating awnings separate the sunroom from the greenhouse. The two story and basement home has an area of 1,577 square feet.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 400 square feet liquid-cooled flat-plate manufactured by Sunworks; south-facing windows and a greenhouse.

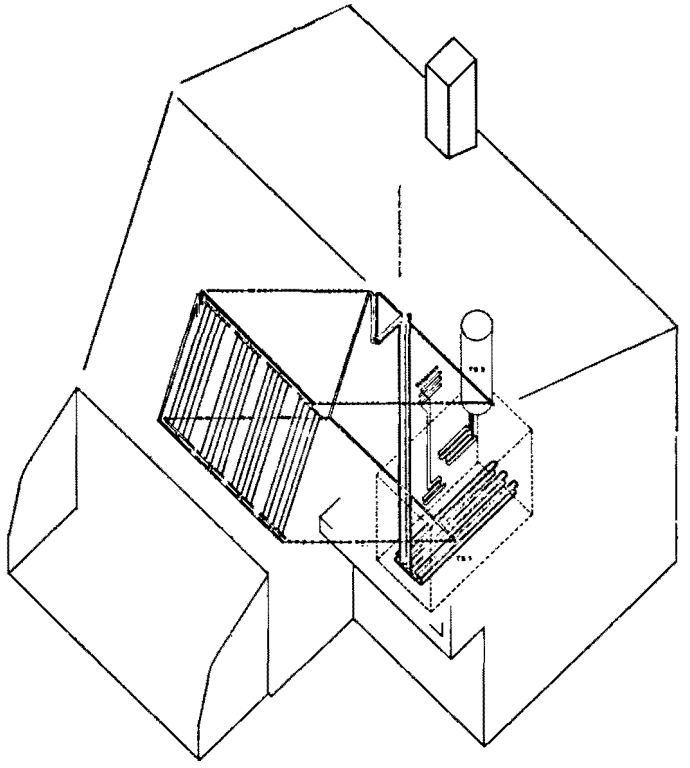
STORAGE: 378 gallons of water within a lined concrete storage tank located beneath the first floor. A separate 65 gallon tank stores the domestic hot water supply. Rock storage below the first floor sunroom supplies house heat from greenhouse solar collection.

DISTRIBUTION: Forced air. A copper coil heat exchanger in the ductwork transfers heat from storage to circulation air.

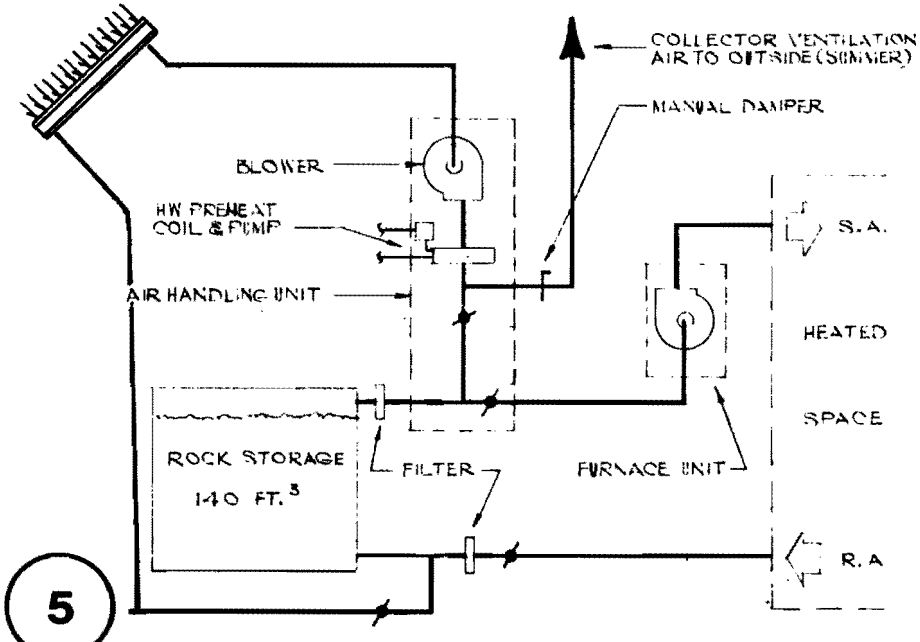
AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace is arranged in-line with the solar distribution system to supplement the solar system as needed.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by a copper coil immersed in the 80 gallon preheat storage tank. Preheated water passes through conventional water heater prior to distribution.

COOLING: Window vents and the roof monitor facilitate natural ventilation.



COLLECTOR TO STORAGE TRANSPORT SUBSYSTEMS



PROJECT INFORMATION

BUILDER: Michael Greene Company, Inc.

DESIGNERS **ARCHITECT:** Michael Greene Company, Inc.
ENGINEER : Solaron Corporation

LOCATION: Moody, Alabama Latitude 33°N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,826 **COOLING** 2,580 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 230 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project is a simple two story single family dwelling design modified to include a solar heating and domestic hot water preheating system. The design contains 1,296 square feet of heated floor area not including a two car garage. An assymetrical roof provides optimum tilt for solar radiation collection as well as an extended overhang to shade the many south-facing windows from the hot summer sun. Storm windows, added insulation and a fireplace are additional energy conservation features that improve the thermal performance of the building.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 273 square foot air-cooled flat-plate manufactured by Solaron Corporation with two sheets of tempered glass as the cover plate; south-facing windows.

STORAGE: 145 cubic feet of one and one-half inch rock within a 5'-3" x 5'-3" x 6'-9" insulated storage bin located in the lower floor.

DISTRIBUTION: Forced air, natural radiation and convection. A blower and motor driven dampers are part of the factory pre-assembled air handling module circulating heated air to occupied spaces from collector or storage.

AUXILIARY ENERGY SYSTEM: Gas furnace. In-line with solar system ducts the furnace provides a full or partial energy boost as required.

DOMESTIC HOT WATER SYSTEM: Finned coil located in the air handling module preheats domestic hot water prior to placement in an insulated 80 gallon storage tank. Preheated hot water passes through a conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: W.J. Faulk

DESIGNERS **ARCHITECT:** W.J. Faulk
ENGINEER: W.J. Faulk

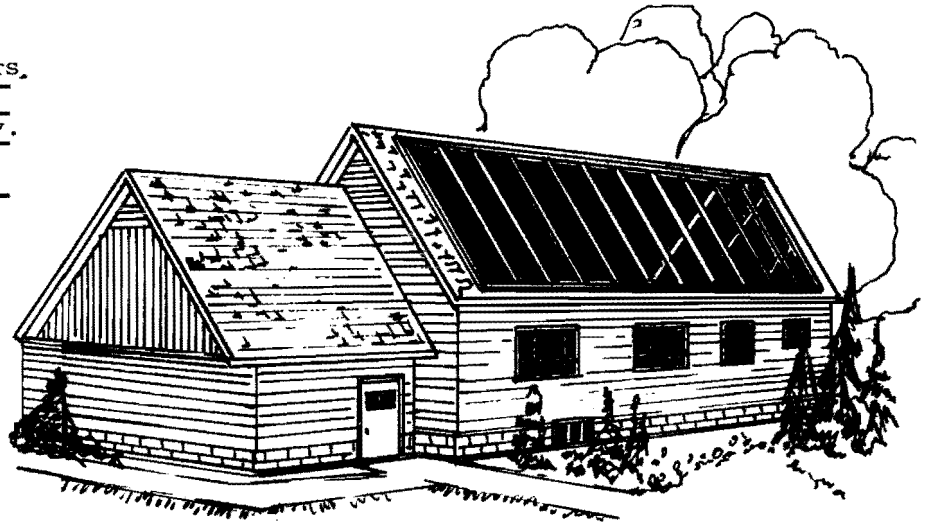
LOCATION: Cleveland, TN Latitude 35°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,000 **COOLING** 150 hrs.
AVE. TEMP. **WINTER** 40 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating and a domestic hot water preheating system to a single family detached dwelling. The heated floor area of the two-story house totals 2,155 square feet. To reduce heat losses, eight inches of insulation are placed in ceiling, floors, and walls. Also, water usage is reduced by an estimated 50 percent by having the water filtered, chemically cleaned, and reused for water closet flushing after being collected from the shower, sink, and tub.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 1,066 square feet liquid-cooled flat-plate manufactured by Revere. The copper absorber is coated with a selective surface and covered by two glass cover sheets.

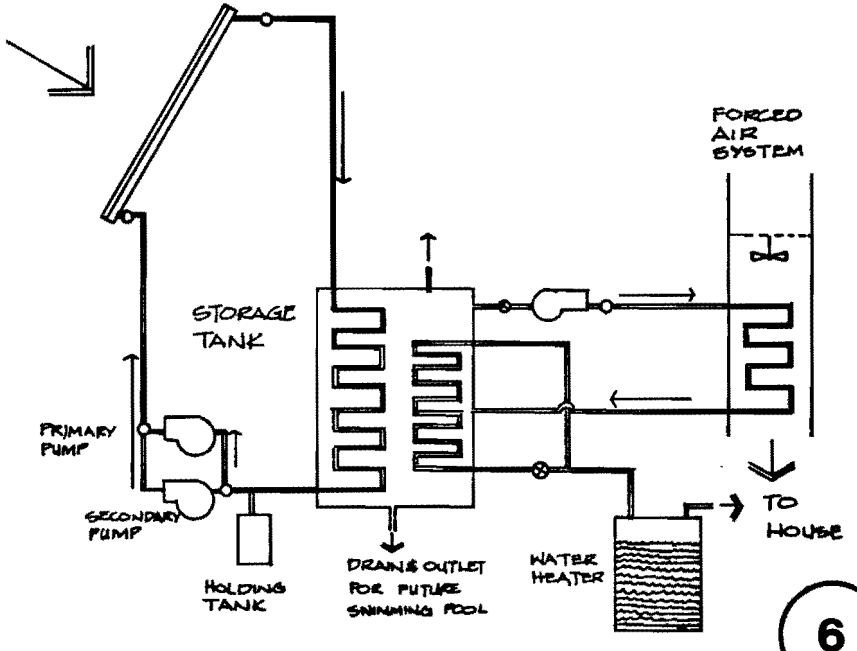
STORAGE: 5,000 gallons of water within an insulated cylindrical storage tank buried adjacent to the house. Access to the tank is provided by a manhole.

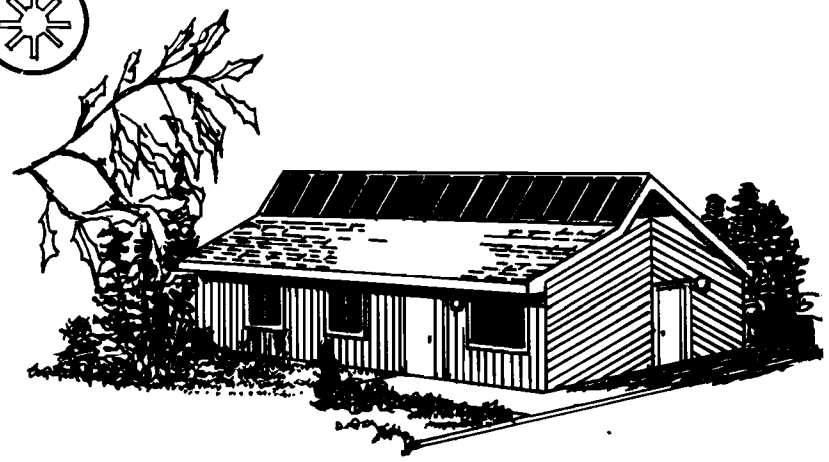
DISTRIBUTION: Forced air. Hot water is pumped from storage through a copper heat exchange coil in the primary supply duct. A fan circulates air over the heated coils to distribution ducts.

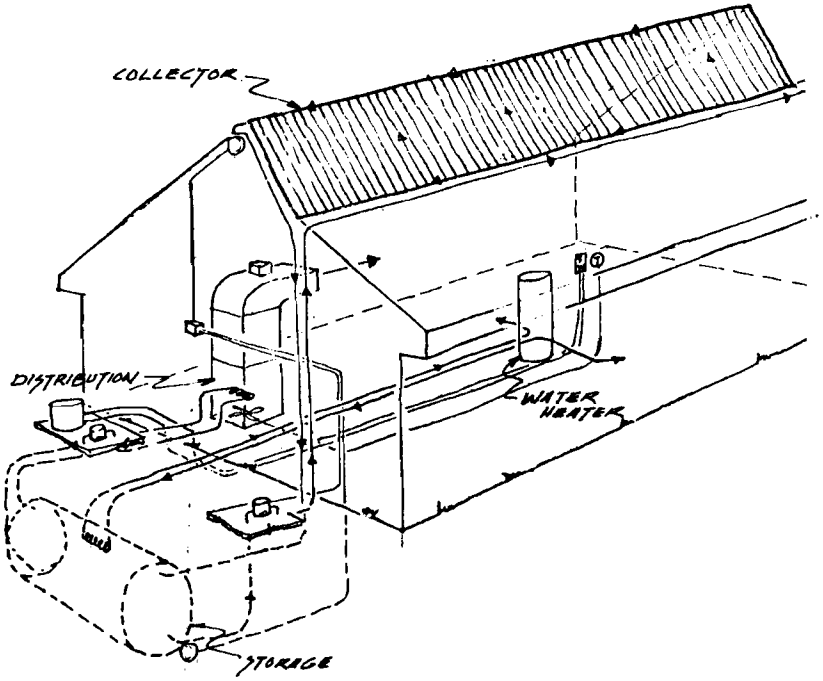
AUXILIARY ENERGY SYSTEM: Electric heat pump. The heat pump with its own heating coil in the primary supply duct supplements the solar heating system.

DOMESTIC HOT WATER SYSTEM: A copper immersion coil in the main storage tank preheats water flowing in a closed loop from a 100 gallon electric water heater.

COOLING: Natural ventilation.







PROJECT INFORMATION

BUILDER: Winford Lindsay
DESIGNERS **ARCHITECT:** Winford Lindsay
ENGINEER : Independent Living, Inc.
LOCATION: Dacula, Georgia Latitude 35°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,095 **COOLING** 1,500 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 230 **JUNE** 570 Ly.

BUILDING DESCRIPTION

The project is a one story wood frame house with 1,000 square feet of heated floor area. The single family dwelling is designed for simple low-cost construction in rural areas. The number of window openings is held to a minimum to reduce heat losses; and their location is governed by the ability to control solar heat gain. As a result, the majority of windows are located on the south side of the house with an extended roof overhang to block the hot summer sun. The design includes a solar heating and domestic hot water preheating system. The solar collectors are integrated with the roof structure.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 250 square foot liquid-cooled flat-plate manufactured by Revere Copper and Brass with an automatic drain down for freeze protection, south-facing windows.

STORAGE: 500 gallons of water within an insulated steel tank buried adjacent to the building. Water from the tank is circulated through the collectors to capture solar energy.

DISTRIBUTION: Forced air. Heated water from the storage tank is pumped to a heat exchanger within a fan coil unit for distribution by ducts throughout the house.

AUXILIARY ENERGY SYSTEM: Electric resistance heating coil located in primary supply duct.

DOMESTIC HOT WATER SYSTEM: A water to water heat exchanger located in the central storage tank preheats the domestic hot water supply prior to passage through a conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Hooker-Barnes

DESIGNERS **ARCHITECT:** Karl Kelley
ENGINEER: Karl Kelley

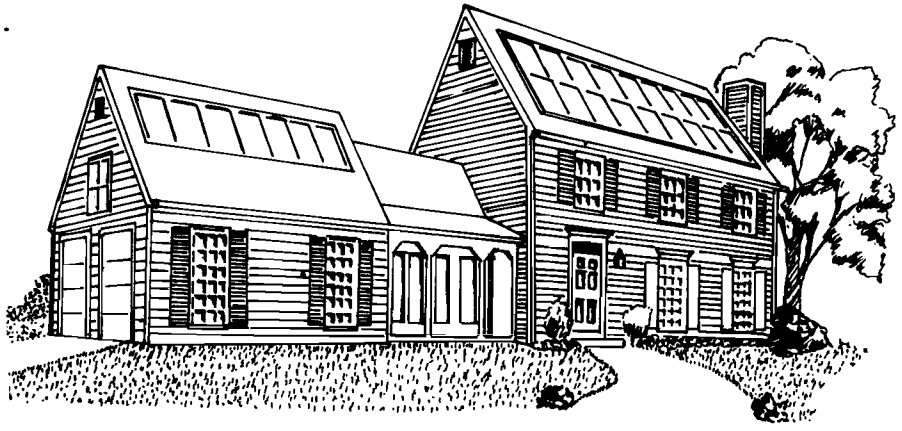
LOCATION: Atlanta, GA Latitude 33,7°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,983 **COOLING** 750 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 210 **JUNE** 560 Ly.

BUILDING DESCRIPTION

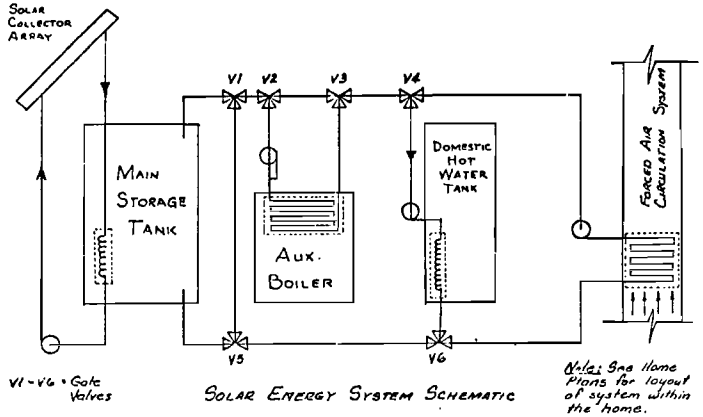
The project combines a "colonial-styled" single family dwelling with a solar heating and domestic water preheating system. The design is a standard 1,622 square foot plan with two floors and a basement that has been modified to reduce heat losses by half. Foil-backed sheetrock, a higher grade and thickness of insulation in ceilings and walls, floor insulation where normally there is none, storm windows, and double-paned glass achieve these savings. The solar collectors are mounted on the sloping south-facing roof of the dwelling and the garage.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 600 square foot liquid-cooled flat-plate manufactured by Revere.



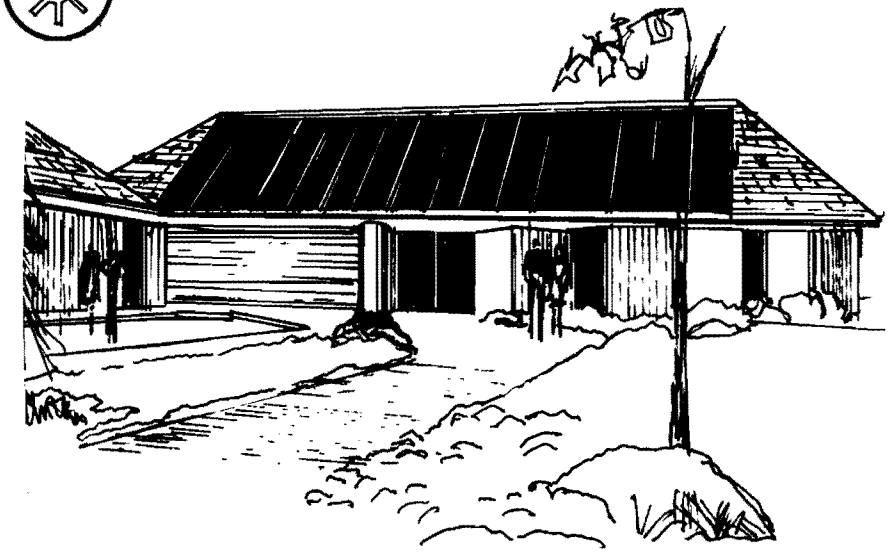
STORAGE: 2,000 gallons of water within a tank located in the basement. The tank is sized for a three to four day storage capacity.

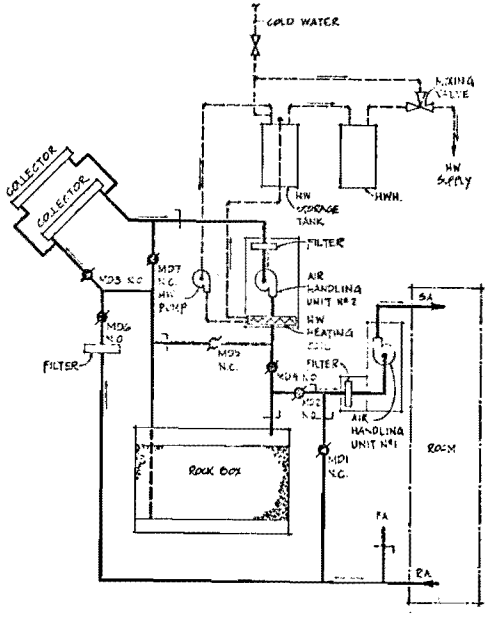
DISTRIBUTION: Forced air. Heated water from the heat storage tank passes through coils in the primary supply duct. Air is blown past the heated coils and distributed to the living spaces by ducts.

AUXILIARY ENERGY SYSTEM: Gas-fired boiler. Water within the boiler is preheated by water for heat storage circulating through a heat exchanger within the boiler tank.

DOMESTIC HOT WATER SYSTEM: Hot water from storage preheats a 120 gallon conventional water heater through a copper heat exchanger.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: Building Industry Assoc. of Central Ohio

DESIGNERS **ARCHITECT:** Brubaker/Brandt Inc.
ENGINEER: Gerrit S. van Straten

LOCATION: Dublin, Ohio Latitude 40°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,431 **COOLING** 600 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 130 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project is a single family detached dwelling that employs a solar heating and domestic hot water preheating system. Insulated boards on sliding tracks sealed to jambs with magnetic gaskets control heat losses from the dwelling's large window area. Exterior walls have been insulated with a new sandwich-type sheathing boards with foamed insulation between metallic foil sheets. The circular fireplace is designed for heat recovery. All electric lights have dimmers to reduce energy consumption. Living spaces total 3,648 square feet.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 1,166 square feet air-cooled flat-plate manufactured by Solaron. The black sheet metal absorber has two glass cover plates above and an airduct below.

STORAGE: 720 cubic feet of Rocks, 1½" in diameter, within a 10'x10'x7' insulated storage bin.

DISTRIBUTION: Forced air. Air is blown through the rock bin by an air-handling module containing blower, motor and drives. The heated air is distributed through the ducts to living spaces.

AUXILIARY ENERGY SYSTEM: Electrical heat pump. The heat pump draws air over coils in the primary supply duct to supplement the solar heating system.

DOMESTIC HOT WATER SYSTEM: A heat exchange coil in the air-handling module preheats water as air flows from collector to rock storage. The heated water is then returned to an 80 gallon storage tank.

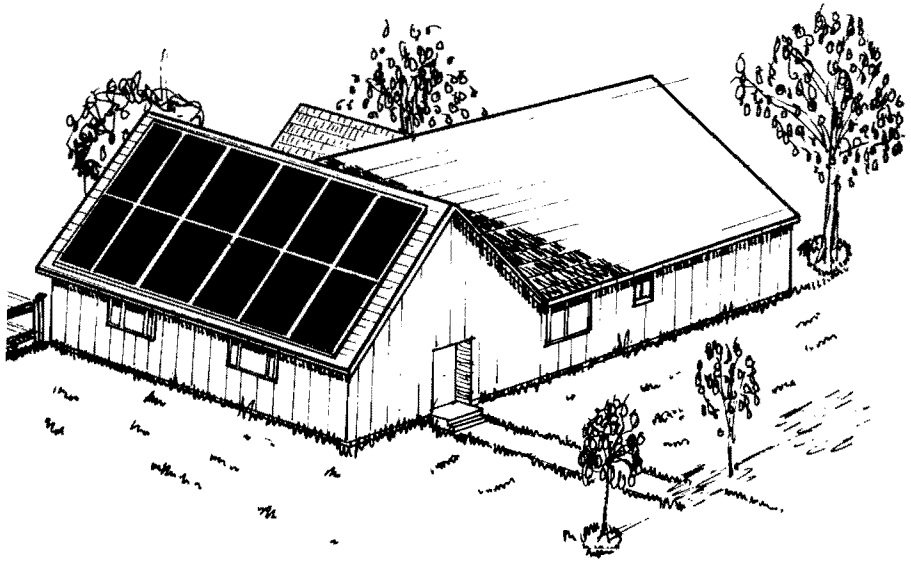
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Korman Corporation
DESIGNERS **ARCHITECT:** Richard G. Guenzel
ENGINEER: Bennett Levin
LOCATION: Blackwood, NJ Latitude 39° 53'N.
HOUSING TYPE: Two Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,101 **COOLING** 150 hrs
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 530 Lv.

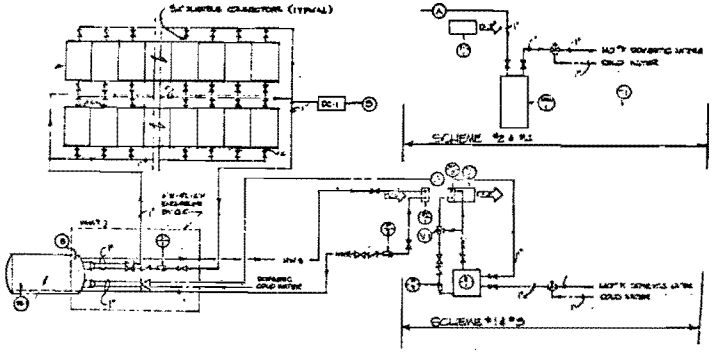
BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with two single family detached dwellings. Each of two-story dwellings with basements has approximately 1,900 square feet of heated floor area. The solar collectors are mounted on the steep south-sloping roof.

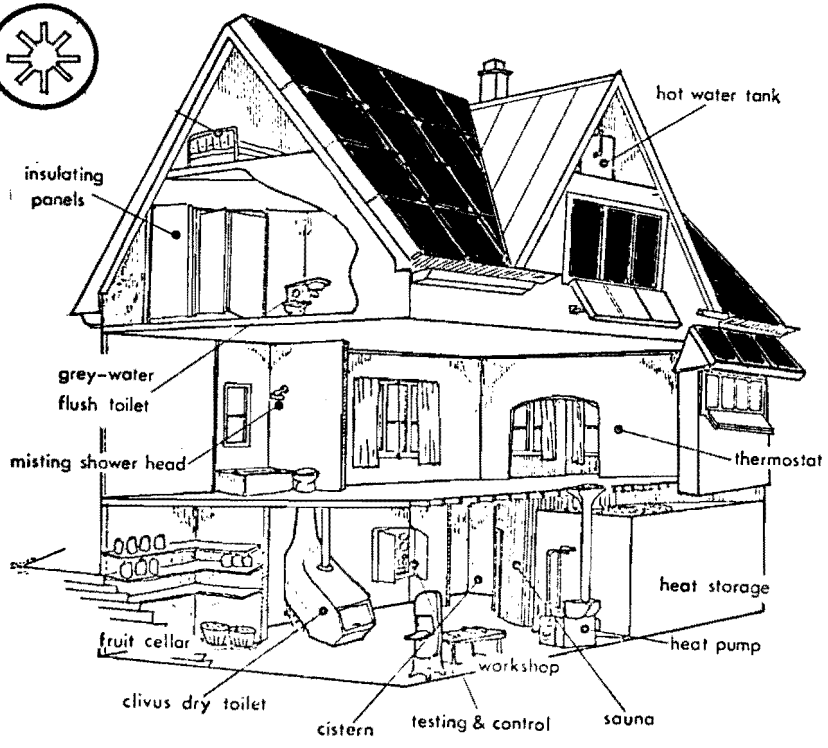


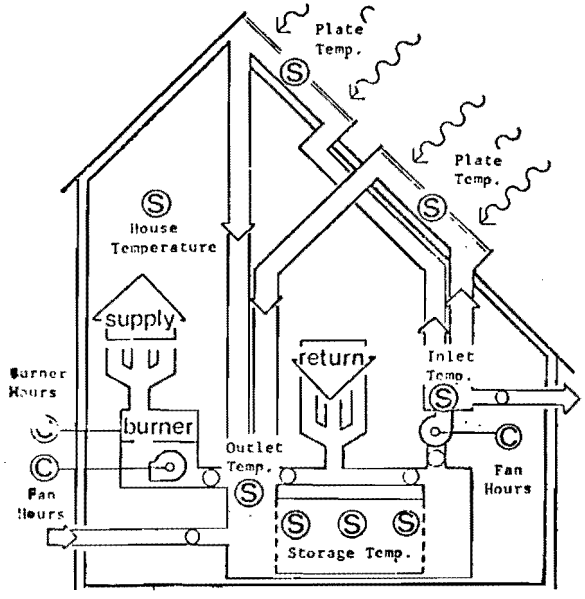
SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 528 and 576 square feet liquid-cooled flat-plate manufactured by G.E.



STORAGE: 850 gallons of water within an insulated cylindrical storage tank buried next to the foundation. Heat from the collectors is transferred to the tank by a water to water heat exchanger.
DISTRIBUTION: Forced air. Both house designs utilize a heat coil located in the primary supply duct which is heated by hot water from storage circulating through it. Air is heated as it is blown past the coil en route to the occupied spaces.
AUXILIARY ENERGY SYSTEM: Oil-fired furnace, electric resistance. One scheme has an oil-fired furnace supplying hot water to a fan coil in the supply duct; the other uses an electric resistance coil.
DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated by circulating the water through a heat exchanger in the storage tank prior to entering the conventional water heater.
COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: University of Wisconsin-Milwaukee
DESIGNERS **ARCHITECT:** School of Architecture
ENGINEER : School of Engineering
LOCATION: Milwaukee, Wisconsin Latitude 42° 57' N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 7,449 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 100 **JUNE** 500

BUILDING DESCRIPTION

The project involves the rehabilitation of an existing single family dwelling and the adaptation of the dwelling design for solar heating and domestic water heating. The two story wood framed house has a floor area of 2,400 square feet. Numerous energy conserving techniques include: additional wall and roof insulation; rain water collection system connected to a cistern for use in water closet flushing; enlarged south-facing windows to increase solar heat gain during the winter, combined with insulated shutters and panels to reduce heat loss and infiltration in the evenings or on sunless days; and the use of large overhangs to shield south-facing windows from summer solar heat gain.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 600 square foot air-cooled flat-plate manufactured by Solaron Corporation with reflective radiation gain from roof and catwalk surfaces; south-facing windows. Domestic hot water is heated by a separate 55 square foot liquid-cooled flat-plate collector.
STORAGE: 22 tons of one to two inch diameter rocks within an 8' x 15' x 5' concrete block storage bin in the basement. The storage bin is insulated with three to five inch polyurethane applied to the exterior.
DISTRIBUTION: Forced air, two stage thermostat with manual damper repositioned for seasonal changeover; natural radiation and convection.

AUXILIARY ENERGY SYSTEM: Gas furnace, between storage and distribution ducts provides supplemental heating during periods of extreme cold or cloudiness.
DOMESTIC HOT WATER SYSTEM: 55 square foot liquid-cooled flat-plate collector (Grumman Sunstream) preheats domestic hot water by a heat exchanger in a tank in the attic before passing to a conventional water heater.
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Friedman, Rosen, and Zien

DESIGNERS **ARCHITECT:** Herbert Zien
ENGINEER : Herbert Zien

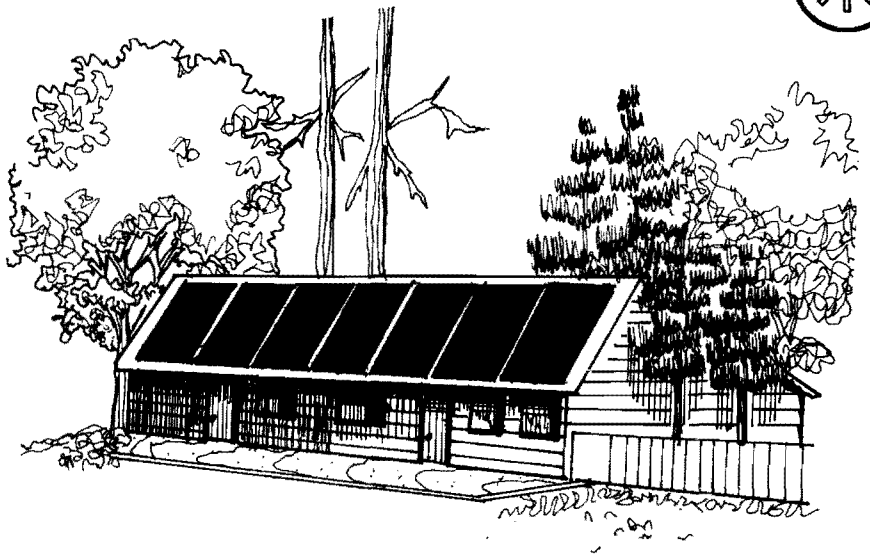
LOCATION: Summit, Wisconsin Latitude 43°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 7,444 **COOLING** 460 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 510 Ly.

BUILDING DESCRIPTION

The project is an application of solar energy to the space heating and domestic hot water needs of a single family detached dwelling. The living spaces total 1,398 square feet. The contemporary wood frame building is simply detailed and compact in shape. Roof-mounted collectors supply a basement storage tank. The project illustrates an innovative concept for the integration of a heat pump with a solar energy system.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 858 square feet air-cooled flat-plate manufactured by Zien. The air collector passes the air over the black painted, galvanized steel absorber twice.

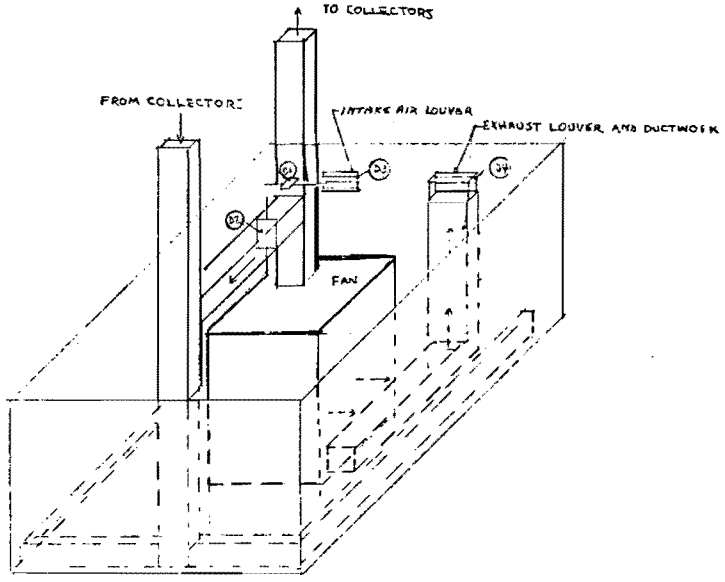
STORAGE: 40 tons of 1½" diameter rocks located in the basement within a "U" shaped rock bin with a heat pump in the center. Domestic hot water is stored in a 150 gallon preheat tank.

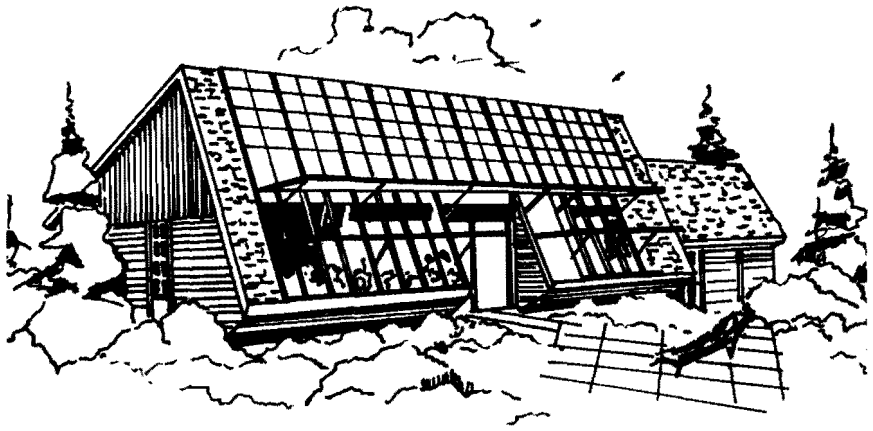
DISTRIBUTION: Forced air. The heat pump fan circulates air over heated rocks in storage. The warmed air enters ducts around the storage bin and is distributed to the occupied spaces.

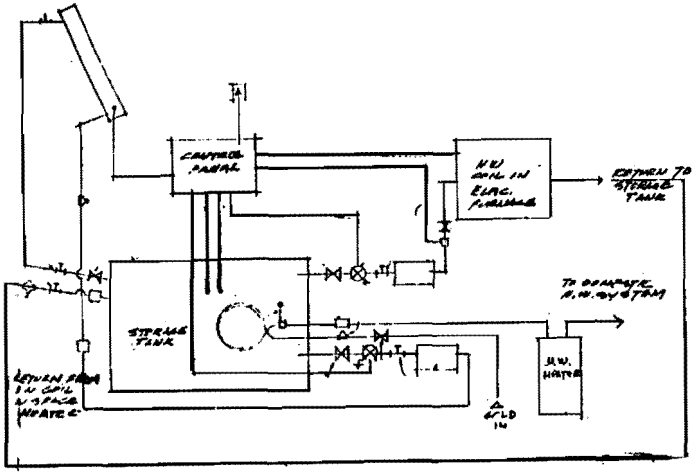
AUXILIARY ENERGY SYSTEM: Two 4 kw electric heaters are built into the heat pump which is used to distribute solar heated air. A 6Kw heater is back-up in case of compressor failure.

DOMESTIC HOT WATER SYSTEM: A copper heat exchange coil in the ductwork of a separate 100 square foot one-pass air collector transfers heat from air to water for storage in the preheat tank.

COOLING: Solar storage assisted heat pump and natural ventilation.







PROJECT INFORMATION

BUILDER: Vincent I. Oredson

DESIGNERS **ARCHITECT:** Vincent I. Oredson

ENGINEER : None designated

LOCATION: Ashland, Oregon Latitude 42°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,000 **COOLING** 650 hrs.

AVE. TEMP. **WINTER** 35 **SUMMER** 65°F.

HORIZ. INSOLATION **JAN.** 100 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar space heating and domestic hot water preheating system to a two bedroom, 1,350 square foot, one story residence. Daytime activities areas are located on the south side of the house to take advantage of the light and the heat. The bedrooms are located on the north side of the house. A south-facing greenhouse supplies light and heat to the interior spaces. All south-facing windows are shaded from the summer sunlight to reduce heat gains.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 320 square foot liquid-cooled flat-plate manufactured by West Coast Solar.

STORAGE: 2,000 gallons of water within an insulated steel tank buried beneath the house.

DISTRIBUTION: Forced air. Hot water circulates through coils within the electric furnace. Air is warmed as it passes through coils for distribution by duct to the living spaces.

AUXILIARY ENERGY SYSTEM: Electric furnace. The furnace provides total or supplemental heat as required to the forced air system.

DOMESTIC HOT WATER SYSTEM: A heat exchanger inside the storage tank preheats the water before it enters a conventional 95 gallon water heater.

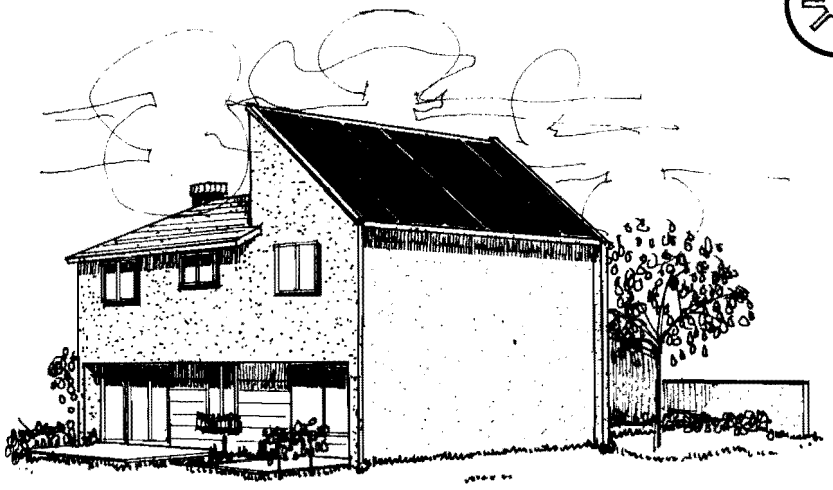
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Classic Development Company
DESIGNERS **ARCHITECT:** Habitat Group
ENGINEER : Dr. Ed Sowell
LOCATION: Brea, California Latitude 33°55'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 1,762 **COOLING** ____
AVE. TEMP. **WINTER** 45 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project integrates a two-story single family dwelling with a solar heating and domestic water heating system. The heated floor area of the contemporary styled dwelling totals 2,240 square feet. Collector placement can be varied with building orientation because each side has a sloping shed roof that could conceivably house the collectors.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 144 square feet liquid-cooled flat-plate manufactured by Raypak. A 3/8" copper tube bonded between two layers of aluminum serves as the absorber.

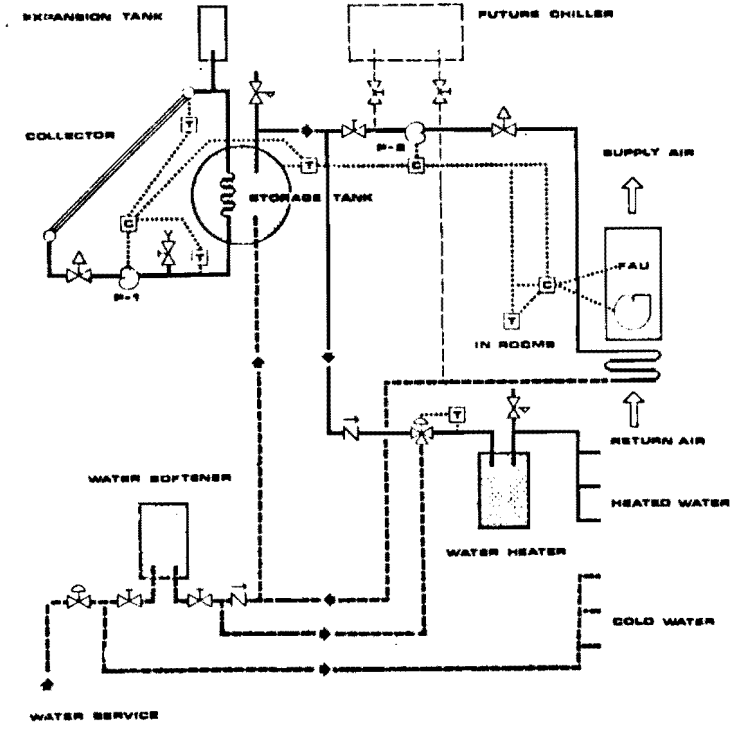
STORAGE: 325 gallons of water within a cylindrical, glass-lined, steel tank located in the basement. Heat from the collectors is lost to the storage medium by a heat exchanger made up of 10.6 square feet of copper coils.

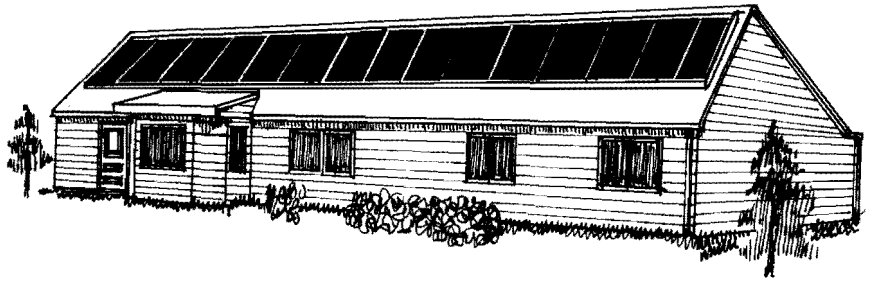
DISTRIBUTION: Forced air. Hot water from storage circulates through a heated exchanger located in the distribution ductwork, thereby heating the air. The furnace fan circulates the warmed air through ducts to the living spaces.

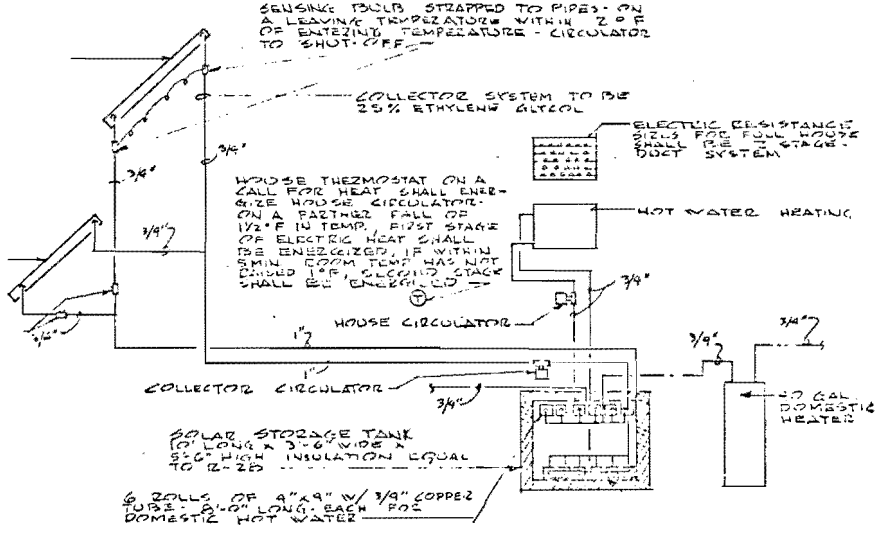
AUXILIARY ENERGY SYSTEM: Gas-fired furnace. A forced air unit using the same ductwork as the solar heating system provides supplemental energy as required.

DOMESTIC HOT WATER SYSTEM: Heated water from storage is pumped to a separate 75 gallon tank within a conventional water heater. If necessary, the water temperature is raised prior to distribution.

COOLING: Natural ventilation. A solar powered cooling system can be added to the solar energy system at a later date.







SOLAR COLLECTOR PIPING DIAGRAM
NO SCALE

PROJECT INFORMATION

BUILDER: Sir Galahad Company
DESIGNERS **ARCHITECT:** Arthur Konikoff
ENGINEER: Solar One Ltd.
LOCATION: Virginia Beach, VA Latitude 37°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,542 **COOLING** 1,100 hrs.
AVE. TEMP. **WINTER** 40 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project consists of two-story single family detached dwelling integrated with a solar heating and domestic hot water preheating system. The roof-mounted collectors and a basement storage tank provide solar heat to the 1,896 square foot home. The contemporary wood frame home uses brick, cedar shingles, and wood siding for the exterior. Added floor, wall and ceiling insulation reduces infiltration and decreases heat loss.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 624 square feet liquid-cooled flat-plate manufactured by Revere. A copper absorber is located below two glass cover sheets.

STORAGE: 1,250 gallons of water within an insulated welded rectangular steel tank located in the basement. Water is circulated through the collectors, heated, and stored in the tank. No heat exchanger is used.

DISTRIBUTION: Forced air. Heated water from the storage tank is pumped through copper coils in the ductwork. Air is blown over the coils, heated and distributed by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Electric heating elements located in the primary supply duct provide total or supplemental heat as required.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated as it passes through the central storage tank. The preheated water is stored in the tank of a conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: City of Santa Clara

DESIGNERS **ARCHITECT:** Ditz-Crane

ENGINEER : Solar King

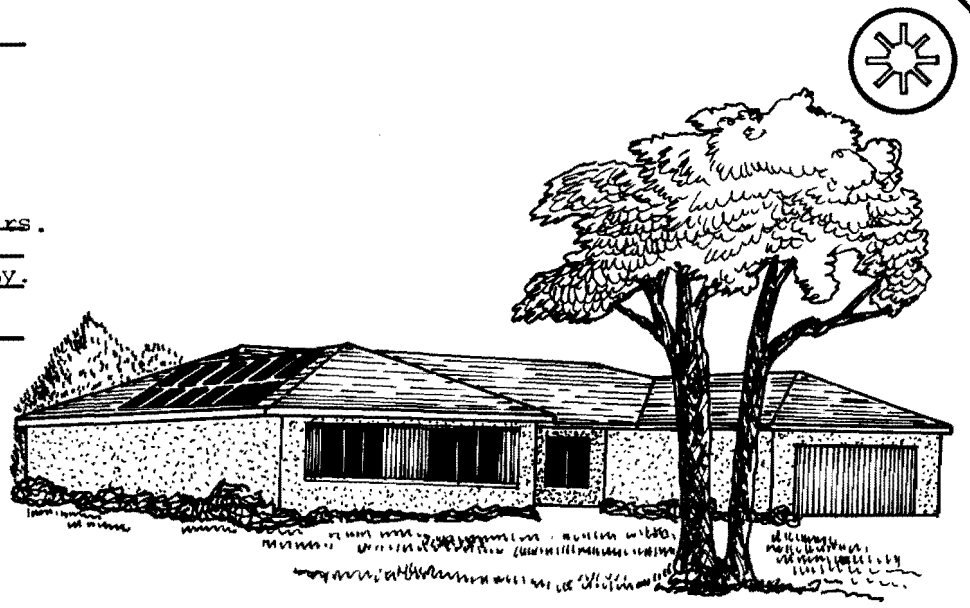
LOCATION: Santa Clara, CA Latitude 37°N.

HOUSING TYPE: Five Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,015 **COOLING** 150 hrs.

AVE. TEMP. **WINTER** 45 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 250 **JUNE** 600 Ly.



BUILDING DESCRIPTION

The project consists of five, single family detached dwellings each combined with a solar heating and domestic hot water preheating system. The two-story house design has a total of 2,000 square feet of heated floor area. The solar energy system will be owned by the public utility company and leased to the individual homeowner.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: Liquid-cooled flat-plate manufactured by Solar King, Inc. The size of the collector varies from 160 to 288 square feet.

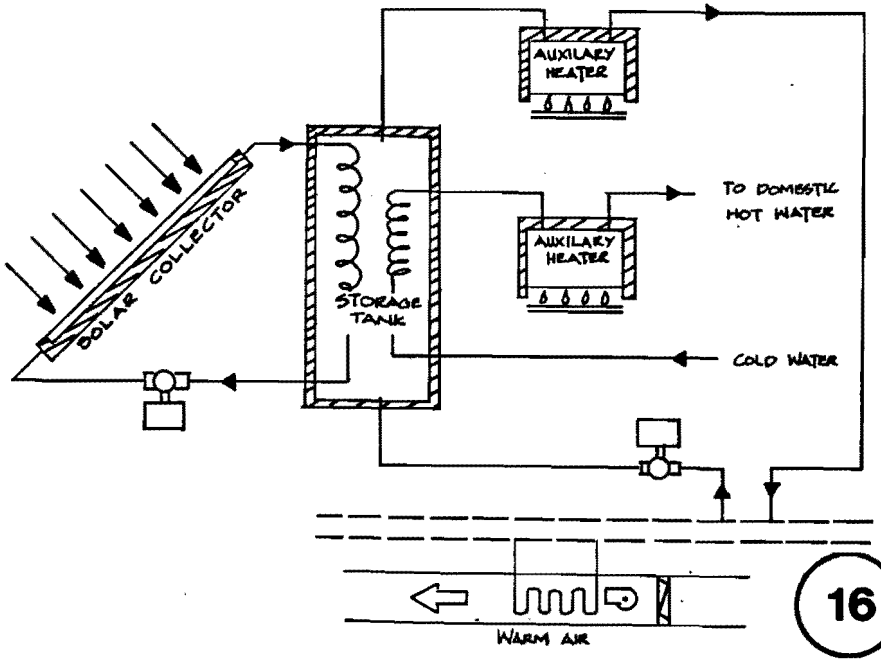
STORAGE: 1,500 gallons of water within an insulated steel tank located in the basement of each dwelling.

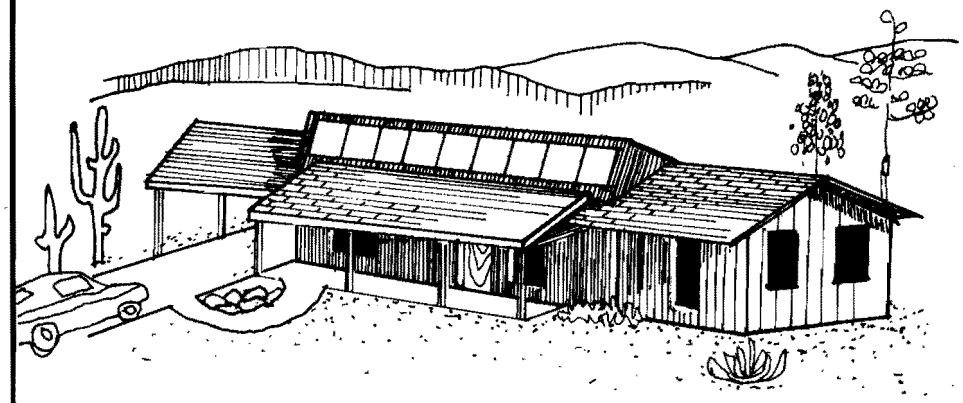
DISTRIBUTION: Forced air. Hot water from storage is pumped through a heating coil in the primary supply duct. A fan circulates air through the coil. The warmed air is then distributed by ducts to living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides total or supplemental heating as required.

DOMESTIC HOT WATER SYSTEM: Hot water from storage circulating through a copper immersion coil preheats the water in the conventional water heater's 70 gallon tank.

COOLING: Natural ventilation.



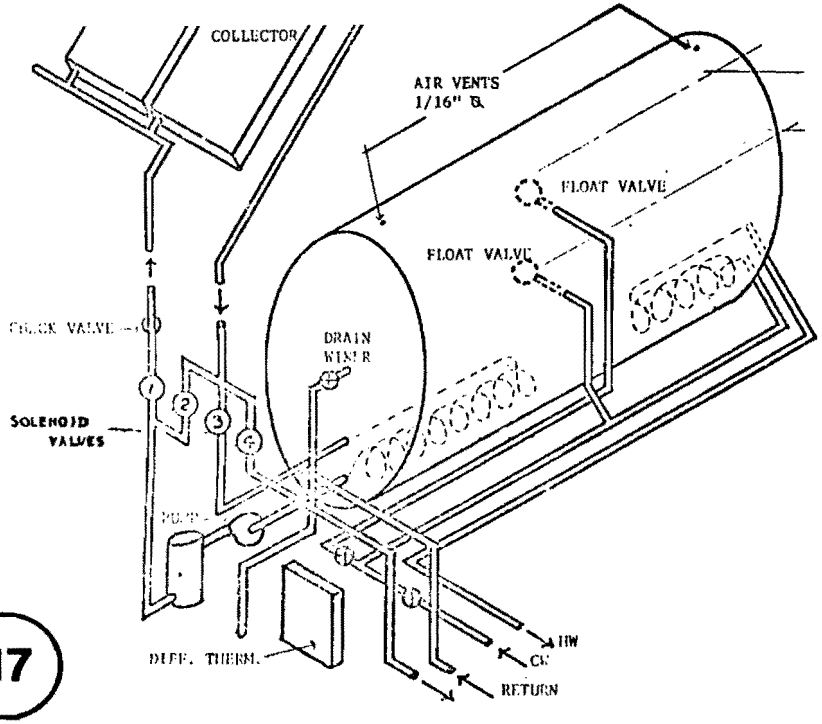


PROJECT INFORMATION

BUILDER: Creek Nation Housing Authority
DESIGNERS **ARCHITECT:** Ragsdale & Christensen
ENGINEER : R.D. Evans
LOCATION: Tulsa, Oklahoma Latitude 36°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,050 **COOLING** 800 hrs.
AVE. TEMP. **WINTER** 35 **SUMMER** 75
HORIZ. INSOLATION **JAN.** 205 **JUNE** 600 Ly.

BUILDING DESCRIPTION

Five existing single family homes are to be connected with a solar heating and domestic hot water preheat system. The solar system is designed as an ancillary structure to be sited as dictated by the design and orientation. The ancillary structure can be designed as a carport, covered play area, storage room or other on-site uses. The one story homes to be served by the solar system are approximately 1,050 square feet each.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 234 square feet, liquid-cooled flat-plate manufactured by RAYPAK.

STORAGE: 500 gallons of water within a 3'-9" x 6'-1" tank behind the collector in the pre-assembled ancillary structure.

DISTRIBUTION: Forced air. Heated water from storage flows through coils that transfers the heat to air, then distributed by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Propane-fired furnace. The furnace heats a separate coil located in the primary supply duct. A full or partial energy boost is supplied depending on storage temperature.

DOMESTIC HOT WATER SYSTEM: A 90 gallon propane-fired tank receives water preheated by passing through a copper coil in the main storage.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: W. Brown Builders

DESIGNERS **ARCHITECT:** Travis-Braun & Associates
ENGINEER : Dring Engineering Co.

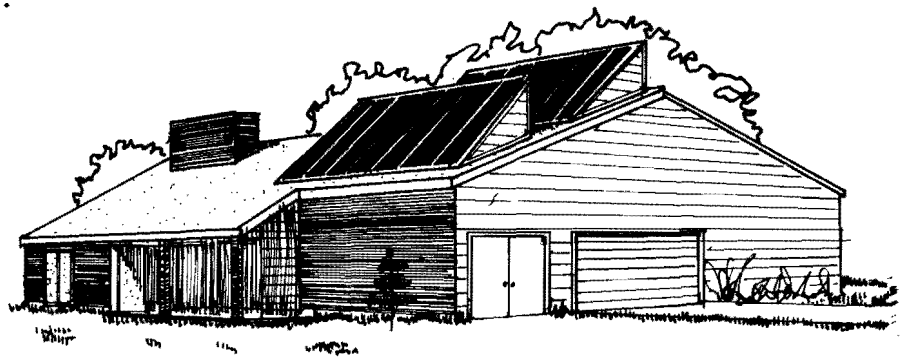
LOCATION: Dallas, Texas Latitude 32°54'N.

HOUSING TYPE: Two - Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,382 **COOLING** 2,587 hrs.
AVE. TEMP. **WINTER** 50 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 650 Ly.

BUILDING DESCRIPTION

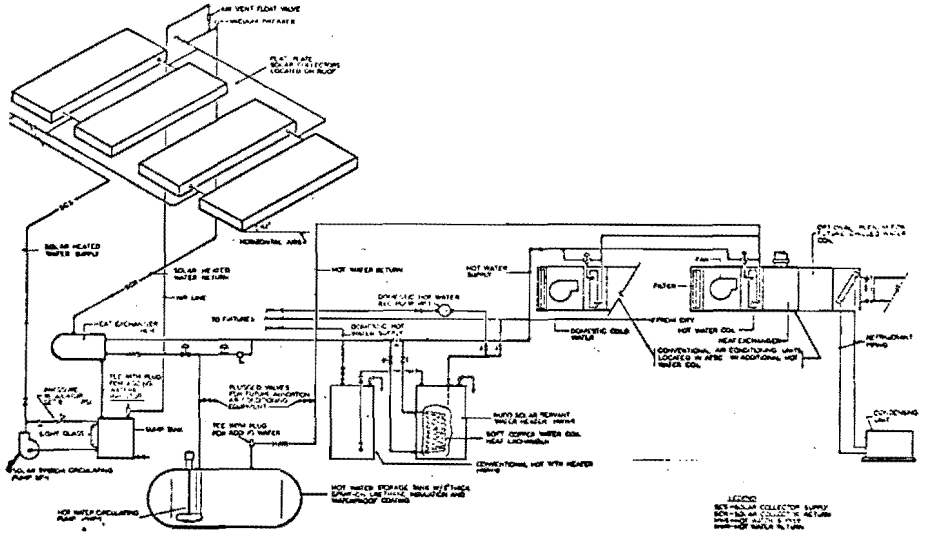
The project applies solar energy for space heating and domestic hot water to two single family detached dwellings. The first home is a 3,395 square foot brick and cedar-sided ranch house. To conserve energy window areas facing north, west and east are reduced and the roof overhang is designed to shade large south-facing windows in summer and admit the heat of sunlight in winter. The second bricked, wood frame residence has 2,300 square feet of living space. Both dwellings have the solar collectors mounted at the optimum tilt on the sloping south-facing roof.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 504 square feet (first house) and 417 square feet (second house) liquid-cooled flat-plate manufactured by Sunsource.



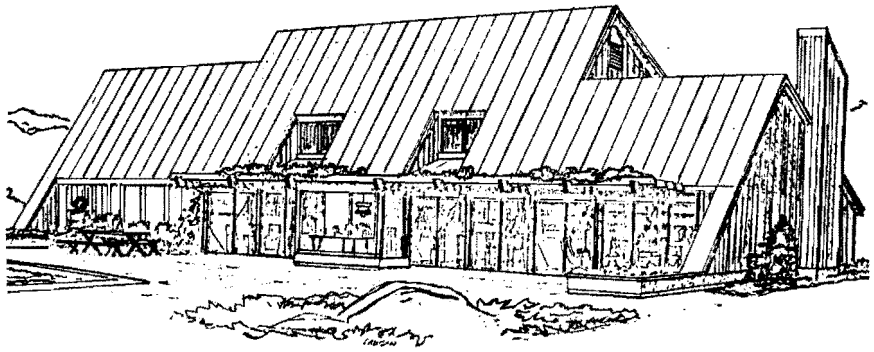
STORAGE: 2,000 gallons of water within an insulated storage tank located in the basement. A heat exchanger transfers energy from the collector to a sump tank which is then transfered to the central storage tank.

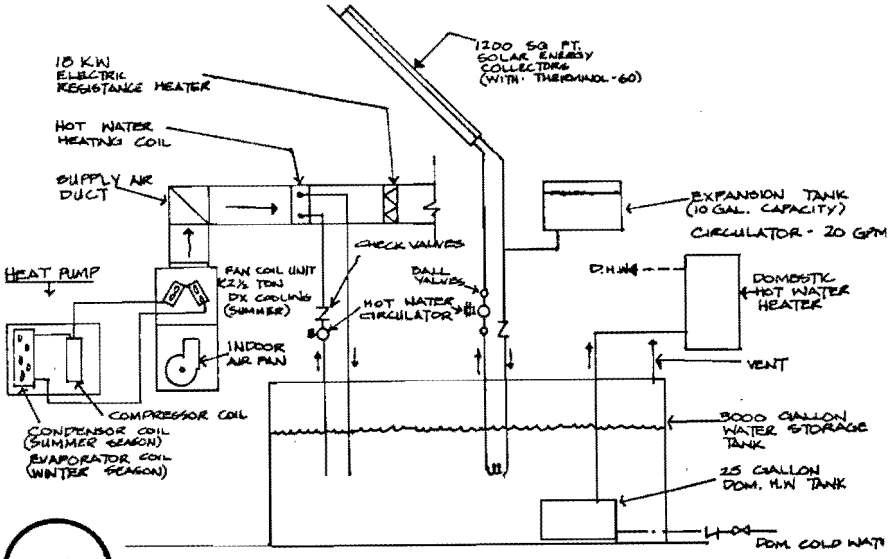
DISTRIBUTION: Forced air. Hot water from storage passes through some heat exchanger coils in the supply air ductwork. A fan circulates air past the coils through the house via the ducts.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace located within the primary supply duct provides supplemental heating as required.

DOMESTIC HOT WATER SYSTEM: 120 gallons of water within an insulated tank is preheated as water from storage is pumped to the distribution fan unit. The preheated water passes through a conventional heater before distribution.

COOLING: Conventional gas fired air conditioner and natural ventilation.





SOLAR AND HEAT PUMP SCHEMATIC DIAGRAM

PROJECT INFORMATION

BUILDER: Solar Structures, Inc.

DESIGNERS **ARCHITECT:** Bill Harz-Wenning

ENGINEER : Solar Structures, Inc.

LOCATION: La Grangeville, NY Latitude 42°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,000 **COOLING** 1,200 hrs.

AVE. TEMP. **WINTER** 25 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 130 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project is a two-story, single family detached dwelling with 3,200 square feet of heated floor area utilizing solar energy for heating and domestic hot water preheating. The design incorporates a number of energy conserving features including: south-facing windows with horizontal louvers projected over them to exclude the summer sunlight and to admit the winter sunlight with its beneficial heat gain; a closed water loop to conserve energy normally lost from fireplace, kitchen appliances, laundry, and bathroom fixtures; and added wall, roof and ceiling insulation.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 1,200 square feet liquid-cooled flat-plate manufactured by Revere. The double-glazed panels cover a selectively coated copper absorbing surface.

STORAGE: 3,000 gallons of water within an insulated storage tank located in the basement. A water to water heat exchanger transfers heat from the solar collector to the water tank.

DISTRIBUTION: Forced air. Hot water from storage circulates through a heating coil in the primary supply duct. A fan blows air over the coils. The heated air is distributed by ducts to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electrical resistance heaters, heat pumps. Two 15 KW resistance heaters are located in the pump supply duct in addition to a 2½ ton heat pump with a fan coil unit.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated within a 25 gallon tank by circulating "hot" water from the main heat storage tank through copper coils. The preheated water passes through a conventional water heater prior to distribution.

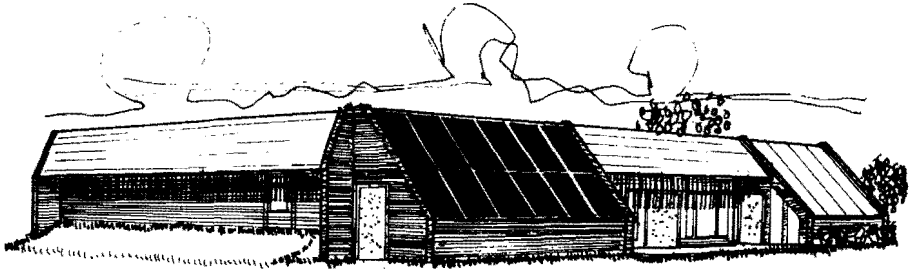
COOLING: Natural ventilation. Heat pump is not solar assisted.

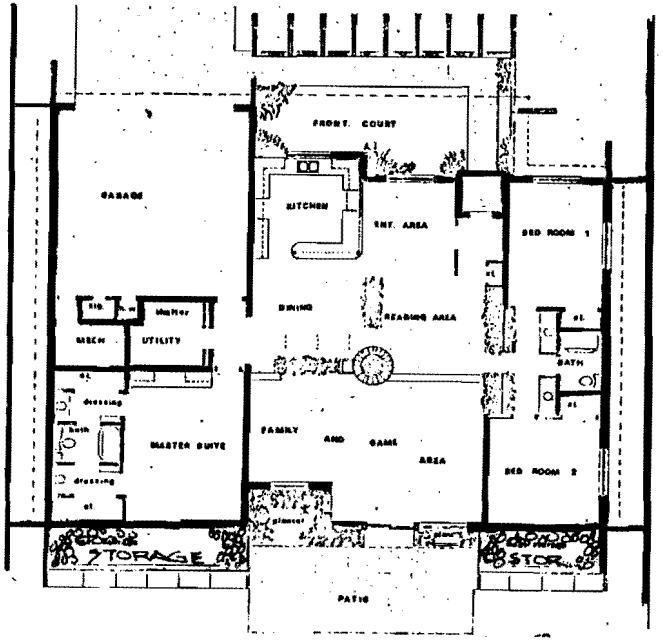
PROJECT INFORMATION

BUILDER: Gordon Deering
DESIGNERS **ARCHITECT:** Kiesling
ENGINEER : Sheridan
LOCATION: Lubbock, Texas Latitude 33°39'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,578 **COOLING** 1,647 hrs.
AVE. TEMP. **WINTER** 40 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 650 Ly.

BUILDING DESCRIPTION

The project is a 4,050 square foot single family dwelling integrated with a solar heating and domestic hot water preheating system. The high wind velocities associated with the area dictated a low-profile building and collector area. The thermal mass of the house was increased by the use of thick masonry walls and floors. Additional energy conserving features include: improved insulation, reduced infiltration, supply air, and an overhang to block the summer sun. Also, glass area is minimized and windows are double glazed.





SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 312 square feet air-cooled flat-plate manufactured by Solaron.

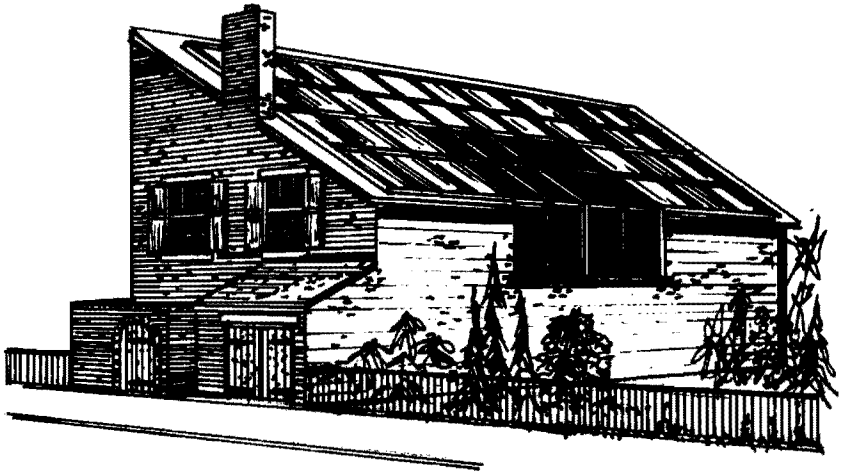
STORAGE: 9.4 tons of rock 3/4" to 1 1/2" diameter within a triangular rock bin behind the collector. There are 60 pounds per square foot of collector.

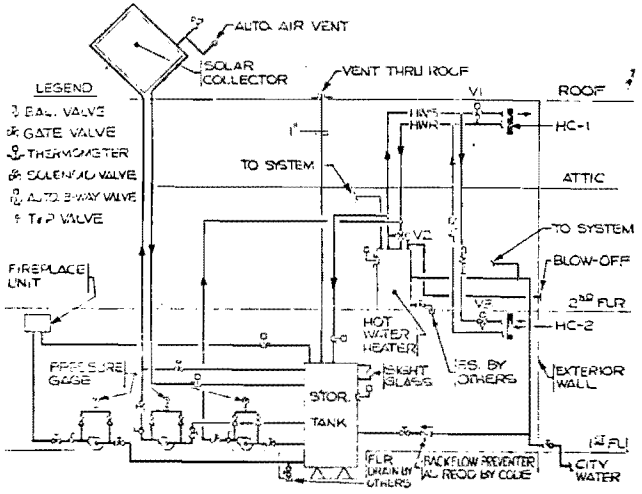
DISTRIBUTION: Forced air. Air is blown through the rock storage by an air to air heat pump with a two-speed fan for circulation. The ductwork is installed in the ceiling with insulated air mains.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides supplemental heat as required. Cooling is achieved electrically.

DOMESTIC HOT WATER SYSTEM: 80 gallons of water are stored in a conventional hot water tank. Water is preheated by a heat exchanger in the ductwork.

COOLING: Natural ventilation. Heat pump is not solar assisted.





PROJECT INFORMATION

BUILDER: Rust Construction Co.

DESIGNERS **ARCHITECT:** Rust Construction Co.
ENGINEER: Inter-Technology Corp.

LOCATION: Alexandria, VA Latitude 39°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,211 **COOLING** 850 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 175 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with a two-story 2,115 square foot single family residence. Roof-mounted collectors are connected with a water storage tank located in the basement. A skylight in the center of the south-facing roof supplies light as well as heat to the dwelling's interior spaces.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 459 square foot liquid-cooled flate-plate manufactured by Solar Corp. Above the selective coating on an aluminum absorber are two glass cover plates.

STORAGE: 1,000 gallons of water within an insulated 4' diameter by 11' long storage tank located in the basement.

DISTRIBUTION: Forced air. Hot water from storage is circulated through coils in the primary supply ducts. A fan distributes the air warmed by the coils to the living spaces by ducts.

AUXILIARY ENERGY SYSTEM: Electrical resistance, heat pump. Electric resistance coils in the supply ducts plus a heat pump provide a total or partial energy source to the solar heating system.

DOMESTIC HOT WATER SYSTEM: Hot water from storage circulates through a heat exchanger within a conventional water heater preheated the domestic hot water supply.

COOLING: Heat pump, but not solar assisted. Natural ventilation.

PROJECT INFORMATION

BUILDER: Armstrong Development Corporation

DESIGNERS **ARCHITECT:** Robert King and Wellington & Assoc.
ENGINEER : Institute for Advanced System Studies

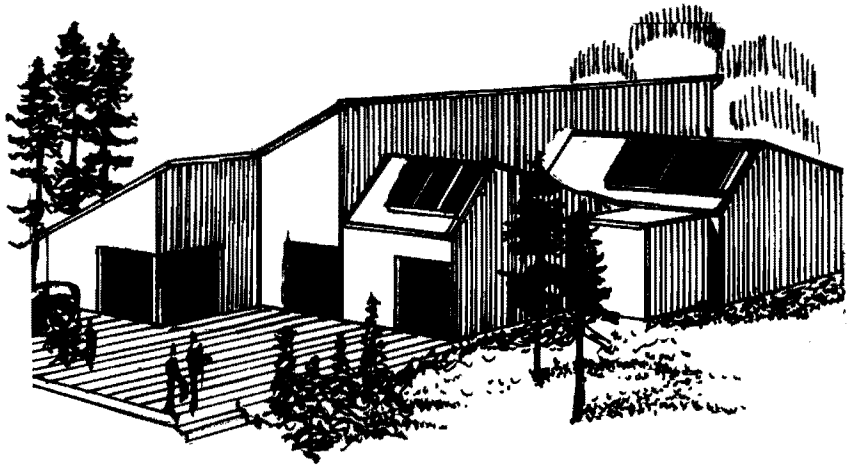
LOCATION: Claremont, California Latitude 34° N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,166 **COOLING** _____
AVE. TEMP. **WINTER** 45 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 650 Ly.

BUILDING DESCRIPTION

The project involves the modification of a previous dwelling design to the design requirements of solar energy. The one story contemporary design has 1,536 square feet of heated floor with a wood and stucco exterior. The collectors are integrated with the roof. Energy conservation features include improved weather stripping, insulating curtains, and slab edge insulation. To utilize winter heat gains while minimizing summer heating, and extended overhang shades the south wall, and deciduous trees shade the east and west walls in summer.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 256 square feet liquid-cooled flat-plate manufactured by Solar Conversion Corp. with double glazing of Tedlar and aluminum absorber fins. A "slug" of warm water is pumped to prevent freezing.

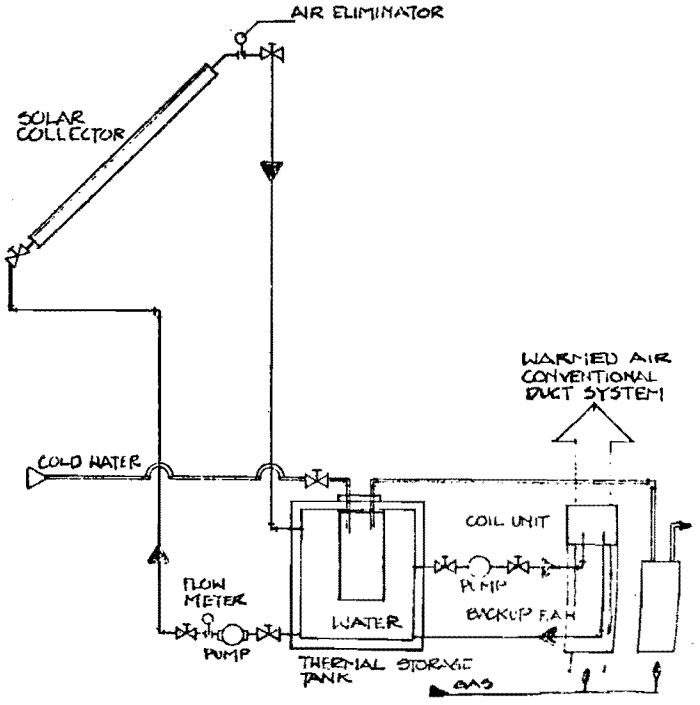
STORAGE: 800 gallons of water within an insulation tank. Horizontal mixing is promoted by baffles. For a 50°F. change of temperature storage has a 334,000 BTU capacity.

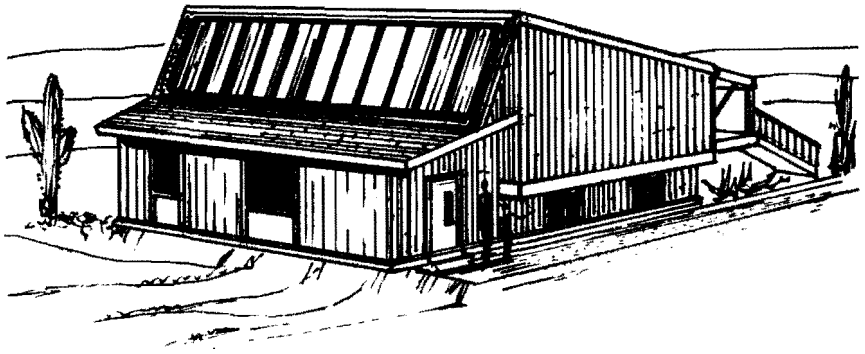
DISTRIBUTION: Hydronic. Fan coil units distribute heat to living space. Hot water from storage is pumped to heat exchanger coils in a gas-fired forced air furnace. Hot air is circulated by furnace blowers.

AUXILIARY ENERGY SYSTEM: Gas furnace. Coils in duct system are heated by furnace or water from solar storage. A back-up fan flows warmed air to the living spaces.

DOMESTIC HOT WATER SYSTEM: A 40 gallon tank is submerged inside the 800 gallon main storage for preheating.

COOLING: Natural ventilation.



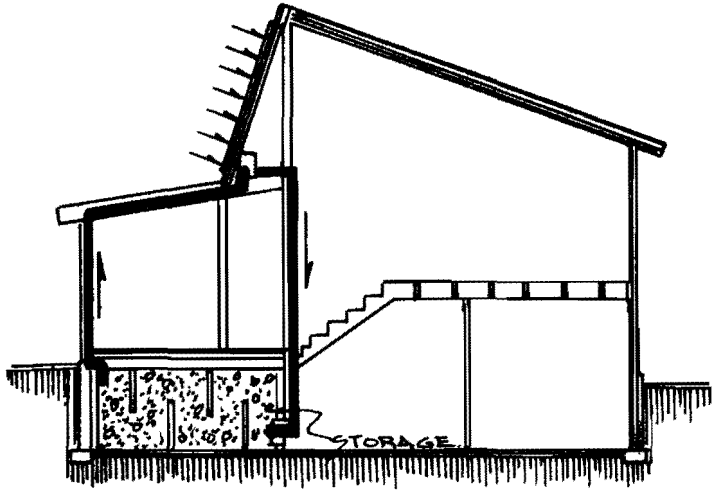


PROJECT INFORMATION

BUILDER: The Blackfeet Tribe
DESIGNERS **ARCHITECT:** W.C. Bierrum
ENGINEER : Archambault & Co.
LOCATION: Blackfeet Indian Reservation, MT Lat. 48°30'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 8,700 **COOLING** 250 hrs.
AVE. TEMP. **WINTER** 15 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 600 Ly.

BUILDING DESCRIPTION

As part of a larger program sponsored by HUD for self-help housing for the Blackfeet Tribe, five single family detached dwellings are combined with a solar heating and domestic hot water preheating system. The two-story homes total 1,226 square feet of heated floor area. Simply styled, the contemporary homes are sheathed by wood on a wood frame. The collectors are mounted on the steeply pitched south-facing roof.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 192 square feet air-cooled flat-plate manufactured by Solar-Aire Inc. A blackened aluminum sheet with attached aluminum cups and baffles lies below two layers of fiberglass cover plates.

STORAGE: 746 cubic feet of rock within an insulated storage bin located in the basement. Partial separations in the storage bin prevent temperature stratification.

DISTRIBUTION: Forced air. The fan of an electric furnace circulates heated air from the collector to the storage bin. Storage radiates this heat directly to living spaces. Direct supply from collectors is sometimes fed into the return air of the furnace.

AUXILIARY ENERGY SYSTEM: Electric furnace. The furnace and a thermostatically controlled wood stove supplement the solar heating system.

DOMESTIC HOT WATER SYSTEM: A preheat coil embedded within the rock storage bin preheats the domestic hot water supply prior to passage through a conventional water heater.

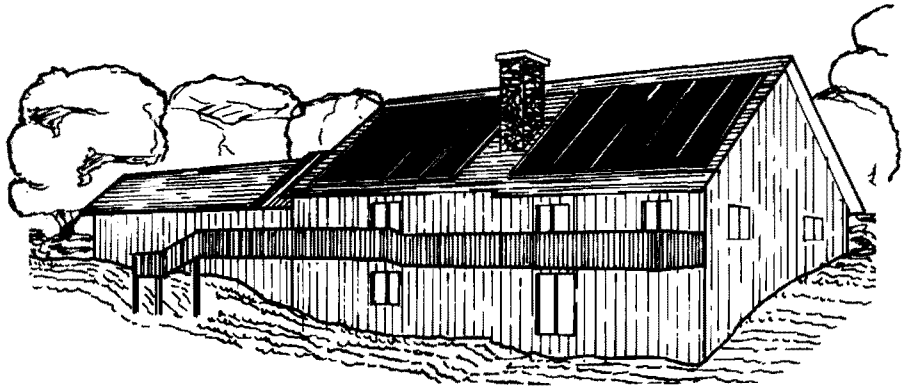
COOLING: Natural ventilation.

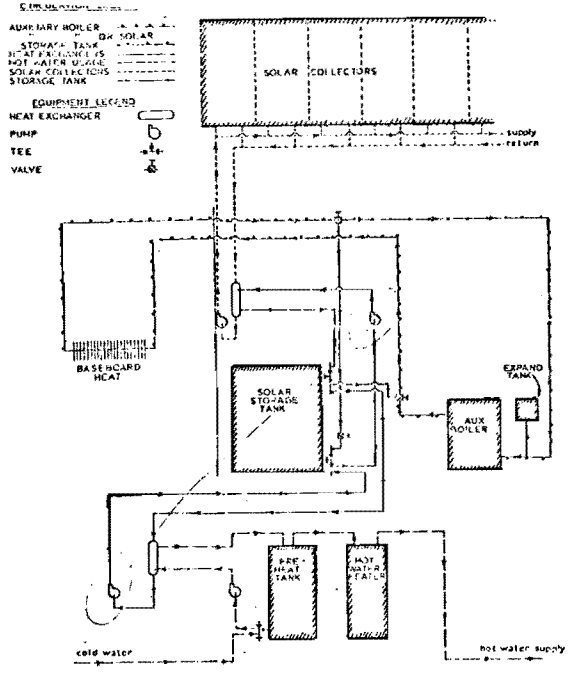
PROJECT INFORMATION

BUILDER: Solar Environmental Engineering Const. Co.
DESIGNERS **ARCHITECT:** Dr. C. Byron Winn
ENGINEER : SECO
LOCATION: Fort Collins, CO Latitude 40° 40'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,200 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 525 Ly.

BUILDING DESCRIPTION

The project consists of a two-story, 2,352 square foot single family detached dwelling with a solar heating and domestic hot water preheating system. Window openings have been minimized to reduce heat gains and extra insulation added to walls, roof and ceiling to reduce heat losses. The chimney is centrally located in the home to maximize the amount of radiant heat available to occupied areas. The exterior walls are covered with cedar siding, while cedar shakes protect the roof.





SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 672 square feet liquid-cooled flat-plate manufactured by Reynolds.

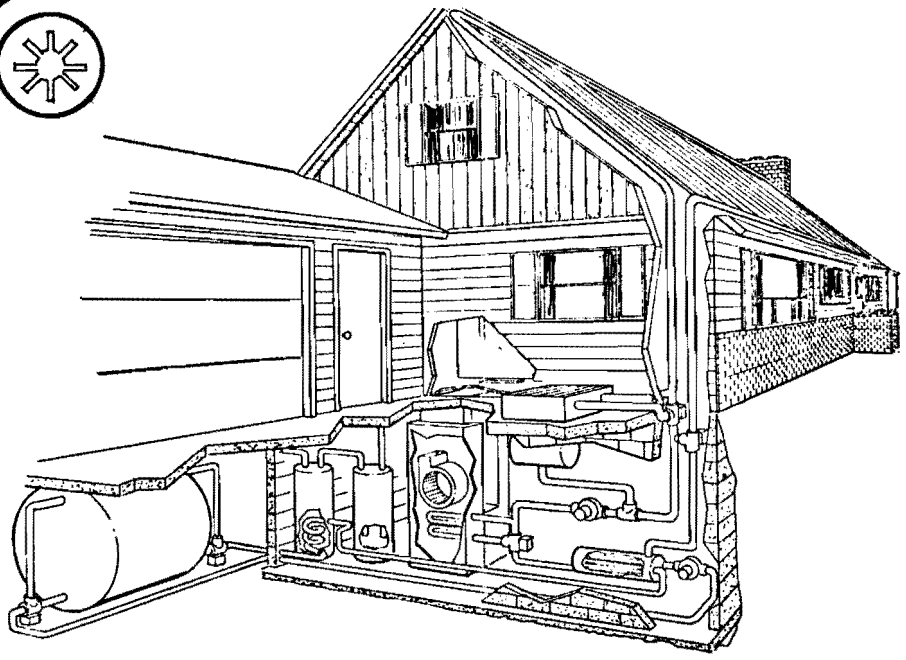
STORAGE: 1,245 gallons of water and corrosion inhibitor within an insulated 11' diameter x 7' storage tank. A separate 75 gallon preheat tank supplies the domestic hot water system.

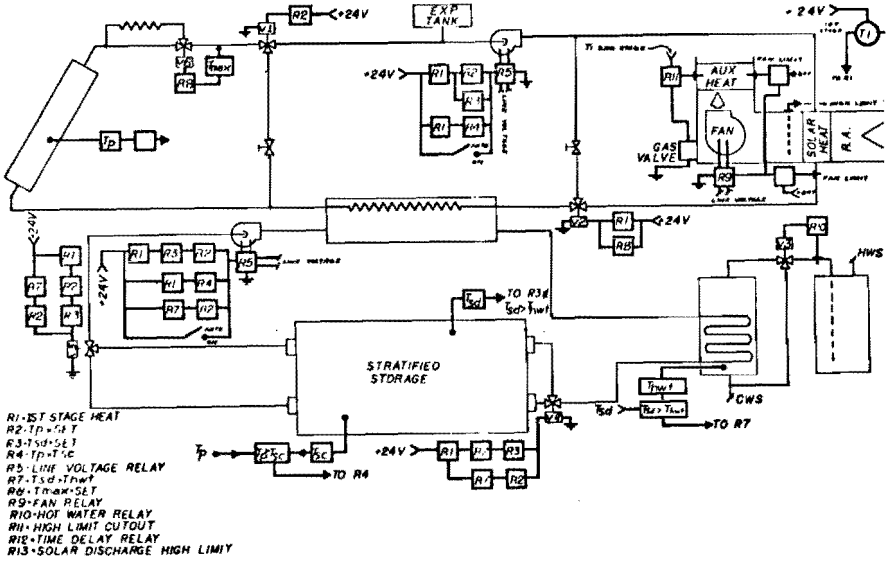
DISTRIBUTION: Hydronic. A heat exchanger transfers heat between the collector loop and the solar storage tank. Water from storage either goes directly to a baseboard heater or if it needs supplemental heat is passed through the boiler.

AUXILIARY ENERGY SYSTEM: Electric boiler. The boiler in-line between storage and baseboard heaters provides auxiliary heating.

DOMESTIC HOT WATER SYSTEM: Domestic hot water supply line passes through the preheat water prior to entering a conventional 100 gallon water heater.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: Marvin Anderson Co.

DESIGNERS **ARCHITECT:** Marlin Grant
ENGINEER: Honeywell Inc.

LOCATION: Bloomington, MN Latitude 45°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 8,382 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 10 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 170 **JUNE** 535 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating and domestic hot water preheating system to a single family detached dwelling. The wood frame two-story house has 1,215 square feet of heated floor area. Collectors are mounted on the steep south-sloping roof. Heat loss is reduced by the addition of more insulation in the walls, floors, and ceiling.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 378 square feet liquid-cooled flat-plate manufactured by Lennox Industries.

STORAGE: 1,000 gallons of liquid within an insulated fiberglass tank located in the basement. Heat removed from the collectors passes through a heat exchange in the storage tank.

DISTRIBUTION: Forced air. A heating coil in the primary supply duct warms air circulated past the coil for distribution by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides total or supplemental energy to a heat exchanger in the ductwork placed after the fan.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated in a 64 gallon stone-lined tank. Heated water from storage circulating through a finned copper heating coil. The preheat tanks supplies a 50 gallon conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Church Community Corporation
DESIGNERS **ARCHITECT:** Ade Bethune
ENGINEER: Gordon Preiss
LOCATION: Newport, R.I. Latitude 41.5°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,972 **COOLING** 250 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 155 **JUNE** 527 Ly.

BUILDING DESCRIPTION

The project combines a 1,400 square foot single family detached dwelling with a solar heating and domestic hot preheating water system. Collectors form an integral part of the south-facing roof. To reduce heat losses additional insulation is placed in the floors, walls, and ceiling. Also winter heat loss is reduced by the use of storm windows. To accommodate the added wall insulation 2"x6" studs spaced 24" on center are used.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 432 square feet air-cooled flat-plate manufactured by Church Development Corp. Air flows through a duct formed by two layers of a double plastic panel.

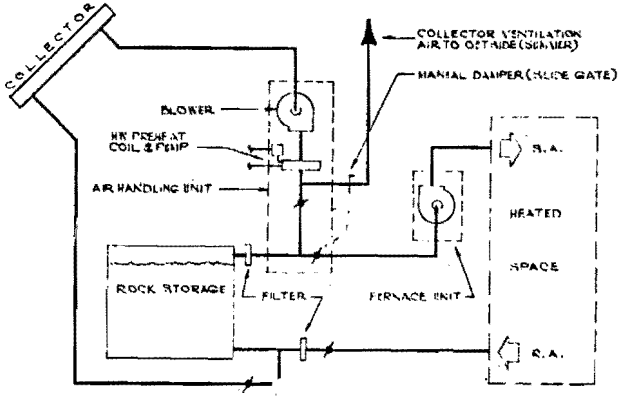
STORAGE: 600 cubic feet of 2½" diameter rock within an insulated concrete bin located in the basement.

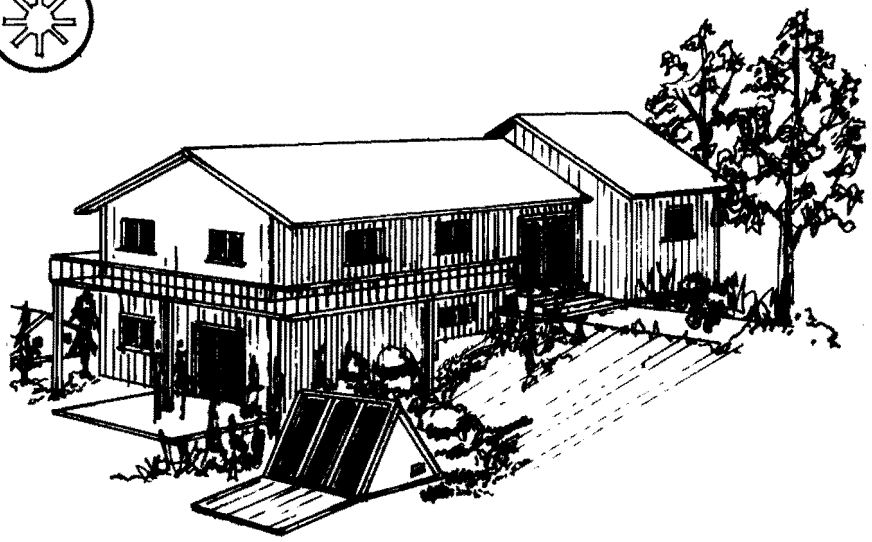
DISTRIBUTION: Forced air. Air is blown through the rock storage bin by an auxiliary blower in the primary supply duct. A blower in the furnace distributes the hot air to living spaces through supply ducts.

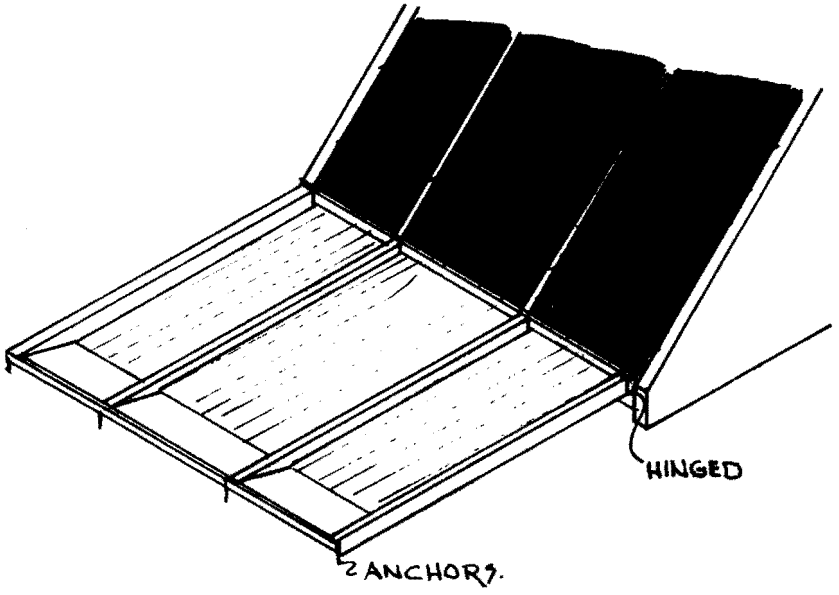
AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace provides supplemental heat to the solar energy system as required.

DOMESTIC HOT WATER SYSTEM: A finned copper coil in the rock storage bin preheats the domestic water supply prior to entering a 30 gallon conventional water heater.

COOLING: Natural ventilation.







PROJECT INFORMATION

BUILDER: Waverly Homes Inc.
DESIGNERS **ARCHITECT:** Robert Jensen
ENGINEER : Sunglow Inc.
LOCATION: Westminster, Colorado Latitude 39°49'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,016 **COOLING** 630 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines a 946 square foot, two-story contemporary ranch house with a solar space heating system. The solar collector is housed in a separately detached structure adjacent to the dwelling. Energy conserving features include 2" x 6" studs used for exterior walls spaced 24" on center allowing for thicker insulation. A continuous soffit vent provides more efficient attic ventilation. Window area is reduced to nine percent of the exterior surface area. These modifications and others reduce the dwelling's heat loss and improve the thermal performance of the solar energy system.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** _____

COLLECTOR: 96 square foot air-cooled flat-plate manufactured by Sunglow. The collector is oriented five degrees west of south.

STORAGE: 13 tons of 3/4" to 1 1/4" diamater river rock within an insulated bin located behind the "A" frame collector.

DISTRIBUTION: Forced air. A fan blows air through the rock storage bin warming the air for distribution throughout the house by ducts. Warm air is also blown out of a heat circulating fireplace.

AUXILIARY ENERGY SYSTEM: A fireplace and an electric resistance coil in the ductwork supplement the solar energy system as required.

DOMESTIC HOT WATER SYSTEM: Conventional domestic hot water heating system.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Terracor, Utah

DESIGNERS **ARCHITECT:** Richard L. Crowther
ENGINEER : Solaron Corporation

LOCATION: Salt Lake City, UT Latitude 40°47'N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,980 **COOLING** 927 hrs
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 165 **JUNE** 620 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating system to a 3,000 square foot single family dwelling. The three-story split-level house integrates the solar system within the building. A number of energy conserving features are incorporated in the design to reduce the dwelling heat loss. These include a skylit airlock entry, double-glazed windows where the outer pane is insulated and the inner pane reflective and 2"x6" studs spaced 24" on center to allow for thicker wall insulation.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** _____

COLLECTOR: 585 square feet air-cooled flat-plate manufactured by Solaron Corporation.

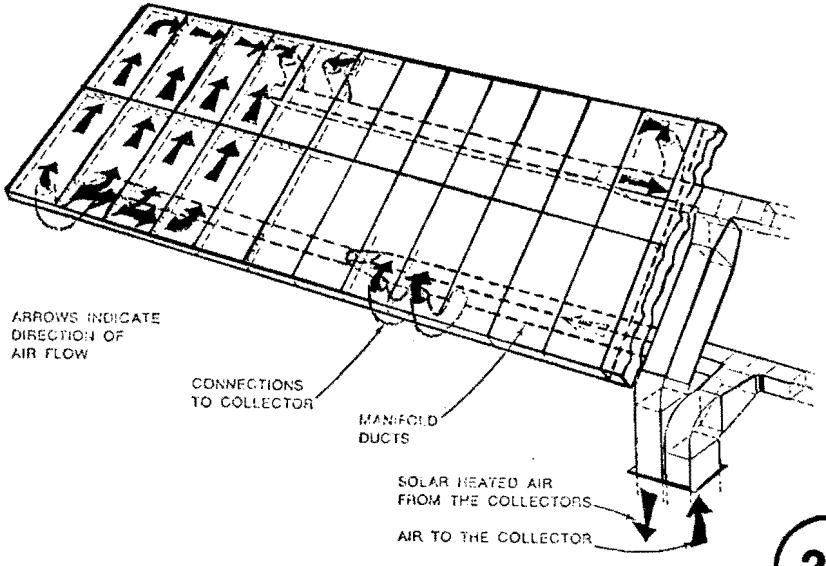
STORAGE: 16 tons (295 cubic feet) of 1½" diameter rock within an insulated storage bin located in the basement.

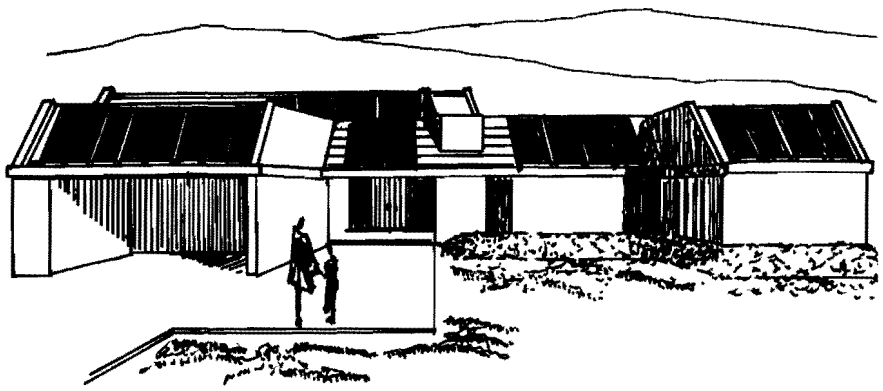
DISTRIBUTION: Forced air. An air handling unit transports heated air from the collector to the rock storage bin. Warmed air is removed from rock storage by a fan and distributed throughout the house by ducts.

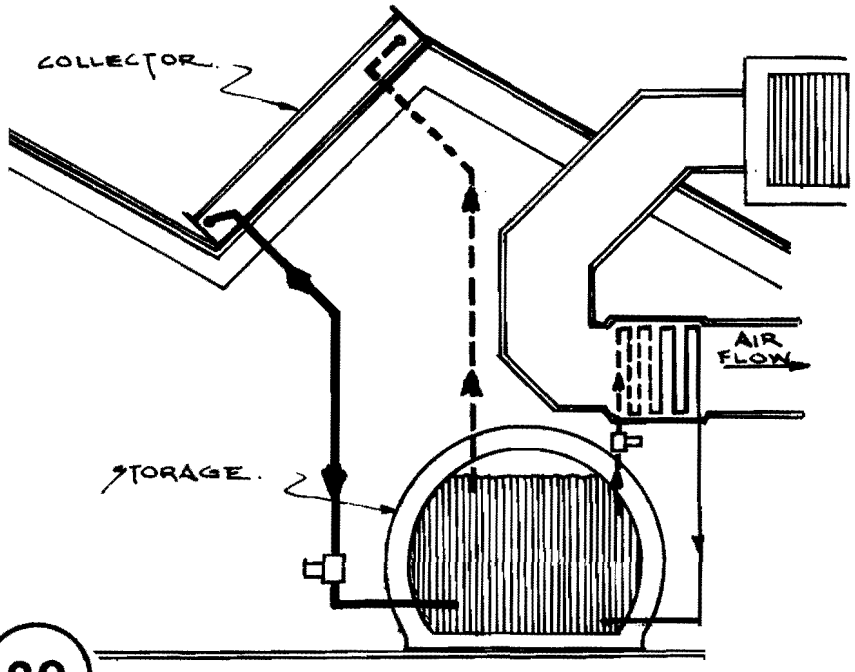
AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace is located on-line between rock storage and occupied spaces, apply total or partial heating as required.

DOMESTIC HOT WATER SYSTEM: Conventional system.

COOLING: Natural ventilation.







PROJECT INFORMATION

BUILDER: Daniel W. Brock, III
DESIGNERS **ARCHITECT:** Daniel W. Brock, III
ENGINEER: Not designated
LOCATION: Mesa, Arizona Latitude 34°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 1,831 **COOLING** 1,000 hrs.
AVE. TEMP. **WINTER** 35 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 300 **JUNE** 720 Ly.

BUILDING DESCRIPTION

The project is a contemporary one story single family dwelling that integrates a solar heating and domestic hot water heating system. The floor area of the residence totals 2,743 square feet. A sawtooth roof arrangement allows the required solar collector area to be incorporated into the building design without dominating the exterior appearance. Earth berms, small shaded south-facing windows and the use of the thermal mass of the building for energy storage are a few of the energy conserving features of the design. To avoid summer heat gain - cooling is aided by small shaded south-facing windows.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 288 square feet liquid-cooled flat-plate manufactured by Sunsource with an automatic drain down for freeze protection.

STORAGE: 1,050 gallons of water within an insulated 5' diameter x 9'6" long tank. A heat exchanger is not used to transfer heat from the collector to storage; rather water in storage is circulated through the collectors and returned to the tank.

DISTRIBUTION: Forced air. A water to air heat exchanger is located in the primary room air supply duct. Air is heated as it is blown through the heat exchange coils and distributed by ducts to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electric heat pump. The heat pump is integrated with the solar system and utilizes the solar storage as a baseline heat supplier.

DOMESTIC HOT WATER SYSTEM: Three liquid-cooled collectors preheat the domestic hot water supply stored in a 60 gallon tank of a conventional electric water heater.

COOLING: None designated. However, the heat pump can be modified to supply space cooling by pumping the refrigerant through coils in the storage at night.

PROJECT INFORMATION

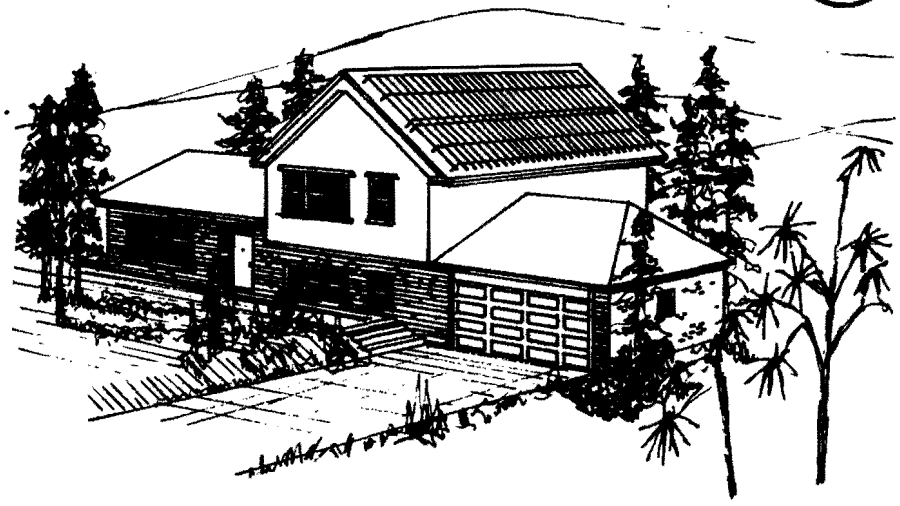
BUILDER: Perl-Mack Co.

DESIGNERS **ARCHITECT:** Robert Keener
ENGINEER : John Tuttle

LOCATION: Denver, CO Latitude 40°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,839 **COOLING** 1,411 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 60°F.
HORIZ. INSOLATION **JAN.** 525 **JUNE** 200 Ly.



BUILDING DESCRIPTION

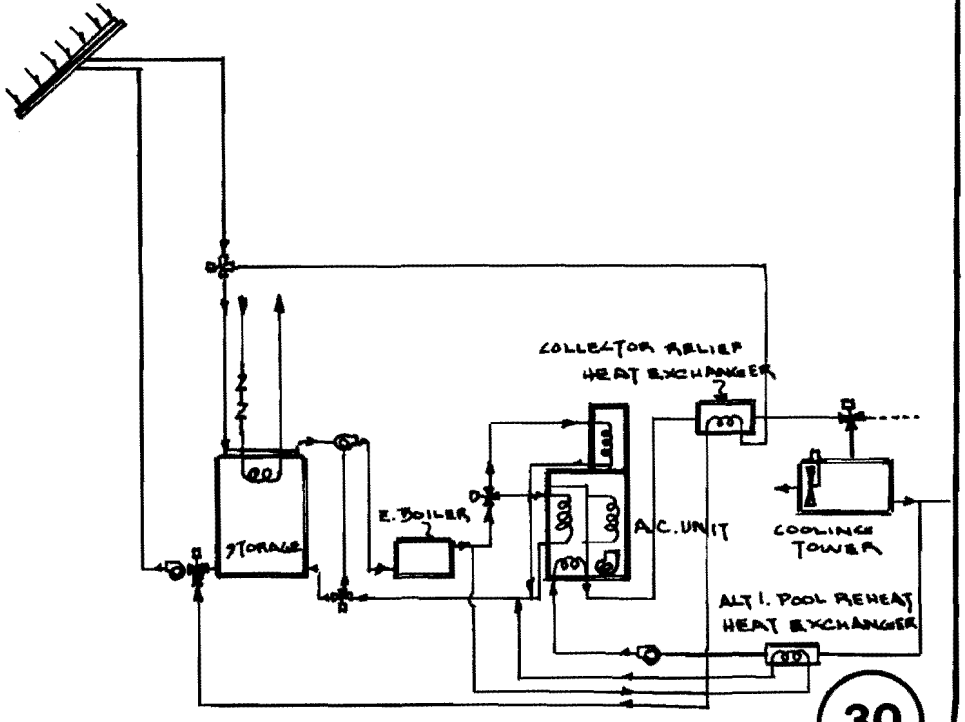
The project involves the application of solar heating, cooling, and domestic hot water heating to a 2,229 square foot, two-story residence. Wall, floor and ceiling insulation is increased to reduce heat losses. The solar collectors are mounted on the south-sloping roof of the house.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 576 square foot liquid-cooled all-glass vacuum tube type collectors manufactured by Owens-Illinois. The inner absorber tube is coated with a selective surface for improved solar collection.

STORAGE: 1,500 gallons of water within an insulated cylindrical storage tank located in the basement.

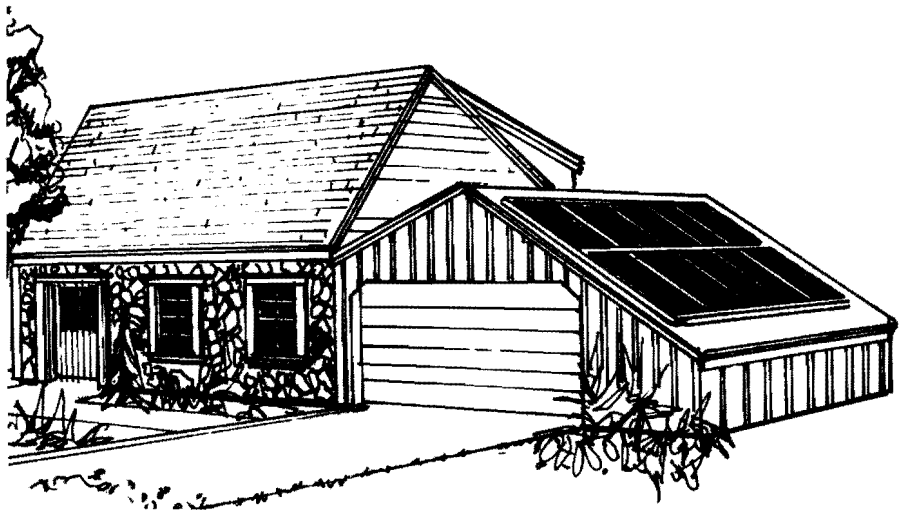


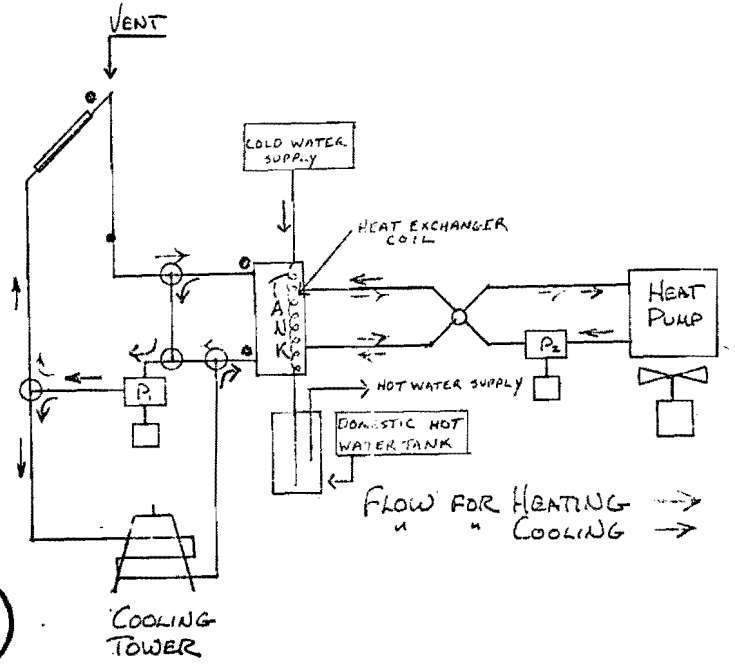
DISTRIBUTION: Forced air. Hot water from storage flows through heat coils in the primary supply duct. The heat pump fan circulates air over the coils warming the air that is distributed by duct to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electric boiler. The boiler provides heated water to the electrically driven heat pump used in off peak hours.

DOMESTIC HOT WATER SYSTEM: A shell in tube heat exchanger in main storage tank preheats water prior to entering a 124 gallon electric domestic water heater.

COOLING: Solar heated water is used to power an absorption cycle cooling unit that supplies cooled water to individual fan coil units.





PROJECT INFORMATION

BUILDER: Ritter Buildings
DESIGNERS ARCHITECT: D.H. Lufkin
ENGINEER : Euda Corporation
LOCATION: Berryville, Virginia Latitude 39°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,679 **COOLING** 1,046 hrs.
AVE. TEMP. **WINTER** 35 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 175 **JUNE** 555 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating, cooling and domestic hot water preheating system to a single family detached dwelling. The two-story house has 1,664 square feet of heated/cooled floor area. The design is compact and well-insulated. Roof-mounted collectors on the garage heat thermal storage located in the basement.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X
COLLECTOR: 210 square foot liquid-cooled flat-plate manufactured by Sunworks.

STORAGE: 1,250 gallons of water within concrete storage tank coated with polyester and epoxy located in the basement.

DISTRIBUTION: Forced air. Hot water from storage passes through a heat pump arranged in-line with the distribution ducts. Air is blown over copper coils, heated and distributed to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electrical resistance, heat pump. 14.4 KW strip heater located in the primary supply duct along with the heat pump provides supplemental energy as required.

DOMESTIC HOT WATER SYSTEM: A copper coil in storage preheats the domestic hot water supply prior to entering a conventional 60 gallon electric water heater.

COOLING: Solar assisted heat pump. Main thermal storage receives heat removed during daytime by the heat pump to be disposed of to the cooling tower at night.

PROJECT INFORMATION

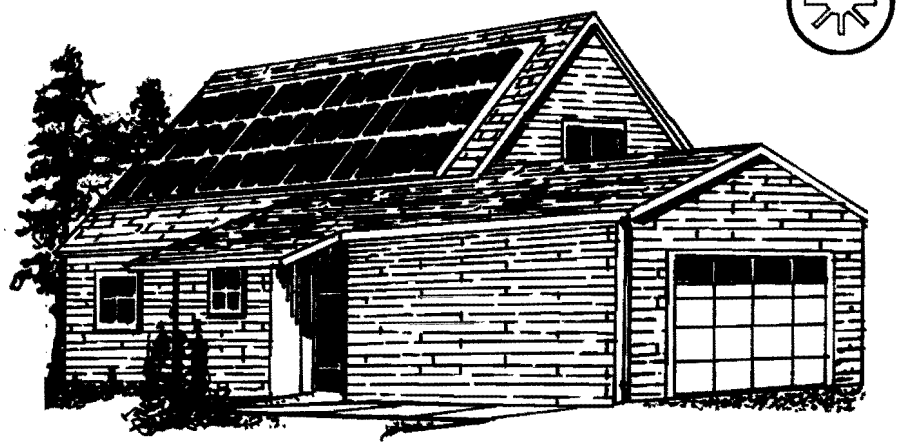
BUILDER: Eco-Era Incorporated

DESIGNERS **ARCHITECT:** Dr. C. Byron Winn & Les Shaw
ENGINEER: Russel M. Miller

LOCATION: Fort Collins, Colorado Latitude 40.7°N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,200 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 15 **SUMMER** 55°F.
HORIZ. INSOLATION **JAN.** 210 **JUNE** 660 Ly.



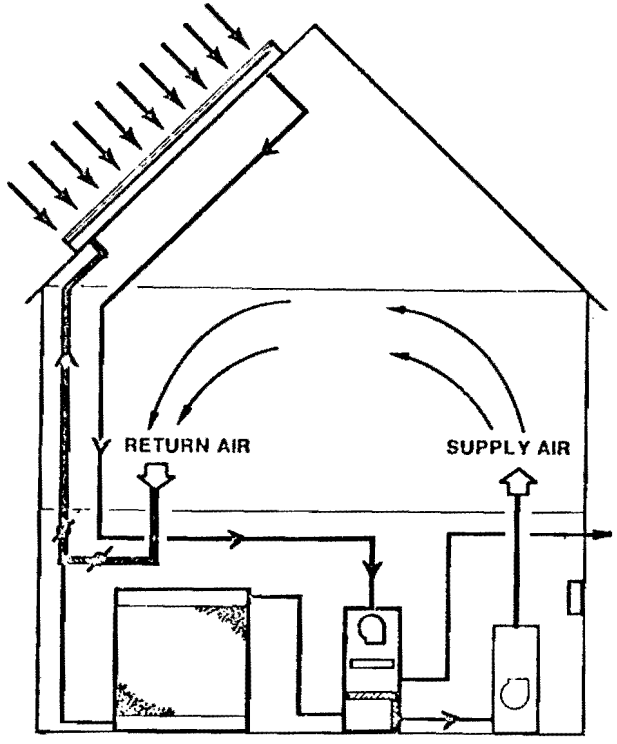
BUILDING DESCRIPTION

The project is a 1,760 square foot two story single family residence incorporating a solar heating and domestic hot water preheating system. The building utilized wood frame construction with a concrete foundation and wood shingled exterior walls. Added wall and roof insulation, smaller window area, and insulated shutters reduce the dwelling's energy requirement and improve the solar system's performance. The solar collectors are integrated with the roof structure and the storage bin is located in the unfinished basement.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 312 square foot air-cooled flat-plate manufactured by Solaron Corporation.



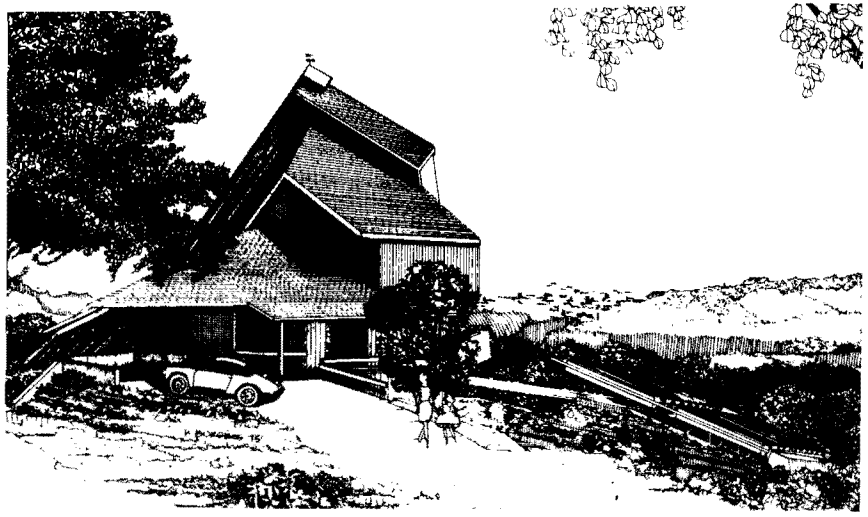
STORAGE: 394 cubic feet of one and one-half inch diameter rock within a 7'6" x 7'6" x 7'0" storage bin located in the basement.

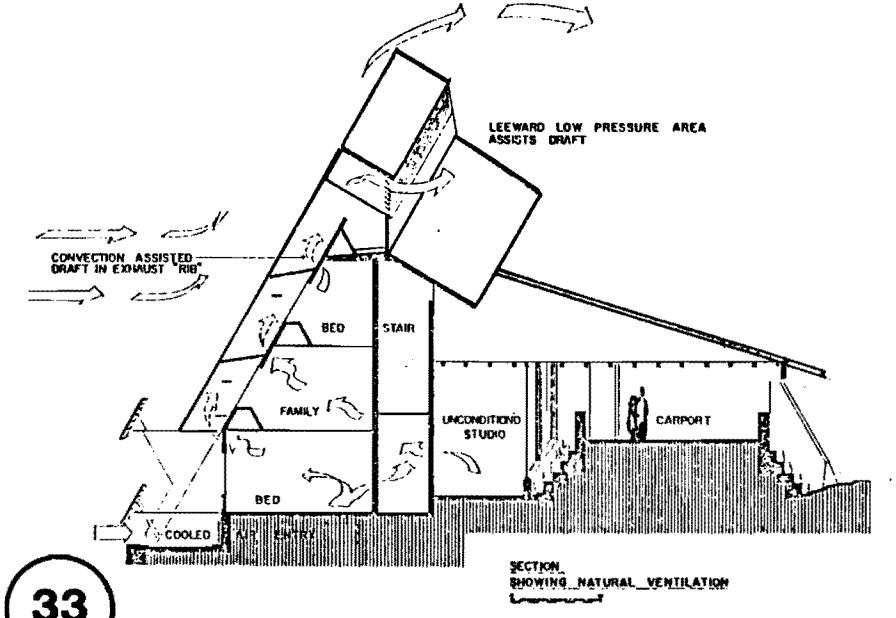
DISTRIBUTION: Forced air. Heated air from the collectors passes directly into the living spaces or the storage bin, or is vented to the outside.. Distribution from storage is accomplished by a blower and ducts.

AUXILIARY ENERGY SYSTEM: Electric heat pump arranged in-line with the collectors, storage, and distribution, the heat pump provides a full or partial energy boost.

DOMESTIC HOT WATER SYSTEM: Preheated by a finned coil heat exchanger located in the primary distribution duct of the central air handling unit. Storage and auxiliary heating is provided by a conventional water heater.

COOLING: Electric heat pump, natural ventilation. Cooling by air to air heat pump is not solar assisted.





SECTION SHOWING NATURAL VENTILATION

PROJECT INFORMATION

BUILDER: Lamar Savings Association

DESIGNERS **ARCHITECT:** Thomas Leach and Associates
ENGINEER : Hammer, Inc.

LOCATION: Austin, Texas Latitude 30.3°N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 1,711 **COOLING** 2,250 hrs.
AVE. TEMP. **WINTER** 50 **SUMMER** 80 °F.
HORIZ. INSOLATION **JAN.** 260 **JUNE** 620

BUILDING DESCRIPTION

The large contemporary single family dwelling is designed to accommodate the hot-dry climatic conditions of the Austin area. The roof planes are designed to create a sheltered main entry and to maximize the use of prevailing winds for natural ventilation. The solar collectors are detached from the dwelling to achieve maximum exposure throughout the year to solar radiation. The 4,050 square feet of heated/cooled floor area is organized into a compact three story plan arrangement. The building is sited on the coolest (maximum shade and exposure to cooling winds) portion of the site.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 60 liquid-cooled linear concentrating collectors manufactured by the Northrup Corporation. A linear fresnel lense focusses solar radiation onto a blackened copper tube at the bottom of a shallow 10' long x 1' deep trough.

STORAGE: 1,800 gallons of water within an insulated 6' diameter x 10' high galvanized steel tank. A water to water heat exchanger transfers captured heat from the collectors to the storage media.

DISTRIBUTION: Forced air. Heated water from storage is pumped to a fan coil unit for distribution by ducts or to an absorption cooling unit for powering the heat activated cooling system. Cooled air is distributed by same ducts.

AUXILIARY ENERGY SYSTEM: Electric resistance coils in primary air distribution ducts. The system is designed to provide full or partial energy supply as required.

DOMESTIC HOT WATER SYSTEM: A heat exchanger located in the storage tank preheats water to approximately 140°F. prior to storage, distribution and possibly an energy boost by a conventional water heater.

COOLING: Absorption-cycle air conditioner. The concentrating collectors supply the necessary high temperatures and the swimming pool is used as a heat sink.

PROJECT INFORMATION

BUILDER: Wayne Nichols-Communico

DESIGNERS **ARCHITECT:** Sun Mountain Design

ENGINEER : Communico

LOCATION: Sante Fe, NM Latitude 36°N.

HOUSING TYPE: Single Family Detached

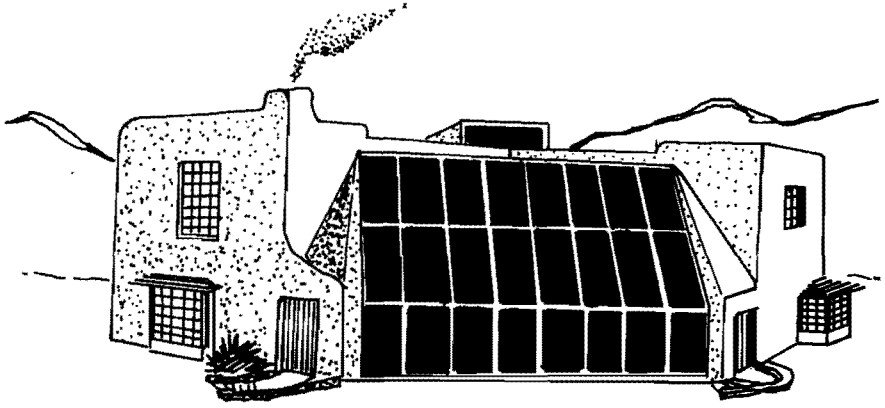
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,886 **COOLING** 700 hrs.

AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 300 **JUNE** 725 Ly.

BUILDING DESCRIPTION

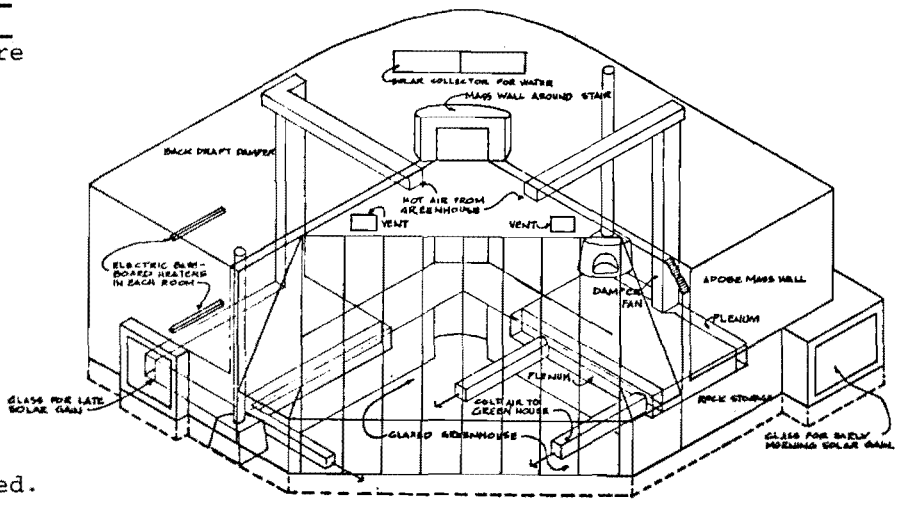
The project is a two-story single family dwelling integrated with a solar heating, cooling, and domestic hot water preheating system. Thick adobe walls behind a south-facing greenhouse of the L-shaped plan absorbs heat and transmits it to the living spaces. Excess heat from the top of the greenhouse is drawn off by two ducts and sent into rock storage bins located below the living and dining room floor. An airlock entry and extra insulation improve the thermal characteristics of the 1,900 square foot dwelling. North walls are wood stud construction with a stucco exterior finish.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: South-facing greenhouse. A separate 34 square foot liquid-cooled flat-plate collector manufactured by Sunsource provides domestic hot water preheating.



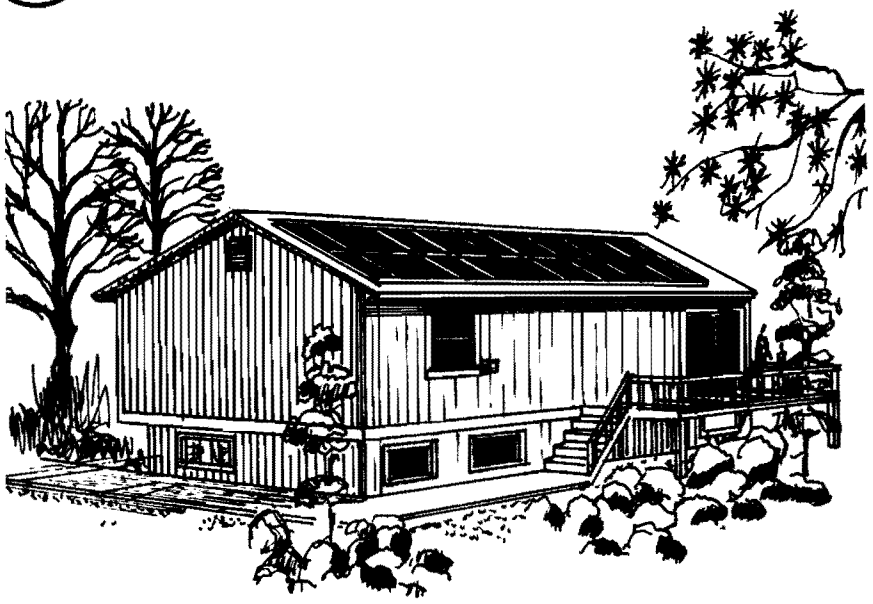
STORAGE: 872 cubic feet of 3"-4" diameter rock within two insulated storage bins beneath the first floor. Domestic hot water storage of 40 gallons is separate.

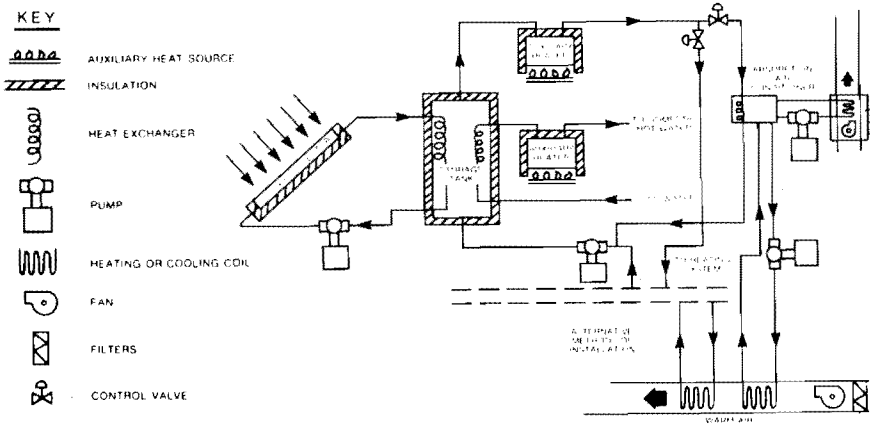
DISTRIBUTION: Forced air. Two ducts draw off excess greenhouse heat to the two rock storage bins. A fan distributes this heat by ducts to the living space. The floor above the storage bins and the adobe wall of the greenhouse act as radiant heat sources.

AUXILIARY ENERGY SYSTEM: Electric coil resistance. A three-stage 10 Kw electric resistance coil in the primary supply. Duct heats air from storage bin as required.

DOMESTIC HOT WATER SYSTEM: A separate liquid-cooled flat-plate collector preheats the domestic hot water supply by circulating the heated water through a heat exchanger in the conventional water heater storage tank.

COOLING: The system is designed to draw cool air into rock storage at night and then distribute cool air to the house during the day.





PROJECT INFORMATION

BUILDER: Peachtree Homes Inc.

DESIGNERS **ARCHITECT:** Denney Associates

ENGINEER: Independent Living Inc.

LOCATION: Shenandoah, Georgia Latitude 33°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,095 **COOLING** 1,589 hrs.

AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.

HORIZ. INSOLATION **JAN.** 230 **JUNE** 570 Ly.

BUILDING DESCRIPTION

The project combines a 1,216 square foot single family detached dwelling with a solar heating, cooling, and domestic hot water preheating system. Heat losses are reduced by added wall, floor, and ceiling insulation. 2"x6" at 24" on center wall studs are used to allow for the added insulation. Also, the dwelling's window area is decreased to reduce heat losses.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 273 square foot liquid-cooled flat-plate manufactured by Revere. The multiple 3'x6' collector panels form an integrated roof system.

STORAGE: 2,000 gallons of water within an insulated welded steel tank located in the basement. A heat exchanger is used to transfer capture heat from the collector to the storage tank.

DISTRIBUTION: Forced air. Hot water is pumped from storage to a fan coil unit in the ductwork. Air is circulated through the coils, heated and distributed by duct to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired heat pump. The heat pump provides total or supplemental hot water to the fan coil as required.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated as it passes through a heat exchanger located in the heat storage tank en route to an oversized conventional water heater.

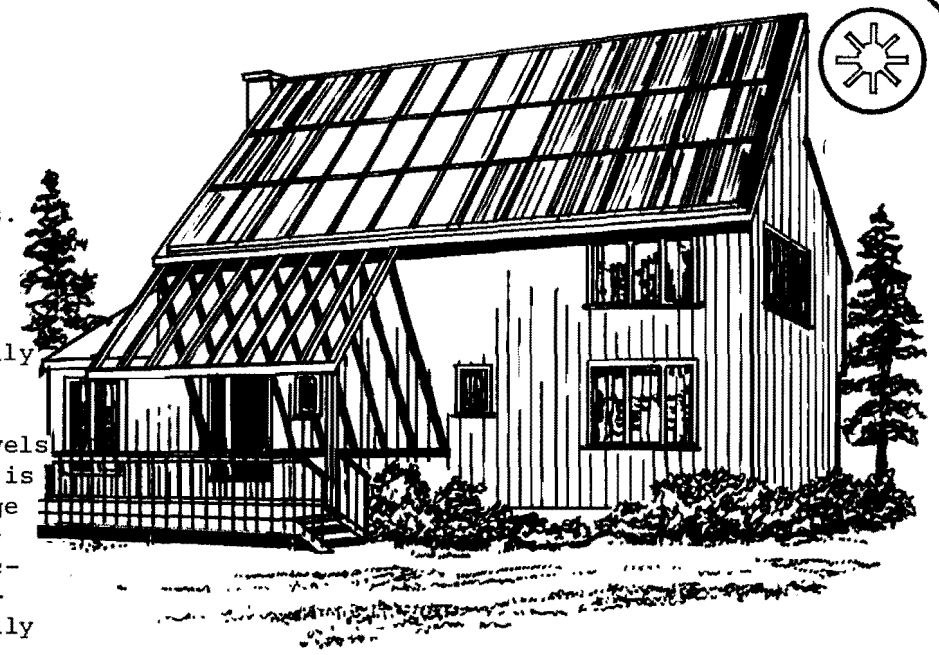
COOLING: Cooling is achieved by circulating solar heated water through an Arkla absorption chiller. The cool water is pumped to the fan coil units for forced air distribution.

PROJECT INFORMATION

BUILDER: Innovative Building Systems, Inc.
DESIGNERS **ARCHITECT:** Innovative Building Systems, Inc.
ENGINEER : Burt, Hill & Assoc. (Solar Design)
LOCATION: Buffalo, New York Latitude 42° 55' N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 7,000 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 66°F.
HORIZ. INSOLATION **JAN.** 120 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project is a large two story contemporary single family dwelling that incorporates a solar heating and domestic hot water preheating system. The wood frame house contains 3,350 square feet of heated floor area on three levels including a full basement. The energy load of the house is reduced by added insulation, double layer glass, and large south-facing windows. The south slope of the double pitched roof is fitted to the optimum angle for solar collection, thereby creating an interesting north-facing clerestory that allows sunlight to enter the second floor family room.

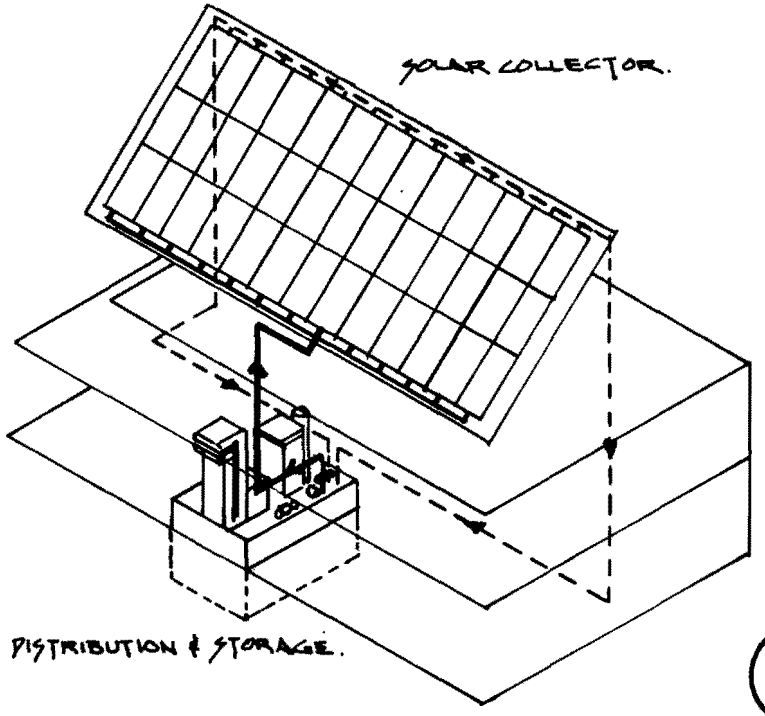


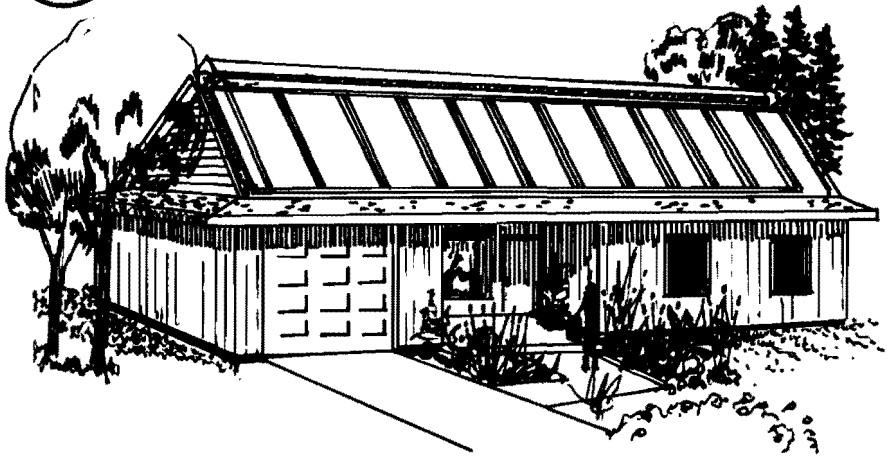
SOLAR ENERGY SYSTEM

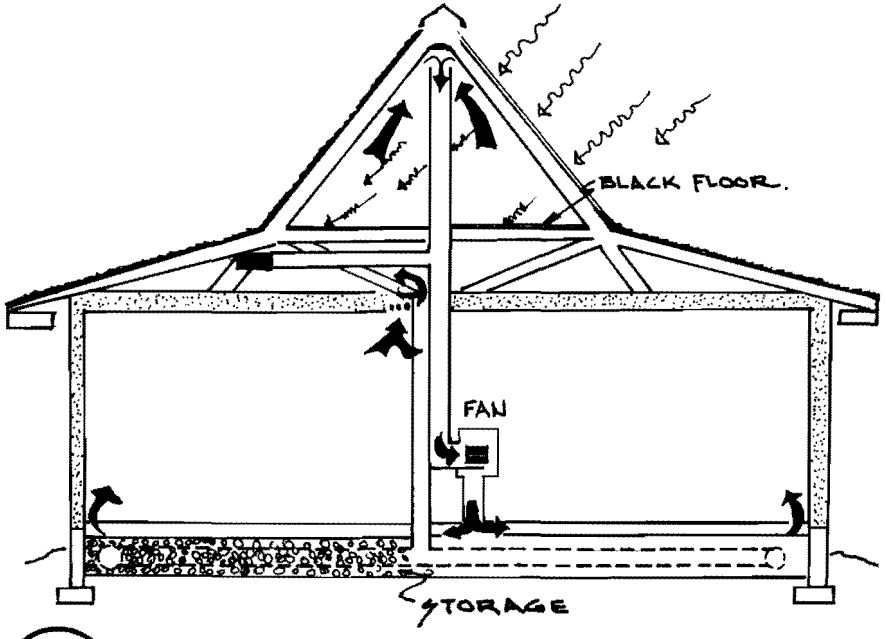
SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X
COLLECTOR: 669 square feet liquid-cooled flat-plate manufactured by PPG. A water-antifreeze solution is used as the heat transfer medium to alleviate potential freezing problems.

STORAGE: 2,000 gallons of water within an insulated reinforced concrete septic tank. A water to water heat exchanger transfers captured heat from the collectors to the storage media.
DISTRIBUTION: Forced air. Air is forced over a water to air heat exchanger for distribution to the dwelling spaces by ducts.

AUXILIARY ENERGY SYSTEM: Two electric heat pumps. One utilizes outside air for operation while the other uses indoor return air. Both are integrated with the solar system.
DOMESTIC HOT WATER SYSTEM: A heat exchanger in storage preheats the water in the 80 gallon tank of the conventional heater. This tank boosts temperature as required.
COOLING: Electric heat pump. An air to air heat pump provides cooling for the dwelling in the summer months by using the thermal storage as a heat sink.







PROJECT INFORMATION

BUILDER: Helio Thermics, Inc.
DESIGNERS **ARCHITECT:** H.F. Zornig
ENGINEER: Helio Thermics, Inc.
LOCATION: Greenville, South Carolina Latitude 34.5°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,884 **COOLING** 750 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project is a low-cost one story single family dwelling that uses an attic space as the solar collector. The 1,080 square foot wood frame house is well insulated, and an air space separates the solar heated, black painted, plywood floor of the attic from the ceiling. In winter the south-facing glazed roof collects heat in the unventilated attic. The heated air is removed to rock storage located in a crawl space under the floor. A continuous operable ridge vent ventilates the attic in the summer.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW**

COLLECTOR: 412.5 square foot air-cooled flat-plate manufactured by Helio Thermics, Inc. The attic collector admits solar radiation through a transparent fiberglass glazed southern roof to a black painted plywood attic floor.

STORAGE: 1,080 cubic feet of one and one-half inch rock are located in a 1' x 27' x 40' crawl space. At 50°F. 20 BTU's are stored per cubic foot of rock.

DISTRIBUTION: Forced air. A thermostatically controlled fan on the ground floor circulates attic heated air to rock storage. The heat is then distributed by hot air to the living space. A manually operated ridge vent controls ventilation.

AUXILIARY ENERGY SYSTEM: Gas-fired water heater located between the fan and rock storage. The water supplies back-up whenever heat from the storage is insufficient.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is heated by a conventional gas water heater.

COOLING: Heat built up in rock storage during the day is removed by venting through the attic space at night.

PROJECT INFORMATION

BUILDER: Self-Help Enterprises

DESIGNERS **ARCHITECT:** Octogon Associates

ENGINEER : Harold Hay & Philip Niles

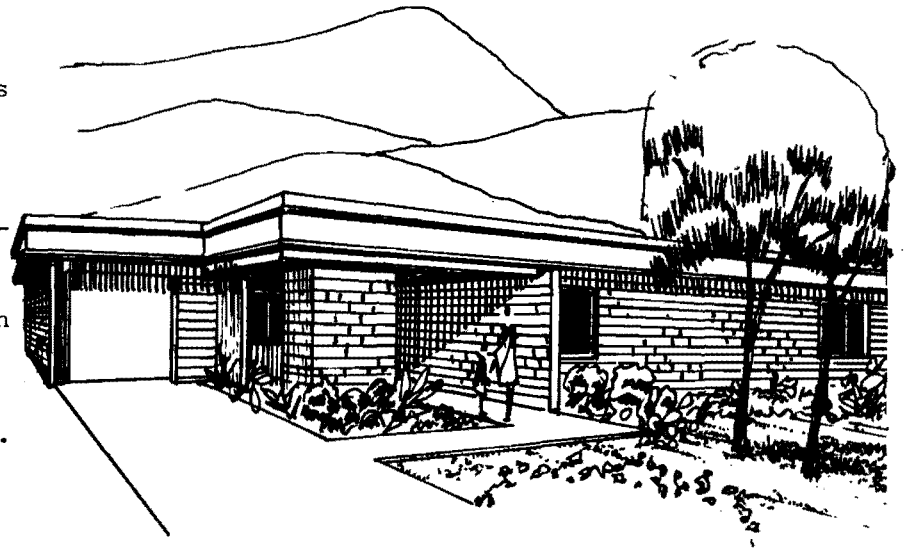
LOCATION: Selma, California Latitude 37°N

HOUSING TYPE: Five Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,619 **COOLING** 1,870 hrs

AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.

HORIZ. INSOLATION **JAN.** 260 **JUNE** 600 Ly.



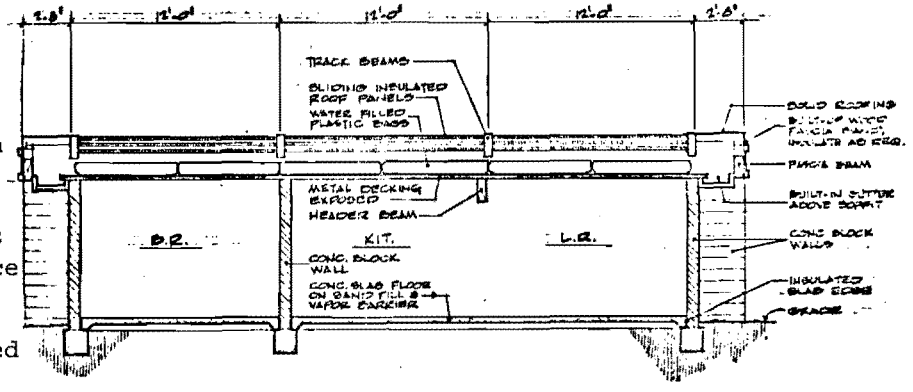
BUILDING DESCRIPTION

The projects consists of five one story single family dwellings each with 1,152 square feet of heated/cooled floor area. Water filled black plastic bags located within the flat roof structure provide passive solar energy collection and storage. The solar system supplies both heating and cooling. Exposure of the bags to solar radiation is controlled by movable insulated panels. Three of the dwellings will be of frame construction, two of concrete block.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW**

COLLECTOR: 960 square feet solar pond utilizing the patented "Skytherm" process. Movable insulated panels regulate solar exposure of the pond (water bags).



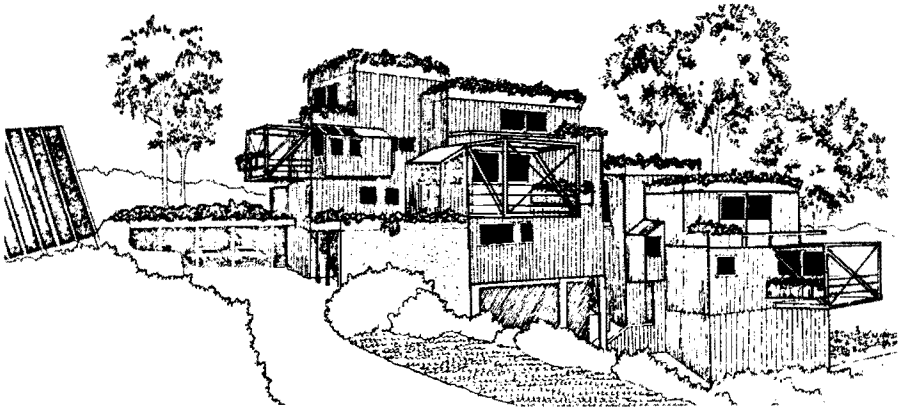
STORAGE: 660 cubic feet of water in black plastic bags located within the roof structure serves as the collector and storage element.

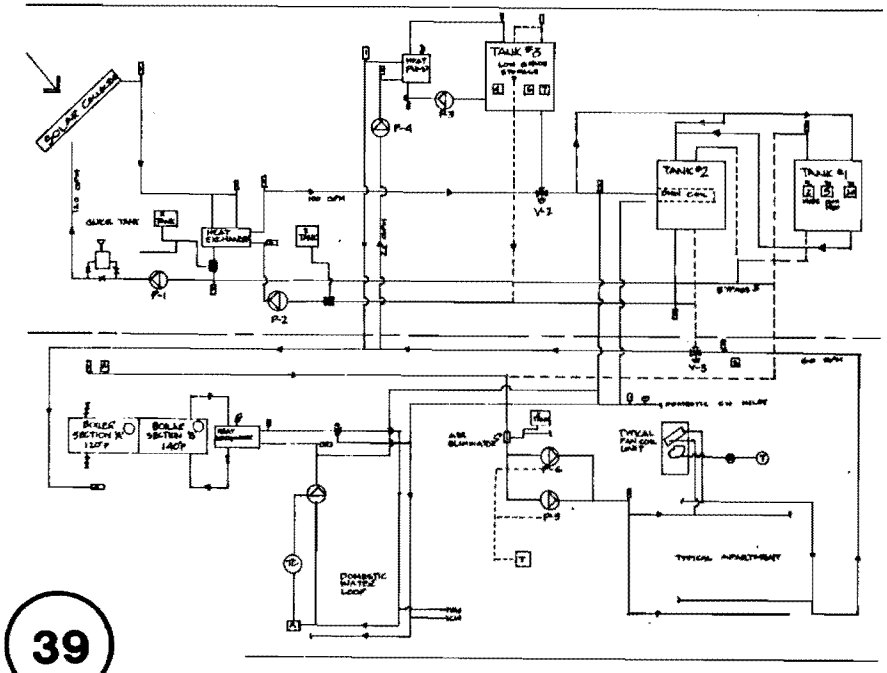
DISTRIBUTION: The water bags radiate captured heat through the corrugated steel roof to the living space. The insulating panels protect the living space from over-heating or cooling by appropriate covering or exposing of the bags

AUXILIARY ENERGY SYSTEM: A 5,000 watt electric resistance heater system and a 4.50 ton evaporative cooler back-up the same energy system.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is heated by a conventional electric water heater.

COOLING: Water bags absorb heat from the house during the day. At night, the panels are opened and the absorbed heat is radiated to the cool night sky.





PROJECT INFORMATION

BUILDER: Grassy Brook Village
DESIGNERS **ARCHITECT:** Robert F. Shannon
ENGINEER: Dubin-Mindell-Bloome & Associates
LOCATION: Brookline, Vermont Latitude 43°N
HOUSING TYPE: Clustered Condominiums - 10 units
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 7,800 **COOLING** _____
AVE. TEMP. **WINTER** 15 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 120 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project consists of ten three-bedroom, 1,200 square foot living units clustered around a common courtyard to form a 12,000 square foot modular complex. The complex makes use of a shared central solar collection and storage system. The collectors and storage elements are located apart from the buildings. Energy conservation features include: common walls reducing by 18 percent vertical exterior wall area exposed to outside, double-glazed windows, extra insulation, and sodded roof.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X
COLLECTOR: 2,520 square feet liquid-cooled, flat-plate arranged in an array of three rows, two panels high each in a sawtooth fashion.

STORAGE: Three 5,000 gallon steel tanks store 15,000 gallons of water to be heated by heat exchange coils from the collectors.

DISTRIBUTION: Forced air. Six fan-coil units per dwelling distribute heat air from the central heating system. A ten-ton electric heat pump is connected to a separate 5,000 gallon tank receiving low-grade heat from the collectors.
AUXILIARY ENERGY SYSTEM: An oil-fired boiler has the capacity to provide 100 percent of required heating. Wood stoves in each dwelling provide back-up.
DOMESTIC HOT WATER SYSTEM: A preheat coil from the collectors heats 600 gallons of water stored in a separate domestic hot water storage tank.

COOLING: Natural ventilation only.

PROJECT INFORMATION

BUILDER: San Antonio Ranch Ltd.

DESIGNERS **ARCHITECT:** Harding, Flores & Madrid
ENGINEER : Honeywell Inc.

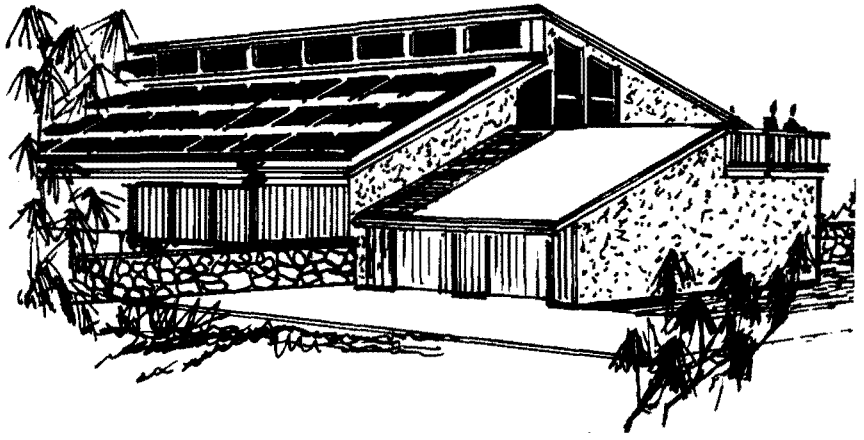
LOCATION: San Antonio, TX Latitude 29° 30'N.

HOUSING TYPE: Three Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 1,546 **COOLING** 2,000 hrs
AVE. TEMP. **WINTER** 55 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 280 **JUNE** 610 Ly.

BUILDING DESCRIPTION

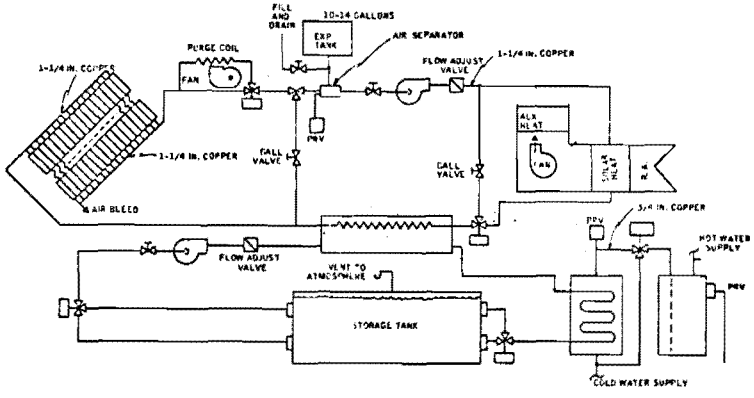
The project involves the integration of a solar heating and cooling system into three single family detached dwellings. The contemporary-style homes have floor areas of 2,044, 1,825, and 1,814 square feet. All are two stories in height and built without a basement. One dwelling makes use of prefabricated concrete wall panels with a site applied coating of stucco. Added wall, floor and ceiling insulation reduce the dwelling's heat losses. The solar collectors are incorporated on the houses sloping south-facing roofs.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW**

COLLECTOR: 850 (approximately) square feet liquid-cooled flat-plate manufactured by Lennox per dwelling.



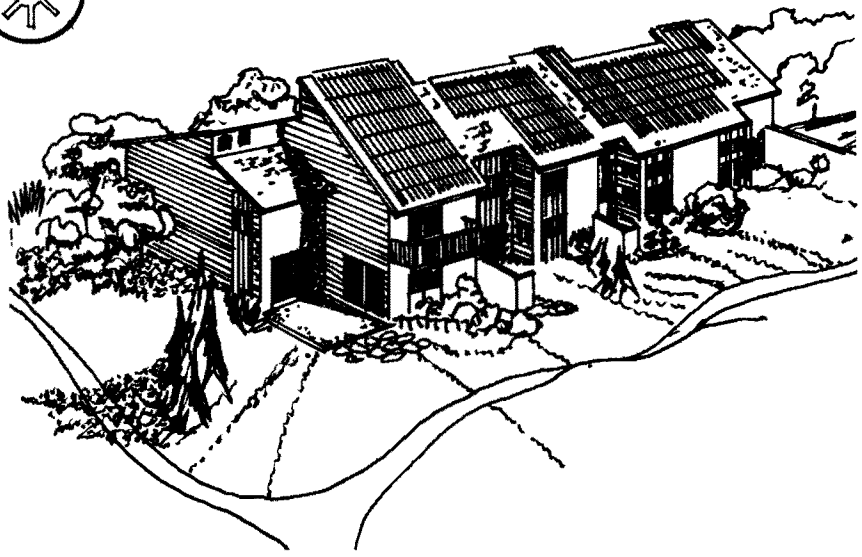
STORAGE: 1,000 gallons of water within a 5'4" diameter storage tank buried in the ground.

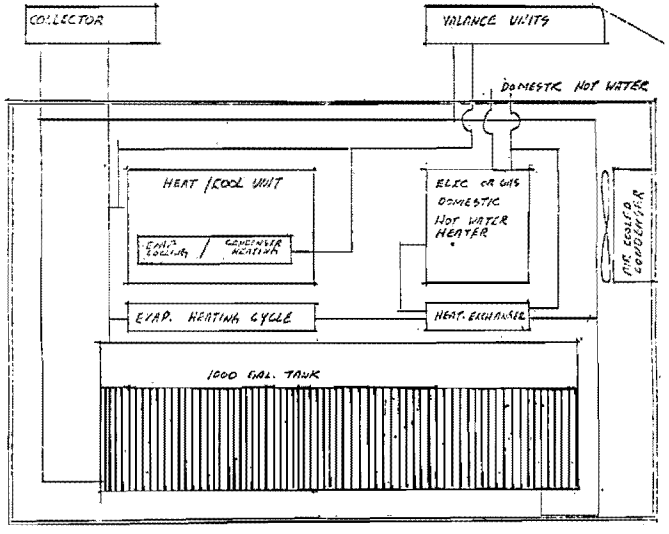
DISTRIBUTION: Forced air. Heated water from storage passes through heat exchange coils in the primary supply duct. A fan in the ductwork circulates air through the coils, warming the air, which is distributed to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired boiler. The boiler provides hot water to the heating coils when storage temperatures cannot satisfy the dwelling's total heating demand.

DOMESTIC HOT WATER SYSTEM: Prior to passage through a conventional water heater domestic water supply is preheated in a preheat tank.

COOLING: An Arkla Absorption cooling unit. Uses hot water from solar storage to develop cold water which is pumped through coils in the primary supply duct.





PROJECT INFORMATION

BUILDER: United Development Co.

DESIGNERS **ARCHITECT:** ECOSOL Ltd.
ENGINEER: United Developmental Co.

LOCATION: Vernon Hills, Illinois Latitude 42°17'N.

HOUSING TYPE: Four - Single Family Attached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,639 **COOLING** 1,550 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70° F.
HORIZ. INSOLATION **JAN.** 170 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines heating and domestic hot water preheating system with four, two story, single family attached dwellings. Each dwelling totals 3,300 square feet of heated floor area. The wood frame building displays contemporary styling and simple details. Collectors are mounted on the sloping south-facing roof. Benefits of attached units are a reduction of heat losses and a decrease in solar system size.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 1,250 square feet liquid-cooled evacuated glass tube module. Three concentric tubes: transparent cover, absorber with selective coating, and a feeder tube comprise each module.

STORAGE: 1,000 gallons of water within an insulated tank located in the basement.

DISTRIBUTION: Hydronic. Heated water from storage is pumped directly to valance heating units in occupied areas. When storage temperatures are insufficient the heat pump and domestic water heater provide supplemental energy.

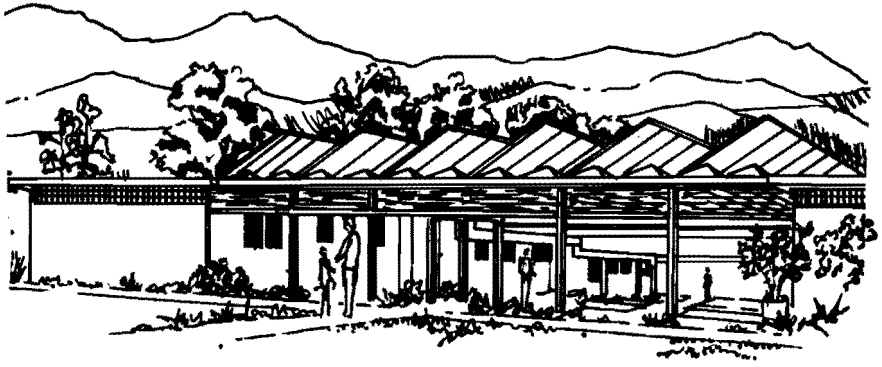
AUXILIARY ENERGY SYSTEM: A gas-fired heat pump elevates storage temperatures prior to pumping the heated liquid to valance units.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by passing the supply line through a copper shell and coil type heat exchanger in the main storage. The preheated water is stored in the tank of a conventional 185 gallon heater.

COOLING: Natural ventilation and heat pump utilizing solar storage.

PROJECT INFORMATION

BUILDER: City of Colorado Springs
DESIGNERS **ARCHITECT:** City of Colorado Springs
ENGINEER : None designated
LOCATION: Colorado Springs, Colorado Latitude 39° 30'
HOUSING TYPE: Two Six-Plex Row Units
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,423 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 15 **SUMMER** 55°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 650 Ly.



BUILDING DESCRIPTION

The project involves the redesign of a complex of one story dwelling units for solar domestic hot water heating. The solar energy system will serve 12 living units. The solar collectors are not integrated with the buildings. The collectors are placed on a structural frame spanning between the two six-unit buildings, thus forming a shaded courtyard. Heating and cooling is also provided for by solar energy.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X
COLLECTOR: 1,500 square feet of liquid-cooled all-glass vacuum tube type collectors manufactured by Owens-Illinois

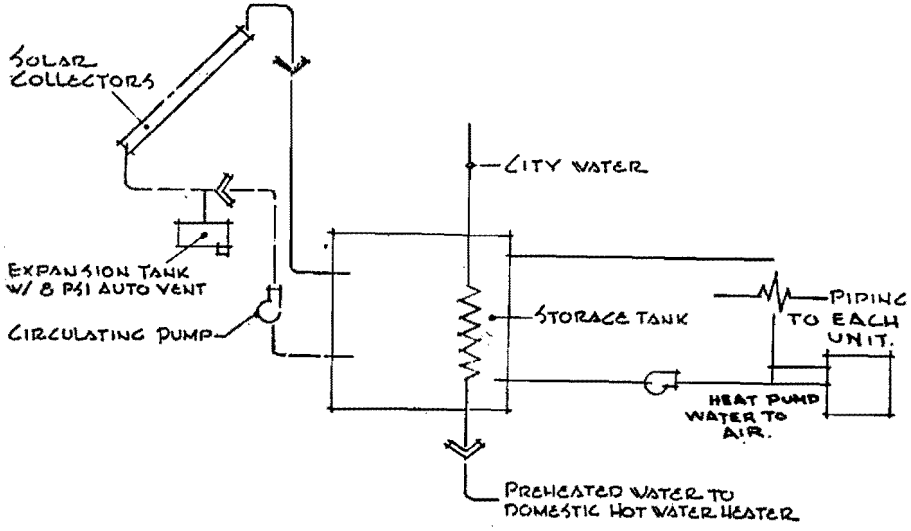
STORAGE: 1,200 gallons of water within an insulated 9' x 25' buried tank.

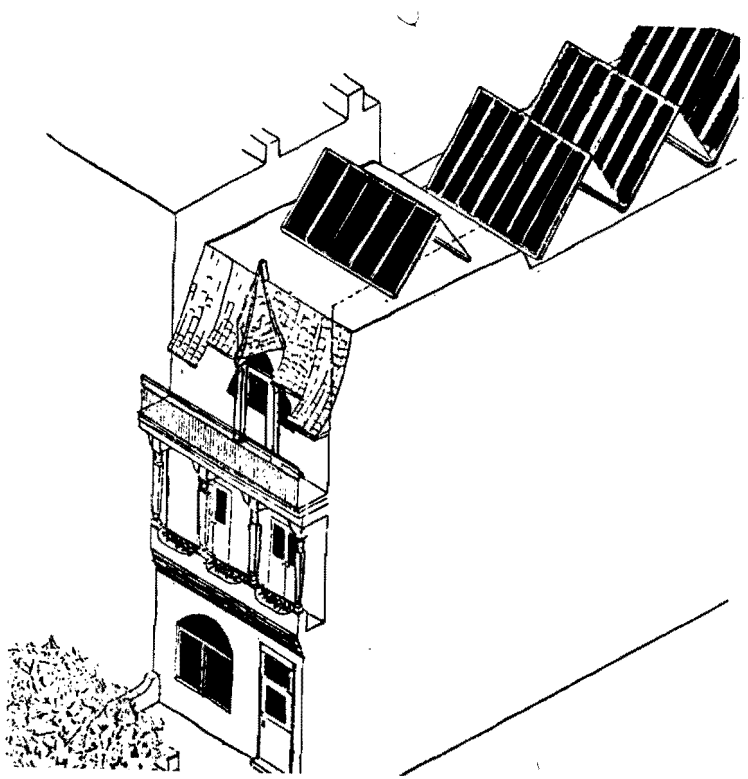
DISTRIBUTION: Forced air with heat pump. Heated water from storage circulates through a heat exchanger in the heat pump. A fan in the heat pump blows air past the hot coil picking up heat for the living space.

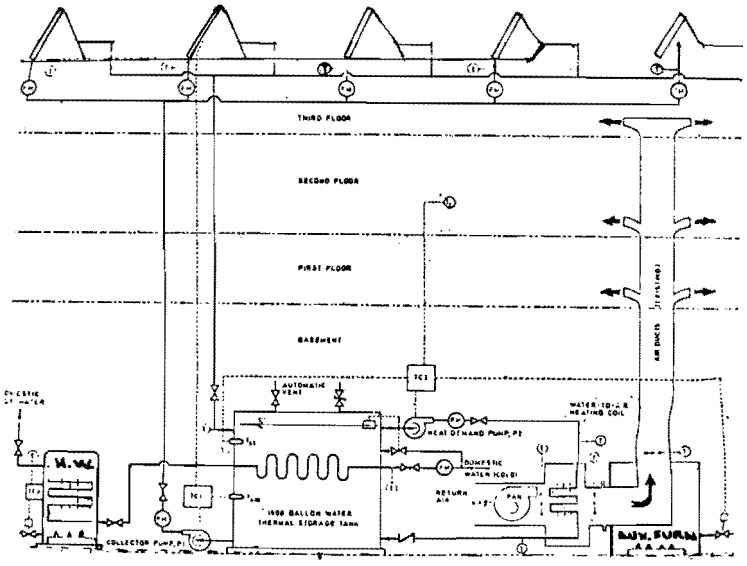
AUXILIARY ENERGY SYSTEM: Gas furnace. Existing furnaces heat a coil in the same ductwork used by the solar distribution system.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by running the supply line through a heat exchanger located in the solar storage tank. Preheated water is placed in the existing 750 gallon storage tank or a conventional water heater prior to distribution to each apart.

COOLING: Heat pump utilizing solar storage as a heat sink; natural ventilation.







PROJECT INFORMATION

BUILDER: University of Pennsylvania
DESIGNERS **ARCHITECT:** Dept. of Engineering
ENGINEER: Dept. of Engineering
LOCATION: Philadelphia, PA Latitude 40°N.
HOUSING TYPE: Single Family Attached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,866 **COOLING** 1,680 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°N.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 520 Ly.

BUILDING DESCRIPTION

The project involves the modification of a three-story 3,942 square foot single family dwelling for a solar preheating system and domestic hot water. To reduce heat loss and infiltration all doors and windows are recaulked. The collectors are supported by a structural steel frame on the roof and are connected by transport piping to a storage tank located in the basement.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** x **COOLING** _____ **DHW** x

COLLECTOR: 584 square feet liquid-cooled flat-plate manufactured by PPG Inc. and International Environment Corporation. The collectors are automatically drained to prevent freezing.

STORAGE: 1,500 gallons of water within two insulated cylindrical tanks 5' diameter by 5' high located in the basement.

DISTRIBUTION: Forced air. Hot water from storage is circulated through a water to air heating coil in the existing ductwork. The air blown over the coil is warmed and distributed by ducts to the occupied areas.

AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace provides supplemental heat as required to the forced air system.

DOMESTIC HOT WATER SYSTEM: A heat exchanger within the main storage tank preheats the domestic hot water supply and possibly is reheated by a conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Stonebraker Investments

DESIGNERS **ARCHITECT:** Joint Venture Inc.
ENGINEER : Steelcraft Co.

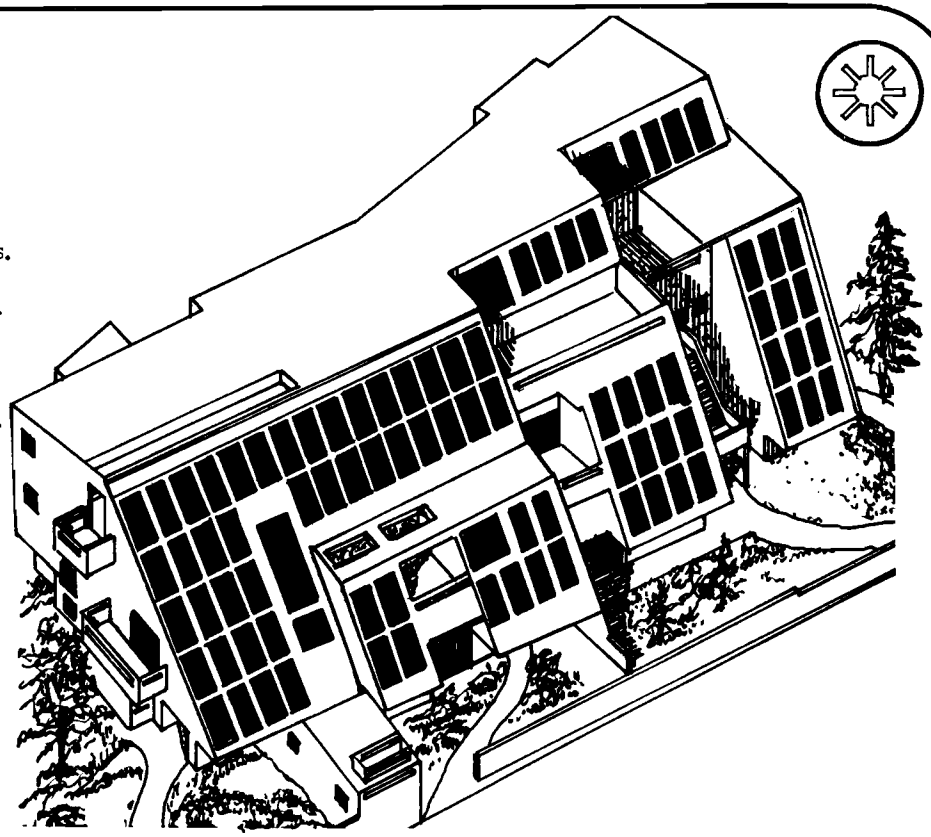
LOCATION: Boulder, Colorado Latitude 40° N

HOUSING TYPE: Garden Apartments

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,285 **COOLING** 630 hrs.
AVE. TEMP. **WINTER** 15 **SUMMER** 55° F.
HORIZ. INSOLATION **JAN.** 201 **JUNE** 525 Ly.

BUILDING DESCRIPTION

The project consists of eight units of student housing totalling 8,479 square feet within a four story building. The wood frame building form is compact. Thus, minimizing exterior exposure. Airlock vestibules aid the maintenance of a stable interior thermal environment. The north side of the building uses trees and minimal fenestration for protection from prevailing winds, while the south side has large openings for solar heat gain in winter but overhangs for summer shading.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: 860 square feet liquid-cooled compound parabolic concentrating collectors manufactured by Steelcraft Corp.

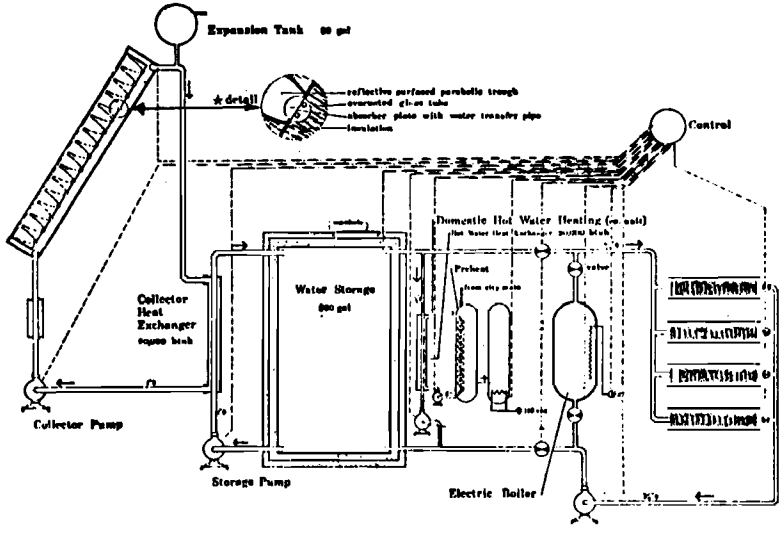
STORAGE: 1,720 gallon tank of de-ionized water and corrosion inhibitor, with heat exchanger between collector and storage tank to heat stored water.

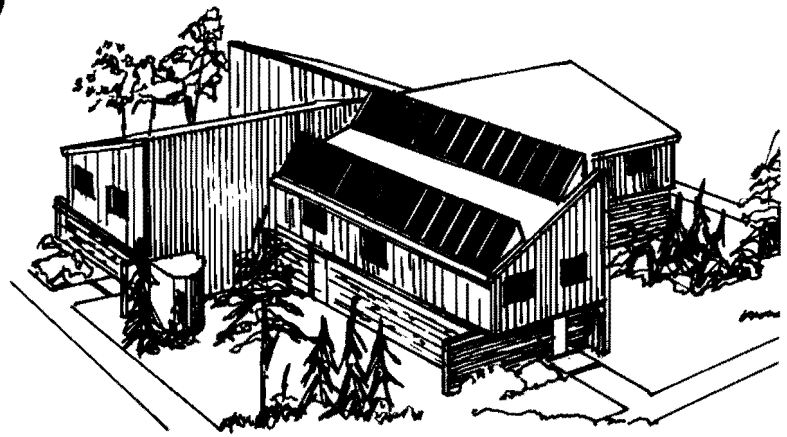
DISTRIBUTION: Centrifugal pumps are used with baseboard convectors. Shell and tube single pass, counter flow heat exchangers are used. Each unit has 87 feet of baseboard convectors supplied by either solar or auxiliary energy.

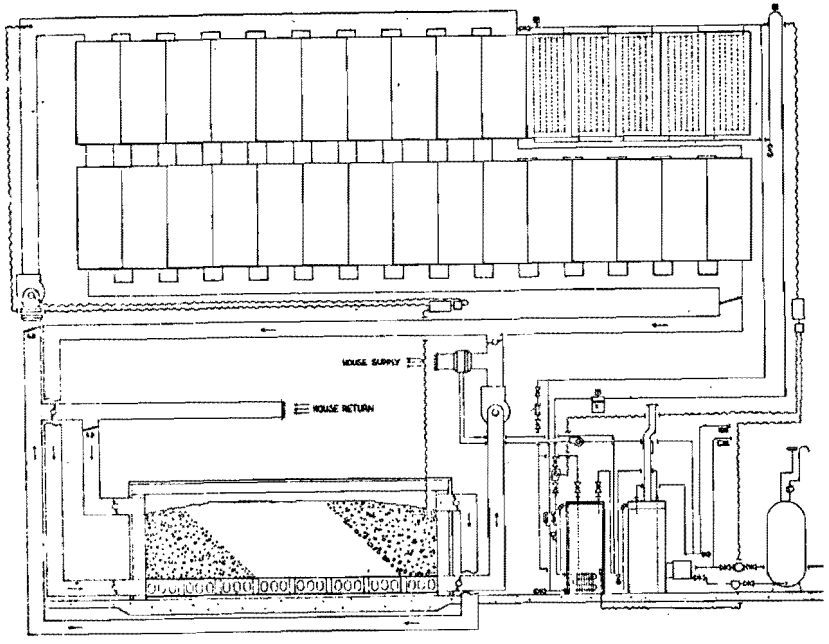
AUXILIARY ENERGY SYSTEM: 16 kilowatt electric boilers and water heaters on-line with solar distribution system.

DOMESTIC HOT WATER SYSTEM: Domestic hot water supply is preheated by a heat coil passing through the separate storage tank.

COOLING: Natural ventilation.







PROJECT INFORMATION

BUILDER: Housing Authority of Newark
DESIGNERS **ARCHITECT:** Held and Rubin
ENGINEER : Sunworks
LOCATION: Newark, New Jersey Latitude 40°44'N.
HOUSING TYPE: Low-Rise Multi-Family
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,034 **COOLING** 150 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F
HORIZ. INSOLATION **JAN.** 150 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project consists of several individual apartment units modified to include a solar heating and domestic hot water preheating system. One apartment group will have solar heated domestic hot water only. The three and four bedroom, two-story apartments have floor areas of 1,132 and 1,348 square feet, respectively. Collectors are roof mounted and storage is located in partially-buried tank adjacent to an outside foundation wall.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X
COLLECTOR: Liquid-cooled flat-plate manufactured by Sunworks. The collector area varies from 504 square feet for space heating and domestic hot water heating to 252 square feet for domestic water heating only.

STORAGE: 1,200 to 1,600 gallons of water within an insulated steel tank partially buried adjacent to the building. The domestic hot water system alone has 560 gallons of storage.

DISTRIBUTION: Hydronic heated water from storage is circulated through baseboard convectors located in each apartment.

AUXILIARY ENERGY SYSTEM: Oil-fired boiler. Water from the solar storage tank passes through the boiler en route to distribution. A total or partial energy boost may be supplied.

DOMESTIC HOT WATER SYSTEM: A copper heat exchanger in a 65 gallon stone-lined tank preheats water prior to entering a conventional 140 gallon electric water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: The Cambridge Development Group

DESIGNERS **ARCHITECT:** James H. Livingston
ENGINEER : Wormser Scientific

LOCATION: Columbia, South Carolina Latitude 34° N

HOUSING TYPE: Single Family Attached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,435 **COOLING** 1,359 hr
AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 230 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project is a four townhouse unit consisting of two two-story 2,530 square feet living units on the ends, and two three-story 1,570 square feet living units in the middle. This particular solar project represents one four-unit building in the second phase of a three phase 398 unit townhouse condominium development. The solar system is integrated with the building design with the collectors located in glass-covered attic space and the storage tanks located in the basement. Energy conserving features include improved wall and roof insulation, double glazing on all windows, and glass doors and large south-facing windows.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** _____ **DHW** X

COLLECTOR: Two 500 square foot pyramidal optic reflective surfaces concentrate solar radiation onto a small (44' x 96") liquid-cooled flat-plate collector manufactured by Olin Brass & Copper. The panel is recessed in the roof. This solar collection concept is patented by Wormser Scientific.

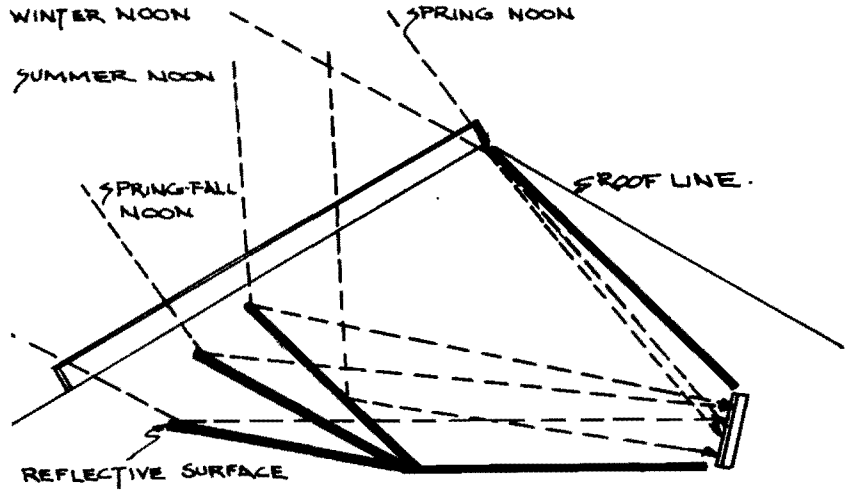
STORAGE: 2,000 gallons of water within two insulated reinforced concrete tanks located in the basement. A heat exchanger transfers heat from the collectors to the storage media.

DISTRIBUTION: Forced air. A heat exchanger is integrated with a heat pump to transfer heat from storage to the occupied spaces. Air is circulated over the exchange coils and distributed by ducts.

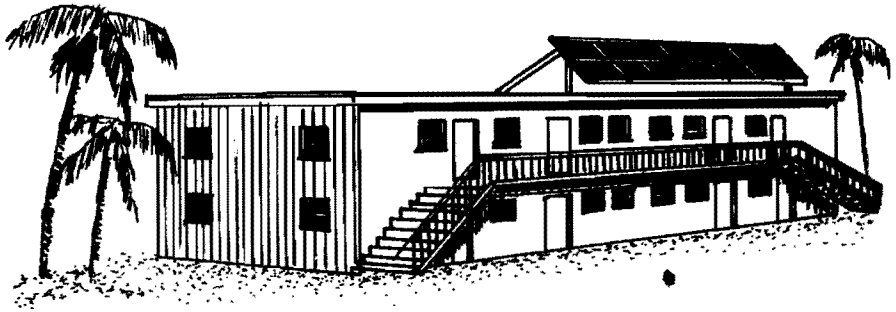
AUXILIARY ENERGY SYSTEM: Electric heat pump with electric resistance elements in primary supply ducts. Temperature sensors within storage and supply ducts determine when auxiliary energy is required.

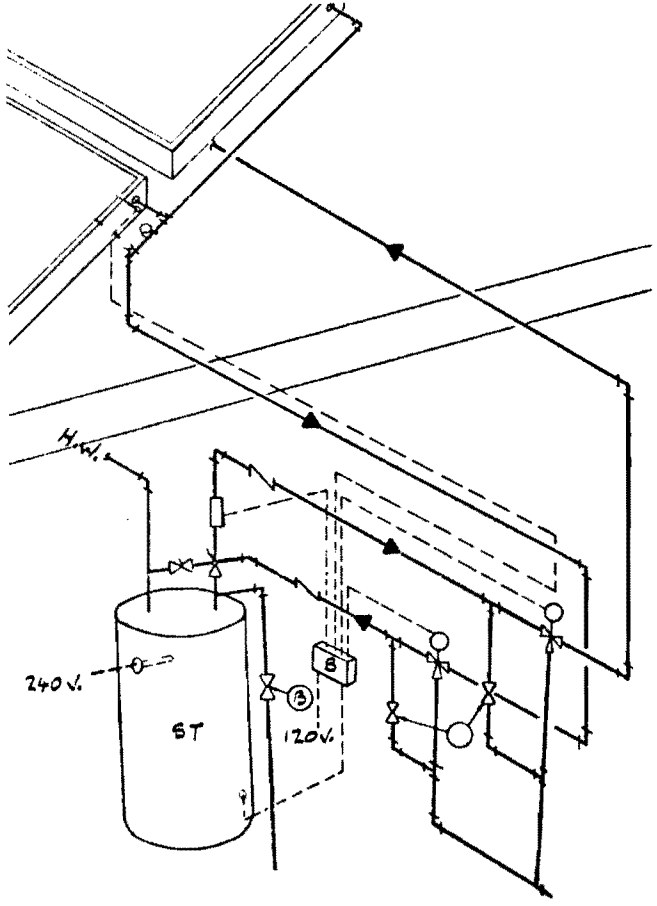
DOMESTIC HOT WATER SYSTEM: 200 gallon domestic hot water preheat tank is located within the central space heating storage tank. Preheated water passes through a conventional water heater where a total or partial energy boost may be supplied if needed.

COOLING: Electric heat pump, natural ventilation. Cooling by air to air heat pump is not solar assisted.



SECTION OF SOLAR COLLECTOR WITHIN ATTIC SPACE





PROJECT INFORMATION

BUILDER: City of St. Petersburg
DESIGNERS **ARCHITECT:** Reynolds, Smith & Hills
ENGINEER : Energy Design Associates
LOCATION: St. Petersburg, Florida Latitude 28°N
HOUSING TYPE: Low-Rise Multi-Family
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 683 **COOLING** 2,000 hrs.
AVE. TEMP. **WINTER** 65 **SUMMER** 85°F.
HORIZ. INSOLATION **JAN.** 400 **JUNE** 530 Ly.

BUILDING DESCRIPTION

The projects involves the integration of a solar domestic hot water system into an existing two story apartment building. The solar collectors are roof-mounted on a steel structural frame secured to the existing roof. Piping from the collectors passes through the building to four shared storage tanks - two on each floor. Each storage tank serves two apartments.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X
COLLECTOR: 144 square foot liquid-cooled flat-plate manufactured by Gulf Thermal Corporation with an automatic drain down system for freeze protection.

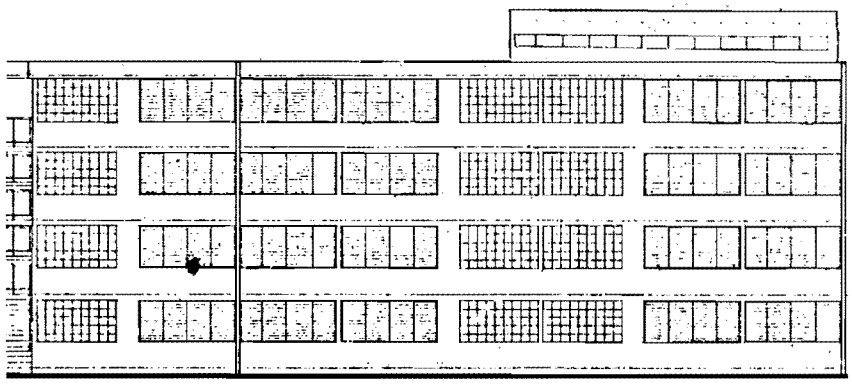
STORAGE: Four 80 gallon insulated storage tanks service eight apartments. A heat exchanger is not used. The water is distributed directly to the dwelling from collector through storage.
DISTRIBUTION: Distribution of solar heated domestic hot water is by the existing piping network. The piping between the collector and the conventional water heater storage tank are insulated to reduce heat loss.
AUXILIARY ENERGY SYSTEM: Existing electric water heaters provide auxiliary energy should the solar system produce insufficient temperatures or become inoperable.
DOMESTIC HOT WATER SYSTEM: The solar energy system is for domestic hot water heating only. For description of system components see collector, storage and distribution above.
COOLING: Not applicable.

PROJECT INFORMATION

BUILDER: Puerto Rico Housing Corporation
DESIGNERS **ARCHITECT:** Gomez Sampera & Associates
ENGINEER : Solar Products & Devices Inc.
LOCATION: Rio Piedras, Puerto Rico Latitude 18°N.
HOUSING TYPE: Low-Rise Multi-Family
CLIMATIC DATA: **DEGREE DAYS** **HEATING** _____ **COOLING** 2,750 DD
AVE. TEMP. **WINTER** 65 **SUMMER** 85°F.
HORIZ. INSOLATION **JAN.** 400 **JUNE** 640 Ly.

BUILDING DESCRIPTION

The project involves the installation of a solar domestic hot water system on a 12 unit two-story apartment building. The solar collectors are mounted on steel supports located on the building's flat roof. A partial wall surrounds the collectors for protection and visual enclosure. The solar energy system consists of six collector storage modules each serving two apartments.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**_____**COOLING**_____ **DHW** X

COLLECTOR: 216 square feet (36 square per module) liquid-cooled flat-plate manufactured by Solar Products Inc. The collector has a black painted galvanized steel absorber with a plastic or fiberglass cover sheet.

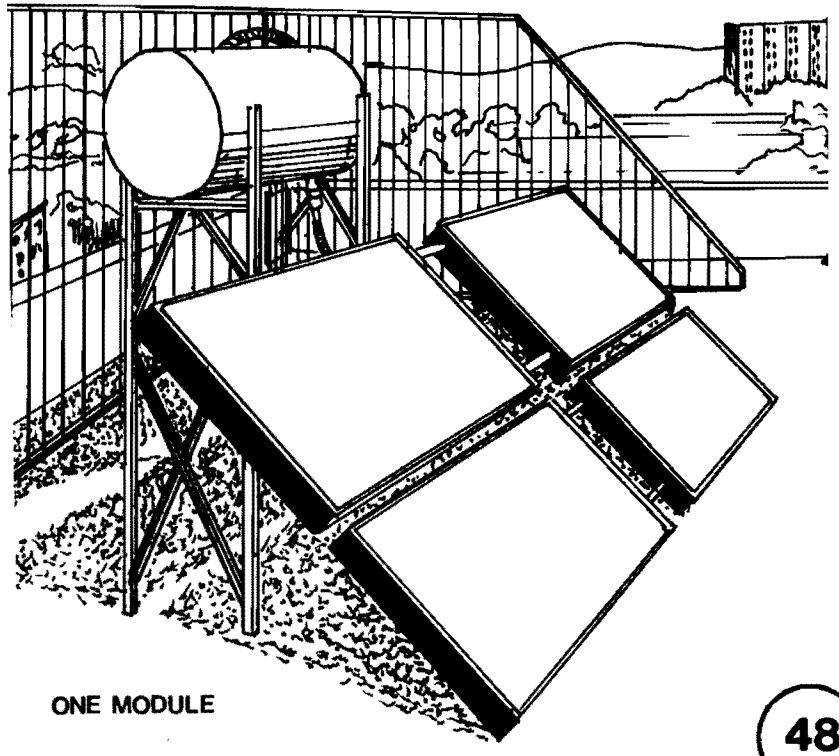
STORAGE: 30 gallons of water within an insulated glass-lined preheat tank located above the collector module with its own preheat tank. The 30 gallon capacity is used in addition to storage within the conventional water heater.

DISTRIBUTION: A thermosyphon arrangement transports heated water from the collector to the preheat tank. Preheated water is distributed by gravity to the conventional water heater located in each apartment.

AUXILIARY ENERGY SYSTEM: An electric heating element supplements the temperature required of preheated water in the conventional heater.

DOMESTIC HOT WATER SYSTEM: See collector, storage and distribution for details.

COOLING: Not applicable.



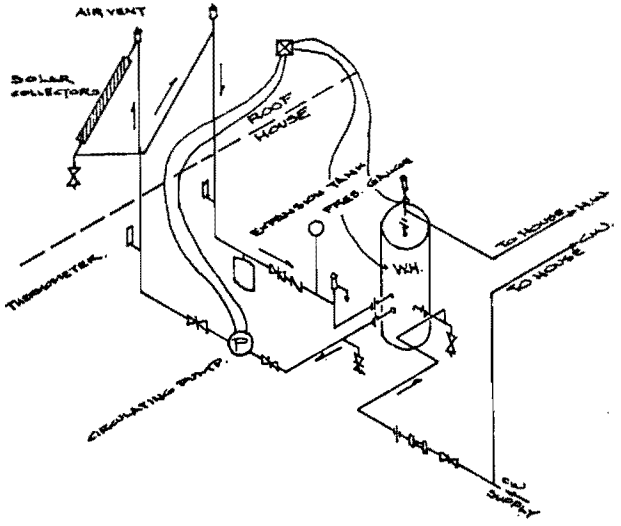
ONE MODULE

PROJECT INFORMATION

BUILDER: Yeonas Co.
DESIGNERS ARCHITECT: Yeonas Co.
ENGINEER : McCombs Solar Co.
LOCATION: Vienna, Virginia Latitude 38° 5' N.
HOUSING TYPE: One Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,224 **COOLING** 800 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 175 **JUNE** 555 Ly.

BUILDING DESCRIPTION

The project outfits one new, single family detached dwellings with solar domestic hot water systems. The solar collectors are mounted on a separate structural frame attached to the house sloping south-facing roof. The frame tilts the collector for year round optimum solar radiation collection.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**_____ **COOLING**_____ **DHW** X
COLLECTOR: 21 square feet liquid-cooled flat-plate manufactured by Sunworks.

STORAGE: 65 gallon tank of a conventional water heater stores preheated water from the collector.

DISTRIBUTION: A copper coil within the storage tank preheats the domestic hot water supply as heated water from the collector circulates through the coil.

AUXILIARY ENERGY SYSTEM: Electric water heater. A conventional water heater with an auxiliary 4.5 KW electric heating element in the tank supplements the preheating system.

DOMESTIC HOT WATER SYSTEM: See collector, storage, distribution, and auxiliary for details.

COOLING: Not applicable.

PROJECT INFORMATION

BUILDER: Drexel University

DESIGNERS **ARCHITECT:** Donald C. Larson
ENGINEER : C. William Savery

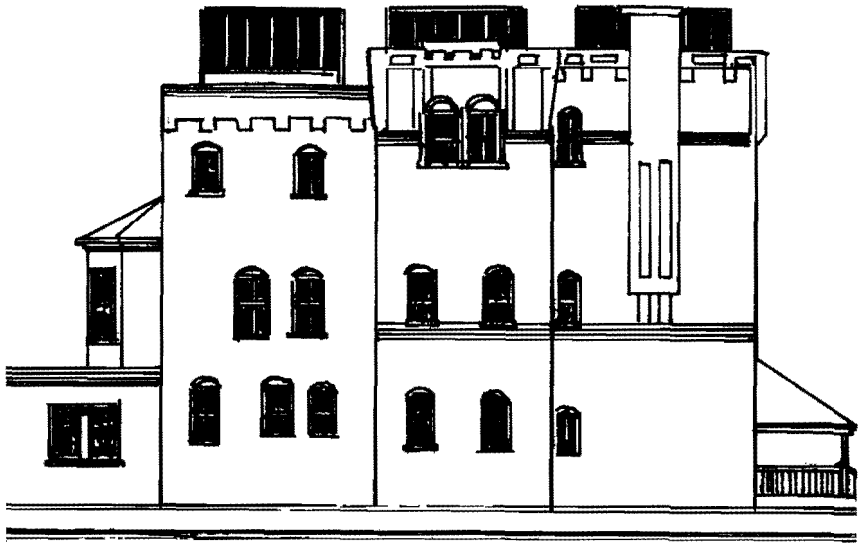
LOCATION: Philadelphia, PA Latitude 40°N.

HOUSING TYPE: Low-Rise Multi-Family

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,400 **COOLING** 700 hrs.
AVE. TEMP. **WINTER** 35 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 520 Ly.

BUILDING DESCRIPTION

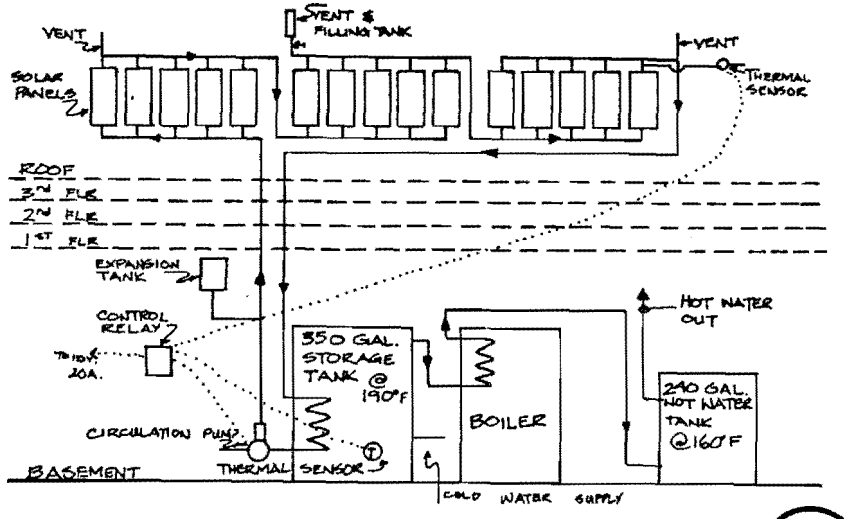
The project involves the rehabilitation and modification of a three-story, five-unit apartment building to include a solar domestic hot water preheating system. The solar collectors are mounted on a structural frame attached to the flat roof. The solar collectors are connected by piping running the height of the building to the storage tank located in the basement. The hot water from the collectors is used to preheat the domestic hot water supply before it passes through a conventional water heater.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 270 square feet liquid-cooled flat-plate manufactured by PPG.



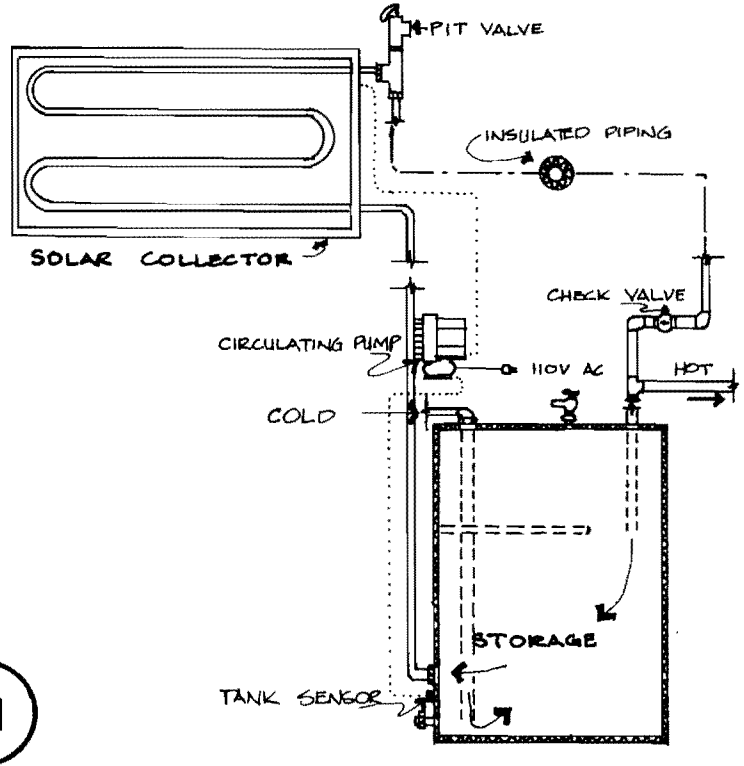
STORAGE: 350 gallons of water within an insulated horizontal cylindrical storage tank located in the basement. Heat is transferred to water storage from the collectors by the use of a heat exchanger.

DISTRIBUTION: Preheated water from the storage tank is circulated through the boiler that maintains a 150°F. temperature in the conventional water heater storage tank.

AUXILIARY ENERGY SYSTEM: Oil-fired boiler. The boiler supplements the preheated water temperature between preheat and regular storage.

DOMESTIC HOT WATER SYSTEM: See collector, storage and distribution above.

COOLING: Not applicable.



PROJECT INFORMATION

BUILDER: Babcock Company

DESIGNERS **ARCHITECT:** Christ Fergis

ENGINEER: Schebke-Shiskin & Associates

LOCATION: Coral Gables, Florida Latitude 25°45'N.

HOUSING TYPE: Single Family Attached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 200 **COOLING** 2,400 hrs.

AVE. TEMP. **WINTER** 65 **SUMMER** 80°F

HORIZ. INSOLATION **JAN.** 350 **JUNE** 540 Ly

BUILDING DESCRIPTION

The project involves adding a solar domestic hot water system to a conventional five unit single family attached dwelling design. The 997 square feet of living space per unit are housed within a concrete masonry structure with a low-pitched reflecting glass, extra insulation, attic ventilation along horizontal soffit areas, a 12" turbine ventilator near the roof ridge, and careful caulking to reduce infiltration losses at all wall penetrations. The solar collectors are located on the sloping south-facing roof of each housing unit.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 24 square feet per apartment liquid-cooled flat-plate manufactured by Capital Solar Heating. Below a double strength glass cover plate is an absorber made of copper tubing and galvanized metal.

STORAGE: The tank of a conventional water heater is used to store solar heated water from the collector.

DISTRIBUTION: Since solar heated water is stored within a conventional water heater distribution is the same as the conventional system.

AUXILIARY ENERGY SYSTEM: Conventional water heater. Solar heated water stored in tank is raised to a useful temperature, if necessary, by a conventional water heater.

DOMESTIC HOT WATER SYSTEM: See collector, storage and distribution for details.

COOLING: Not applicable.

PROJECT INFORMATION

BUILDER: City of Pueblo, Colorado

DESIGNERS **ARCHITECT:** not designated

ENGINEER: Hurtig, Gardner & Froelich

LOCATION: Pueblo, Colorado Latitude 38° N

HOUSING TYPE: Five Single Family Detached

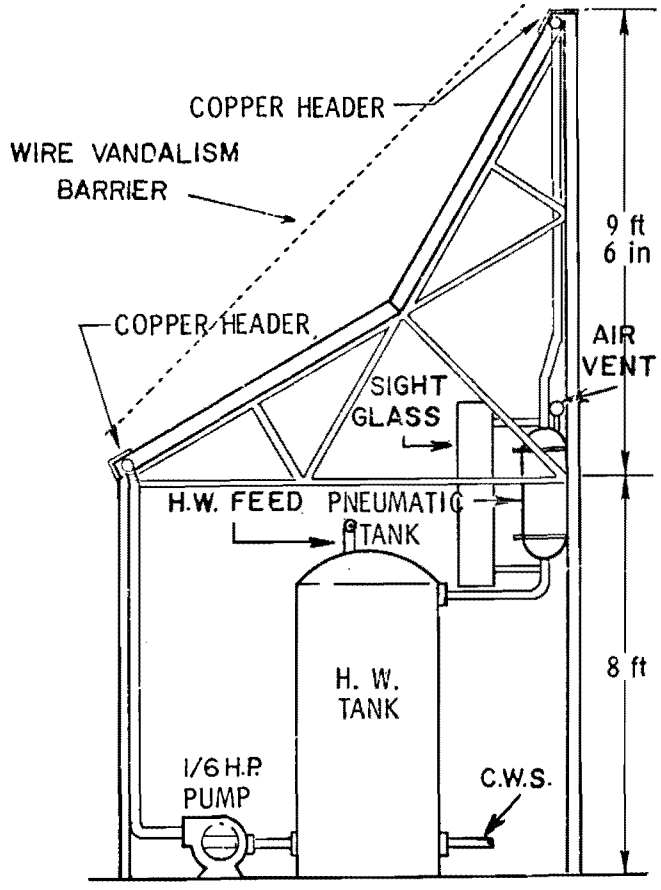
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,400 **COOLING** 900 hrs.

AVE. TEMP. **WINTER** 20 **SUMMER** 60°F.

HORIZ. INSOLATION **JAN.** 240 **JUNE** 630 Ly.

BUILDING DESCRIPTION

The project involves the application of a central solar domestic hot water heating system to five existing single family dwellings. A centrally located detached unit houses the solar collectors, heat storage tank, and necessary pumps and valves. The unit is connected by insulated pipes to the domestic hot water heaters of the five houses. Chicken wire covers the glass collection surfaces for protection from vandalism.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** ____ **COOLING** ____ **DHW** X

COLLECTOR: 144 square feet liquid-cooled flat-plate manufactured by RAYPAK Inc. The system employs an automatic drain down for freeze protection. One-half the collector array is fitted for maximum summer efficiency while the other half is fitted for maximum winter efficiency.

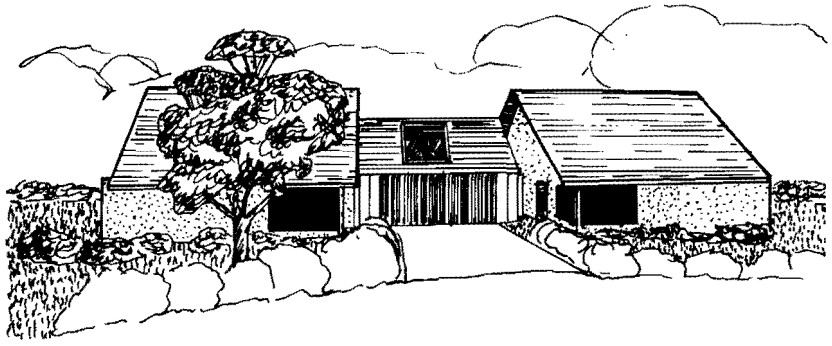
STORAGE: 350 gallons of water stored within a glass lined steel tank. The water circulated through the collectors is pumped to storage and then to the dwellings for distribution and possibly an energy boost.

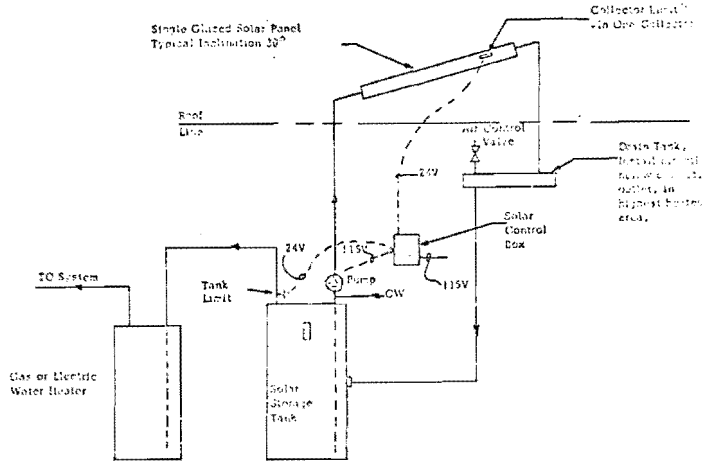
DISTRIBUTION: Underground insulated pipes connect the central collection and storage unit to the conventional water heaters located in each house.

AUXILIARY ENERGY SYSTEM: Gas-fired hot water heater. The existing water heaters are used for individual dwelling hot water storage and for supplying energy boost.

DOMESTIC HOT WATER SYSTEM: The solar energy system is for domestic water hot water heating only. For description of system components, see collector, storage, and distribution above.

COOLING: Not applicable.





PROJECT INFORMATION

BUILDER: Leisure Technology of California, Inc.

DESIGNERS **ARCHITECT:** Leisure Technology of Calif., Inc.
ENGINEER: Raypak, Inc.

LOCATION: Camarillo, California Latitude 35°N.

HOUSING TYPE: Single Family Attached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 2,050 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar domestic hot water preheating system to a 1,200 square foot single family attached dwelling. A single solar collector panel is mounted at the proper orientation and tilt on the dwelling's sloping south-facing roof. The collector is connected to a storage tank located in the basement of the house.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 18 square feet liquid-cooled flat-plate manufactured by Raypak. The black painted absorber consists of an aluminum surface with copper bonded tubes.

STORAGE: 40 gallons of water within an insulated storage tank located in the basement.

DISTRIBUTION: Domestic water is preheated by the collector and stored in the 40 gallon storage tank. The preheated water passes through a conventional water heat where an energy boost may be supplied before being distributed to the house.

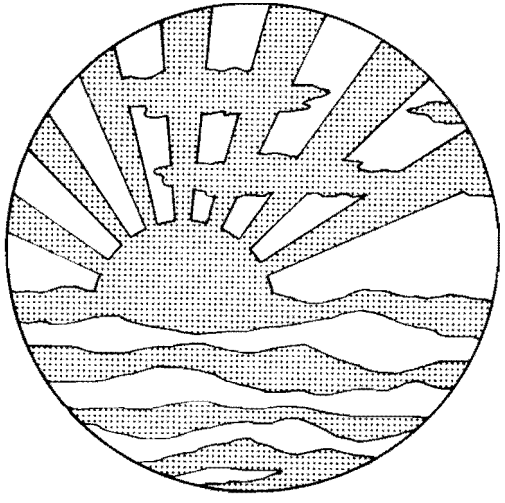
AUXILIARY ENERGY SYSTEM: Electric water heater. 30 gallon electric water heater provides total or partial heating as dictated by temperatures from the preheat tank.

DOMESTIC HOT WATER SYSTEM: Refer to collector, storage, and distribution for details.

COOLING: Not applicable.

CREDITS

This publication has been prepared for the Division of Energy, Building Technology and Standards of the Department of Housing and Urban Development by the AIA Research Corporation. The AIA/RC staff responsible for publication preparation are: Michael Holtz, Project Manager and Editor; Michael Albanes, Technical Writer and Illustrator; Tom Mucha, Graphics Illustrator; and Andi Ashley, Manuscript Typist. Special thanks to Joseph Sherman, Director; David Moore, Program Manager; William Freeborne, Project Coordinator; and Toba Penny, Consultant Division of Energy, Building Technology and Standards, HUD for their assistance and support of this effort.



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