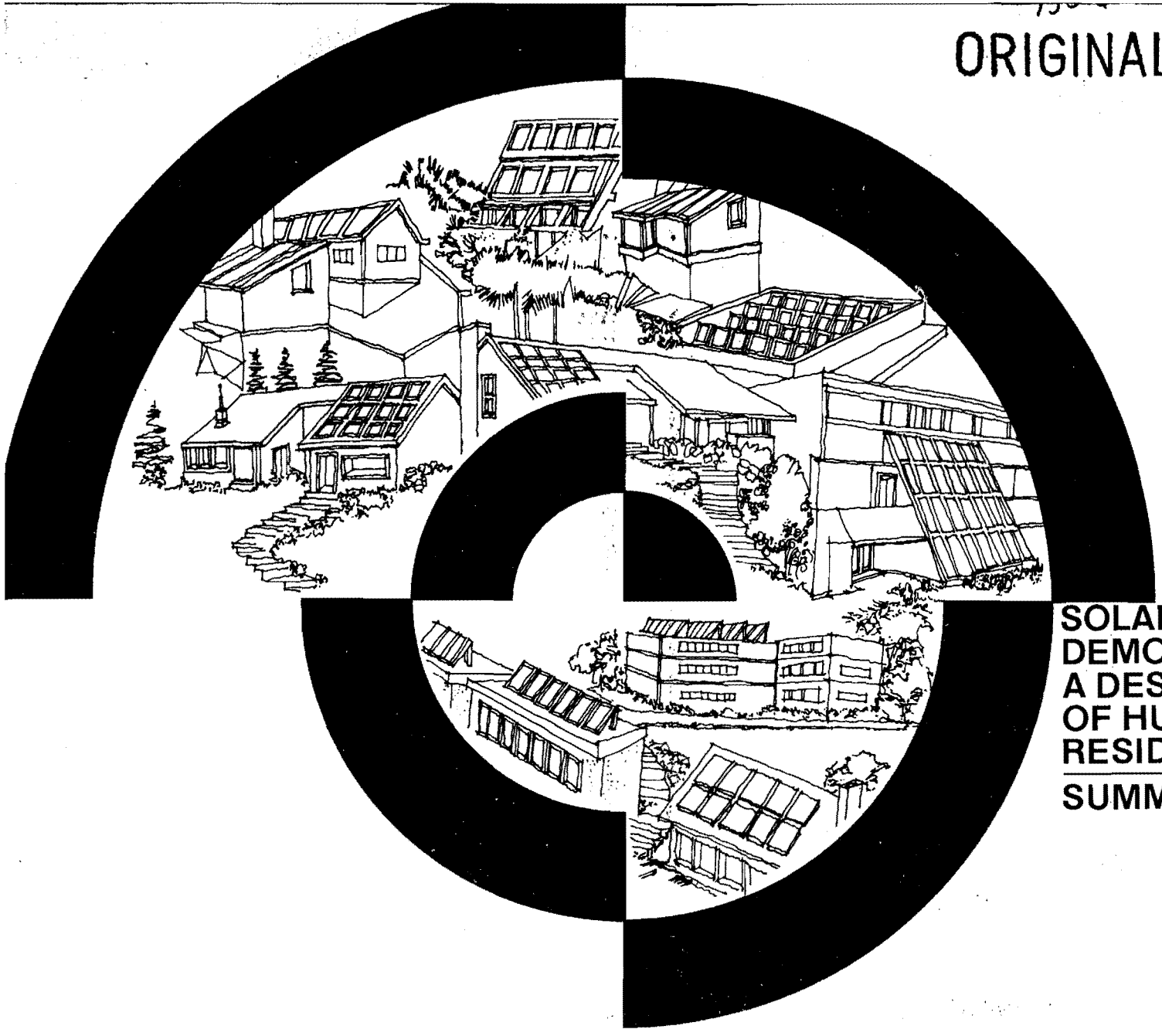
ORIGINAL



SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM A DESCRIPTIVE SUMMARY OF HUD CYCLE 3 SOLAR RESIDENTIAL PROJECTS

SUMMER 1977

U.S. DEPARTMENT OF
HOUSING AND URBAN DEVELOPMENT
OFFICE OF POLICY DEVELOPMENT AND RESEARCH
Division of Energy, Building Technology and Standards
in cooperation with the Department of Energy

preface

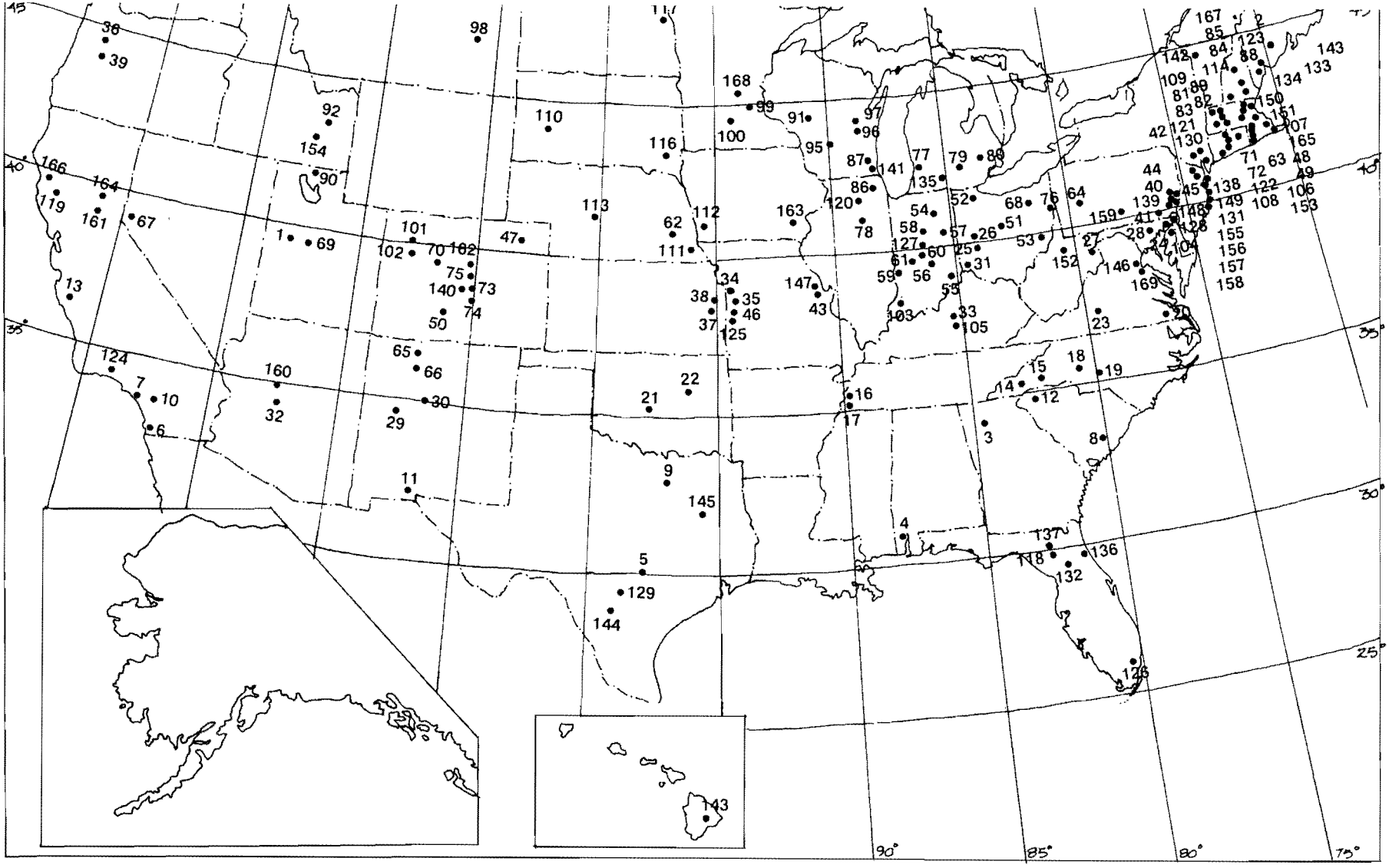
The award of more than $6 million in grants to buy and install solar energy equipment in 3,468 residences was announced on May 31, 1977 by the Department of Housing and Urban Development. In a national effort to generate widespread use of solar energy, HUD is sponsoring five cycles of demonstration residential structures with solar heating and cooling systems.

The application forms for the HUD third cycle of solar residential demonstration projects were issued in January 1977, and over 700 applications were received in response to the invitation. A total of 3,468 housing units were selected.

Some projects may have been withdrawn or changed in this third demonstration program prior to the start of construction.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 grants have taken place. 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 building, and describes the solar energy system.

We hope that this publication will help in developing information on systems and market practices that will further encourage the use of solar energy technology, and will add to the public's awareness of solar energy as an alternative energy source.



November 1977
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lists of projects

Project No.	Builder/ Applicant	System Type	System Function	No. & Type Dwelling	New/ Retrofit	DD/ YR	Project Location
1	IPK Corporation	Active	H	3 SFD	New	5983	Granger, UT
2	Pleasant Pt. Passamaquoddy Reserv.	Active	H	1 SFD	New	9767	Perry, ME
3	Harbor Oaks Apartments	Active	H	40 MF Low	Retrofit	2983	Decatur, GA
4	Edsel Inc.	Active	HW	1 SFD	New	1560	Mobile, AL
5	Carl Morris Custom Builder	Active	HW	1 SFD	New	1711	Austin, TX
6	San Diego Estates & Gas & Electric Co.	Active	HW	1 SFD	New	2006	Ramona, CA
7	Creative Real Estate Development, Inc.	Active	HW	2 SFD	New	2061	Trabuco Canyon, CA
8	Everett A. Knight Agency	Active	HW	2 SFD	New	2336	Summerville, SC
9	Brad Popkin, Inc.	Active	HW	1 SFD	New	2363	Carrollton, TX
10	Ortiz & Reill Developers	Active	HW	12 SFD	New	2660	Escondido, CA
11	Lambert & Winton	Active	HW	20 SFD	New	2770	Santa Teresa, NM
12	Batesville Property Association	Active	HW	3 SFD	New	2884	Greenville, SC
13	Mar-Mac Development, Inc.	Active	HW	2 SFD	New	3030	Monterey, CA
14	Morgan Chapel Enterprises	Active	HW	2 SFD	New	3191	Columbus, NC
15	Habitat 2000 Inc.	Active	HW	1 SFD	New	3191	Pineville, NC
16	Acropolis Joint Venture	Active	HW	1 SFD	New	3232	Memphis, TN
17	Rainey Bros. Construction, Inc.	Active	HW	1 SFD	New	3232	Memphis, TN
18	Page Associates, Inc.	Active	HW	1 SFD	New	3393	Pinehurst, NC
19	L&O Investments, Inc.	Active	HW	1 SFD	New	3393	Fayetteville, NC
20	S. M. Nichols, Builder	Active	HW	1 SFD	New	3393	Williamsburg, VA
21	Moore-Norman Vo-Tech Foundation, Inc.	Active	HW	1 SFD	New	3725	Norman, OK
22	Conners Construction Co., Inc.	Active	HW	3 SFD	New	3725	Tulsa, OK
23	Solar Structures	Active	HW	1 SFD	New	4166	Lynchburg, VA
24	Duerbeck Building Corp.	Active	HW	1 SFD	New	4204	Jarretsville, MD
25	Caprice Builders, Inc.	Active	HW	1 SFD	New	4216	Troy, OH
26	First Piqua Corp.	Active	HW	1 SFD	New	4218	Piqua, OH
27	Middle Creek Investment Corp.	Active	HW	6 SFD	New	4224	Inwood, WV
28	Damascus Land Corp.	Active	HW	1 SFD	New	4224	Damascus, MD
29	Sandia Homes, Inc.	Active	HW	1 SFD	New	4345	Albuquerque, NM
30	Public Service Co. of New Mexico	Active	HW	25 SFD	New	4361	Rio Rancho/ El Dorado, NM
31	Universal Homebuilders, Inc.	Active	HW	2 SFD	New	4407	Fairfield, OH
32	Ray L. Hasse	Active	HW	1 SFD	New	4456	Prescott, AZ
33	Whitman & Associates, Inc.	Active	HW	1 SFD	New	4683	Lexington, KY
34	Bond Construction Co.	Active	HW	1 SFD	New	4711	Gladstone, MO
35	Bond Construction Co.	Active	HW	1 SFD	New	4711	Gladstone, MO

40	William Pelton Inc.	Active	HW	1 SFD	New	4855	Bryn Mawr, PA
41	Christopher Shipp Productions	Active	HW	1 SFD	New	4865	West Grove, PA
42	Pomona Heights, Inc.	Active	HW	1 SFD	New	4871	Pomona, NY
43	Parkton Development Co.	Active	HW	1 SFD	New	4900	Barnhart, MO
44	Regent Valley Builders, Inc.	Active	HW	1 SFD	New	5000	Milford Twshp., PA
45	Regent Valley Builders, Inc.	Active	HW	1 SFD	New	5000	Towamenan Twshp., PA
46	Ed Thomas & Associates	Active	HW	1 SFD	New	5050	Richmond, MO
47	Fossil Creek Meadows Realty	Active	HW	1 SFD	New	5396	Ft. Collins, CO
48	Sundman Realty Co.	Active	HW	1 SFD	New	5630	Monument Beach, MA
49	Indian Cove Associates	Active	HW	5 SFD	New	5634	Marion, MA
50	United Construction of Colorado	Active	HW	2 SFD	New	5639	Canon City, CO
51	Davidson Phillips Inc.	Active	HW	1 SFD	New	5660	Columbus, OH
52	Boyle & Schey Builders	Active	HW	5 SFD	New	5660	Findlay, OH
53	Sims Brothers Builders	Active	HW	3 SFD	New	5660	Marietta, OH
54	Vernon O. Freeman	Active	HW	1 SFD	New	5699	Muncie, IN
55	Steinkamp and Co.	Active	HW	1 SFD	New	5699	Batesville, IN
56	Ron Smith Custom Builder, Inc.	Active	HW	1 SFD	New	5699	Greenwood, IN
57	Graber Homes, Inc.	Active	HW	1 SFD	New	5699	Fort Wayne, IN
58	W. J. Leffel Construction	Active	HW	1 SFD	New	5699	Peru, IN
59	Stan Peebles & Company	Active	HW	1 SFD	New	5699	Terre Haute, IN
60	R&R Builders, Inc.	Active	HW	1 SFD	New	5699	Fountaintown, IN
61	Miles Richmond Inc.	Active	HW	1 SFD	New	5699	Liberty, IN
62	Peterson Construction Co.	Active	HW	1 SFD	New	5864	Lincoln, NE
63	M. F. Smith Associates	Active	HW	1 SFD	New	5954	Jamestown, RI
64	Walnut Ridge	Active	HW	1 SFD	New	5989	N. Franklin Twp., PA
65	Schepps Construction	Active	HW	1 SFD	New	6007	Santa Fe, NM
66	Stanley Associates	Active	HW	1 SFD	New	6007	Santa Fe, NM
67	Frontier Development Co.	Active	HW	5 SFD	New	6037	Silver Knolls, NV
68	Alpha Construction Co.	Active	HW	4 SFD	New	6037	Canton, OH
69	Tios Corporation	Active	HW	1 SFD	New	6052	Salt Lake City, UT
70	Colorado Rural Housing Development Corp.	Active	HW	10 SFD	New	6132	Ft. Lupton, CO
71	William Francini	Active	HW	1 SFD	New	6172	Unionville, CT
72	The Madrid Corp.	Active	HW	1 SFD	New	6172	Tolland, CT
73	Witkin Homes, Inc.	Active	HW	1 SFD	New	6283	Denver, CO
74	Gutrich Development Co., Inc.	Active	HW	1 SFD	New	6283	Aurora, CO
75	Douglas E. Myers	Active	HW	1 SFD	New	6283	Boulder, CO
76	Volpini & Sorice Builders	Active	HW	1 SFD	New	6417	Poland Twshp., OH
77	Sanford & Son, Builders	Active	HW	1 SFD	New	6668	Benton Harbor, MI
78	Sungate Construction Co.	Active	HW	2 SFD	New	6845	Kingston, IL

Project No.	Builder/ Applicant	System Type	System Function	No. & Type Dwelling	New/ Retrofit	DD/ YR	Project Location
79	Sam Eyde Construction Co.	Active	HW	1 SFD	New	6928	East Lansing, MI
80	Gerholz Community Homes	Active	HW	1 SFD	New	7041	Flint, MI
81	Hammerhead Construction Co.	Active	HW	2 SFD	New	7053	Westfield, MA
82	Landgraf Associates, Inc.	Active	HW	2 SFD	New	7053	Springfield, MA
83	Joseph Real Estates & Development	Active	HW	1 SFD	New	7053	West Springfield, MA
84	Barrett Mountain	Active	HW	2 SFD	New	7237	New Ipswitch, NH
85	First Fidelity Service Corp.	Active	HW	3 SFD	New	7250	Nashua, NH
86	Robert M. Roloson	Active	HW	1 SFD	New	7268	Lake Forest, IL
87	Zien Mechanical Contractors	Active	HW	1 SFD	New	7444	Milwaukee, WI
88	Aidco Maine Corp.	Active	HW	1 SFD	New	7511	Harpswell, ME
89	Plantation Valley Homes, Inc.	Active	HW	1 SFD	New	7519	Amherst, MA
90	Villatek	Active	HW	1 SFD	New	7582	Logan, UT
91	Nelson-Lewis Construction	Active	HW	1 SFD	New	7589	Osceola, WI
92	Cascade Construction	Active	HW	1 SFD	New	7591	Rexburg, ID
93	Sun Spec	Active	HW	1 SFD	New	7650	Kalispell, MT
94	Fort Belknap Indian Community	Active	HW	5 SFD	New	7650	Harlem, MT
95	J. A. Verthein Construction Co.	Active	HW	1 SFD	New	7723	Baraboo, WI
96	Robert J. Zimmerman	Active	HW	1 SFD	New	7748	Eldorado, WI
97	Family Homes United, Inc.	Active	HW	5 SFD	New	7863	Winneconne, WI
98	Northern Cheyenne Indian Housing Authority	Active	HW	5 SFD	New	7870	Lame Deer, MT
99	Hobmar Homes, Inc.	Active	HW	1 SFD	New	7944	Minnetonka, MN
100	Professional Builders, Inc.	Active	HW	1 SFD	New	8816	Hutchinson, MN
101	Grand County Fuel & Supply Co.	Active	HW	1 SFD	New	10800	Granby, CO
102	JMC & Charles Schiffer Associates	Active	HW	20 SFD	New	10926	Silver Thorne, CO
		Active	HW	8 SFA	New	10926	Silver Thorne, CO
103	Trica Corporation	Active	HW	8 SFA	New	4435	Newburgh, IN
104	Centennial Development & Building Corp.	Active	HW	15 SFA	New	4654	Baltimore, MD
105	Philip Sims	Active	HW	2 SFA	New	4683	Lexington, KY
106	Laura L. Baker	Active	HW	5 SFA	New	5630	Falmouth, MA
107	Corcoran, Mullins, Jennison	Active	HW	2 SFA	New	5630	Brewster, MA
108	Frank Chapman	Active	HW	5 SFA	New	5897	New Haven, CT
109	Friends Community Development	Active	HW	69 SFA	New	6367	Northeastern, MA
110	Harney Lumber Co.	Active	HW	12 SFA	New	6483	Rapid City, SD
111	Quadro, Inc.	Active	HW	6 SFA	New	6612	Plattsmouth, NE
112	Glenwood Housing, Inc.	Active	HW	8 SFA	New	6612	Glenwood, IA
113	Callaway Housing Corp.	Active	HW	8 SFA	New	6673	Callaway, NE
114	Forest Park Village	Active	HW	12 SFA	New	7360	North Conway, NH
115	Blackfeet Indian Tribe	Active	HW	10 SFA	New	7650	Cut Bank, MT
116	Environmental Contact	Active	HW	4 SFA	New	8115	Sioux Falls, SD
117	Liberty Estates Developers	Active	HW	12 SFA	New	8865	Grand Forks, ND

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
121	South Bronx Community Housing Corp.	Active	HW	8 MF Low	Retrofit	5219	New York, NY
122	Utility Electrical Contractors	Active	HW	52 MF Low	Retrofit	5897	Hamden, CT
123	Oak Street Associates	Active	HW	91 MF Mid	Retrofit	7511	Lewiston, ME
124	L&S Operating Co.	Active	HW	317 MF High	Retrofit	1390	Santa Monica, CA
125	Bond Construction Co.	Active	W	1 SFD	New	4900	Gladstone, MO
126	Hialeah Housing Authority	Active	W	25 SFD	Retrofit	141	Hialeah, FL
127	Historic Landmarks Foundation of Indiana	Active	W	1 SFD	Retrofit	5699	Indianapolis, IN
128	Bestfield Builders	Active	W	14 SFA	New	4930	Wilmington, DE
129	Starr Homes	Active	W	3 SFA	Retrofit	1549	Lago Vista, TX
130	Sunset Park Redevelopment Committee, Inc.	Active	W	4 SFA	Retrofit	5219	New York, NY
131	Bedford-Stuyvesant Restoration Corp.	Active	W	10 SFA	Retrofit	5219	New York, NY
132	Kissimmee Court Apartments	Active	W	87 MF Low	Retrofit	766	Kissimmee, FL
133	John M. Corcoran & Co.	Active	W	24 MF Low	New	6368	Saugus, MA
134	Raynham Housing Authority	Active	W	62 MF Low	New	6612	Raynham, MA
135	Willow Creek II Ltd. Partnership	Active	W	71 MF Low	New	6909	Kalamazoo, MI
136	Embry Riddle Aeronautical University	Active	W	186 MF Low	Retrofit	879	Daytona Beach, FL
137	University of Florida—Housing Div.	Active	W	8 MF Low	Retrofit	1599	Gainesville, FL
138	Ferry Street Group—N.J. School of Architecture	Active	W	1 MF Low	Retrofit	4859	Newark, NJ
139	Hollow Run Associates	Active	W	30 MF Low	Retrofit	5101	Havertown, PA
140	Denver Housing Authority	Active	W	8 MF Low	Retrofit	6283	Denver, CO
141	Lincoln Lutheran	Active	W	50 MF Low	Retrofit	7635	Racine, WI
142	Cathedral Square Corp.	Active	W	100 MF Mid	New	8269	Burlington, VT
143	Diamond Head Alii Corp.	Active	W	54 MF Mid	Retrofit	0	Honolulu, HI
144	Housing Authority of San Antonio	Active	W	100 MF Mid	Retrofit	1549	San Antonio, TX
145	Navarro College	Active	W	25 MF Mid	Retrofit	3154	Corsicana, TX
146	Barcroft Council Co-Owners	Active	W	140 MF Mid	Retrofit	4224	Falls Church, VA
147	Pantheon Corp.	Active	W	112 MF Mid	Retrofit	4900	St. Louis, MO
148	The Fumo-Manfredi Partnership	Active	W	9 MF Mid	Retrofit	5101	Philadelphia, PA
149	Jefferson Adams Rehabilitation Company	Active	W	172 MF Mid	Retrofit	5219	Hoboken, NJ

Project No.	Builder/ Applicant	System Type	System Function	No. & Type Dwelling	New/ Retrofit	DD/ YR	Project Location
150	Gloucester Housing Authority	Active	W	97 MF Mid	Retrofit	5634	Gloucester, MA
151	Hancock House Realty Trust	Active	W	92 MF Mid	Retrofit	5634	Qunicy, MA
152	City of Clarksburg	Active	W	21 MF Mid	Retrofit	5675	Clarksburg, WV
153	Worcester Polytechnical Institute	Active	W	36 MF Mid	Retrofit	6969	Worcester, MA
154	Idaho State University	Active	W	160 MF Mid	Retrofit	7033	Pocatello, ID
155	Lefrak Organization	Active	W	96 MF High	New	5219	New York City, NY
156	Mounthatten Equities	Active	W	188 MF High	Retrofit	5219	New York City, NY
157	924 West End Avenue, Inc.	Active	W	68 MF High	Retrofit	5219	New York City, NY
158	Lefrak Organization	Active	W	207 MF High	Retrofit	5219	New York City, NY
159	United Methodist Home for the Aging	Active	W	150 MF High	New	5987	Mechanicsburg, PA
160	Hullco Construction Company	Passive	H	1 SFD	New	4456	Prescott, AZ
161	Living Systems & Jonathan Hammond	Passive	HCW	1 SFD	New	2819	Davis, CA
162	Colorado Sunworks Partnership	Passive	HCW	1 SFD	New	6360	Lorgmont, CO
163	Werner, Nowysz, & Pattschill	Passive	HCW	1 SFD	New	6711	Iowa City, IA
164	John Delapp Design & Construction	Hybrid	HW	1 SFD	New	2819	Davis, CA
165	R. L. Seaberg Assoc.	Hybrid	HW	1 SFD	New	5630	Cotuit, MA
166	Sun House Design & Environmental Design	Hybrid	HW	1 SFD	New	6672	Bodega Bay, CA
167	Stylecraft Homes, Inc.	Hybrid	HW	1 SFD	New	7694	Keene, NH
168	Gridley Construction Company	Hybrid	HW	1 SFD	New	8382	Maple Grove, MN
169	Strawbridge Square Associates	Hybrid	HW	12 SFA	New	4224	Fairfax County, VA

The use of solar energy for residential heating, cooling and domestic water heating is rapidly emerging as a viable and cost effective alternative to our present energy resources. This is due not only to the growing cost of non-renewable fossil fuels and the availability of solar equipment, but also to increasing consumer acceptance and confidence in solar heating and cooling. The fact that the number and variety of locations of solar heated and cooled buildings has increased dramatically over the last several years has contributed significantly to this growing consumer confidence. No longer is solar energy simply an article in the paper or weekly magazine or a brief television commercial, it is a building that can be seen down the street or over in the next town. It is this exposure to the actual workings of a solar system that has increased understanding and built confidence.

People are beginning to think more about the climate in which they live, its influence on the amount of energy they need for heating in winter and cooling in summer, how their lifestyles as well as their houses influence energy use, and about what they can expect from solar energy in their location. This level of thinking has resulted in an increased interest in working with energy from the sun. Since the sun cannot be isolated from the other environmental forces affecting a building, the development of solar energy use demands an integrated approach to conditioning a building, by responding to all environmental forces: vegetation, topography, drainage, soils, microclimate. The sun, in combination with the environment, can produce a more natural and affordable heating and cooled environment for the changing future.

In response to these developments, the Solar Heating and Cooling Demonstration Act of 1974 authorized an extensive research, development and demonstration program of solar heating and cooling systems in buildings. As part of the ongoing national program, directed by the Department of Energy, the residential demonstration program managed by HUD is designed to:

- finance solar systems in both new and existing dwellings
- develop performance criteria and test procedures for solar dwellings
- disseminate solar heating and cooling information
- undertake market development efforts to encourage the rapid and widespread acceptance of solar heating and cooling technologies by the housing industry throughout the U.S.

The present HUD Solar Demonstration Program is building upon earlier efforts to establish solar energy as a viable energy alternative and to encourage the use of solar energy by the designer, the builder, and the consumer in residential applications. The solar heated and/or cooled dwellings illustrated on the following pages represent the third series of projects selected under the HUD program. One important step for the development of these objectives is the distribution of information. Therefore this third publication describing the solar demonstration projects selected for HUD grants is being issued. The projects are organized by system type, building type, and degree day location, as presented in the list of projects. Within each project summary, three areas of concern are documented in order to provide a clear and concise understanding of the project. THE PROJECT INFORMATION section presents general background and climatic data. A brief discussion of the dwellings' energy conservation features, factors which improve the systems efficiency considerably, is found in the BUILDING DESCRIPTION/ENERGY CONCERNS section. The components and the relationships between components in the solar energy system are described in the final SOLAR ENERGY SYSTEM section.

A more specific glossary of terms applying to each section is found in the appendix along with maps of climatic design conditions.

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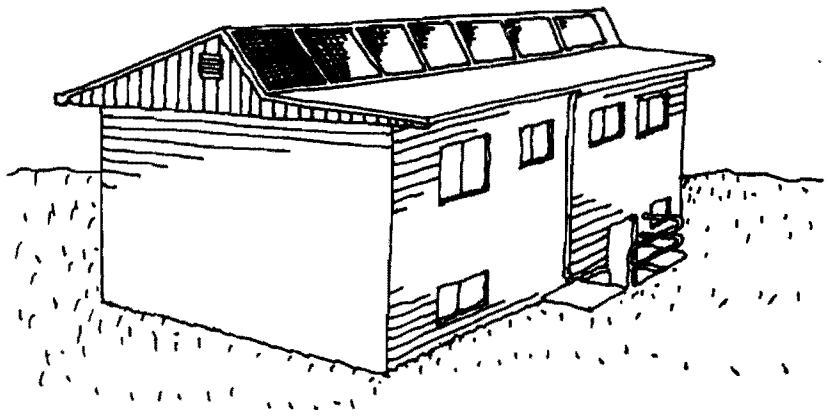
project summaries



PROJECT INFORMATION:

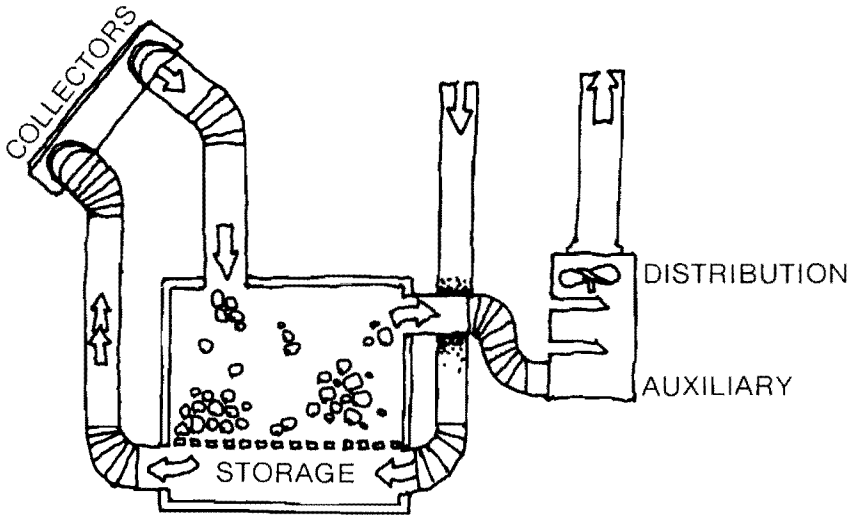
BUILDER/APPLICANT: IPK Corporation
DESIGNER: Gordon Young
SOLAR SUB: Griep Heating
LOCATION: Granger, UT
HOUSING TYPE: SFD, 3 Units
CLIMATIC DATA:
HEATING DD: 5,983
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 603 BTU/sq. ft.

LATITUDE: 40°46'N
AREA: 1,500 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 70%

BUILDING DESCRIPTION/ENERGY CONCERNS

This two level single family detached home has 1,500 sq. ft. of living space, including 3 bedrooms. The building envelope is well sealed to reduce heat losses. The roof has 14" of blown insulation, the walls and the floors have 6" of batt insulation. Also, the window surfaces, which are subject to high heat losses, are double pane to reduce the loss. There are 3 similar houses being built in this project.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating
PREDICTED SOLAR CONTRIBUTION: 40%

COLLECTOR: 171 sq. ft. of Griep Heating flat plate collectors are used in this system. The panels are mounted directly onto the roof and face directly south at a 56° tilt. Air is drawn through the panels, heated, and blown to a rock storage area.

STORAGE: 286 sq. ft. of rock storage is located in a concrete bin in the basement. The bin has 2" rigid insulation.

DISTRIBUTION: The heated air in storage is blown to the space by a fan in the auxiliary unit.

AUXILIARY ENERGY SYSTEM: An electric heater with 34,000 BTUH capacity provides auxiliary heating.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house.

UTAH
5983 DD
3 SFD NEW
ACTIVE HEATING
1

HEATING DD: 8,380
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 492 BTU/sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 58%

8380 DD

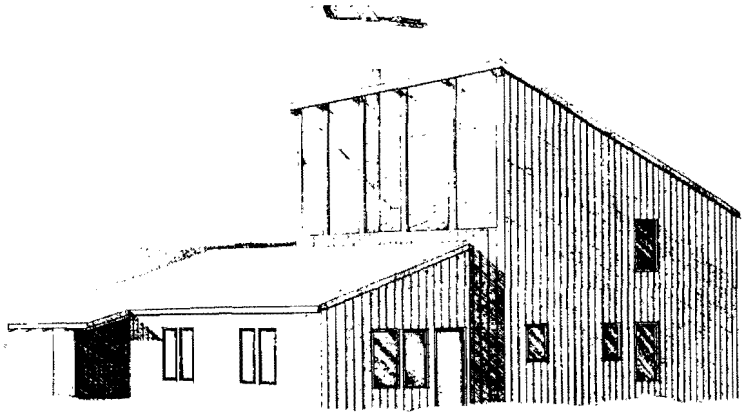
1 SFD NEW

ACTIVE HEATING

2

BUILDING DESCRIPTION/ENERGY CONCERNS

These two single family detached homes each have 1,440 sq. ft. of living space and five bedrooms. Huge south facing windows in the attic space protect 200 sq. ft. of solar collectors. The outer walls are insulated with 6 in. of batt insulation and the roof has 3 inches of rigid insulation. The attic and the rest of the house can be vented, for summer cooling.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating
PREDICTED SOLAR CONTRIBUTION: 51%

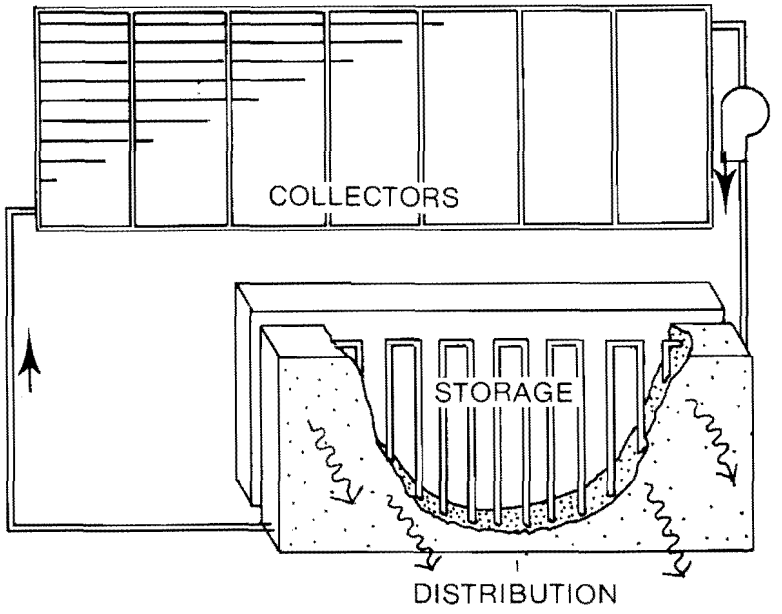
COLLECTOR: Ten Sunworks collectors—a total of 200 sq. ft.—are rack mounted on the attic floor at an angle of 20° facing 10° west of south. Sunlight passing through iron free glass activates a light sensor and opens and closes a huge trap door which acts as movable insulation.

STORAGE: Solar heated water from the collectors are circulated through pipes in two concrete storage walls (362 sq. ft.) and returned to the collectors.

DISTRIBUTION: Natural radiation from the storage walls heats the living space.

AUXILIARY ENERGY SYSTEM: A conventional oil-fired boiler for baseboard hot water heating provides 86,000 BTUH of backup and auxiliary energy.

MODES OF OPERATION: Collector to storage to house, auxiliary to house.



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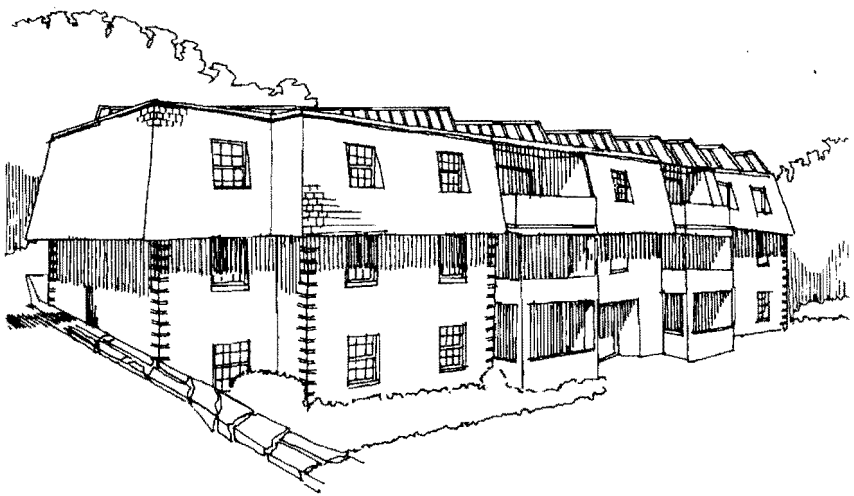
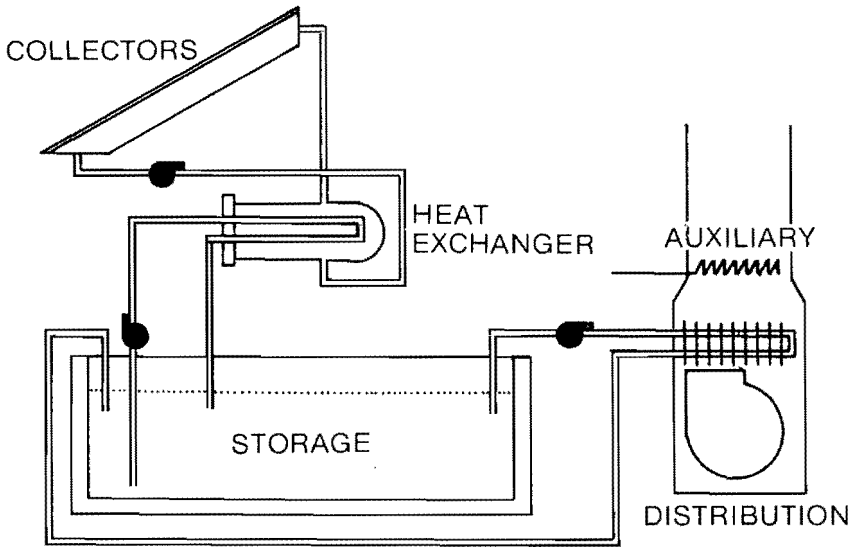




PROJECT INFORMATION:

BUILDER/APPLICANT: Harbor Oaks Apartments
DESIGNER: J. E. Haley & J. W. Stephens
SOLAR SUB: L. S. Bowers & J. W. Stephens
LOCATION: Decatur, GA
LATITUDE: 34°40'N
HOUSING TYPE: MF Low, 40 Units
AREA: 1,100 sq. ft.
CLIMATIC DATA:
HEATING DD: 2,983
DESIGN TEMP: WINTER: 20° F
HORIZ. INSOL. JAN. DAY: 807 BTU/ sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 60%

BUILDING DESCRIPTION/ENERGY CONCERNS

Four garden apartments within a large complex are being retrofitted with a solar system for space heating. Three of the buildings house 2-bedroom apartments, with 950 sq. ft. in each and the fourth building has 3 bedroom apartments with 1,100 sq. ft. in each. There is a total of 40 units in the project.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating
PREDICTED SOLAR CONTRIBUTION: 89%

COLLECTOR: The flat plate collectors are rack mounted on the flat roof of these buildings and cover a total area of 7,000 sq. ft. (2,500 sq. ft. on the 3 bedroom building and 1,500 sq. ft. on each 2 bedroom building). The collectors are manufactured by Scientific Atlanta and use a silicone based fluid to carry collected heat to a central heat exchanger.

STORAGE: Concrete block tanks, sealed and waterproofed, provide 6,000 gallons of solar storage, holding the water which has been heated in the heat exchanger. The tanks are located on the basement floor of each building and have volumes of 1,500 gallons (2 bedroom building), and 2,500 gallons (3 bedroom building).

DISTRIBUTION: Heated storage water is pumped through a coil in the supply air duct of the hot air distribution system.

AUXILIARY ENERGY SYSTEM: An electric resistance strip, also located in the supply air duct, provides auxiliary heat.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house.

GEORGIA
2983 DD
MF LOW RETRO
ACTIVE HEATING
3

ALA

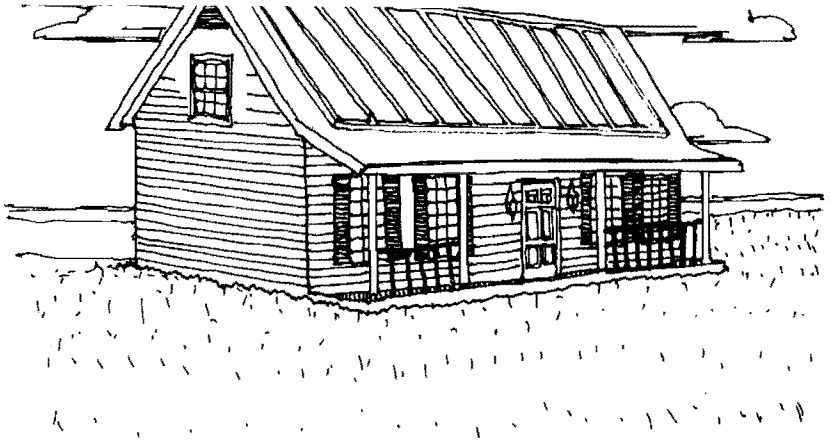
1560 DD

1 SFD NEW

ACTIVE HEATING & DHW

HEATING DD: 1,560
DESIGN TEMP: WINTER: 24° F
HORIZ. INSOL. JAN. DAY: 792 BTU/sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 64%



BUILDING DESCRIPTION/ENERGY CONCERNS

This house has 2,000 sq. ft. of living area and 4 bedrooms. The south wall of the house is shaded by a porch, limiting the heat gain during the summer to reduce the demand on the cooling system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 89%

COLLECTOR: The house has 471 sq. ft. of Revere flat plate collectors located on the south facing roof at a 40° angle. Water is the heat transfer medium and carries the sun's heat to storage.

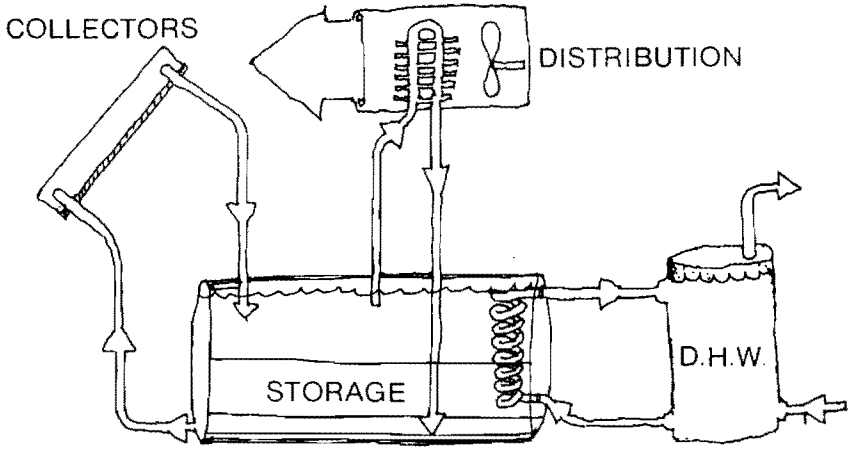
STORAGE: A 2,000 gallon water tank, located in a storage building attached to the house, stores collected heat. "2" of polyurethane surrounds the tank to prevent heat loss.

DISTRIBUTION: A coil in the air supply duct transfers heat from storage water to air, for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heat as needed, and helps cool the house in the summer.

DOMESTIC HOT WATER: Water from a 80 gallon hot water storage tank passes through a coil immersed in storage. The preheated water is returned to the storage tank until it is needed. When needed, it is pumped to a 40 gallon conventional DHW heater where it is brought up to operating temperature and then supplied to the house.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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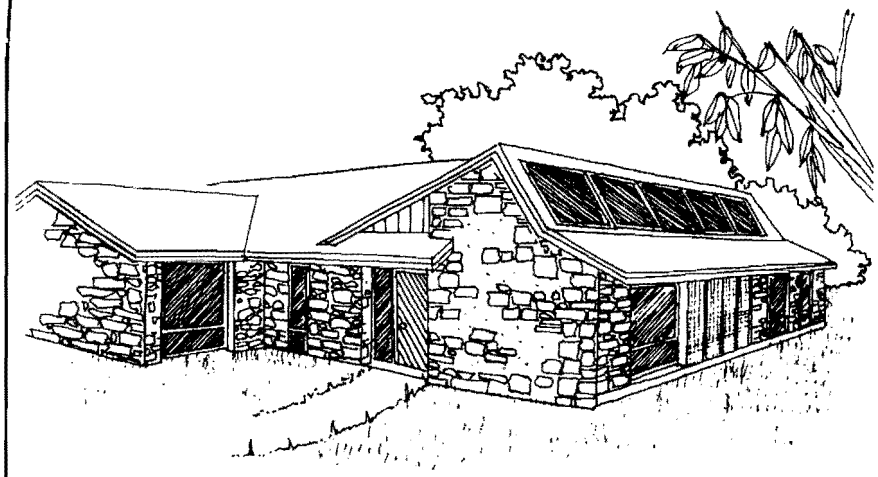
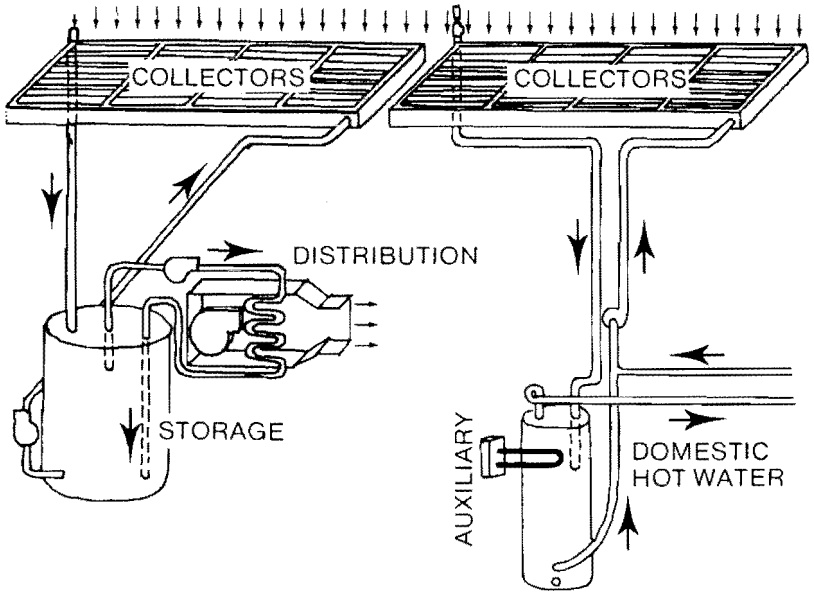




PROJECT INFORMATION:

BUILDER/APPLICANT: Carl Morris Custom Builder
DESIGNER: W. R. Coleman
SOLAR SUB: Austin Heating & Cooling
LOCATION: Austin, TX
LATITUDE: 30°02'N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,183 sq. ft.
CLIMATIC DATA:
HEATING DD: 1,711
DESIGN TEMP:
DESIGN TEMP: WINTER: 29° F
INDOOR: 73° F
HORIZ. INSOL. JAN. DAY: 1,032 BTU/sq. ft.
% SUN/YR: 63%

BUILDING DESCRIPTION/ENERGY CONCERNS

A number of energy conserving features designed to reduce heat loss have been incorporated into this 3-bedroom, 2,183 sq. ft. home. The house is protected from the winds by trees and by a garage to the north. The main entry, on the west side of the house, is recessed to offer protection from the winter winds and minimize heat gain. Generous roof overhangs on the south also help to reduce heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 79%

COLLECTOR: Cole Solar Systems manufactured the collectors used in this project. The liquid flat plate collectors have been mounted on the south side of the roof at a 45° angle. Water serves as the transfer media, and freezing is prevented by circulating hot water through the collector.

STORAGE: A 400 gallon water tank provides storage for the solar system. The tank is protected against heat loss by 3½" of insulation.

DISTRIBUTION: Solar heated water is circulated through a coil in the air ducts, for hot air distribution.

AUXILIARY ENERGY SYSTEM: Auxiliary heat is provided by an electric resistance coil in the air ducts.

DOMESTIC HOT WATER: A separate set of collectors, also manufactured by Cole Systems, help to provide hot water for domestic use. City water is pumped directly through the collector for solar preheating and then to the conventional DHW system.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house DHW preheat.

TEXAS
1711 DD
1 SFD NEW
ACTIVE HEATING & DHW
5

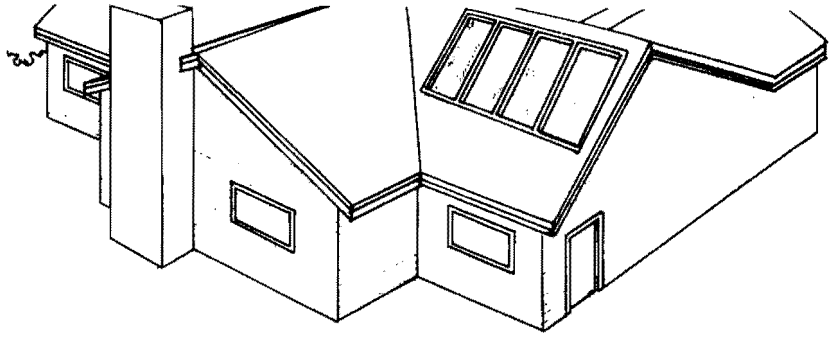
CALIF(

2006 DD

1 SFD NEW

ACTIVE HEATING & DHW

HEATING DD: 2,006 DESIGN TEMP:
DESIGN TEMP: WINTER: 27° F INDOOR: 72° F
HORIZ. INSOL. JAN. DAY: 1,132 BTU/sq. ft. % SUN/YR: 69%



BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home has 2,470 sq. ft. of living space, including 4 bedrooms. Walls have R-11 insulation and ceilings have R-19 insulation. Roof overhangs provide shading and facilitate cooling in summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 82%

COLLECTOR: 277 sq. ft. of Solaron flat plate air collectors are mounted directly onto the roof facing due south at a tilt of 22°. Air is drawn through the collector, heated, and blown to a rock storage or to space by a central air handler.

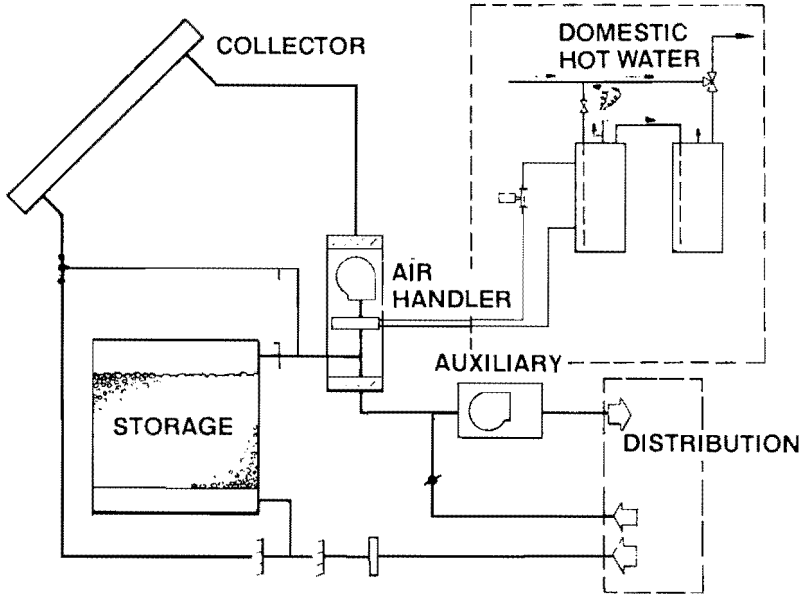
STORAGE: 138.5 cu. ft. of rock storage is located in a wood frame box with 4½ in. batt insulation.

DISTRIBUTION: Heated air from the collectors is blown directly to the living space or to a rock bin storage unit for later use.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides back up heating capacity.

DOMESTIC HOT WATER: Cold water is preheated in an air to water heat exchange coil located in the air handler. It returns to the storage tank before entering a conventional DHW tank.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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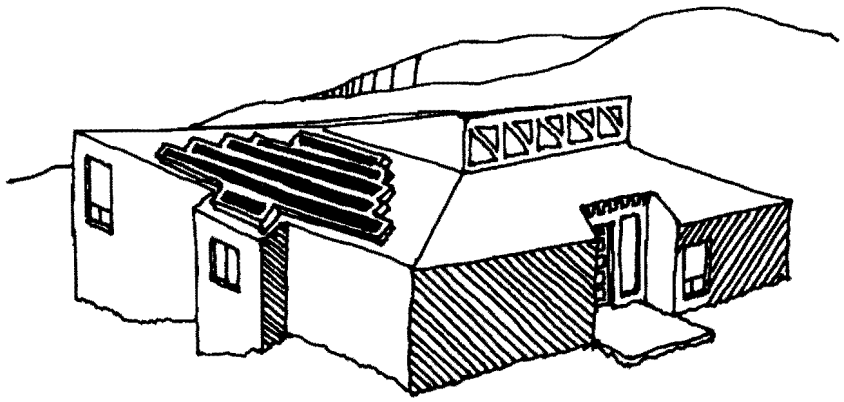
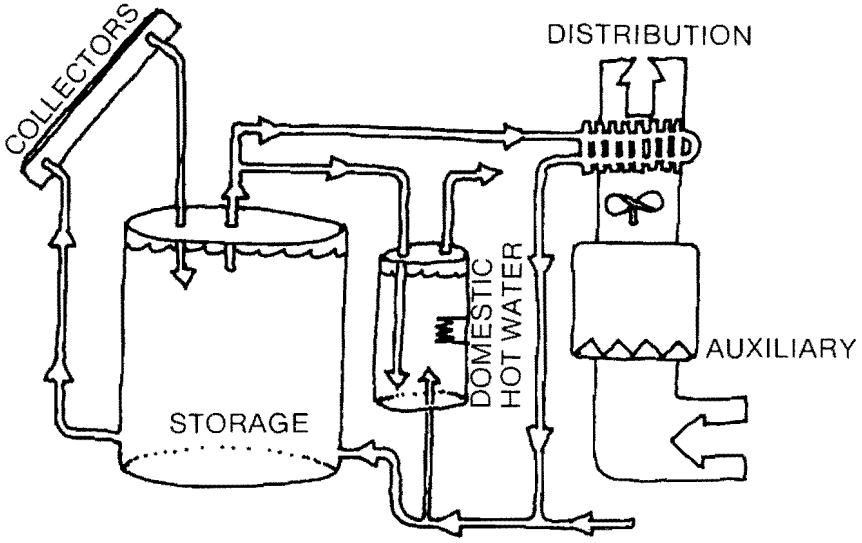


PROJECT INFORMATION:

BUILDER/APPLICANT: Creative Real Estate Development
DESIGNER: Peyo/Mihalovski
SOLAR SUB: Wayne Stanfield
LOCATION: Trabuco Canyon, CA
LATITUDE: 32°N
HOUSING TYPE: SFD, 2 Units
AREA: 2,000 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 2,061
DESIGN TEMP:
DESIGN TEMP: WINTER: 27° F
INDOOR: 72° F
HORIZ. INSOL. JAN. DAY: 903 BTU/sq. ft.
% SUN/YR: 65%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves two single family detached homes. Each home has approximately 2,000 sq. ft. of living space including three bedrooms. Minimal window surface area reduces heat loss and energy demand.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 90%

COLLECTOR: 240 sq. ft. of collector surface consisting of Solargenics water flat plate panels is mounted directly onto the roof at a tilt of 30°. Water is pumped through the collectors, heated, and pumped to a storage tank.

STORAGE: A 2,000 gallon steel water storage tank stores water heated in the collectors.

DISTRIBUTION: Heated water from storage is pumped to a water to air heat exchange coil in a heat pump duct. The stored heat is transferred to the air and blown to the house.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy.

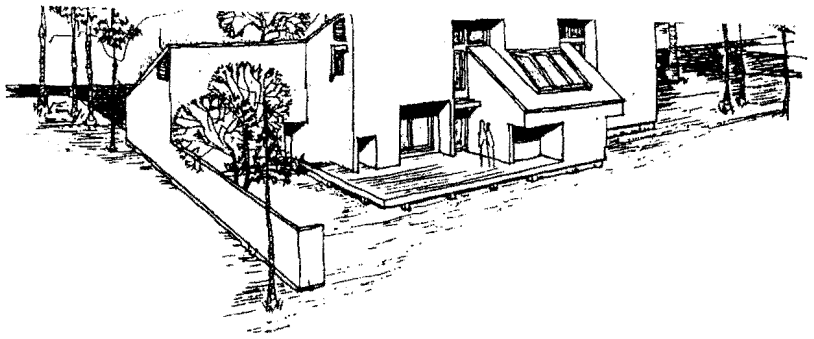
DOMESTIC HOT WATER: Heated water from solar storage is transferred to a conventional DHW heater, to provide hot water preheat.

MODES OF OPERATION: Collector to storage, auxiliary to house, storage to auxiliary to house, DHW preheat.

CALIFORNIA 2061 DD 2 SFD NEW ACTIVE HEATING & DHW

7

LOCATION: Cumming, Ga.
HOUSING TYPE: SFD, 2 Units
AREA: 1,570 sq. ft.
CLIMATIC DATA:
HEATING DD: 2,336
DESIGN TEMP: WINTER: 26° F
HORIZ. INSOL. JAN. DAY: 932 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 63%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project which includes two 3 bedroom homes, provides for solar space heating in one home and domestic hot water heating in both homes. The buildings each contain 1,570 sq. ft. of space and make use of various energy conserving features. These features include: double glazed windows, insulated shutters and generous wall and roof insulation which inhibit heat transfer. Overhangs minimize heat gain. A heat recovery system is used in conjunction with the fireplace in order to reduce heat loss. Natural ventilation is aided by the use of attic vents and fans.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 81%

COLLECTOR: Solaron collectors, integrally mounted between the roofing members, have been used in this project. These flat plate collectors, which are constructed of steel, use air as the heat transfer media. The house with DHW only has 59 sq. ft. of collector; the other has 312 sq. ft.

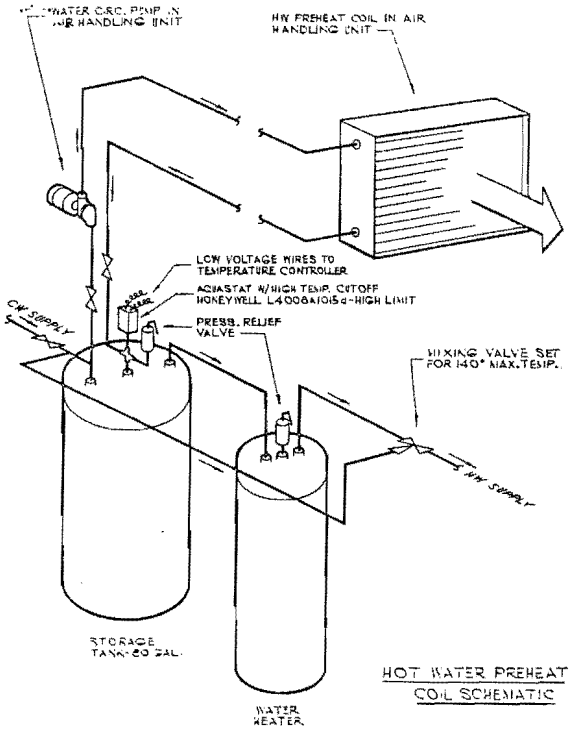
STORAGE: A rock bin, protected by both rigid and batt insulation, provides 156 cu. ft. of solar storage.

DISTRIBUTION: Solar heated air from the collector moves through an air handler where it may be passed either directly to the building or to the rock storage. A forced hot air system provides distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides for auxiliary heating.

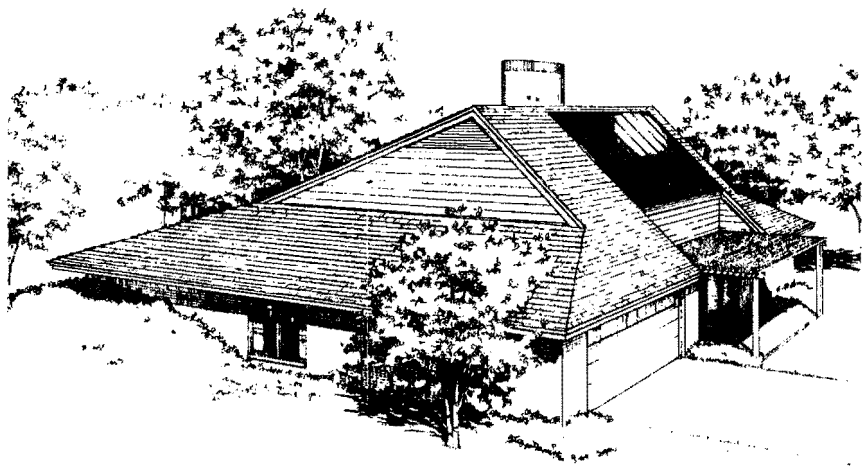
DOMESTIC HOT WATER: City water is pumped directly to a conventional hot water tank and from there through a coil contained in the collector to storage duct work. The water in the coil is heated at this point and then returned to a DHW tank for distribution.

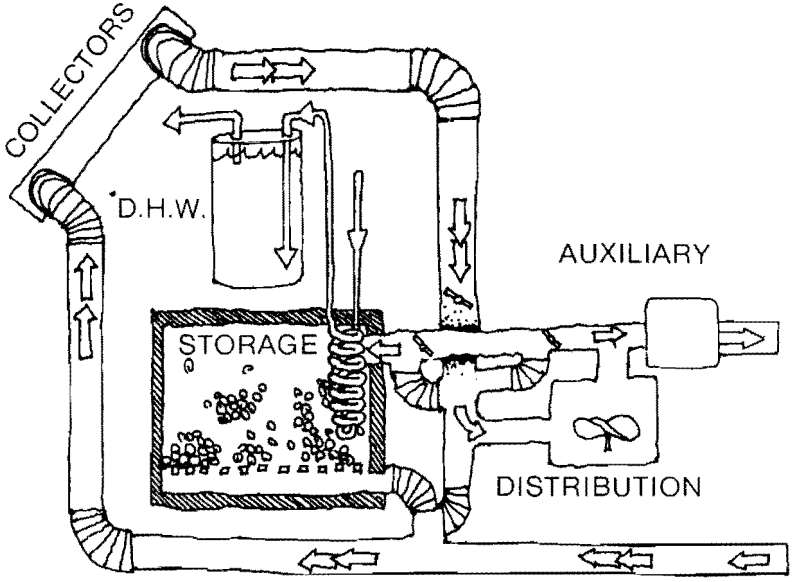
MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.



HOT WATER PREHEAT COIL SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6





PROJECT INFORMATION:

BUILDER/APPLICANT: Brad Popkin Inc.
DESIGNER: R. Fusch & C. Womack
SOLAR SUB: Don Sanders & Associates
LOCATION: Carrollton, TX
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 2,363
DESIGN TEMP: WINTER: 19° F
HORIZ. INSOL. JAN. DAY: 925 BTU/sq. ft.

LATITUDE: 32°0'
AREA: 2,295 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 64%

BUILDING DESCRIPTION/ENERGY CONCERNS

Several energy conserving features are included in the design of this 3 bedroom single family residence. To protect the house against unwanted heat loss, heavy insulation has been placed in the ceiling (R-20) and walls (R-28). Earth is piled against the north walls to reduce the wall area exposed to winter winds, and to make use of the naturally stable earth temperatures to temper the winter cold and the summer heat. A reduced window area minimizes heat losses and gains, while overhangs shade the windows in summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 61%

COLLECTOR: 235 sq. ft. of Northrup flat plate collectors are integrated into the 46° tilt of the south facing roof. Air circulates through the collector carrying heat through an air handling unit to storage.

STORAGE: The heat storage bin is integrated into the hearth and fireplace inside the house. The insulated bin holds 117 cu. ft. of rocks to store the collected heat.

DISTRIBUTION: An air handling unit pulls air through the collector and forces it either to storage or directly into the house.

AUXILIARY ENERGY SYSTEM: An electric furnace supplies auxiliary energy for the hot air distribution system.

DOMESTIC HOT WATER: Incoming cold water is preheated in a coil embedded in the rock storage bin, before reaching a conventional DHW heater.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, (all via air handling unit) auxiliary to house, DHW preheat.

TEXAS
2363 DD
1 SFD NEW
ACTIVE HEATING & DHW
9

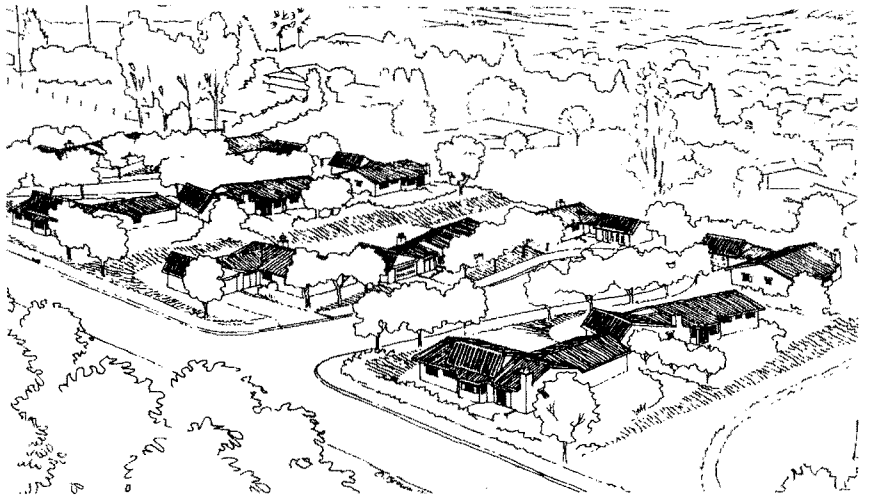
CALIFC 2660 DD 12 SFD NEW ACTIVE HEATING & DHW

10

HEATING DD: 2,660 DESIGN TEMP:
DESIGN TEMP: WINTER: 25° F INDOOR:
HORIZ. INSOL. JAN. DAY: 1,132 BTU/sq. ft. % SUN/YR: 69%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves a development of 12 "solar homes," each with 3 bedrooms and 1,536 sq. ft. The houses are landscaped on the east and west to reduce summer heat gain from early and late day sun. Overhangs also shade the walls to reduce heat gain. The walls are insulated with 3½" of batt insulation, and the ceilings have 5½" of batt. All windows are double glazed for further thermal efficiency. Heat from the fireplace is radiated directly to the living space, but also helps to preheat the solar storage water in piping running behind the hearth.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 94%

COLLECTOR: 196 sq. ft. of flat plate collectors are mounted on the garage roof at a 45° angle. Collectors are manufactured by Southwest Ener-Tech. Water is the heat transfer medium and is drained down to prevent freezing.

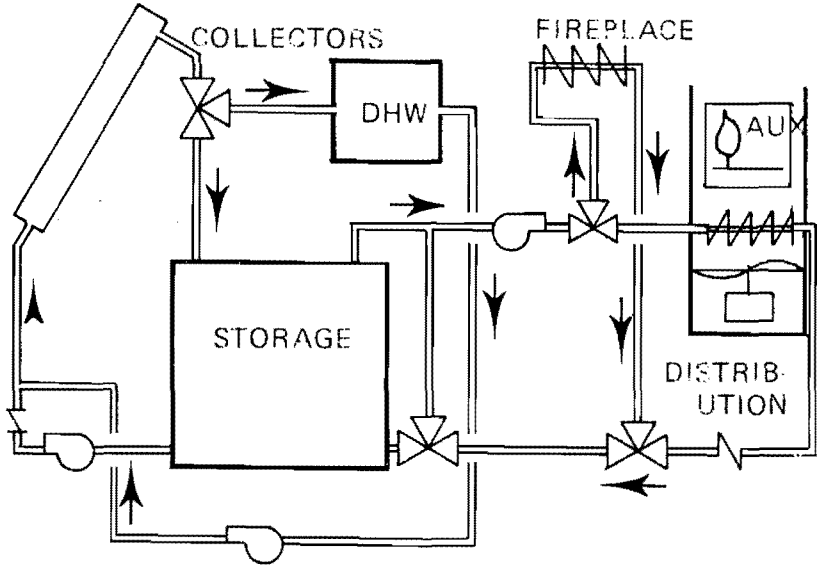
STORAGE: A 750 gallon water tank, located in the ground floor utility room, stores the solar heated water.

DISTRIBUTION: Solar heated water from storage is pumped through a water-to-air coil in the duct of the air distribution system. Heat is transferred to air, for forced air distribution.

AUXILIARY ENERGY SYSTEM: A gas-furnace provides auxiliary heat for the hot air distribution system.

DOMESTIC HOT WATER: When solar storage reaches adequate distribution temperature, heated water will flow from the collectors to a heat exchanger in the 66 gallon DHW tank, preheating the water for domestic hot water demand.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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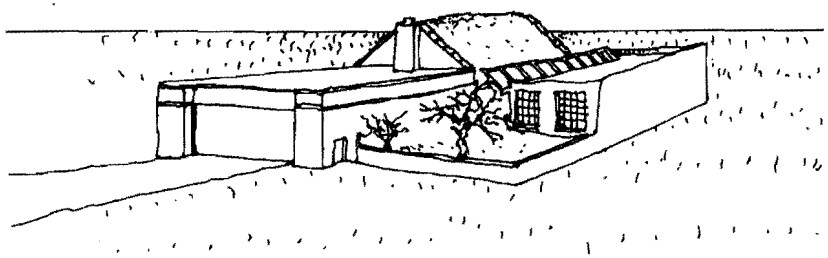
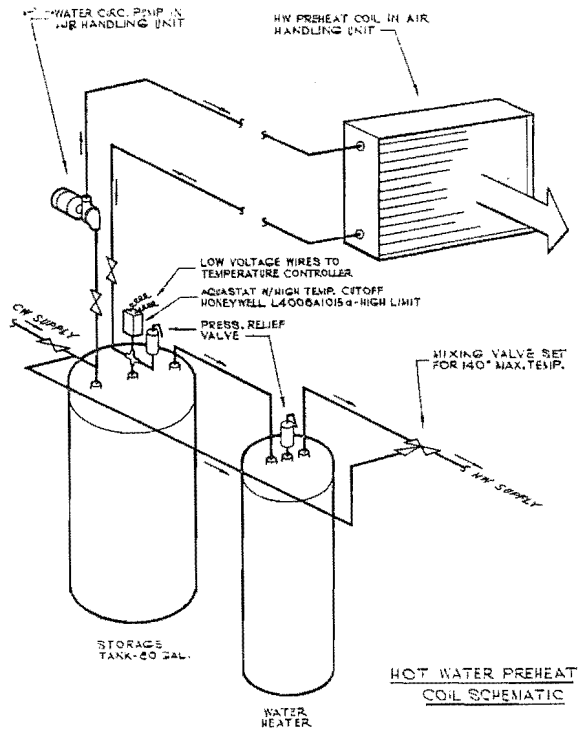




HOT WATER PREHEAT COIL SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

PROJECT INFORMATION:

BUILDER/APPLICANT: Lambert & Winton
DESIGNER: Jack & Scott Winton
SOLAR SUB: Scott Winton
LOCATION: Santa Teresa, NM
LATITUDE: 31°48'N
HOUSING TYPE: SFD, 20 Units
AREA: >1339 sq. ft.
CLIMATIC DATA:
HEATING DD: 2,700
DESIGN TEMP: WINTER: 25° F
DESIGN TEMP:
HORIZ. INSOL. JAN. DAY: 1,232 BTU/sq. ft.
INDOOR: 70° F
% SUN/YR: 80%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 20 detached patio houses in 4 different models. They range from 1,339 sq. ft. to 1,722 sq. ft. and all have 3 bedrooms. The houses have increased insulation, with 6" insulation (batt) in the walls and 12" in the ceiling. The slab is also insulated to prevent heat loss. A fireplace in each of the units can provide additional heat for the house.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 79-81%

COLLECTOR: Each of the twenty houses use Solaron flat plate air collectors mounted at a 45° tilt for solar energy collection. The areas of the collector arrays range from 234 sq. ft. to 312 sq. ft. Air once heated in the collectors, is blown through an air handling unit to storage or to the living space.

STORAGE: A concrete storage bin is located under the floor of each house for solar storage. The volume of the rock storage bins range from 117 cu. ft. to 156 cu. ft. 1½" of foam insulation isolate the storage bins.

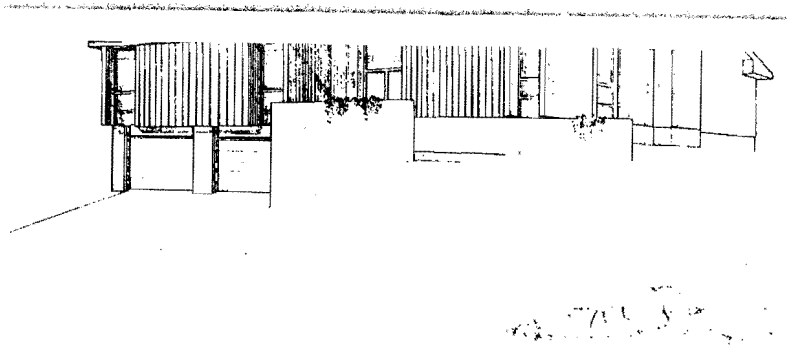
DISTRIBUTION: The air handling unit draws air from the collector or from storage for hot air distribution to the space.

AUXILIARY ENERGY SYSTEM: An electric furnace provides auxiliary heat.

DOMESTIC HOT WATER: Cold water is pumped from an 82 gallon preheat tank to an air to water heat exchange coil located in the air handling unit. The preheated water returns to the storage tank, until needed, when it is pumped through a conventional DHW tank.

MODES OF OPERATION: Collector to storage, collector to house, storage to auxiliary to house, (all via air handler) auxiliary to house; DHW preheat.

HEATING DD: 3,154
DESIGN TEMP: WINTER: 26° F
HORIZ. INSOL. JAN. DAY: 810 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 63%



BUILDING DESCRIPTION/ENERGY CONCERNS

These three single family detached homes vary in size and style, the largest of which contains 4 bedrooms and 1,957 sq. ft. of space. All of these homes feature generous insulation and limited window area (12% of total surface area). In addition, the homes take advantage of other energy conserving features such as air lock entry vestibules, overhangs, attic vents and foundation slab insulation.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 70%

COLLECTOR: Each home has 300 sq. ft. of Gulf Thermal collectors which have been mounted directly on to the roof. These collectors use water as the heat transfer media and a drain down system as a method for freeze prevention. The collectors have been angled at 45° and face directly south.

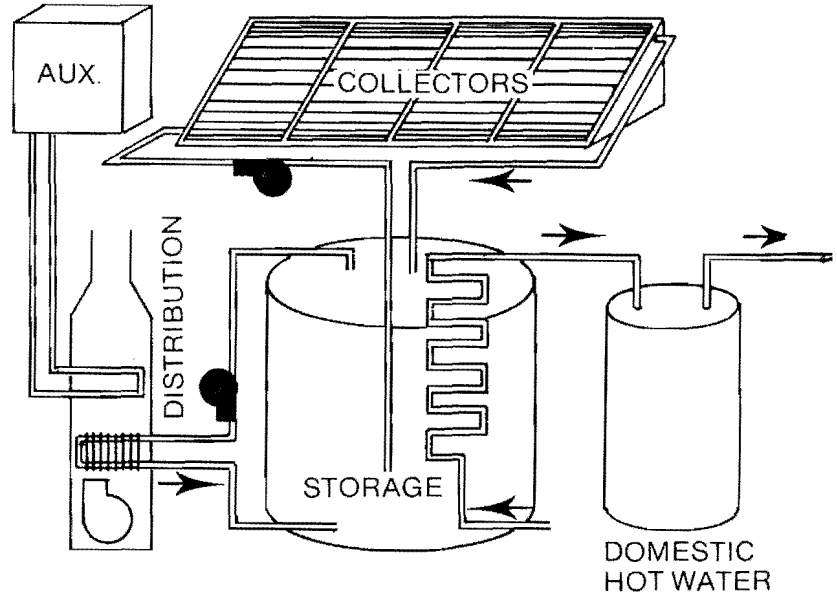
STORAGE: A 1,000 gallon water tank, insulated with 1½" of urethane and 6" of batt insulation provides for heat storage.

DISTRIBUTION: A water to air heat exchanger is located in the air handler for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy for heating and cooling.

DOMESTIC HOT WATER: City water is pumped through a heat exchange coil in the solar storage tank. Once preheated, this water is pumped to a conventional DHW tank for hot water distribution.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.



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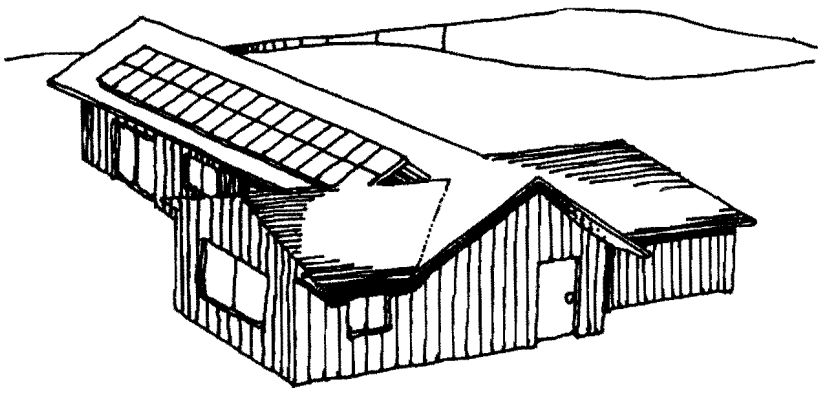
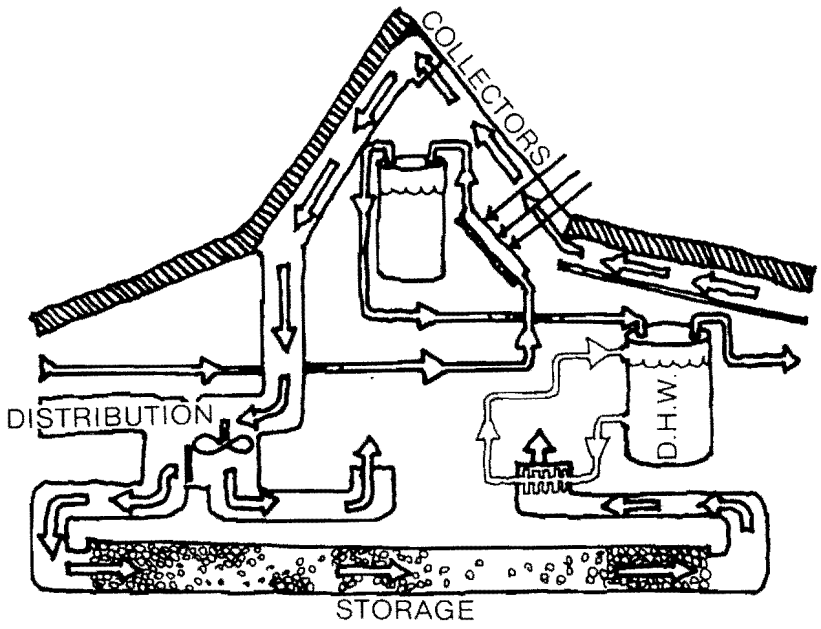




PROJECT INFORMATION:

BUILDER/APPLICANT: MAR-MAC Development, Inc.
DESIGNER: Heliothermics
SOLAR SUB: MAR-MAC Development, Inc.
LOCATION: Monterey, CA — **LATITUDE:** 36°N
HOUSING TYPE: SFD, 2 Units — **AREA:** 1608 sq. ft.
CLIMATIC DATA:
HEATING DD: 3030 — DESIGN TEMP: INDOOR:
DESIGN TEMP: WINTER: 33°F
HORIZ. INSOL. JAN. DAY: 680 BTU/sq. ft. — % SUN/YR: 77%

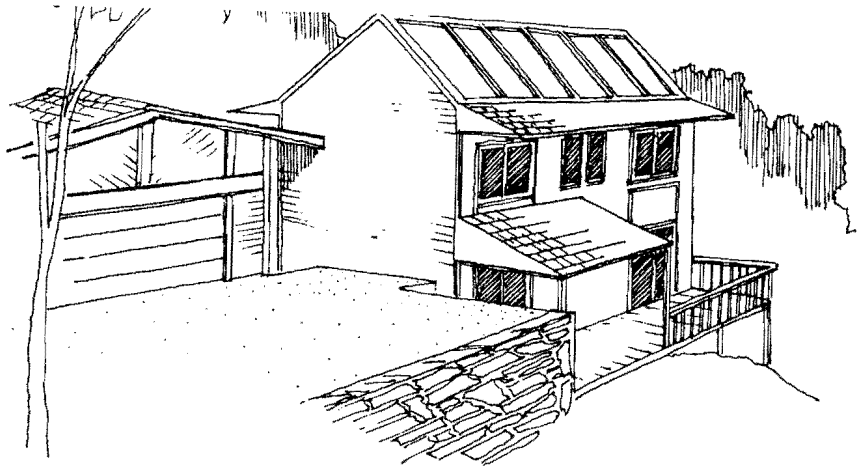
BUILDING DESCRIPTION/ENERGY CONCERNS

This single family house incorporates many energy conserving techniques, in addition to the solar energy system. The house is partially buried into a south facing slope to reduce the wall area exposed to cold winter winds. The foundation walls are insulated with 1½" of rigid insulation, the upper walls have 6" of batt and the roof has 9" of batt insulation. Window surfaces, all double glazed, have been reduced on the north, to prevent convective loss and increased on the south, to maximize passive gain. A louvered overhang shades the southern windows during the summer. Also, the fireplace is designed to recirculate heat to the living spaces.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 34%
COLLECTOR: The system uses 206 sq. ft. of flat-plate collectors manufactured by Revere. They are mounted at a 35° tilt on the south facing roof. The heat transfer medium used is water, which drains down to prevent freezing.
STORAGE: Two precast concrete tanks, one with a volume of 500 gallons and the other with 800 gallons, are located in the basement. They are linked together so that they may operate as one heat storage system.
DISTRIBUTION: Water is pumped from the tank, directly linked to the collectors, to a heat exchanger in the return air duct of the air distribution system. After releasing its heat to the air, the water returns to the second storage tank before returning at a cooler temperature to the collectors. This system increases the efficiency of the collector. A solar-assisted heat pump, using the warm storage water to increase its coefficient of performance, is also used to provide space heat.
AUXILIARY ENERGY SYSTEM: Electric strip heaters in the air duct provide additional auxiliary when neither the solar system or the heat pump are in operation.
DOMESTIC HOT WATER: Incoming cold water passes through a preheat coil in the main storage tank before entering a 52 gallon conventional DHW tank.
MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

HEATING DD: 3,191
DESIGN TEMP: WINTER: 30° F INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 869 BTU/sq. ft. % SUN/YR: 68%



BUILDING DESCRIPTION/ENERGY CONCERNS

This two level single family detached home includes 1,160 sq. ft. of living space and two bedrooms. Walls, ceilings, and floors are heavily insulated, and there are no windows on the north and west sides. The main entrance is an airlock vestibule also to conserve heat. Almost all windows are oriented south.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 68%

COLLECTOR: 457 sq. ft. of collector surface is integrated directly into the roof, and faces due south at an angle of 50°. Air is drawn through these "Heliothermics" air collectors and once heated, blown to rock storage or directly to the living space.

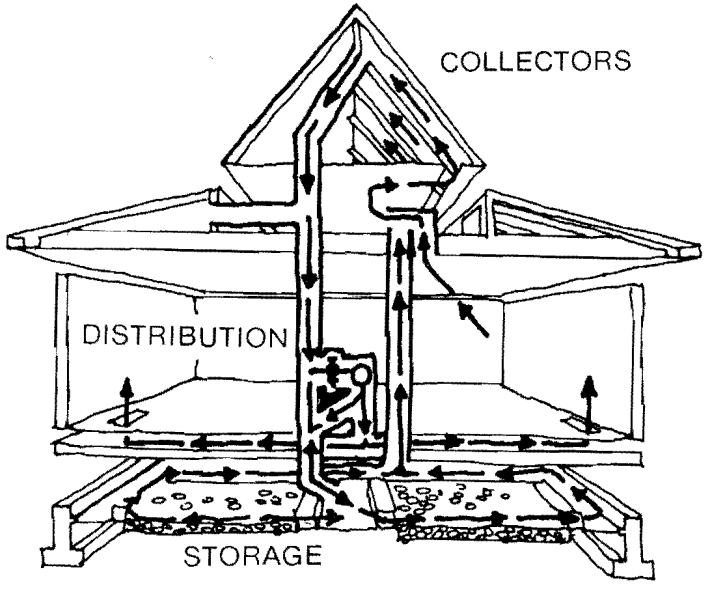
STORAGE: 1,280 cu. ft. of rock storage is located in beds beneath the floor. The beds are insulated with 2" of rigid extruded insulation.

DISTRIBUTION: Distribution is forced hot air through floor registers.

AUXILIARY ENERGY SYSTEM: A gas fired furnace with 60,000 BTUH capacity provides auxiliary energy.

DOMESTIC HOT WATER: City water is preheated directly in a separate array of collector panels on its way to a conventional gas fired hot water heater.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.



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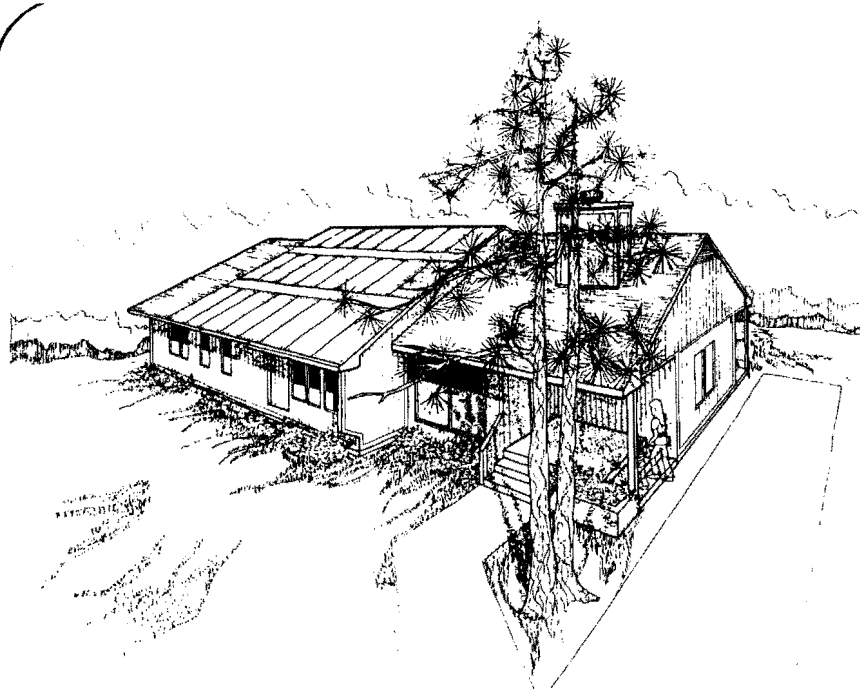
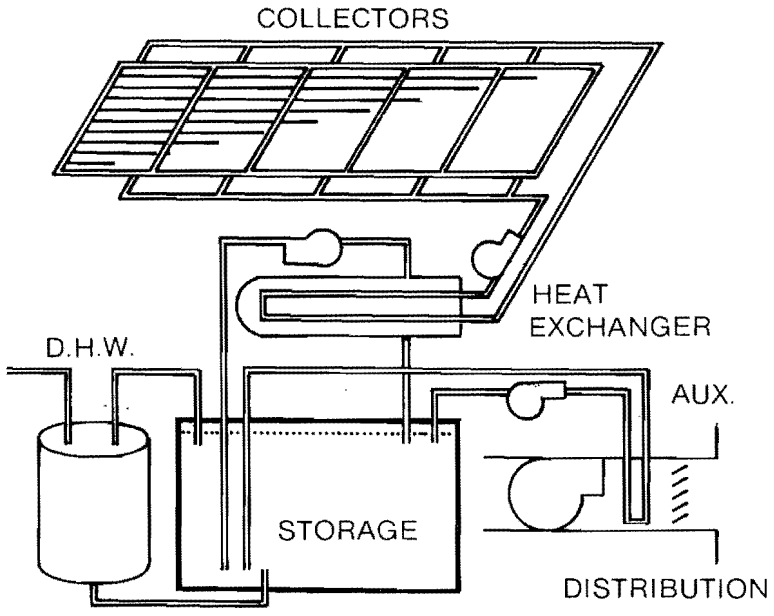
November 1977
HUD-PDR-230-1





PROJECT INFORMATION:

BUILDER/APPLICANT: Habitat 2000, Inc.
DESIGNER: Louis Abernathy
SOLAR SUB: P. C. Godfrey
LOCATION: Pineville, NC
LATITUDE: 35°14'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,200 sq. ft.
CLIMATIC DATA:
HEATING DD: 3,191
DESIGN TEMP: WINTER: 30° F
HORIZ. INSOL. JAN. DAY: 869
DESIGN TEMP:
INDOOR: 72° F
% SUN/YR: 68%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home consists of 1,220 sq. ft. of living space and 3 bedrooms. The ceiling is insulated with two 6" layers of batt insulation. The walls and floors have 3" of rigid insulation. The two main entries include airlock vestibules to provide temperature control. The attic is vented and extensive roof overhangs shade in summer. Window area is reduced and faces mostly south. No windows face west.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 76%

COLLECTOR: 344 sq. ft. of collector surface, consisting of 24 Revere solar panels, is mounted directly to the roof and faces due south at a tilt of 35°. The collectors include copper tube-in-strip absorber plates, through which antifreeze is circulated to collect solar heat. This collected heat is transferred to storage water through a central shell and tube heat exchanger.

STORAGE: A 600 gallon steel water tank, operating between 85° F and 200° F, provides solar storage. The tank is insulated with 4" of rigid insulation.

DISTRIBUTION: Hot water from the solar storage tanks is pumped through a water-to-air heat exchanger in the return air ducts for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric pump will supply auxiliary heating to the hot air system. An emergency electric strip heater is also located in duct work.

DOMESTIC HOT WATER: Heated water from storage is pumped directly to the conventional DHW heater.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 3191 DD NORTH CAROLINA

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HEATING DD: 3,232
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 695 BTU/sq. ft.

DESIGN TEMP:
INDOOR: 75° F
% SUN/YR: 64%

BUILDING DESCRIPTION/ENERGY CONCERNS

This new ranch type house has 3 bedrooms and 1,223 sq. ft. of floor area. In an effort to reduce heat losses, the walls are heavily insulated and the windows and doors have insulating glass.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: Solaron flat plate collectors are used to collect heat for this system. They are mounted at a 37° tilt and cover 206 sq. ft. Air is pulled through the collector to storage by the air handling unit for solar heat collection.

STORAGE: A 138 cu. ft. bin, filled with fist sized rocks, stores the collected solar heat. The bin is located in a storage room adjoining the house.

DISTRIBUTION: The air handling unit blows collected heat in storage through air ducts to the living space.

AUXILIARY ENERGY SYSTEM: Electricity provides auxiliary heating when it is needed.

DOMESTIC HOT WATER: City water flows from an 82 gallon water storage tank through an air-to-water heat exchanger in the air handler. As the solar heated air flows across the coils, heat is transferred to the water, which then flows back to the storage tank. An adjacent conventional DHW tank provides for distribution and auxiliary heating.

MODES OF OPERATION: Collector to storage, collector to house, storage to house, (all via air handler) auxiliary to house, DHW preheat.

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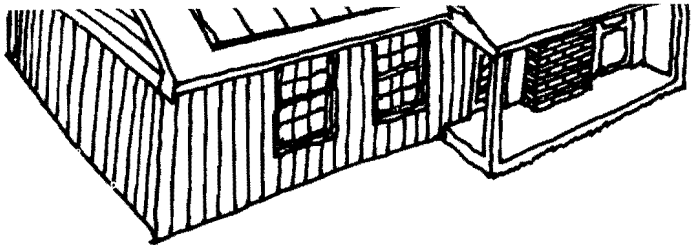
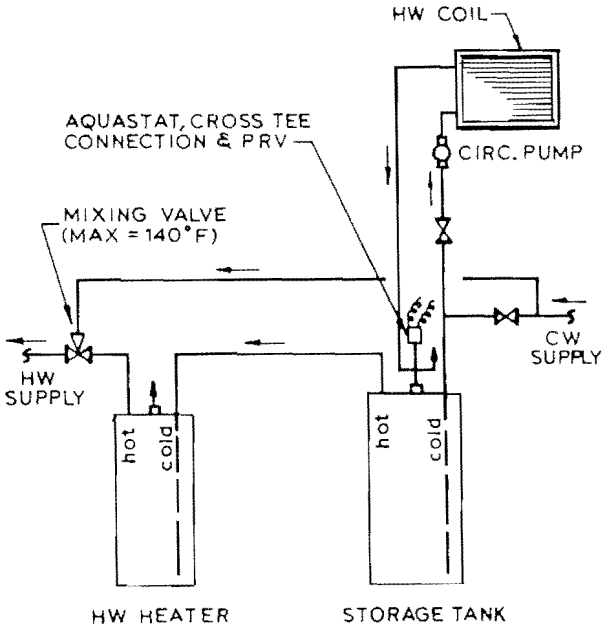
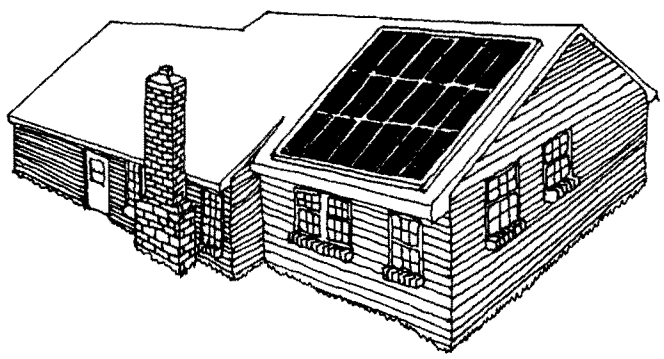


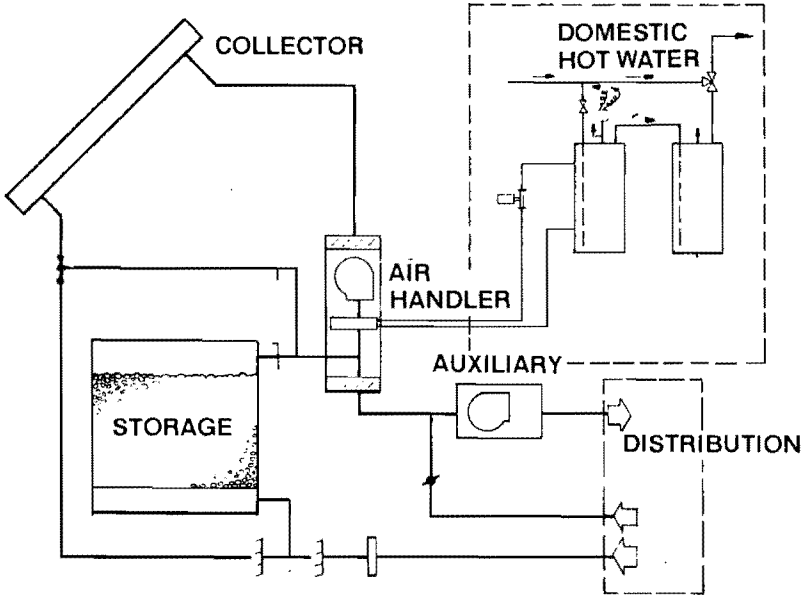


HW PREHEAT SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

November 1977
HUD-PDR-230-1





FOR TYPICAL SOLARON HEATING DIAGRAM
SEE PROJECT NUMBER 6

PROJECT INFORMATION:

BUILDER/APPLICANT: Rainey Bros. Construction Co., Inc.
DESIGNER: Alfred M. Alperin
SOLAR SUB: Dennie Bomar
LOCATION: Memphis, TN
LATITUDE: 35°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,660 sq. ft.
CLIMATIC DATA:
HEATING DD: 3,232
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 695 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 64%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one level, single family detached home has 1,660 sq. ft. of living space and three bedrooms. The walls include 3½" of batt insulation with 1" of rigid insulation, and ceilings have 12" of blown insulation. An integrated fireplace provides supplementary radiant heat. The attic is vented for summer cooling.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 58%

COLLECTOR: 320 sq. ft. of Solaron collector panels are mounted directly onto the roof, facing due south at a tilt of 37°. Air is drawn through the collectors and blown to a rock storage.

STORAGE: 175 cu. ft. of rock storage is located in a wood frame bin at the rear of the house. The bin is insulated with 3" of batt insulation and rests on a concrete slab.

DISTRIBUTION: A central air handling unit blows air across the rock storage for forced hot air distribution.

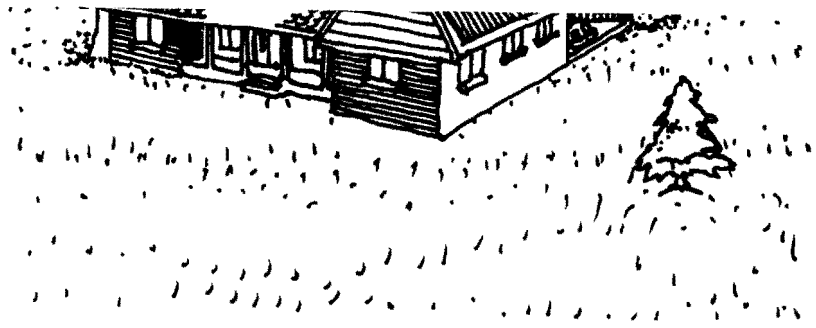
AUXILIARY ENERGY SYSTEM: An electric furnace heating system provides back-up heating.

DOMESTIC HOT WATER: Cold water supply passes through a fin-coil heat exchanger located in the collector to storage air duct. City water is thus preheated on its way to an 80 gallon conventional DHW heater.

MODES OF OPERATION: Collector to storage, collector to house, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

BUILDING DESCRIPTION/ENERGY CONCERNS

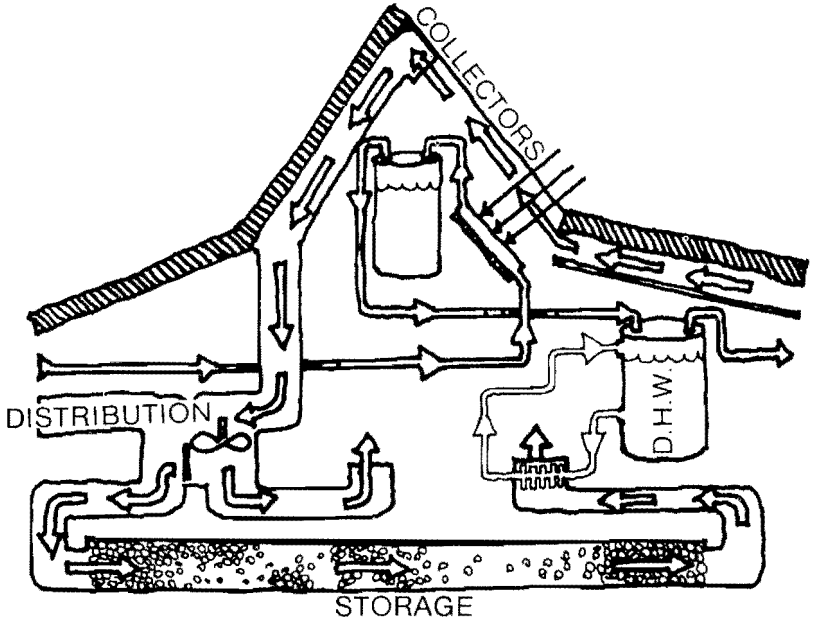
This 2 bedroom home contains 1,886 sq. ft. of living space. The house is landscaped with evergreen trees to guard against wind on the north and east sides as well as deciduous trees on the south. The carport on the east side isolates the house from morning solar gain in addition to shading both the porch and the kitchen. The front door is recessed in order to prevent heat gain. Generous overhangs help to shade windows during the summer but are designed to allow solar heat gain in the winter. The house is well insulated with R-38 insulation in the ceiling and R-19 in the walls and floor. During the summer, warm air is vented through the attic and the rock storage bed is cooled at night through the collectors to assist in cooling.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 90%

COLLECTOR: This system, devised by Heliothermics, Inc., utilized the entire roof (the south side of the roof is glazed while the north side is painted black and well insulated) and the attic as a collector. In this manner 500 sq. ft. of collector surface is provided.
STORAGE: A 540 cu. ft. rock storage bed is located in the basement for solar storage.
DISTRIBUTION: Warmed air is drawn from the attic away into the living space or down to the rock storage bed.
AUXILIARY ENERGY SYSTEM: Auxiliary energy is provided by the DHW system. Hot water from the DHW heater is pumped through a water-to-air heat exchanger in the air supply ducts for hot air distribution.
DOMESTIC HOT WATER: Separate flat plate collectors are contained in the attic for solar hot water heating. City water flows through these collectors and then to a water storage tank located also within the sun's rays in the attic. Preheated water is then gravity fed to the conventional DHW heater.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, DHW preheat.



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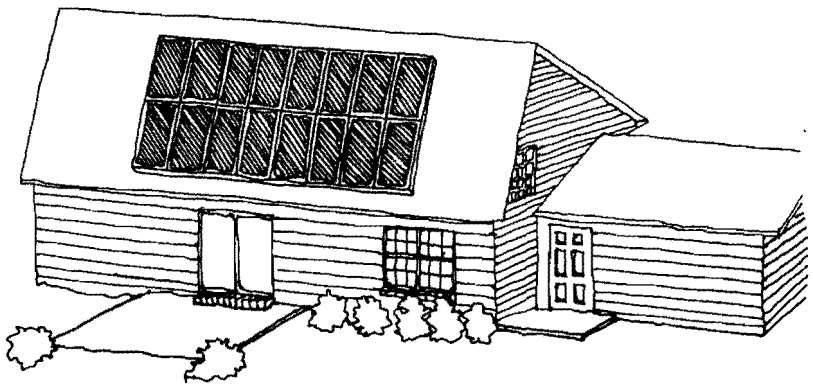

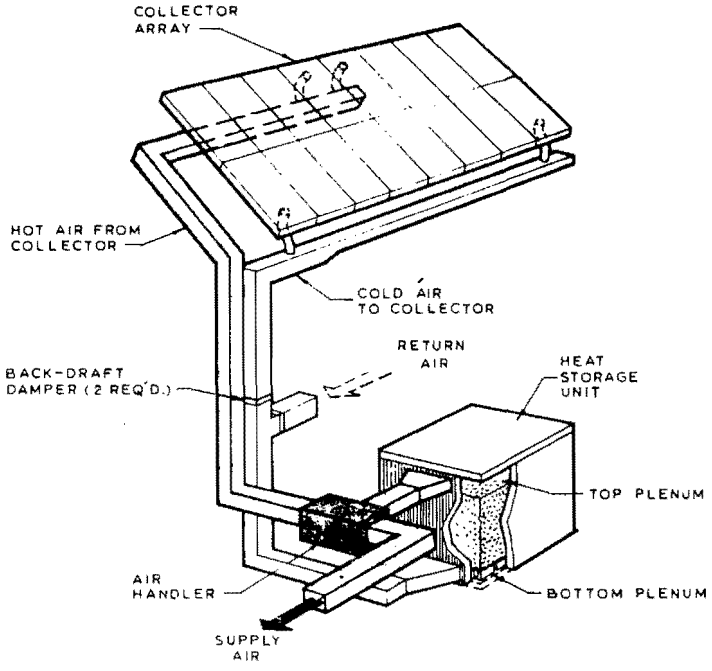

GENERAL SYSTEM DESCRIPTION FIGURE 1.

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

PROJECT INFORMATION:

BUILDER/APPLICANT: L & O Investments, Inc.
DESIGNER: Ray Williamson
SOLAR SUB: Williams Electric
LOCATION: Fayetteville, NC
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 3,393
DESIGN TEMP: WINTER: 30° F
HORIZ. INSOL. JAN. DAY: 869 BTU/sq. ft.

LATITUDE: 35°N
AREA: 1,920 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 61%

BUILDING DESCRIPTION/ENERGY CONCERNS

This new single family home includes approximately 1,920 sq. ft. of living space and 3 bedrooms. Window area has been reduced and judiciously placed. 4" of batt insulation is used in the walls and roof. The rock storage box is within the home itself so that heat otherwise lost will aid in heating the living space.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 67%

COLLECTOR: 312 sq. ft. of Solaron flat plate air collectors are mounted directly on the roof facing south at a tilt of 60°. Air is drawn through the collectors and blown through an air handling unit to rock storage or the living space.

STORAGE: 156 cu. ft. of storage rock is located in the basement in a concrete block bin with batt insulation.

DISTRIBUTION: The central air handling unit blows air across the rock storage for forced hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump of 26,000 BTUH capacity provides back-up and auxiliary energy.

DOMESTIC HOT WATER: City water is preheated in a water-to-air coil located in the collector's return air duct, before being pumped to the conventional hot water heater.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 3393 DD NORTH CAROLINA

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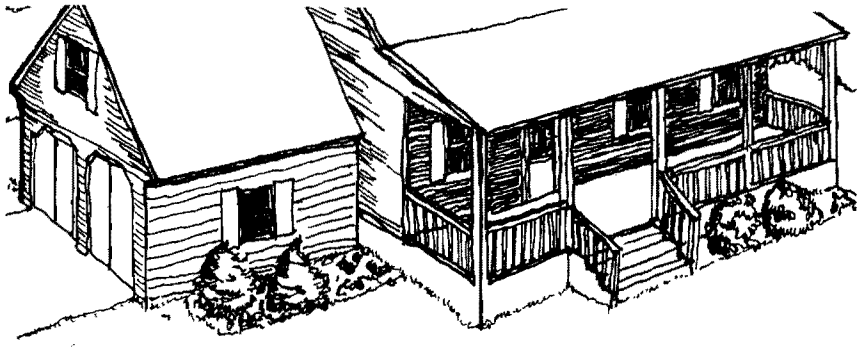
DESIGN TEMP: WINTER: 10° F INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 881 BTU/sq. ft. % SUN/YR: 61%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom home, located in the Kingsmill Development, has 2,272 sq. ft. of space. In order to protect the house from the winter winds the garage has been placed to the northwest. The entry also has a separate vestibule to provide an air and temperature lock. To prevent summer heat gain, energy conserving features include a porch which serves to shade the southern exposures, and attic vents which aid natural ventilation.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: 468 sq. ft. of Solaron flat plate collectors have been mounted directly onto the roof at a 47° angle. Air serves as the heat transfer media.

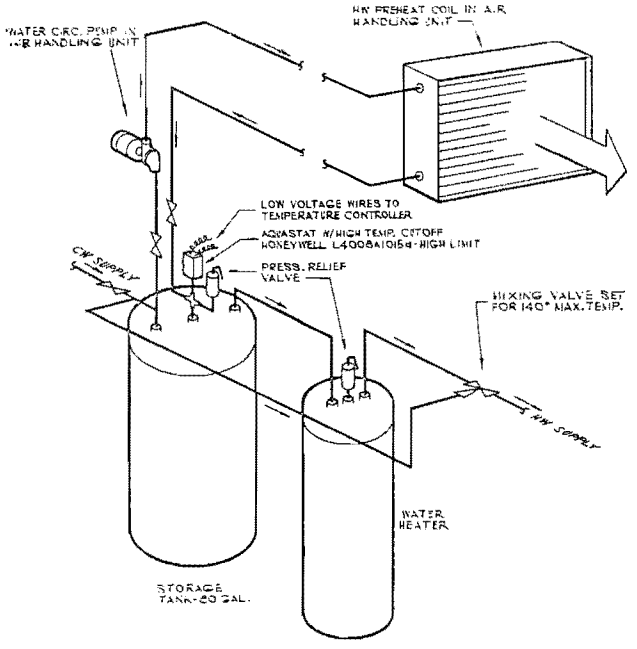
STORAGE: Solar heated air circulates from the collectors to an air handler unit from this point, it may be blown either into a 234 cu. ft. rock bin for storage or into the home for distribution.

DISTRIBUTION: The air handler unit provides for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heat when necessary.

DOMESTIC HOT WATER: Water is drawn from an auxiliary water tank, preheated in a water to air coil in the air handling unit, and returned to the storage tank. A second conventional DHW tank provides for distribution and auxiliary.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

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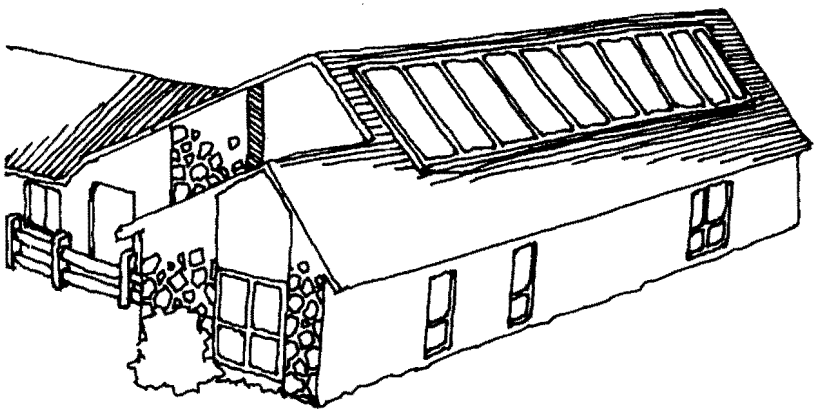

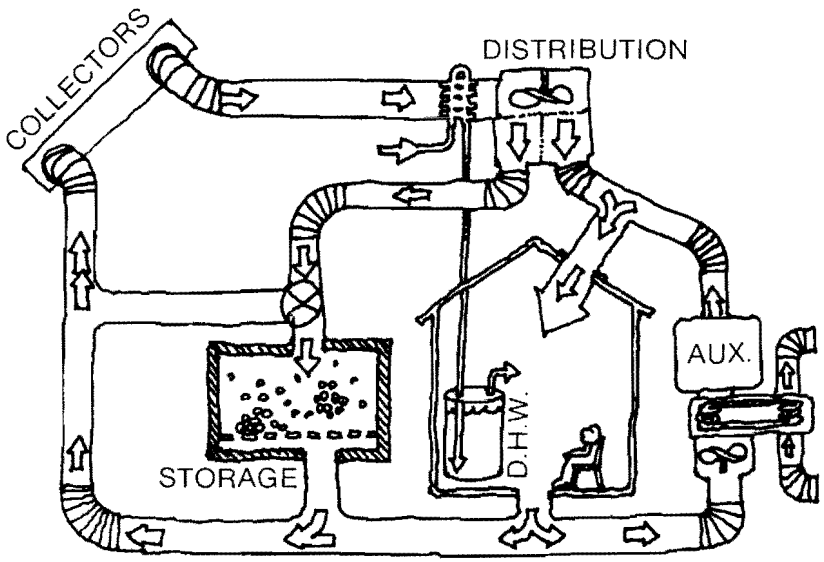

PROJECT INFORMATION:

BUILDER/APPLICANT: Moore-Norman Vo-Tech Foundation, Inc.
DESIGNER: Karen Taylor Chaffin
SOLAR SUB: Norman Plumbing Supply
LOCATION: Norman, OK
LATITUDE: 35°N
HOUSING TYPE: SFD
AREA: 1,960 sq. ft.
CLIMATIC DATA:
HEATING DD: 3,725
DESIGN TEMP: WINTERS: 15° F
HORIZ. INSOL. JAN. DAY: 929 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 68%

BUILDING DESCRIPTION/ENERGY CONCERNS

This new single family detached home of 1,960 sq. ft. contains 3 bedrooms. Constructed of wood and stone, the one-story house is basically square in plan thereby minimizing surface area and heat loss. The building is sited with the garage to the northwest in order to serve as a wind break. An attic fan and vents provide ventilation in the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%

COLLECTOR: 265 sq. ft. of flat plate collectors, manufactured by Sunworks, are directly mounted to the south side of the roof at a 50° tilt. Air is heated in the collector and blown to storage.

STORAGE: A 200 cu. ft. rock storage bin is located in a mechanical space adjacent to the house.

DISTRIBUTION: Forced air is used to distribute heat throughout the house.

AUXILIARY ENERGY SYSTEM: An electric heat pump, with a resistance heat coil provides auxiliary heat.

DOMESTIC HOT WATER: City water is pumped directly to a heat exchanger within one of the warm air ducts, and then to storage. An auxiliary 40 gallon electric water heater is provided.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.

OKLAHOMA 3725 DD 1 SFD NEW ACTIVE HEATING & DHW

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HORIZ. INSOL. JAN. DAY: 758 BTU/sq. ft. % SUN/HR: 66%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project consists of three single family detached homes with 2 and 3 bedrooms. The houses range from 1,520 to 1,744 sq. ft. in floor area. In order to reduce heat losses in winter, and to provide some cooling assist in summer, earth has been bermed against the north wall. The building is well sealed against heat loss, including 1" of foam insulation below the first floor slab. Window surfaces are minimal on the north and west to prevent unwanted heat loss and overhangs shade south facing windows to prevent overheating in the summer. The entry, located on the south, is recessed and protected to reduce infiltration and heat exchange.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65-70%

COLLECTOR: The three houses use 195 sq. ft. to 234 sq. ft. of Solaron collectors, rack-mounted on the south facing roofs. Air is blown through the collectors, carrying solar heat to a central air handler which blows the hot air either to storage or directly to the house.
STORAGE: Each of the houses has a concrete storage bin which holds from 97 to 117 cu. ft. of rocks. The bins are located on the first floor and are insulated with 2" of batt insulation.
DISTRIBUTION: An air handler pulls air from either the collector or from storage and blows it to the space for hot air distribution.
AUXILIARY ENERGY SYSTEM: Electric heat pumps provide auxiliary energy.
DOMESTIC HOT WATER: Water flows from a preheat tank through a coil located in the air handler. Once heated, the water flows back to the preheat tank. On demand, the water is pumped to a conventional 75 gallon DHW tank for auxiliary heating and for distribution.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

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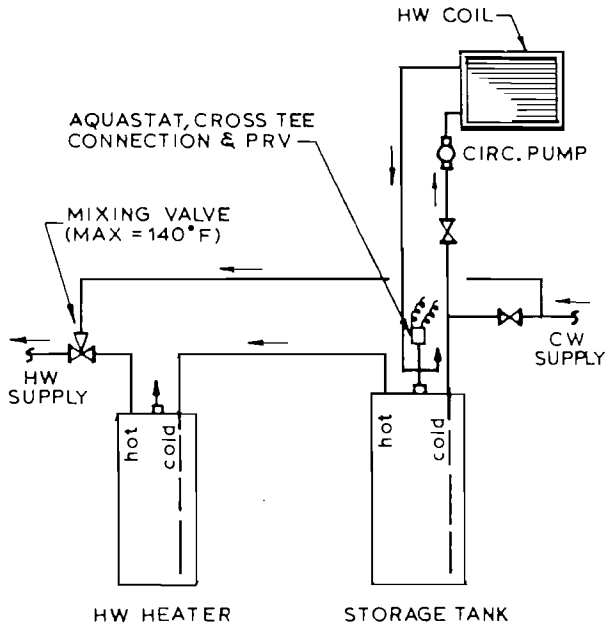
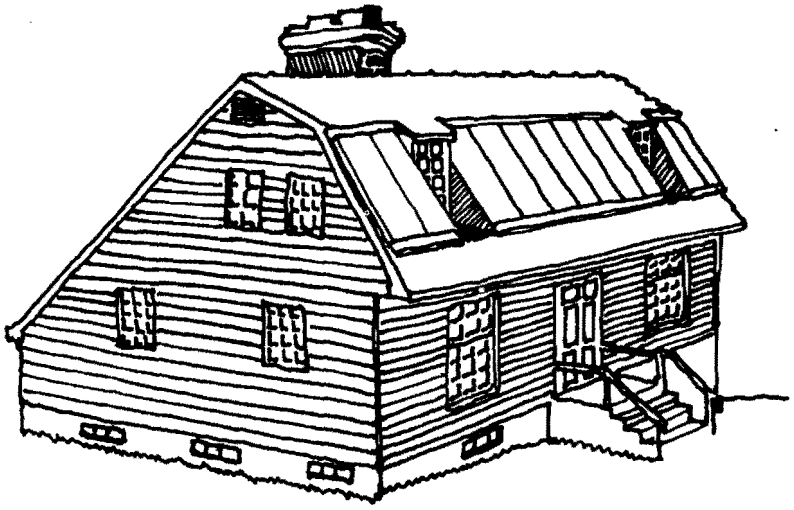


HW PREHEAT SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6



PROJECT INFORMATION:

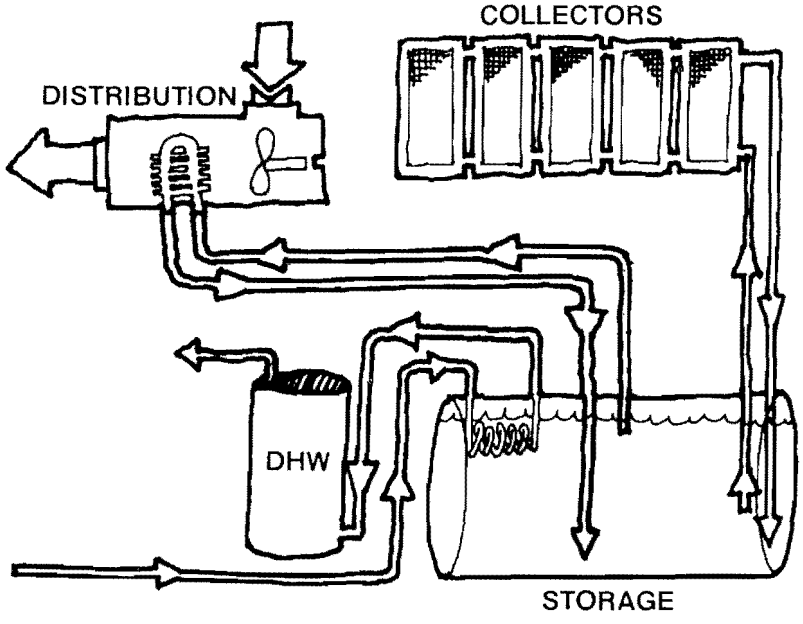
BUILDER/APPLICANT: Solar Structures
DESIGNER: W. W. Hays & J. M. Owen
SOLAR SUB: W. W. Hays & J. M. Owen
LOCATION: Lynchburg, VA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 4,166
DESIGN TEMP: WINTER: 10° F
HORIZ. INSOL. JAN. DAY: 636 BTU/sq. ft.

LATITUDE: 37°30'N
AREA: 2,000 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 60%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom single family home of 2,000 sq. ft. has numerous energy conserving features. The insulation in the walls and ceiling has been increased and all windows are double glazed. The window area has been reduced on the north side of the house and designed on the south to take advantage of the winter sun. In an effort to fully use heat from the fireplaces, water coils behind the fire absorb heat and carry it to the solar storage tank to supplement heat collected by the solar system.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 71%

COLLECTOR: Sunworks manufactured the flat plate collectors used in this project. They cover 206 sq. ft. of the south facing roof which is at a 53° tilt. The collectors use an antifreeze and water mixture to capture heat.

STORAGE: The solar heated antifreeze is carried to a 1,500 gallon storage tank located in the basement of the house.

DISTRIBUTION: The heated liquid from storage is pumped through a water to air heat exchanger located in the return air duct of the air distribution system. Thus collected solar heat is transferred to air and blown to the living space.

AUXILIARY ENERGY SYSTEM: Electricity provides energy for the heat pump auxiliary.

DOMESTIC HOT WATER: Incoming water is pumped through a coil in the storage tank, preheating the DHW supply.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW | 1 SFD NEW | 4204 DD | MARY

DESIGN TEMP: WINTER: 0°
HORIZ. INSOL. JAN. DAY: 644 BTU/sq. ft. % SUN/YR: 56%

BUILDING DESCRIPTION/ENERGY CONCERNS

This single family house incorporates many energy conserving techniques, in addition to the solar energy system. The house is partially buried into a south facing slope to reduce the wall area exposed to cold winter winds. The foundation walls are insulated with 1½" of rigid insulation, the upper walls have 6" of batt and the roof has 9" of batt insulation. Window surfaces, all double glazed, have been reduced on the north to prevent convective loss, and increased on the south to maximize passive gain. A louvered overhang shades the southern windows during the summer. Also, the fireplace is designed to recirculate heat to the living spaces.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water

PREDICTED SOLAR CONTRIBUTION: 34%

COLLECTOR: The system uses 206 sq. ft. of flat-plate collectors manufactured by Revere. They are mounted at a 35° tilt on the south facing roof. The heat transfer medium used is water, which drains down to prevent freezing.

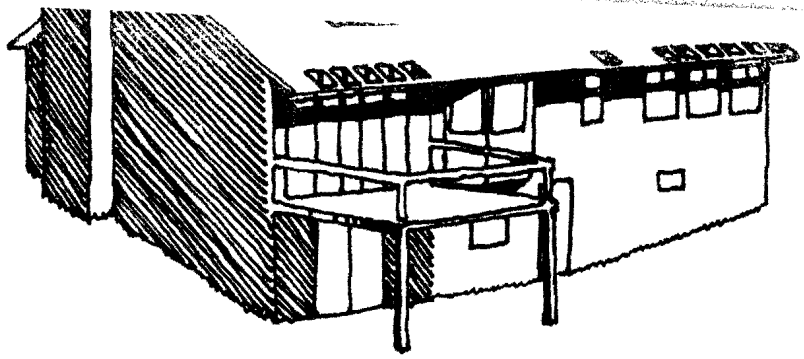
STORAGE: Two precast concrete tanks, one with a volume of 500 gallons and the other of 800 gallons, are located in the basement. They are linked together so that they may operate as one heat storage system. system.

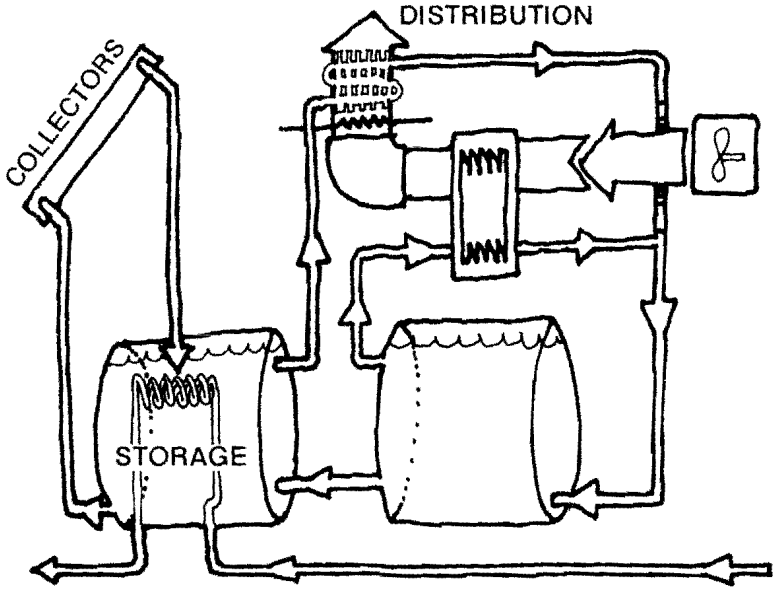
DISTRIBUTION: Water is pumped from the tank, directly linked to the collectors, to a heat exchanger in the return air duct of the air distribution system. After releasing its heat to the air, the water returns to the second storage tank before returning at a cooler temperature to the collectors. This system increases the efficiency of the collector. A solar-assisted heat pump, using the warm storage water to increase its coefficient of performance, is also used to provide space heat.

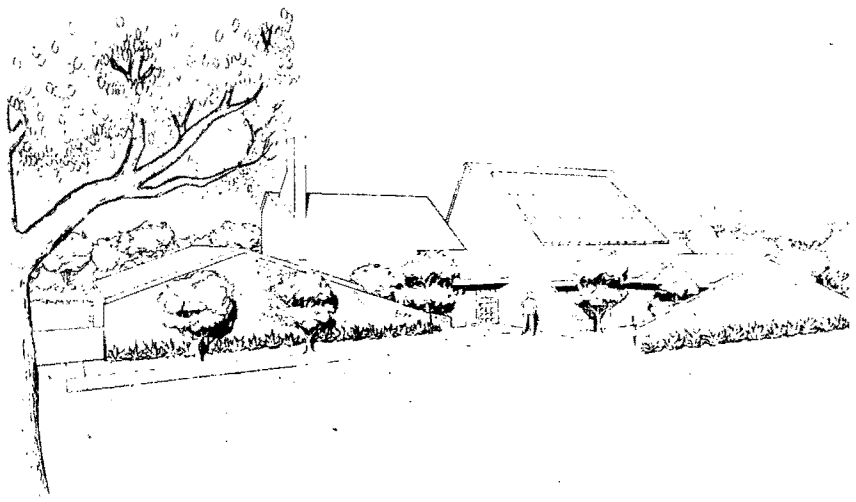
AUXILIARY ENERGY SYSTEM: Electric strip heaters in the air duct provide additional auxiliary when neither the solar system or the heat pump are in operation.

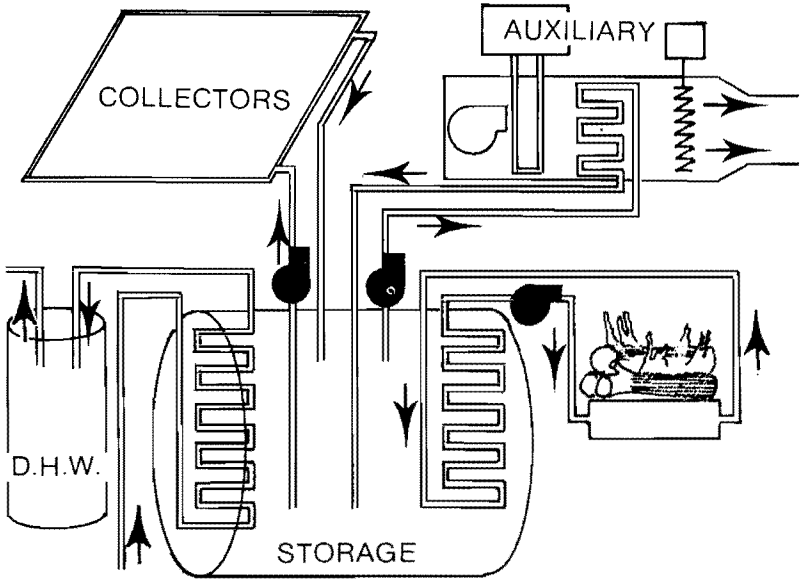
DOMESTIC HOT WATER: Incoming cold water passes through a preheat coil in the main storage tank before entering a 52 gallon conventional DHW tank.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.









PROJECT INFORMATION:

BUILDER/APPLICANT: Caprice Builders, Inc.
DESIGNER: James J. Wagner. Arch.
SOLAR SUB: Solar Industries, Inc.
LOCATION: Troy, OH
LATITUDE: 40°N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,400 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,216
DESIGN TEMP:
DESIGN TEMP: WINTER: —4° F
INDOOR: 65° F
HORIZ. INSOL. JAN. DAY: 474 BTU/sq. ft.
% SUN/YR: 38%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 2,400 sq. ft. single family home uses a number of methods to reduce the amount of energy needed to provide comfort. The house has large south facing windows which provide passive heat gain in winter, but are shaded to prevent heat gain in summer. Wing walls extend beyond the building to deflect the cold winter winds, reducing convective losses. The walls are well insulated, as is the ceiling and the foundation. The heat from the fireplace is carried to the solar storage tanks, by water pipes under the fire.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 93%

COLLECTOR: 473 sq. ft. of Revere collectors are mounted on the roof facing 6° west of south, at a 30° tilt. Water is used to transfer heat from the collector to the storage tank.

STORAGE: Heated water is stored in a 1,000 gallon tank buried behind the house. The tank is insulated with 4" of rigid foam insulation.

DISTRIBUTION: When the water in storage is hot enough, it is pumped to a heat exchange coil in the hot air furnace. Heat is transferred to air and blown to the living space.

AUXILIARY ENERGY SYSTEM: Electricity provides power for 2 auxiliary systems: a heat pump and a resistance coil in the supply air duct. The fireplace supplies additional auxiliary heat.

DOMESTIC HOT WATER: Incoming cold water passes through a coil in the storage tank before reaching a 40 gallon DHW tank with an electric auxiliary heater.

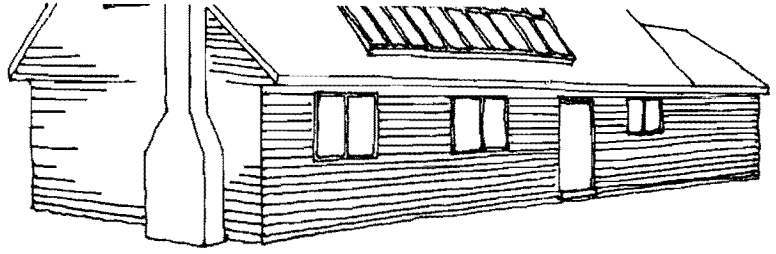
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 4218 DD

26

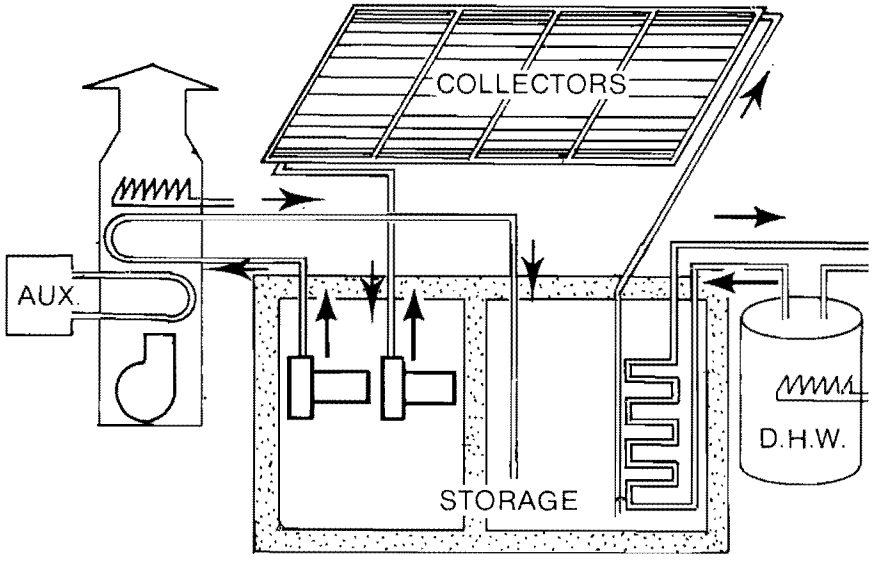
BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom home has 1,932 sq. ft. of space. Generous insulation and minimized window area aids in reducing heat loss and heat gain. The garage is positioned to the west in order to break oncoming winds. A heat recovery system allows energy produced in the fireplace to be stored by the solar storage tank. Furthermore, additional windows, carefully placed on the east and west ends of the second floor, encourage natural ventilation.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 91%



COLLECTOR: Revere collectors covering 225 sq. ft., are mounted directly to the roof at a 37° tilt. Water circulates through these panels in order to collect and transfer energy. A drain down system has been used to prevent freezing.

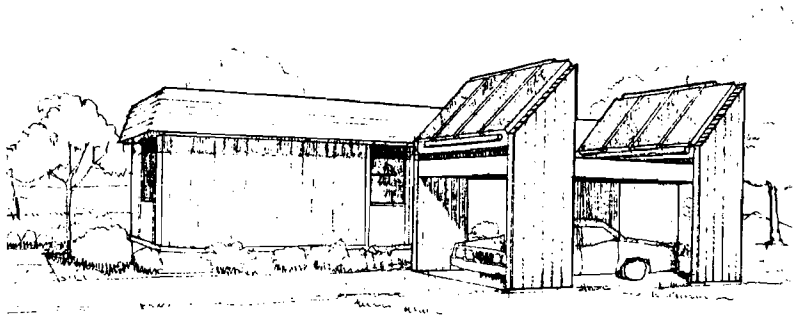
STORAGE: A concrete tank, containing 990 gallons of water, provides for heat storage. The tank is lined with a resin and protected with 4" of insulation.

DISTRIBUTION: A hot water coil, coming from the main storage tank, is located in the air handling unit. The hot water circulated through this coil preheats the air which is distributed to the house.

AUXILIARY ENERGY SYSTEM: A heat pump will provide auxiliary energy in the event that the solar system proves to be inadequate.

DOMESTIC HOT WATER: Incoming cold water circulates through a coil in the main storage tank to preheat DHW.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.

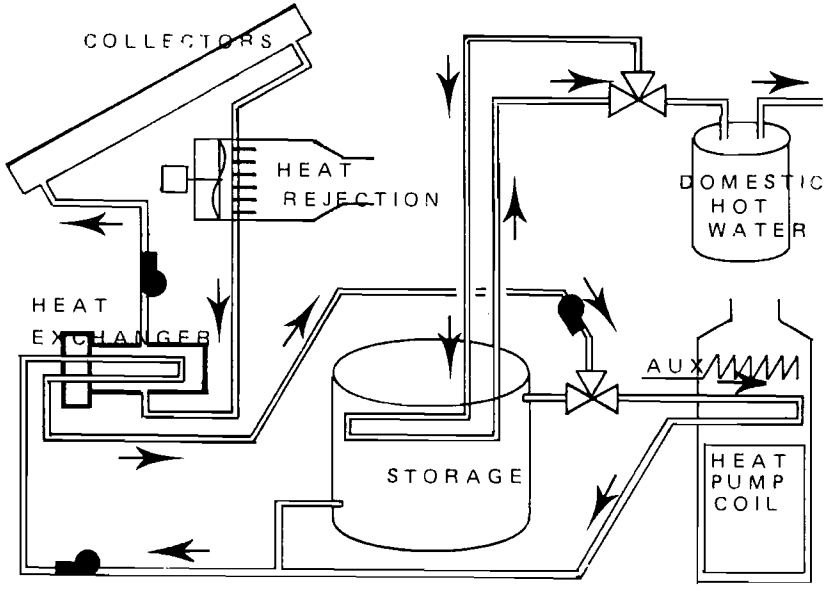


PROJECT INFORMATION:

BUILDER/APPLICANT: Middle Creek Investment Corp.
DESIGNER: Phil Kruger
SOLAR SUB: International Compendium
LOCATION: Inwood, WV
LATITUDE: 39°N
HOUSING TYPE: SFD, 6 Units
AREA: 1,064 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,224
DESIGN TEMP:
DESIGN TEMP: WINTER: 0° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 370° BTU/sq. ft.
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

This project includes 6 mobile homes in three models. Each model contains 2 or 3 bedrooms, and have between 800 and 1,100 sq. ft. of living space. Insulation has been increased and the units have been bermed on the north and west in order to further reduce heat loss.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating and Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTOR: Approximately 168 sq. ft. of Lennox flat plate collectors have been rack mounted on the carport roof, adjacent to each home. The collectors have been placed at a 50° tilt and oriented directly south. An antifreeze transfer media is used.

STORAGE: A hot water tank, located in the crawl space under the home, has a storage capacity of 280 gallons. A heat exchanger transfers the energy from the antifreeze to the water storage media.

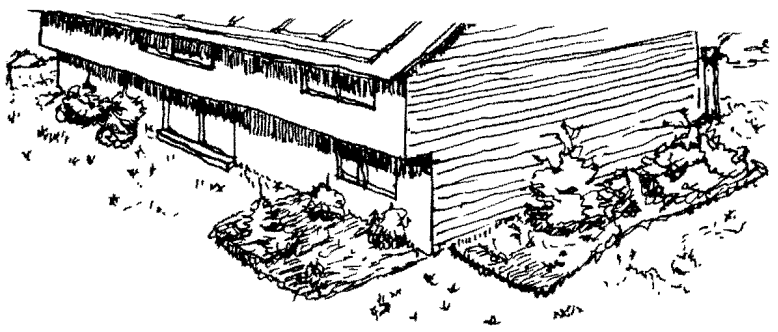
DISTRIBUTION: Water from the storage tank is pumped through a coil in the air duct. Air blown over this coil is warmed and then distributed through the house. Electricity serves as the auxiliary energy system.

DOMESTIC HOT WATER: A coil located in the main solar storage tank, serves to preheat DHW.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.

MAI 4224 DD 1 SFD NEW ACTIVE HEATING & DHW

DESIGN TEMP: WINTER: 0°
HORIZ. INSOL. JAN. DAY: 644 BTU/sq. ft. % SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

Four bedrooms and 1,624 sq. ft. of living space are contained in this new single family detached home. Generous overhangs to the south protect windows on that side from excessive amounts of sun. The east and west faces are windowless eliminating problems of sun protection on those sides. In addition, the basically square floor plan results in a building of minimal surface area, which reduces unwanted heat loss and heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTOR: 261 sq. ft. of evacuated tube collectors, manufactured by KTA, have been used in this project. These collectors consist of copper tubes encased in two concentric glass tubes. The interior half of the outer tube is coated with a silver reflective surface. The tubes are mounted facing due south at a 55° tilt.

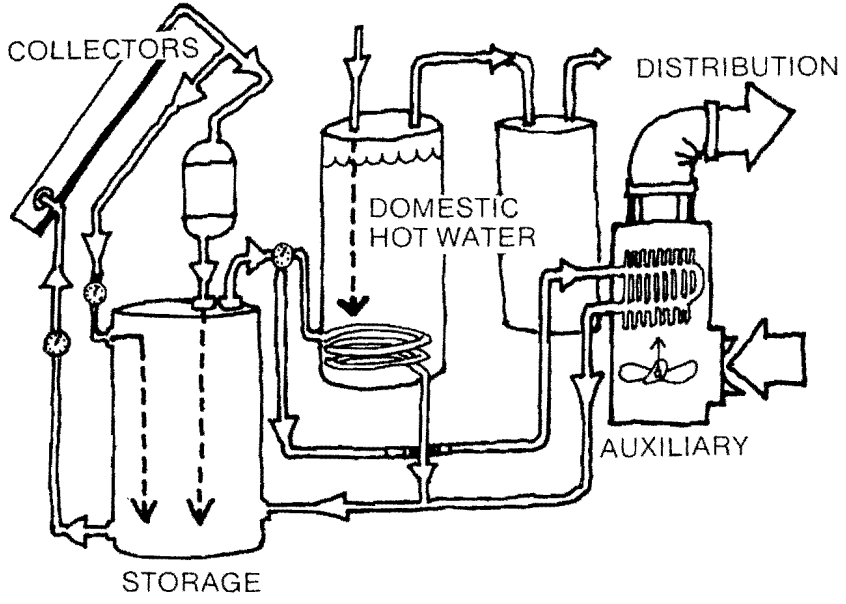
STORAGE: Solar heated water from the collectors is stored in an insulated steel water tank of 535 gallon capacity.

DISTRIBUTION: Heated water from storage is pumped through a coil in the air handler for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric auxiliary unit provides additional heat for the system.

DOMESTIC HOT WATER: A coil from the solar storage tank is contained in the first of two conventional DHW tanks. Solar heated water circulating through this coil serves to preheat the DHW. The second tank provides for additional storage as well as auxiliary heating.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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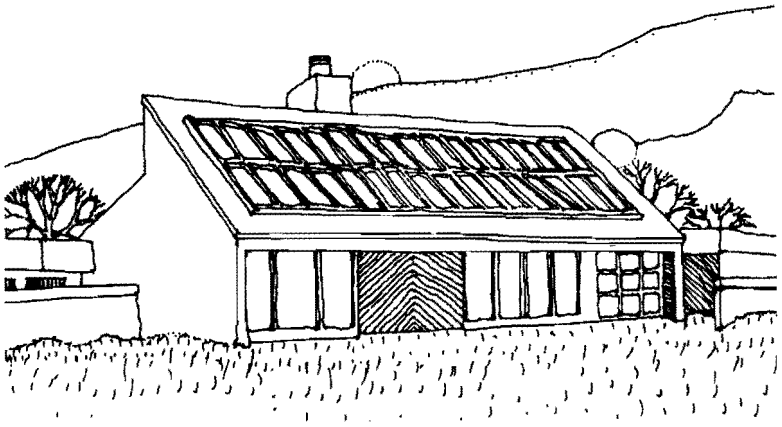
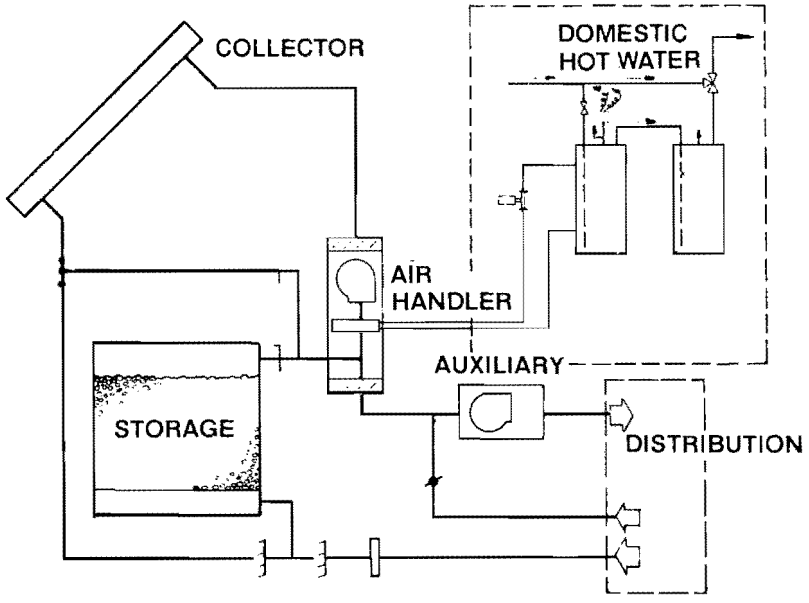
HUD-PDR-230-1





PROJECT INFORMATION:

BUILDER/APPLICANT: Sandia Homes, Inc.
DESIGNER: Roland Peters, AIA
SOLAR SUB: H. Preston Gunter
LOCATION: Albuquerque, NM — **LATITUDE:** 33°N
HOUSING TYPE: SFD, 1 Unit — **AREA:** 1,250 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,345 — DESIGN TEMP:
DESIGN TEMP: WINTER: 10° F — INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 1,121 BTU/sq. ft. — % SUN/YR: 76%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 1,250 sq. ft. single family home has 3 bedrooms and opens up to the south to take advantage of direct sun in the winter. The window area on the north wall is small, reducing heat loss, and the location of closets on that wall provides an additional buffer. The large south facing windows are shaded by 2' overhangs to prevent overheating in summer. The walls have an R-16 insulation value, with 4" of batt insulation and 1" of foam. The ceilings have 9" of batt insulation, providing a well-insulated building.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%

COLLECTOR: The 45° slope of the south-facing roof is the location of 452 sq. ft. of Solaron flat plate collectors. Air passes through the collector to an air handling unit, and from there to storage or directly to the living space.

STORAGE: A 253 cu. ft. rock storage bin, located under the mechanical space, stores solar heat. The concrete bin is insulated with 1½" of rigid insulation.

DISTRIBUTION: An air handler pulls heated air from solar storage or directly from the collector for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric furnace supplies auxiliary heat.

DOMESTIC HOT WATER: Incoming cold water enters a pre-heat tank, then flows through a heat exchange coil in the air handler, and returns to the preheat tank. When demanded, the preheated water flows to a conventional DHW tank and is boosted to operating temperature.

MODES OF OPERATION: Collector to storage, collector to house, storage to auxiliary to house (all via air handler) auxiliary to house DHW preheat.

NEW MEXICO 4345 DD 1 SFD NEW ACTIVE HEATING & DHW

29

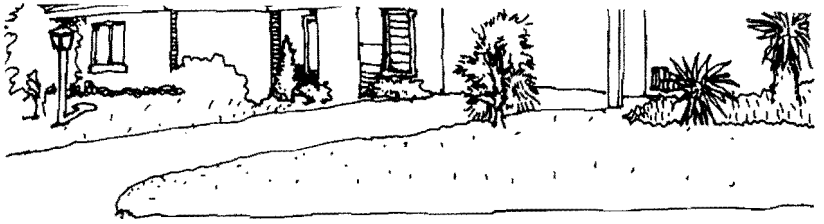
ACTIVE HEATING & DHW 25 SFD NEW 4361 DD NEW

30

HORIZ. INSOL. JAN. DAY: 1,121 BTU/sq. ft. % SUN/YR: 70%

BUILDING DESCRIPTION/ENERGY CONCERNS

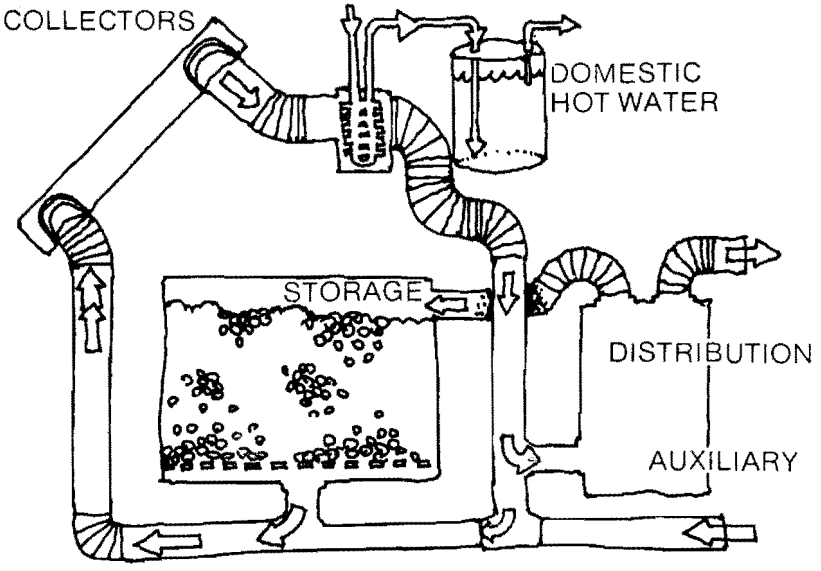
A number of these prototypical houses, designed to include 3 bedrooms in 2,113 sq. ft. of space, have been built in 2 different locations. Two of these single family detached homes have been built in a development near Santa Fe while another 23 have been built in a development near Albuquerque. Each home has been built using 2" by 6" wall construction with 5" of batt insulation. Twelve inches of ceiling insulation helps to further reduce heat loss. Each fireplace has been equipped with a heat recovery system. Ridgeline venting aids natural ventilation while roof overhangs to the south help to guard against unwanted solar gain.

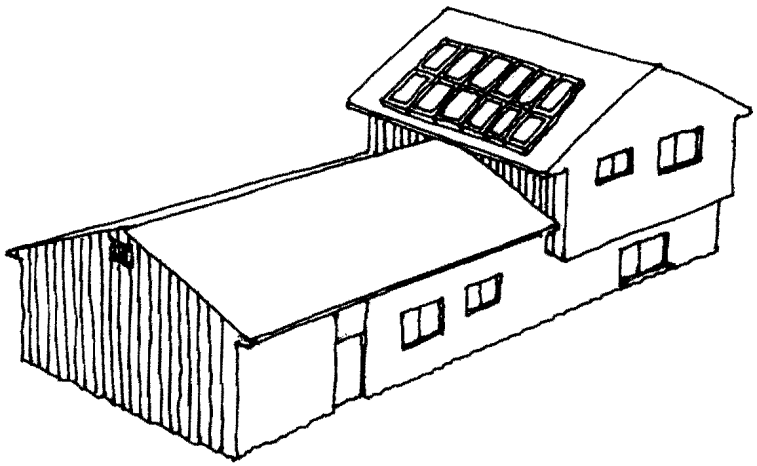


SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water.
PREDICTED SOLAR CONTRIBUTION: 68%

COLLECTOR: 150 sq. ft. of flat plate collectors, manufactured by Solar Seven Industries, have been mounted to the south side of the roof at a 32° tilt. These air collectors are composed of a galvanized steel absorption plate covered with a single cover plate. Venting helps to prevent damage caused by overheating. Solar heated air from the collectors passes through an air handler from which it is either distributed to the house or blown into the storage bin.
STORAGE: The storage bin is constructed of concrete and insulated with 1½" of rigid insulation. The rock storage bin has a capacity of 225 cu. ft.
DISTRIBUTION: Solar heated air from the collectors or from the storage bin, is distributed throughout the house by an air handling unit.
AUXILIARY ENERGY SYSTEM: Electric strip heating has been included as an auxiliary heating system.
DOMESTIC HOT WATER: A preheat coil, located in the collector return air duct provides the mechanism for warming city water.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house. DHW preheat.



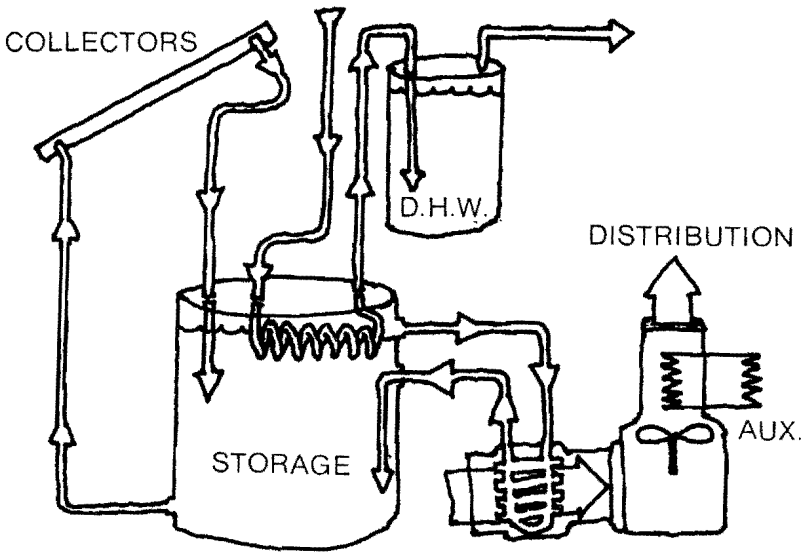


PROJECT INFORMATION:

BUILDER/APPLICANT: Universal Homebuilders, Inc.
DESIGNER: G. R. Davies & R. P. Zerkle
SOLAR SUB: Joseph W. Schwarz
LOCATION: Fairfield, OH
LATITUDE: 39°05'N
HOUSING TYPE: SFD, 2 Units
AREA: 1,880 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,407
DESIGN TEMP: WINTER: 0°F
Z. INSOL. JAN. DAY: 474 BTU/sq. ft.
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 60%

BUILDING DESCRIPTION/ENERGY CONCERNS

These two new single family homes have 3 bedrooms each, with split level layouts in 1,880 sq. ft. of floor area. The walls of the houses are designed to minimize heat loss, with 5½" of batt insulation in the walls and 12" of roof insulation. In addition, 1" of rigid insulation is used as wall sheathing, and 2" perimeter insulation lines the foundation. There are small window surfaces, and no windows on the north side of the house, minimizing convective heat losses. All the windows are double glazed, and overhangs shade the openings in summer.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating and Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 41%

COLLECTOR: 187 sq. ft. of Sunworks collectors are mounted on the roof facing due south at a tilt of 26°. Water is the heat transfer media and is drained down to holding tanks for freeze prevention. The water is pumped through the collector.
STORAGE: Each house has a 500 gallon water storage tank, insulated with 6" of batt. The tank is located in the utility room on the lower level.
DISTRIBUTION: Hot water is taken directly from storage and pumped through a coil in the supply duct of the air distribution system. Air is blown across the coil and once heated and blown to the house.
AUXILIARY ENERGY SYSTEM: An electric heat pump and a secondary resistance coil provide auxiliary energy.
DOMESTIC HOT WATER: Incoming cold water is circulated through a coil in the solar storage tank, preheating the water before it reaches the conventional 80 gallon DHW tank.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

OHIO
4407 DD
2 SFD NEW
ACTIVE HEATING & DHW
31

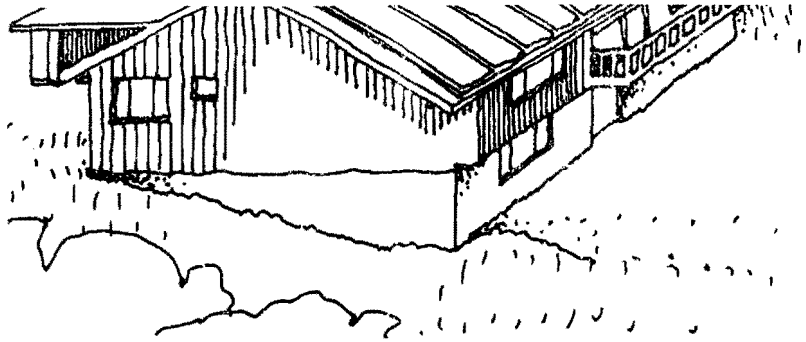
ACTIVE HEATING & DHW 1 SFD NEW 4456 DD

32

DESIGN TEMP: WINTER: 37° F INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 1,110 BTU/sq. ft. % SUN/YR: 80%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom home contains over 2,240 sq. ft. of living space. It is landscaped with decidious trees to the south which provide shade during the summer but allow for full exposure of house and collectors during the winter. The house is partially buried in order to reduce heat transfer from the cold northwest winds. The square plan and the limited window area also help to minimize heat transfer. Overheating is prevented by ridge vents and generous overhangs.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating and domestic hot water
PREDICTED SOLAR CONTRIBUTION: 89%

COLLECTOR: 790 sq. ft. of site built liquid flat plate collectors are placed directly on the south side of the roof. Water is circulated through the panels for solar collection.

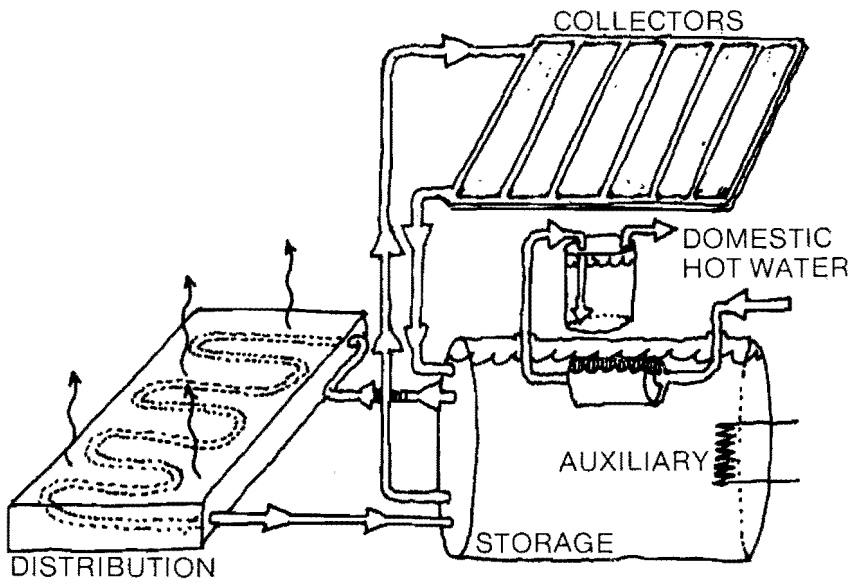
STORAGE: Two tanks are used to store a total of 3000 gallons of solar heated water.

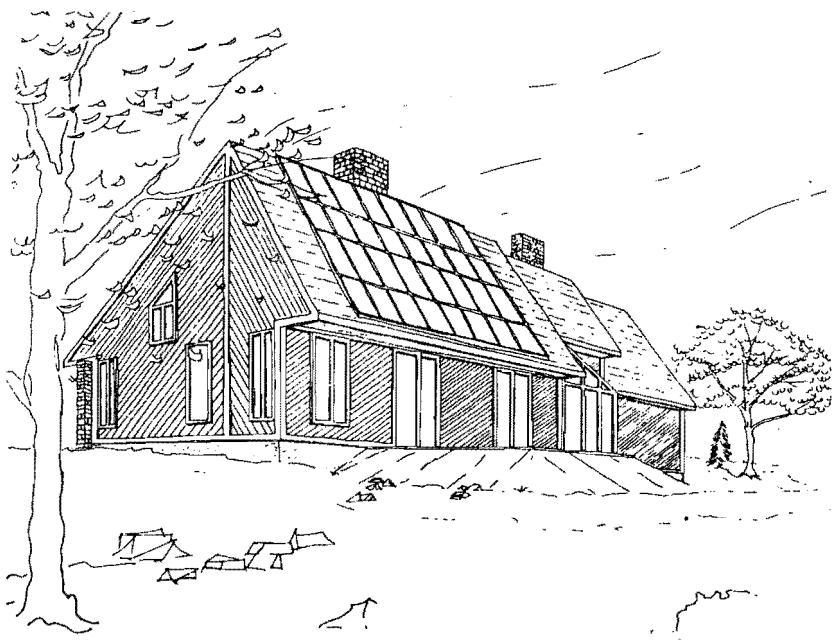
DISTRIBUTION: Solar heated water is pumped from the storage tanks through piping which is contained in the house floor. Through the use of this radiant distribution floor, heat transfer is direct and efficient.

AUXILIARY ENERGY SYSTEM: An electric resistance coil immersed in each of the storage tanks provides auxiliary heating and potential for off peak hour loading.

DOMESTIC HOT WATER: A DHW preheat tank is enclosed in one of the solar storage tanks. City water is heated directly in this preheat tank and then pumped to a conventional DHW system for distribution and auxiliary heating.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to storage to house, auxiliary heating, DHW preheat.





PROJECT INFORMATION:

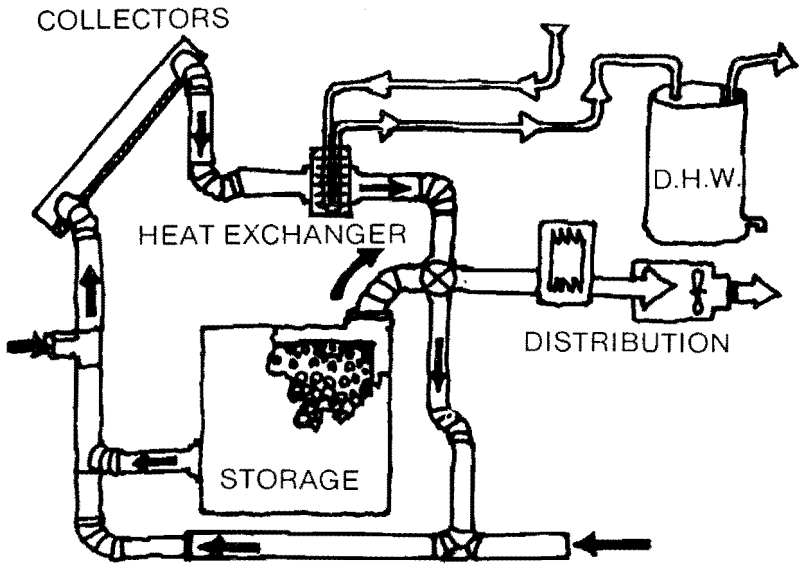
BUILDER/APPLICANT: Whitman & Associates
DESIGNER: P. Sims & J. Morgan
SOLAR SUB: Miley Heating & Air Conditioning
LOCATION: Lexington, KY
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 4,683
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 636 BTU/sq. ft.

LATITUDE: 38°
AREA: 2,568 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 60%

BUILDING DESCRIPTION/ENERGY CONCERNS

Many energy conserving features have been incorporated into this 4 bedroom home of 2,568 sq. ft. A stone veneer, applied to the windowless north wall helps to reduce heat loss. The main entry, also on the north side, incorporates a double door vestibule which acts as an airlock. Generous south facing windows allow for heat gain in the winter but are protected by overhangs in the summer. A small green house, oriented to the southeast, also can provide some direct gain solar heat.



SOLAR ENERGY SYSTEM: ACTIVE

SOLAR APPLICATION: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 72%

COLLECTOR: 624 sq. ft. of Series 2000 Solaron flat plate air collectors have been mounted directly on the roof at a 45° tilt.

STORAGE: A large bin, constructed of concrete block and insulated with 3½" of batt, accommodates 317 cu. ft. of rock storage.

DISTRIBUTION: Solar heated air may be blown into the house directly from the collectors or maybe circulated to the storage bin for later hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy.

DOMESTIC HOT WATER: A coil contained in the collector to storage air duct serves to preheat domestic hot water.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

KENTUCKY
4683 DD
1 SFD NEW
ACTIVE HEATING & DHW
33

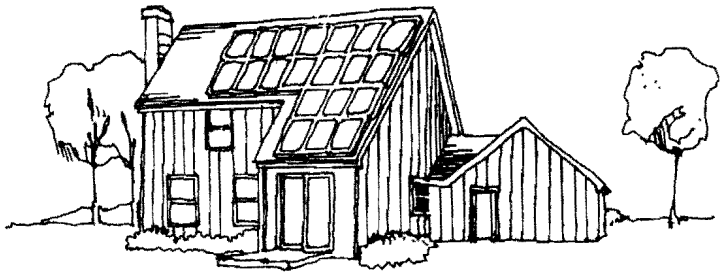
MISS 4711 DD 1 SFD NEW ACTIVE HEATING & DHW

34

CLIMATIC DATA:

HEATING DD: 4,711
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 629 BTU/sq. ft.

DESIGN TEMP:
INDOOR: 72° F
% SUN/YR: 65%



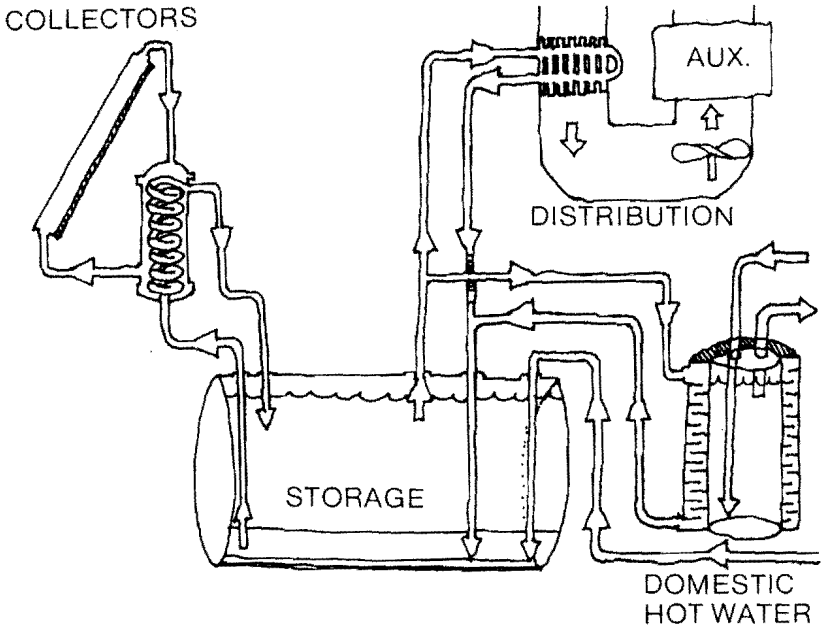
BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Missouri, this 4 bedroom home contains 3000 sq. ft. of space. The house was constructed using 2x6 studs to allow space for 6" of wall insulation. In addition, insulated glass, ½" thick was used. Hollow core, steel doorways, filled with urethane also contribute to conserving energy in this home. Furthermore, the fireplace, which draws air for combustion from the outside, incorporates a heat recovery system. Attic vents help to reduce heat gain and aid natural ventilation.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 75%

COLLECTOR: 406 sq. ft. of flat plate liquid collectors are used to supply this home with space heating and domestic hot water. These collectors, manufactured by MIROMIT Ashkelon Metal Products, Ltd., are mounted directly to the southside of the roof at a 36° tilt. An antifreeze which is comprised of 50% water and 50% propylene glycol, circulates through the collectors. The collectors themselves are comprised of a steel absorption plate covered with a single sheet of tempered glass.
STORAGE: The antifreeze circulates through a heat exchange unit where it transfers energy to water. This water is stored in an 800 gallon glass lined steel tank.
DISTRIBUTION: A coil, contained in the ductwork, transfers heat to the air that is then distributed throughout the house.
AUXILIARY ENERGY SYSTEM: An electric coil, placed in the top of the main storage tank, warms the storage water when solar radiation is adequate to do so.
DOMESTIC HOT WATER: A coil from the main storage is located in the DHW tank. This coil serves to preheat potable water for domestic use.
MODES OF OPERATION: Collector to storage, storage to house, auxiliary to storage to house, DHW preheat.



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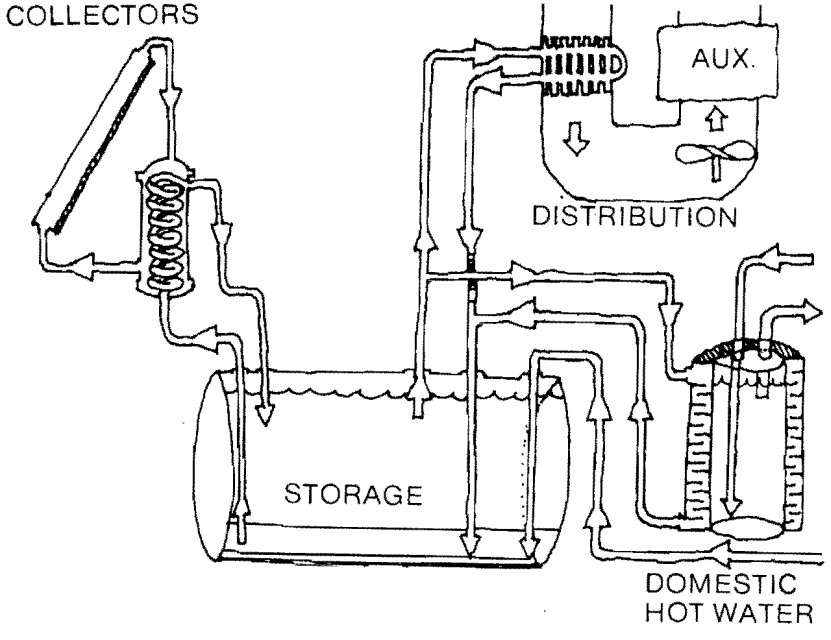


PROJECT INFORMATION:

BUILDER/APPLICANT: Bond Construction Co.
DESIGNER: W. M. Owens
SOLAR SUB: Ionic Solar
LOCATION: Gladstone, MO
LATITUDE: 39°N
HOUSING TYPE: SFD, 1 Unit
AREA: 3,000 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,711
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 629 BTU/sq. ft.
DESIGN TEMP: INDOOR: 72° F
% SUN/YR: 65%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 4-bedroom house is identical to the previous project, but the collector area is smaller, so the solar contribution to the heating load is smaller. It contains 3,000 sq. ft. of space. The house was constructed using 2" x 6" studs to allow space for 6" of wall insulation. In addition, insulated glass, ½" thick was used. Hollowcore steel doorways filled with urethane also contribute to conserving energy in this home. Furthermore, the fireplace, which draws air for combustion from the outside, incorporates a heat recovery system. Attic vents help to reduce heat gain and aid natural ventilation.

SOLAR ENERGY SYSTEM: ACTIVE

SOLAR TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

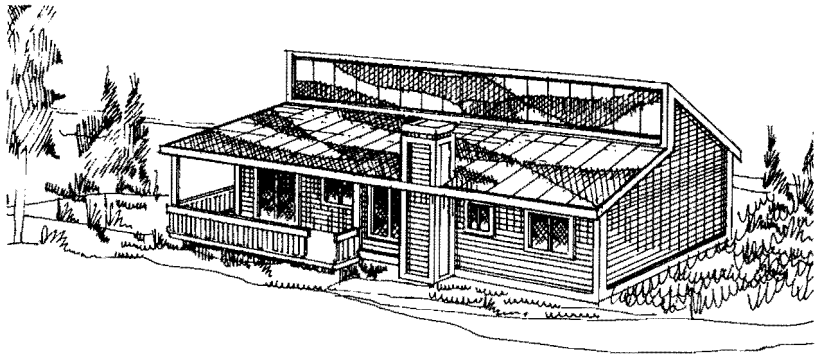
COLLECTOR: 365 sq. ft. of flat plate liquid collectors are used to supply this home with space heating and domestic hot water. These collectors, manufactured by MIROMIT Ashkelon Metal Products, Ltd., are mounted directly to the southside of the roof at a 36° tilt. An antifreeze, which is comprised of 50% water propylene glycol, circulates through the collectors. The collectors themselves are comprised of a steel absorption plate covered with a single sheet of tempered glass.
STORAGE: The antifreeze circulates through a heat exchange unit where it transfers energy to water. This water is stored in a 750 gallon glass-lined steel tank.
DISTRIBUTION: A coil, contained in the ductwork, transfers heat to the air that is then distributed throughout the house.
AUXILIARY ENERGY SYSTEM: An electric coil placed in the top of the main storage tank, warms the storage water when solar radiation is inadequate.
DOMESTIC HOT WATER: A coil from the main storage is located in the DHW tank. This coil serves to preheat potable water for domestic use.
MODES OF OPERATION: Collector to storage, storage to house, auxiliary to storage to house, DHW preheat.

HEATING DD: 4,754 DESIGN TEMP: WINTER: 10° F HORIZ. INSOL. JAN. DAY: 369 BTU/sq. ft. DESIGN TEMP: INDOOR: % SUN/YR: 49%

ACTIVE HEATING & DHW 2 SFD NEW 4754 DD

BUILDING DESCRIPTION/ENERGY CONCERNS

Two models of one level single family detached homes each have 3 bedrooms. One model has 1,400 sq. ft. of living space, and the other has 1,500 sq. ft. Walls have 6" batt insulation, as do the floors. Ceilings have 12" blown insulation. Most of the double glazed windows face south in order to catch direct sunlight, and other window surface areas are minimal.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 72%

COLLECTOR: 318 sq. ft. of collector surface, consisting of 17 Sunworks flat plate water panels, is mounted directly onto the roof facing due south at a 90° tilt. The roof below the collectors reflects incident radiation onto the collector surface, increasing collected solar heat. Water is pumped through the collectors, heated, and pumped to heat storage tank.

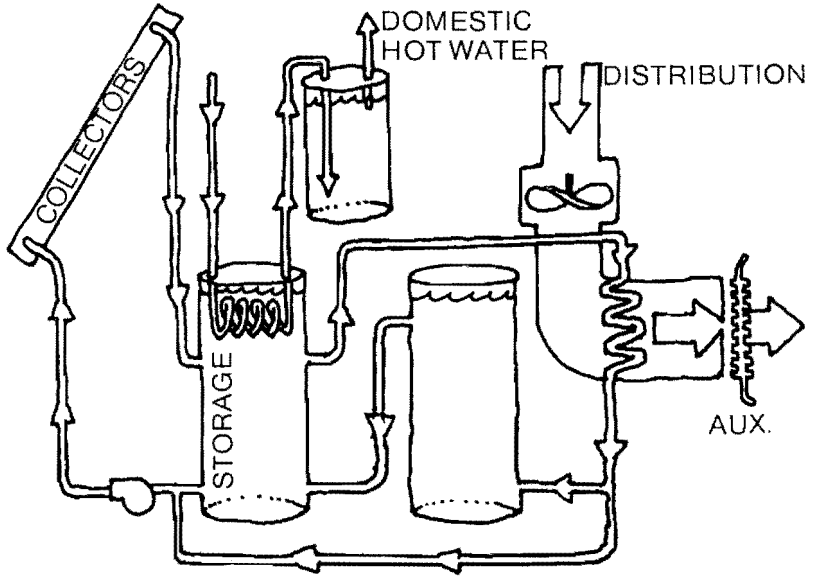
STORAGE: 2,500 gallons of water storage are located in reinforced plastic tanks in the basement. The tanks are insulated with 6" batt insulation.

DISTRIBUTION: Heated water is pumped from storage through a water to air coil heat exchanger in the heating ducts for forced air distribution.

AUXILIARY ENERGY SYSTEM: Electric resistance heaters provide auxiliary heating.

DOMESTIC HOT WATER: Cold water is preheated in a coil in storage before going to a conventional water heater.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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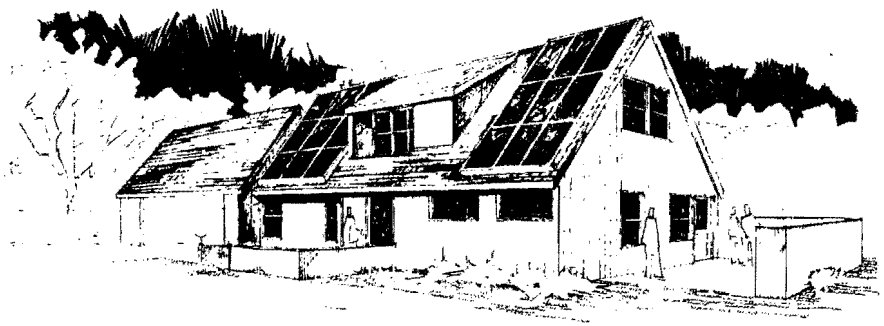
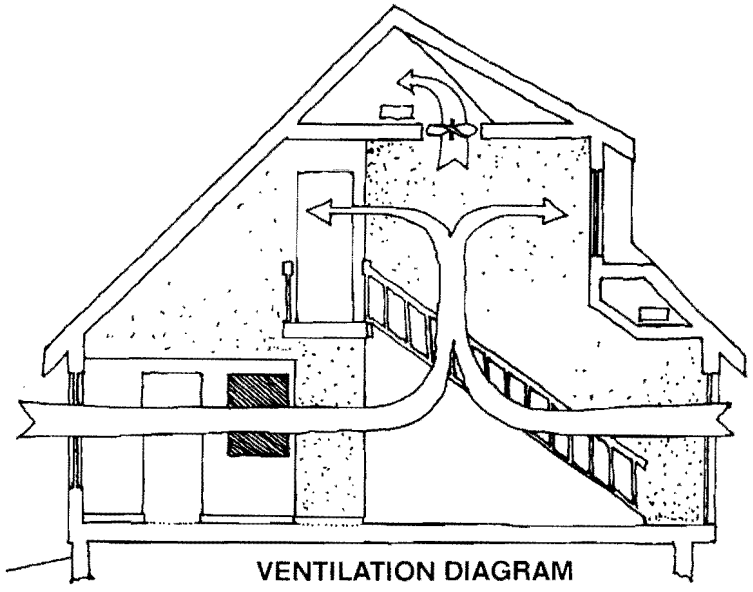


PROJECT INFORMATION:

BUILDER/APPLICANT: Ed Thomas Associates
DESIGNER: Marion G. Hymer
SOLAR SUB: City Wide Heating & Cooling
LOCATION: Paola, KS
LATITUDE: 39°N
HOUSING TYPE: SFD, 2 Units
AREA: 2,116 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,763
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 710 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 70%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom home has 2,116 sq. ft. of space. The garage, which is sited to the northwest, serves as a wind block and reduces convective heat losses in winter. The house is well insulated with walls rated at R-19 and ceilings rated at R-30. Storm windows and insulated shutters further protect against heat loss. Operable windows, attic vents and fans, take advantage of prevailing southwestern winds to ventilate the home in the summer.



VENTILATION DIAGRAM

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%

COLLECTOR: Solaron collectors, mounted at a 45° tilt and oriented due south, provide solar energy for the heating and domestic hot water system. The collectors cover an area of 315 sq. ft. and use air to transfer collected heat to storage.
STORAGE: A rock-filled bin provides a storage capacity of 160 cu. ft. This bin is protected against heat loss by 2" of side insulation and 3" of top insulation.
DISTRIBUTION: Warmed air is distributed by a centrally located air handler. Air from the collectors or from storage is forced through this air handler and then into the house.
AUXILIARY ENERGY SYSTEM: Auxiliary energy is provided by an electric heat pump.
DOMESTIC HOT WATER: A coil in the air handling unit circulates city water through the heating system which serves to preheat water for domestic use.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

KANSAS
4763 DD
2 SFD NEW
ACTIVE HEATING & DHW
37

ACTIVE HEATING & DHW   2 SFD NEW   4763 DD   K

HEATING DD: 4,7[illegible]
DESIGN TEMP: WINTER: 0° F   INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 714 BTU/sq. ft.   % SUN/YR: 62%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves a 3 bedroom house with 2,116 sq. ft. of space and is similar to the previous project. The walls are well insulated, with batt insulation to a R-19 rating in the walls and R-30 in the ceilings. Heat losses from the window surfaces are reduced by storm windows and insulation shutters. Natural ventilation is induced by opening windows and providing attic vents and fans, cooling the house in summer months.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION:

COLLECTORS: Solaron collectors, mounted at a 45° tilt and oriented due south provide solar energy for the heating and domestic hot water system. The collectors cover an area of 315 sq. ft. and use air to transfer collector heat to storage.

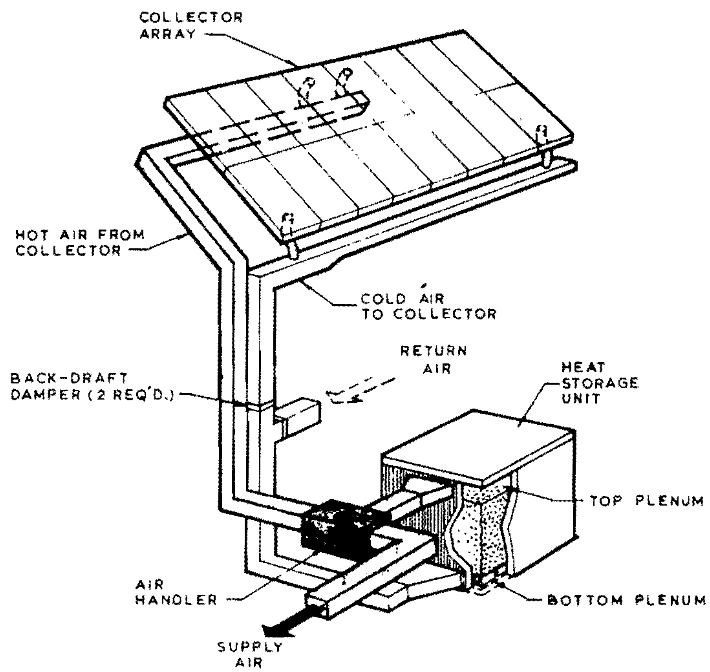
STORAGE: A rock-filled bin provides a storage capacity of 160 cu. ft. This bin is protected against heat loss by 2" of side insulation and 3" of top insulation.

DISTRIBUTION: Warmed air is distributed by a centrally located air handler. Air from the collectors or from storage is forced through this air handler and then into the house.

AUXILIARY ENERGY SYSTEM: Auxiliary energy is provided by an electric heat pump.

DOMESTIC HOT WATER: A coil in the air handling unit circulates city water through the heating system which serves to preheat water for domestic use.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.



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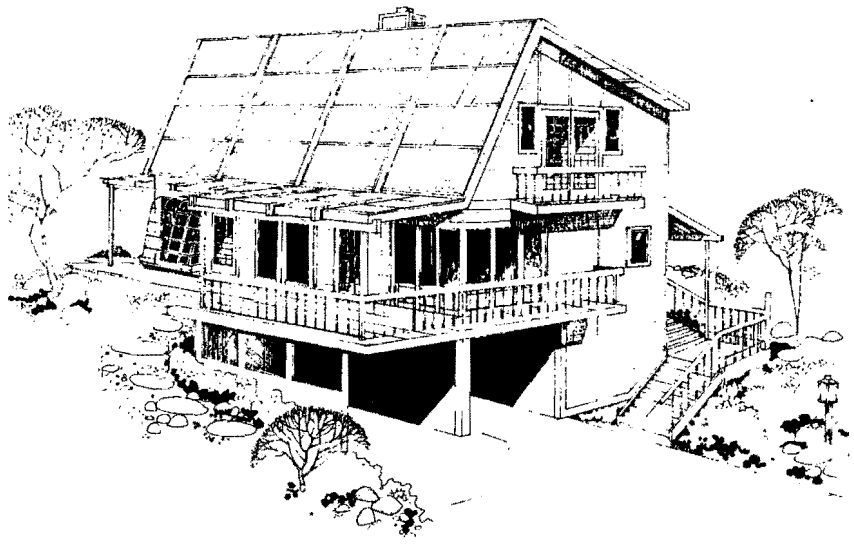
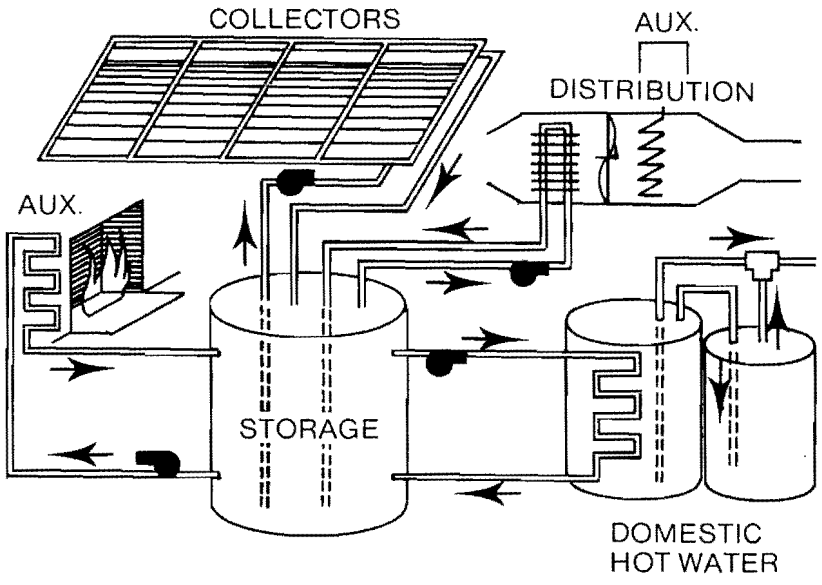




PROJECT INFORMATION:

BUILDER/APPLICANT: Larry Barr & Lance Pugh, Partners
DESIGNERS: L. Medinger & Si Martin
SOLAR SUB: Medinger, Inc.
LOCATION: Ashland, OR
LATITUDE: 42°22'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,400 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,766
DESIGN TEMP: WINTER: 10°F
HORIZ. INSOL. JAN. DAY: 330 BTU/sq. ft.
DESIGN TEMP: INDOOR: 65%
% SUN/YR: 48%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom detached home has a floor area of 1,400 sq. ft. It is partially buried on the north side and is well insulated to minimize heat loss. The walls have a rating of R-19 with 5½" of batt insulation, and the ceiling has a rating of R-37. All windows are double glazed and along with an air lock entry, they prevent cold air from entering the house. A south facing greenhouse and large south-facing windows provide supplementary heat. A retractable awning provides shade for the windows. The system's water coils run behind the fireplace enroute to storage, utilizing otherwise lost heat. An operable skylight at the peak of the roof induces ventilation which cools the house in the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 69%

COLLECTOR: 464 sq. ft. of Reynolds flat plate collectors are mounted at a 55° tilt on the southern roof. Water with corrosion inhibitors flows through the collectors to collect heat and is drained down to prevent freezing.

STORAGE: The solar heated liquid flows to a 1,000-gallon water tank located in the basement.

DISTRIBUTION: Hot water from storage is pumped through an air-to-water heat exchange coil in the return air duct of the distribution system. Air blows across the coil picking up heat, which is then blown to the house.

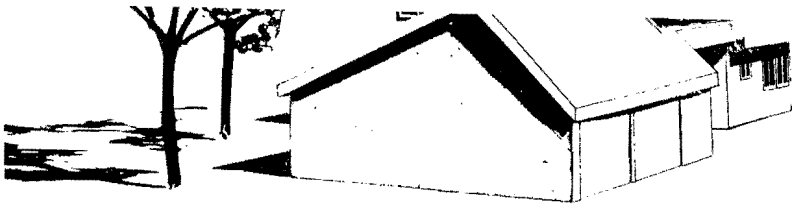
AUXILIARY ENERGY SYSTEM: An electric furnace supplies hot air for auxiliary heat.

DOMESTIC HOT WATER: Hot water from the solar storage is pumped through a heat exchanger in an 82 gallon preheat tank. On demand, heated water is transferred to a conventional DHW tank.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

OREGON
4766 DD
1 SFD NEW
ACTIVE HEATING & DHW
39

DESIGN TEMP.: WINTER: -
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft. % SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

This two level single family detached home has 3,200 sq. ft. of living space and four bedrooms. All walls are insulated with 6" of batt insulation, the roof is insulated with 12" of batt insulation, and the floors are insulated with 2" of rigid perimeter insulation. A heat circulating fireplace, with a glass curtain to prevent heat loss, provides supplementary heat. An operable clerestory aids in natural ventilation for summer cooling.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 62%

COLLECTOR: 507 sq. ft. of collector surface, consisting of 28 Solaron air collectors, is mounted directly to the roof, facing south at a tilt of 45°. Air is drawn through the collectors, heated, then blown to rock storage.

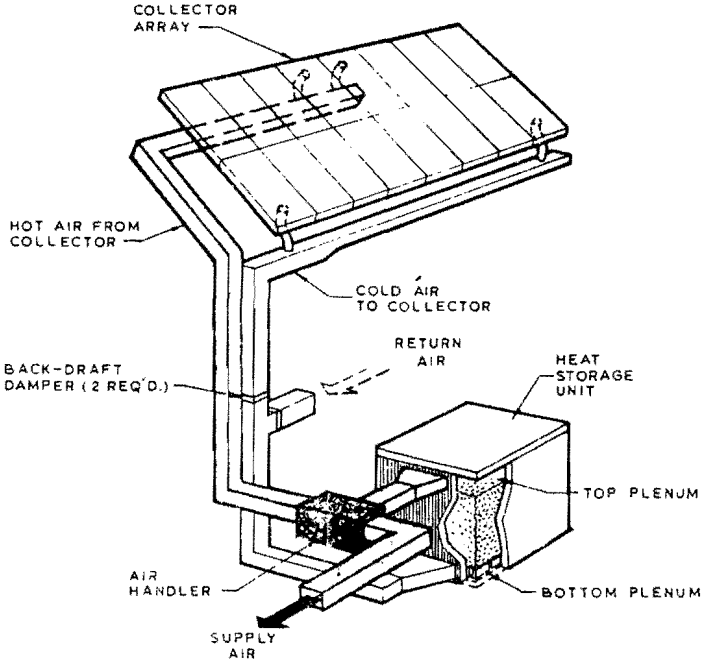
STORAGE: 254 cu. ft. of rock storage is located in a concrete bin, sealed with 2" rigid insulation.

DISTRIBUTION: A central air handling unit blows air directly from the collectors or from the rock storage for forced hot air distribution.

AUXILIARY ENERGY SYSTEM: An oil fired furnace provides auxiliary heat.

DOMESTIC HOT WATER: Cold water is preheated in a fin-coil exchange located in the collector to storage air duct, and returned to a hot water storage tank. The adjacent conventional DHW tank provides distribution and auxiliary heating.

MODES OF OPERATION: Collector to storage, collector to house, storage to auxiliary to house, auxiliary to house, DHW preheat.



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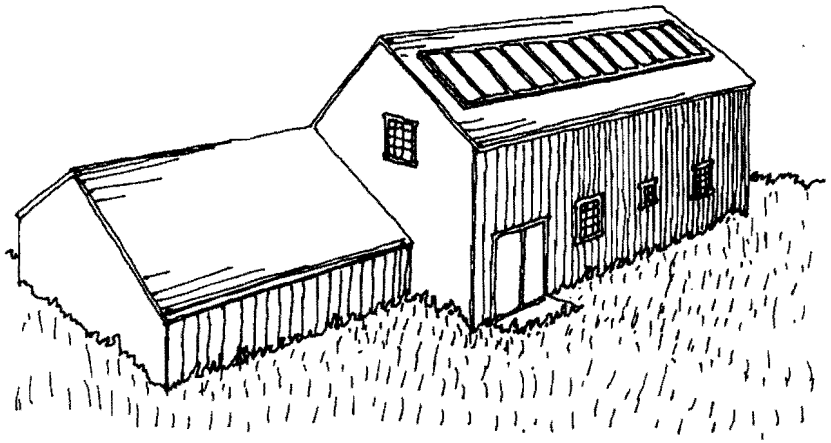
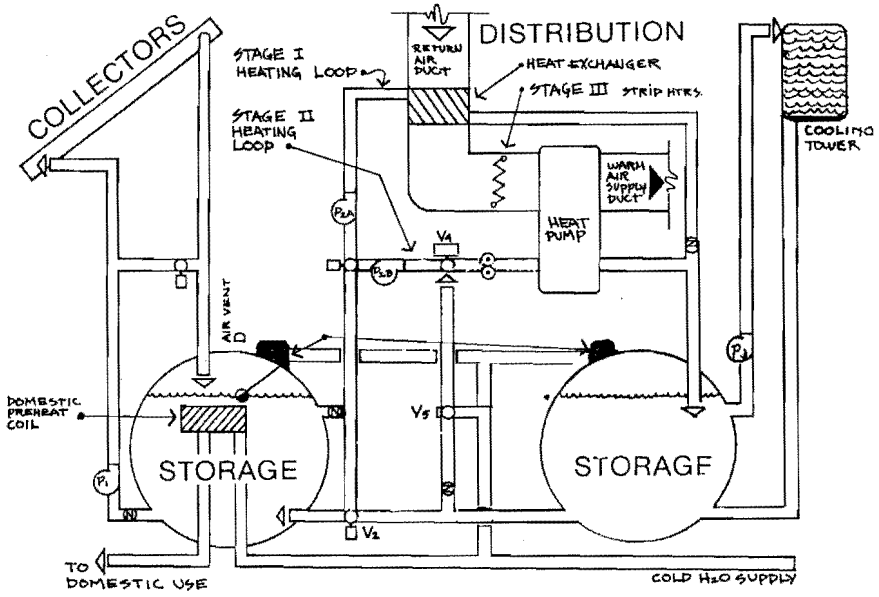




PROJECT INFORMATION:

BUILDER/APPLICANT: Christopher Shipp Productions
DESIGNER: Christopher Shipp
SOLAR SUB: Myron Haas
LOCATION: West Grove, Pa. **LATITUDE:** 39°N
HOUSING TYPE: SFD, 1 Unit **AREA:** 2,655 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,865 DESIGN TEMP:
DESIGN TEMP: WINTER: 0° F INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft. % SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

This new single family detached home provides 2,655 sq. ft. space and may be adapted to incorporate 2 to 5 bedrooms. The insulated walls are of 2" x 6" construction; the roof is protected with 10" of insulation. A garage placed to the northwest further protects the house in that it provides a wind barrier. Window area on all faces has been minimized in order to reduce problems of heat gain or heat loss.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 39%

COLLECTOR: Revere panels provide 206 sq. ft. of collector surface area. They are mounted directly on the roof, oriented due south and tilted to a 35° angle. Freezing of the water transfer media is prevented by a drain down system.

STORAGE: Two tanks, containing a total of 1,030 gallons of water provide a solar storage system.

DISTRIBUTION: Heated water from the collectors circulates to the first storage tank and then directly through a coil located in the house supply duct or used to boost a back-up heat pump. The water then circulates to the second cooler, storage tank. This second storage tank also provides for cold water storage to assist the summer cooling cycle. An attached cooling tower recools the storage water for continuous operation.

AUXILIARY ENERGY SYSTEM: In addition to the heat pump, electric resistance strips, contained in the air supply duct provide local heating.

DOMESTIC HOT WATER: A heat exchange coil, in the first solar storage tank, provides for DHW preheat.

MODES OF OPERATION: Collector to storage, storage to house, storage to heat pump to house, auxiliary to house, DHW preheat.

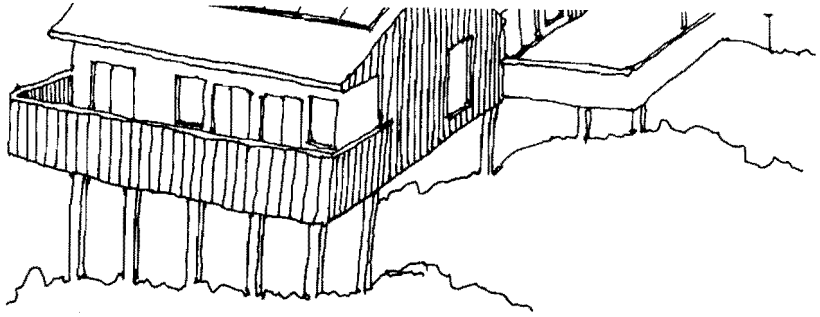
NE

4871 DD

1 SFD NEW

ACTIVE HEATING & DHW

DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft. % SUN/YR: 59%



BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home consists of 2,430 sq. ft. of living space and three bedrooms. Ceilings, floors and walls are all insulated with 6" of batt insulation. Window areas are modest with the largest glazed areas facing south.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 69%

COLLECTOR: 627 sq. ft. of collector surface, consisting of 32 KTA liquid solar panels, is mounted directly onto the sloping roof facing south at a tilt of 22½°. Antifreeze is circulated through fluted copper tubing painted black which is encased in concentric glass tubes with a silver reflective interior surface. The reflective surface is rotated to the optimum angle for solar energy collection. The antifreeze is transferred to the storage medium through a shell and tube heat exchanger.

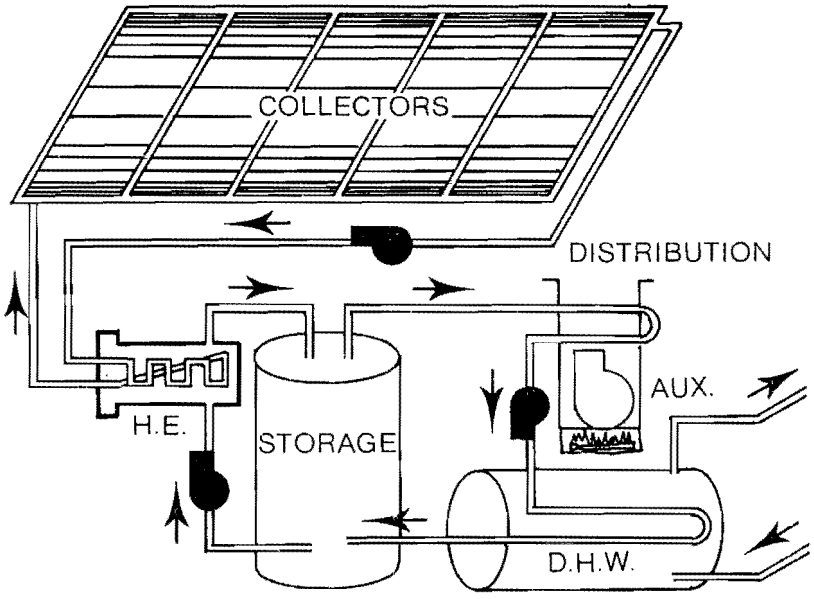
STORAGE: A 1,500 gallon steel water tank with an epoxy lining is located under the house, the tank has 12" of batt insulation.

DISTRIBUTION: The heated storage water is pumped through water-to-air heat exchanger coils in the heating ducts for forced hot air distribution.

AUXILIARY ENERGY SYSTEM: An oil-fired furnace provides auxiliary energy.

DOMESTIC HOT WATER: Heated storage water is also circulated through a finned heat exchanger immersed in a hot water tank for DHW preheat.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.



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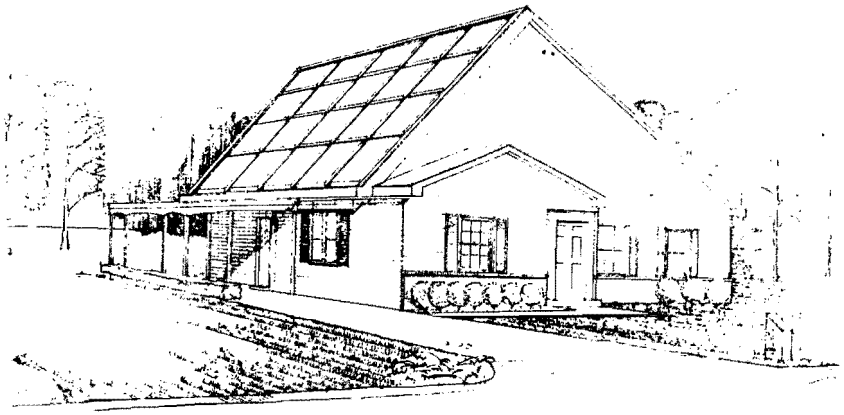
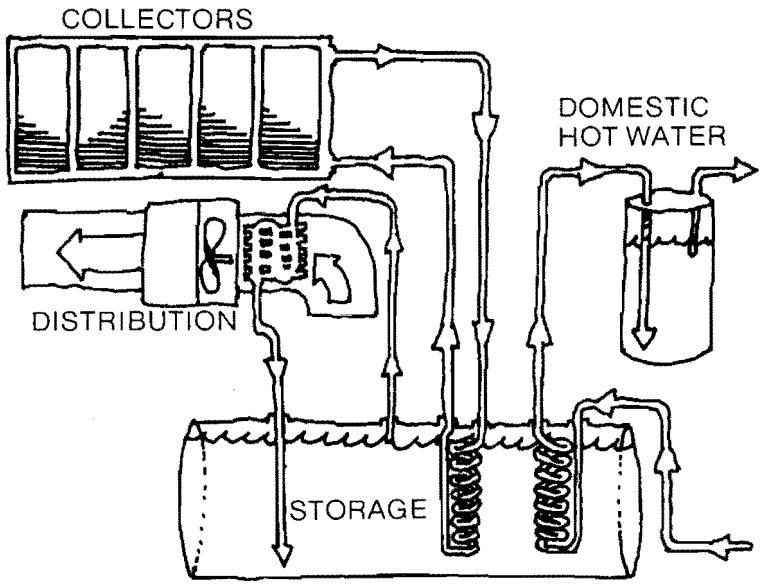


BUILDER/APPLICANT: Parkton Development Co.
DESIGNER: Arthur H. Pederson, McMullin/Littlefield
SOLAR SUB: McMasters Corporation
LOCATION: Barnhart, MO — **LATITUDE:** 38°21N
HOUSING TYPE: SFD, 1 Unit — **AREA:** 1,300 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,900 — DESIGN TEMP: INDOOR:
DESIGN TEMP: WINTER: 0° F — % SUN/YR: 61%
HORIZ. INSOL. JAN. DAY: 627 BTU/sq. ft.

BUILDING DESCRIPTION/ENERGY CONCERNS

Many energy conserving features have been used in this design in order to minimize heat loss; the home is well insulated and vestibules serve as air locks. Furthermore, winter sun advantages are maximized by south facing windows whereas summer sun loads are minimized by deep roof overhangs. Thermostatically controlled attic vent fans cool the attic during the summer.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

COLLECTOR: Liquid flat plate panels, constructed using a copper absorption plate and covered with a single sheet of tempered glass, collect solar energy for heating and domestic hot water. These collectors, manufactured by Revere, are rack mounted at a 53° tilt. An antifreeze, composed of 50% glycol and 50% water, is used as a transfer media.

STORAGE: A steel tank, containing 560 gallons of water, provides storage for the system. Antifreeze, from the collectors, transfers its heat to the water by circulating through a coil in the tank.

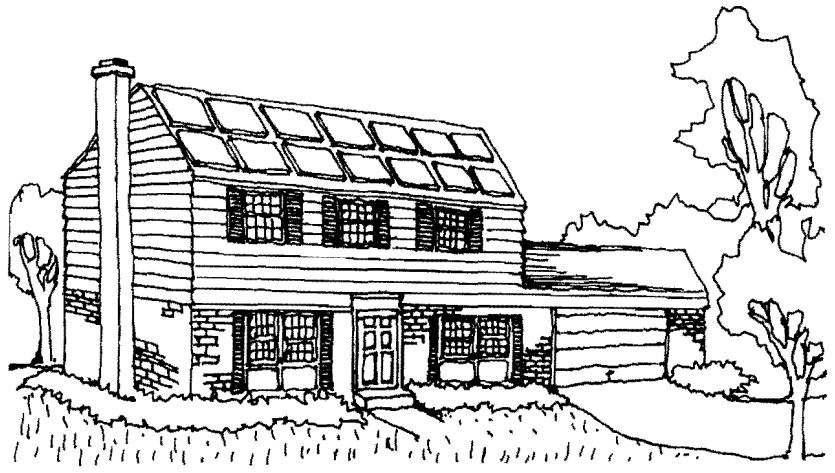
DISTRIBUTION: A coil in the return duct warms the air which circulates throughout the home.

AUXILIARY ENERGY SYSTEM: A gas furnace serves as an auxiliary heating system.

DOMESTIC HOT WATER: City water is pumped through a coil in the main storage tank. This serves as a mechanism for preheating DHW.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, DHW preheat.

PROJECT INFORMATION:
BUILDER/APPLICANT: Regent Valley Builders, Inc.
DESIGNER: Bradley R. Davis
SOLAR SUB: Meenan Oil Co., Inc.
LOCATION: Milford Township, PA
LATITUDE: 40°15'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,450 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,000
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 51%

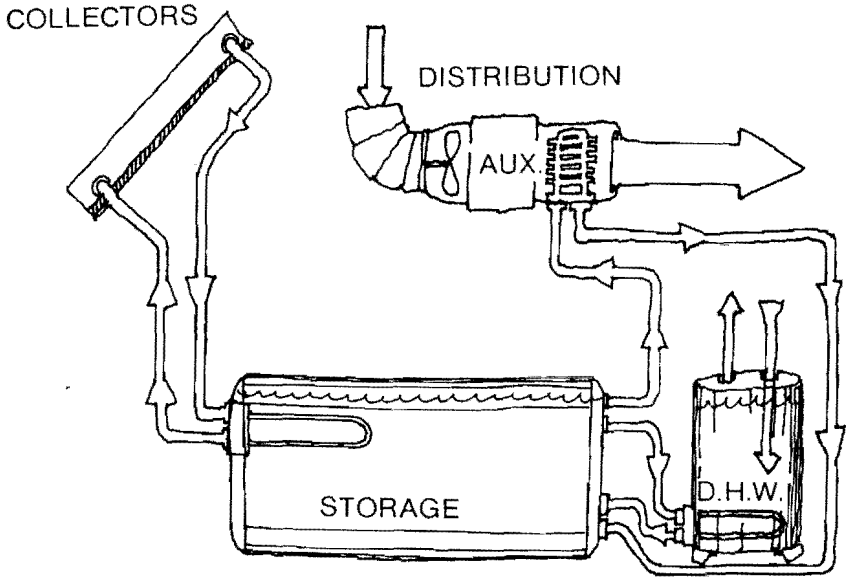


BUILDING DESCRIPTION/ENERGY CONCERNS

This 1,450 sq. ft. single family solar home is being built in a large development of 76 houses. The 4 bedroom house features an energy conservation package which includes R-19 blown insulation in the roof and R-12 batt insulation in the walls. 1½" perimeter insulation prevents heat loss through the foundation walls. The window area has been reduced and storm windows have been provided.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%



COLLECTOR: Daystar flat-plate collectors are located on 50° pitch of the south facing roof of the house. They cover 260 sq. ft. and are directly mounted to the roof surface. A glycerol and water solution, which acts as an antifreeze, flows through the collector carrying heat to a heat exchanger immersed in the storage tank.

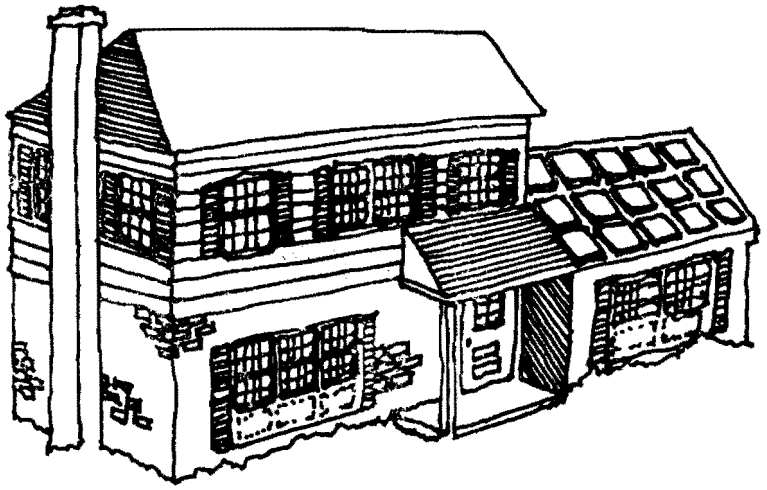
STORAGE: A 500 gallon water tank is buried next to the house, storing the solar heat picked up from the collector solution in the heat exchanger. The tank is insulated with 4" of rigid urethane.

DISTRIBUTION: The heated water in solar storage is pumped to a water-to-air coil in the return duct of the air distribution system. The water releases its heat to the air for hot air distribution.

AUXILIARY ENERGY SYSTEM: An oil fired furnace provides auxiliary heat for the house.

DOMESTIC HOT WATER: Solar heated water is pumped from the solar storage tank to a heat exchanger in the bottom of the 80 gallon conventional DHW heater, preheating the water.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



PROJECT INFORMATION:

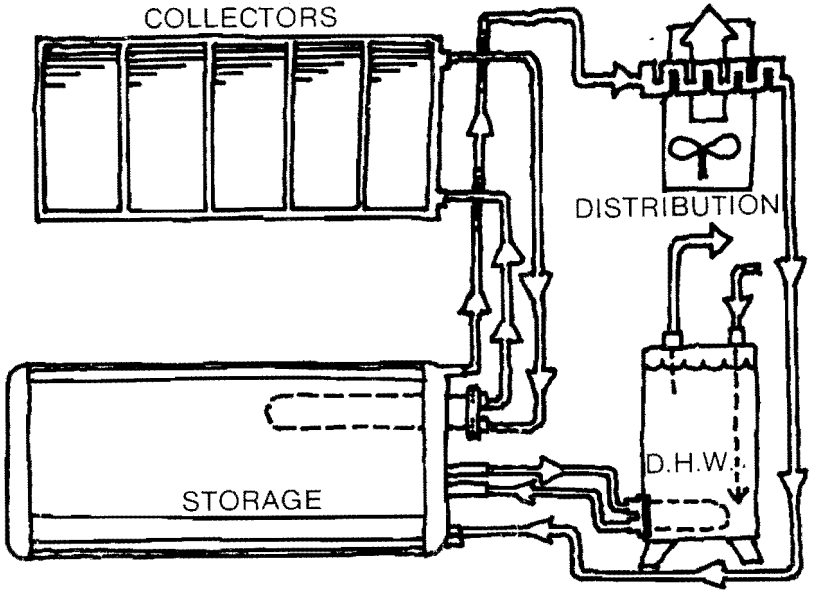
BUILDER/APPLICANT: Regent Valley Builders, Inc.
DESIGNER: Bradley R. Davis
SOLAR SUB: Meenan Oil Co., Inc.
LOCATION: Towamenkin Township, PA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,000
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft.

LATITUDE: 40°15'N
AREA: 1,980 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 4 bedroom single family detached home has 1,980 sq. ft. of floor area, and uses solar energy for space heating and domestic hot water heating. Energy conservation methods include heavy insulation in the ceiling (R-30), in the walls, and around the foundation. Other houses in this subdivision are designed with reinforced roof structures and additional storage spaces so that solar systems may be added later.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 56%

COLLECTOR: These Daystar flat-plate collectors cover 252 sq. ft. of the south facing garage roof. An antifreeze and water solution flows through the collectors, carrying heat to a heat exchanger immersed in the storage tank.

STORAGE: Via the heat exchanger, collected heat is transferred to the 500 gallons of water storage located in an insulated tank and buried next to the building.

DISTRIBUTION: Solar heated water is pumped to a heat exchange coil in the air distribution duct, transferring heat from water to air.

AUXILIARY ENERGY SYSTEM: An oil fired furnace provides auxiliary heat when necessary.

DOMESTIC HOT WATER: Heated water from solar storage is pumped through a heat exchanger in the bottom of the 80 gallon DHW tank, preheating the water and reducing the amount of energy needed to raise the water to operating temperature.

MODES OF OPERATION: Collector to storage, storage to auxiliary to space, auxiliary to space, DHW preheat.

MISSOURI

5050 DD

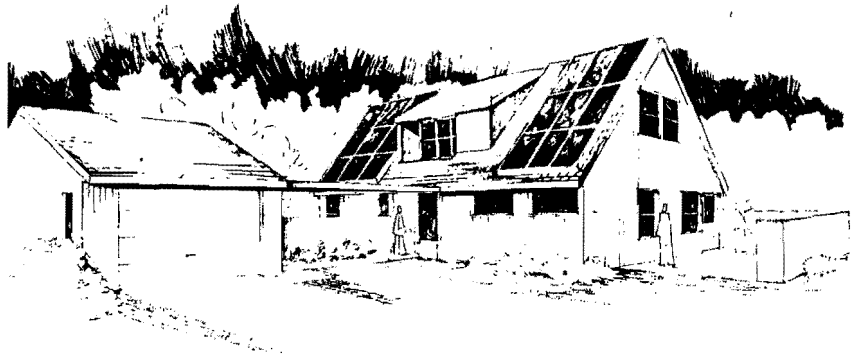
1 SFD NEW

ACTIVE HEATING & DHW

PROJECT INFORMATION:
BUILDER/APPLICANT: Ed Thomas Associates
DESIGNER: Marion G. Hymer
SOLAR SUB: City Wide Heating & Cooling
LOCATION: Richmond, MO
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,050
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 710 BTU/sq. ft.

LATITUDE: 39°N
AREA: 2,116 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 62%



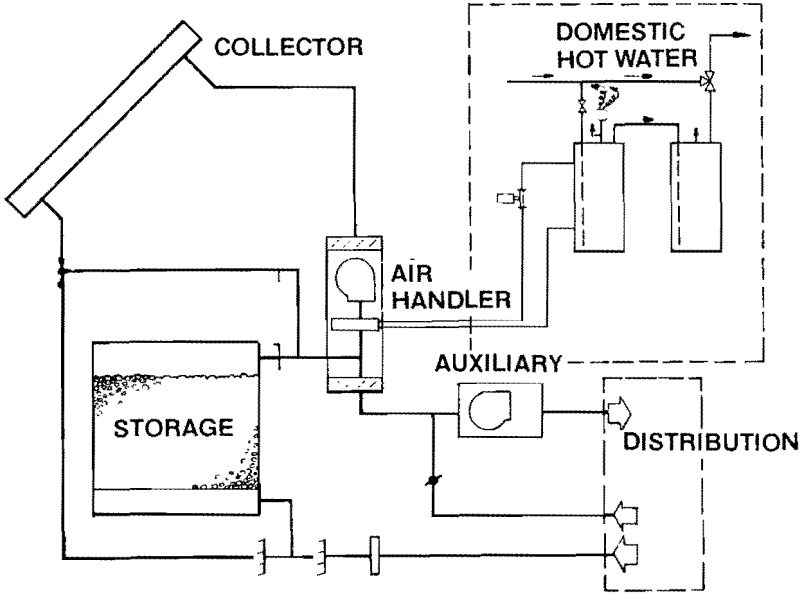
BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves a 3 bedroom house with 2,116 sq. ft. of space and is similar to two of the previous projects. The walls are well insulated, with batt insulation to a R-19 rating in the walls and R-30 in the ceilings. Heat losses from the window surfaces are reduced by storm windows and insulating shutters. Natural ventilation is induced by opening windows and providing attic vents and fans, cooling the house in the summer months.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%

COLLECTOR: Solaron collectors, mounted at a 45° tilt and oriented due south, provide solar energy for the heating and domestic hot water system. The collectors cover an area of 315 sq. ft. and use air to transfer collector heat to storage.
STORAGE: A rock-filled bin provides a storage capacity of 160 cu. ft. This bin is protected against heat loss by 2" of side insulation and 3" of top insulation.
DISTRIBUTION: Warmed air is distributed by a centrally located air handler. Air from the collectors or from storage is forced through this air handler and then into the house.
AUXILIARY ENERGY SYSTEM: Auxiliary energy is provided by an electric heat pump.
DOMESTIC HOT WATER: A coil in the air handling unit circulates city water through the heating system which serves to preheat water for domestic use.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



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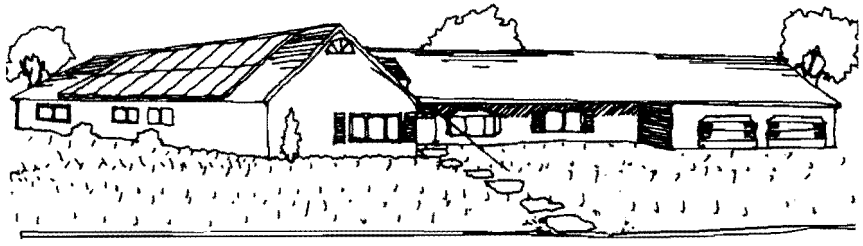
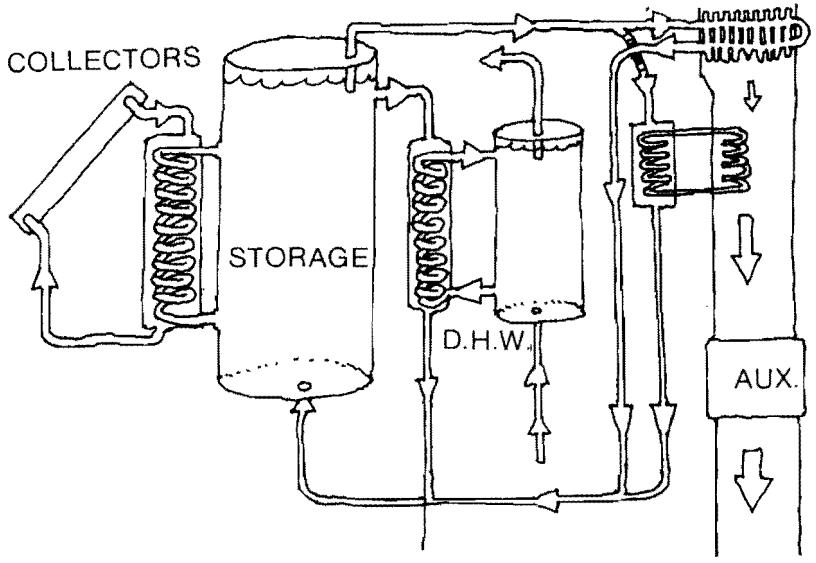




PROJECT INFORMATION:

BUILDER/APPLICANT: Fossil Creek Meadows Realty
DESIGNER: Ed Hoover & C. B. Winn
SOLAR SUB: Allen Plumbing & Heating
LOCATION: Ft. Collins, CO
LATITUDE: 40° N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,772 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,396
DESIGN TEMP: WINTER: −3°F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.
DESIGN TEMP: INDOOR: 68° F
% SUN/YR: 67%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves a 3 bedroom single family detached home with a floor area of 1,772 sq. ft. The garage is located on the north where it provides a thermal buffer against cold winter winds. Insulation values are R-19 in the wall and R-30 in the ceiling. All windows are double glazed to further reduce heat losses.

SOLAR ENERGY SYSTEM: ACTIVE

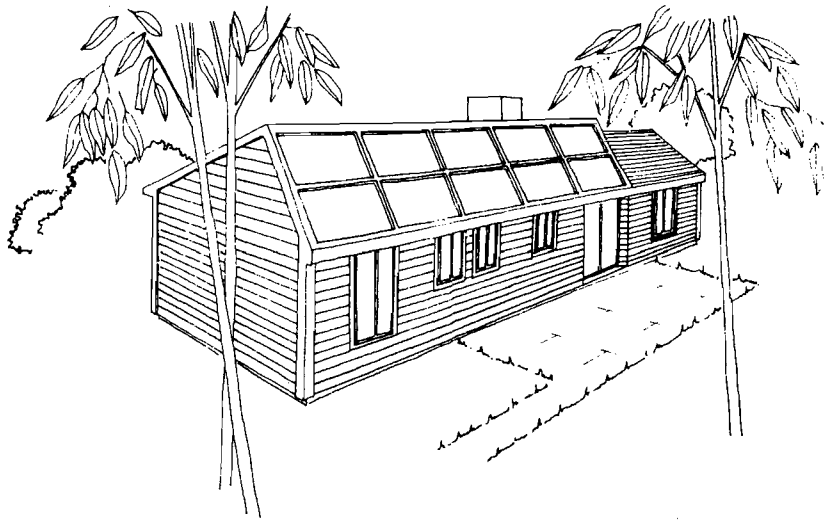
SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTOR: Manufactured by Reynolds Metals, these flat plate collectors cover 420 sq. ft. of the south-facing roof at a 45° tilt. A 50/50 solution of water and antifreeze flows through the collector to a central heat exchanger for solar heat collection.
STORAGE: Water from a 900 gallon solar storage tank also flows through the central heat exchanger transferring the collected heat to storage water. The tank is located in an equipment room on the ground floor.
DISTRIBUTION: Hot storage water is pumped through a water-to-air coil in the return air duct for hot air distribution.
AUXILIARY ENERGY SYSTEM: Electric resistance heaters are located in the air ducts to supply auxiliary heat.
DOMESTIC HOT WATER: Hot water from the solar storage tank flows through a heat exchanger along with cold water from a 40 gallon preheat tank. The preheated water returns to this tank until needed. A conventional DHW heater provides for distribution and auxiliary.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

PROJECT INFORMATION:
BUILDER/APPLICANT: Sundman Realty
DESIGNER: Ross M. Donald
SOLAR SUB: Kenneth Sundman
LOCATION: Monument Beach, MA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,630
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 477 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,092 sq. ft.

DESIGN TEMP:
INDOOR: 65° F
% SUN/YR: 50%



BUILDING DESCRIPTION/ENERGY CONCERNS

This one level, single family home has 1,092 sq. ft. of living space and three bedrooms. The ceiling is insulated with 12" of batt insulation and the walls have 6" of batt insulation. To accommodate solar panels, the house has been stretched on the east-west axis (maximizing southern exposure) and the roof slopes at an angle of 50°. There are no windows on the east and west.

SOLAR ENERGY SYSTEM: ACTIVÉ

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 64%

COLLECTOR: 300 sq. ft. of Fern Engineering air collector panels are mounted directly onto the roof facing due south. The copper collector plate is painted selective black.

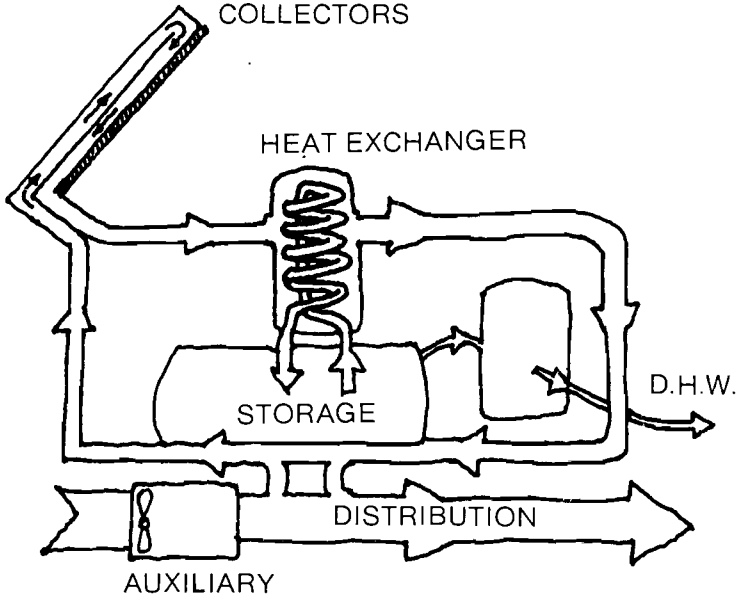
STORAGE: The solar heat is transferred to a 500-gallon water tank insulated with 12" of foil-faced batt insulation through an air-to-water heat exchanger.

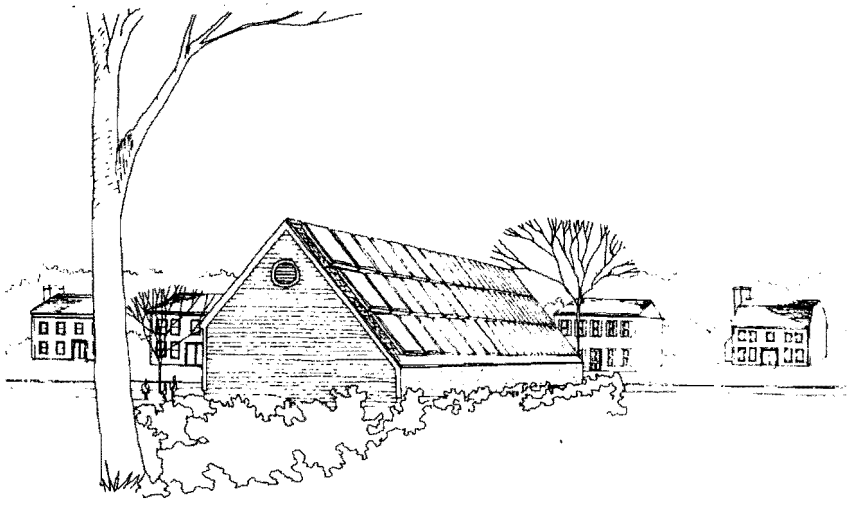
DISTRIBUTION: A forced air distribution system collects heat directly from the air collectors or from the water storage heat exchanger for solar heating the living space.

AUXILIARY ENERGY SYSTEM: An oil-fired furnace provides auxiliary heating, and an electric resistance water heater provides auxiliary hot water.

DOMESTIC HOT WATER: Solar heated water is pumped directly from storage to the 80-gallon electric water heater for DHW supply.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, domestic hot water preheat.

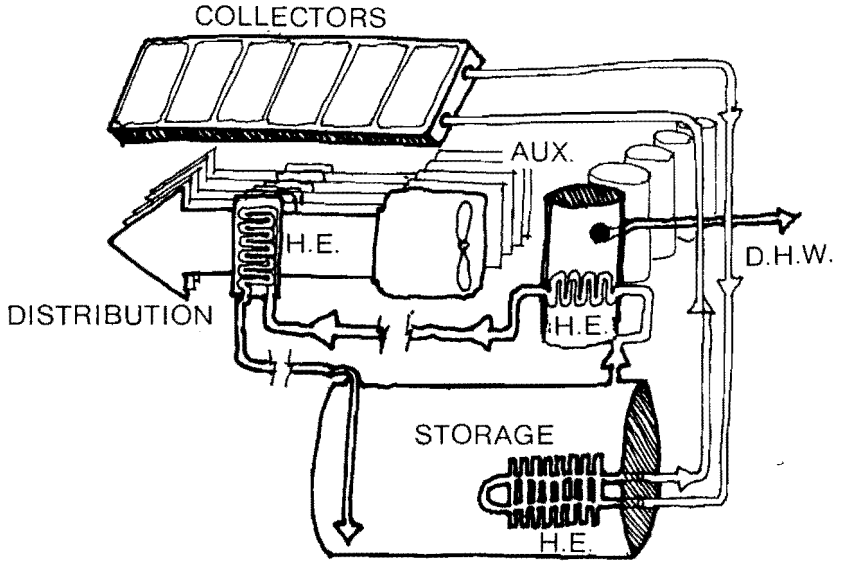




PROJECT INFORMATION:
BUILDER/APPLICANT: Indian Cove Associates
DESIGNER: Warren Mackenson
SOLAR SUB: Warren Mackenson
LOCATION: Marion, MA
LATITUDE: 41°36'N
HOUSING TYPE: SFD, 5 Units
AREA: 1,398-1,872 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,680
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 477 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

In this project, an array of collectors located on a communal 5-car garage supplies solar energy for 5 single-family detached homes. The houses range from 1,398 sq. ft. to 1,872 sq. ft., and each has 3 bedrooms. The walls of the houses have 6" insulation and the ceilings have 12" insulation, so that heat losses will be reduced.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 58%

COLLECTORS: Located on the south, facing 52° slope of the garage roof, the Daystar liquid collectors cover 1,248 sq. ft. An antifreeze and water solution is pumped through the collectors and then to a central storage tank.

STORAGE: A 2,300 gallon storage tank is located in the garage building. The collected heat is transferred to water in the storage tank via a heat exchanger. The tank is insulated with 5" of spray-on foam.

DISTRIBUTION: When heat is needed in the houses, heated water is pumped from the central storage tank through underground pipes to coils located in the return air ducts of each auxiliary furnace. The solar heat is thus transferred to the air and blown into the living areas.

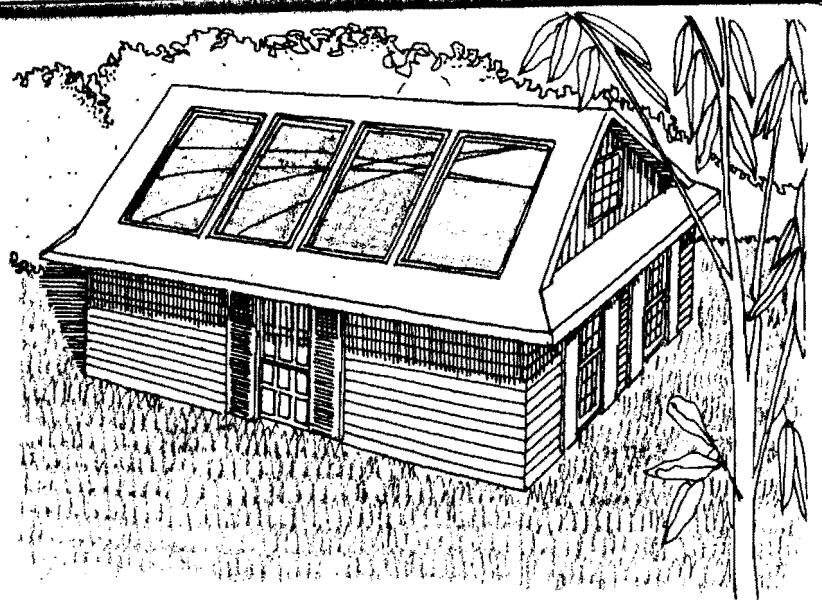
AUXILIARY ENERGY SYSTEM: An oil-fired furnace in each unit provides auxiliary heat.

DOMESTIC HOT WATER: As a boost for the DHW system, a preheat water coil runs from the major solar loop through the bottom of the conventional DHW tank.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

50 ACTIVE HEATING & DHW 2 SFD NEW 5639 DD COLORADO

BUILDER/APPLICANT: United Construction of Colorado
DESIGNER: R. H. Henkhaus
SOLAR SUB: United Construction of Colorado
LOCATION: Canon City, CO
LATITUDE: 39°N
HOUSING TYPE: SFD, 2 Units
AREA: 1,389 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,639
DESIGN TEMP:
DESIGN TEMP: WINTER: 0° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 840 BTU/sq. ft.
% SUN/YR: 67%



BUILDING DESCRIPTION/ENERGY CONCERNS

This model, which contains 3 bedrooms in 1,389 sq. ft., is used to build two homes, each located in different developments. The building has been designed so that the north facing garage breaks the wind and protects the main entry. The house is very well insulated, with a rating of R-50 for the ceiling, and R-23 for the walls. All windows are double glazed and all doors are filled with foam in order to protect against heat loss. Furthermore, window area has been kept to a minimum. Attic vents help to ventilate the home and roof overhangs reduce initial heat gain during summer months.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 67%

COLLECTOR: Mounted directly to the roof at a 40° tilt, these are flat plate collectors manufactured by Solaron. Each home has 312 sq. ft. of collector surface. Air is pulled through the collectors by a central air handler.

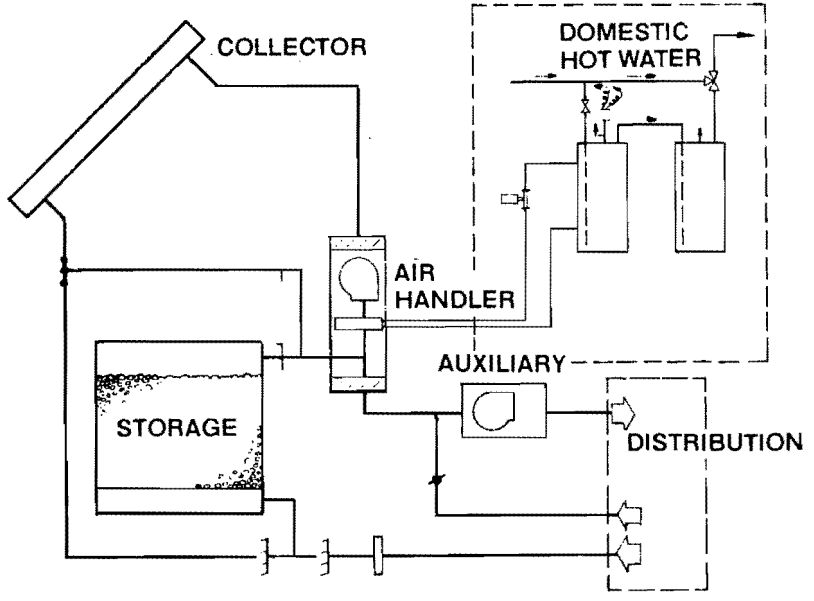
STORAGE: A rock bin, protected with rigid and batt insulation, provides 156 cu. ft. of storage for the heated air that is blown there after collection.

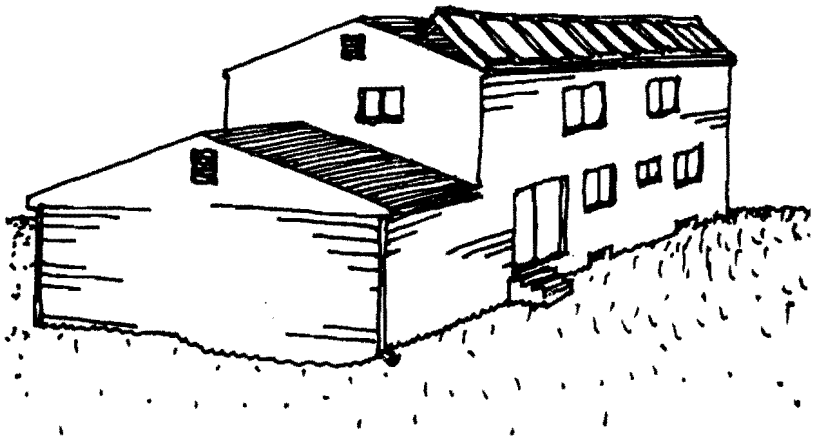
DISTRIBUTION: Air from the collectors circulates through an air handler and then either into the house or to the storage bin.

AUXILIARY ENERGY SYSTEM: One of the homes contains a gas-fired furnace, while the other contains an electric heat pump. Both of these systems provide an alternative energy source.

DOMESTIC HOT WATER: A preheat coil is located in the central air handling unit. Water is pumped from a conventional DHW tank and through this coil where it is preheated. Once warmed, the water is returned to the tank until it is needed. Auxiliary heating is supplied by an electric unit.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.





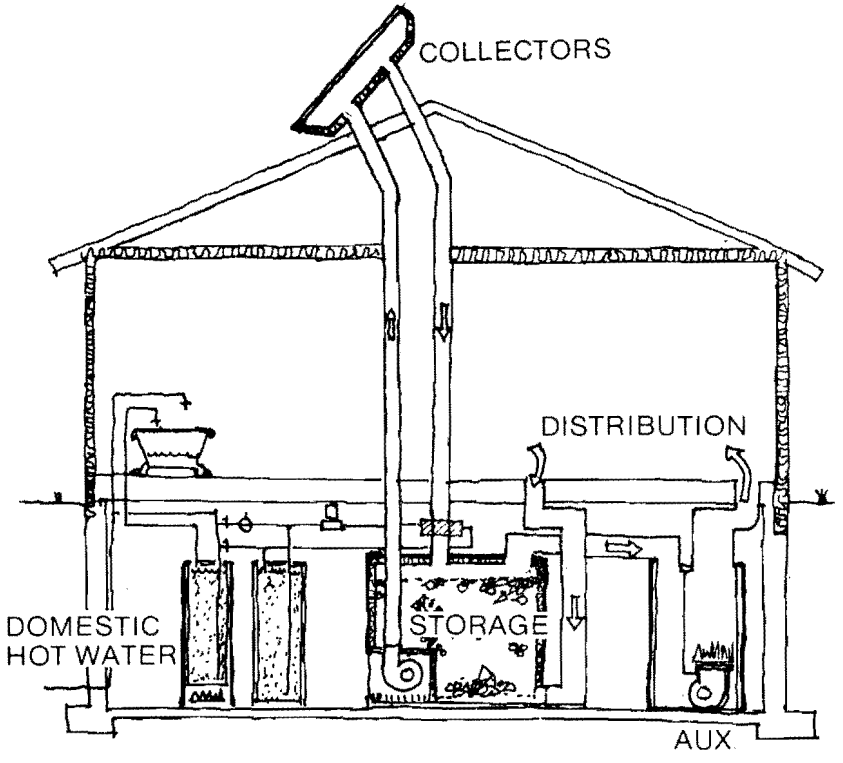
PROJECT INFORMATION:
BUILDER/APPLICANT: Davidson Phillips, Inc.
DESIGNER: Glenn F. Groth
SOLAR SUB: Brent F. Revert
LOCATION: Columbus, OH
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,660
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 475 BTU/sq. ft.

LATITUDE: 40°N
AREA: 1,700 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 35%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 level single family home has 1,700 sq. ft. of living space, including 4 bedrooms. Walls are insulated with 6" of batt insulation and the roof is insulated with 12" of blown insulation.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49%

COLLECTOR: 214 sq. ft. of Sun Stone flat plate air collectors are mounted to the roof with brackets. The panels face due south at a tilt of 50° Air is drawn through the panels and blown to a rock storage bin.

STORAGE: 214 cu. ft. of rock storage is located in the basement in a concrete bin. The bin is insulated with 2" of rigid insulation.

DISTRIBUTION: Air returning from the living space enters the bottom of rock storage and is drawn from the top of the rock storage, along with the entering heated collector air.

AUXILIARY ENERGY SYSTEM: An electric heat pump is integrated into the duct system for auxiliary heating.

DOMESTIC HOT WATER: Cold water is preheated in a fin-coil heat exchanger located in the collector storage duct, then transferred to the conventional hot water heater.

MODES OF OPERATION: Collector to storage, auxiliary to house, storage to auxiliary to house, DHW preheat.

OHIO
5660 DD
1 SFD NEW
ACTIVE HEATING & DHW
51

OHIO

5660 DD

5 SFD NEW

ACTIVE HEATING & DHW

52

PROJECT INFORMATION:
BUILDER/APPLICANT: Boyle & Schey Builders
DESIGNER: Paul S. Jacobson
SOLAR SUB: John E. Boyle
LOCATION: Findlay, OH
HOUSING TYPE: SFD, 5 Units
CLIMATIC DATA:
HEATING DD: 5,660
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 474 BTU/sq. ft.

LATITUDE: 40°05'N
AREA: 2,000 sq. ft. unit

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 35%

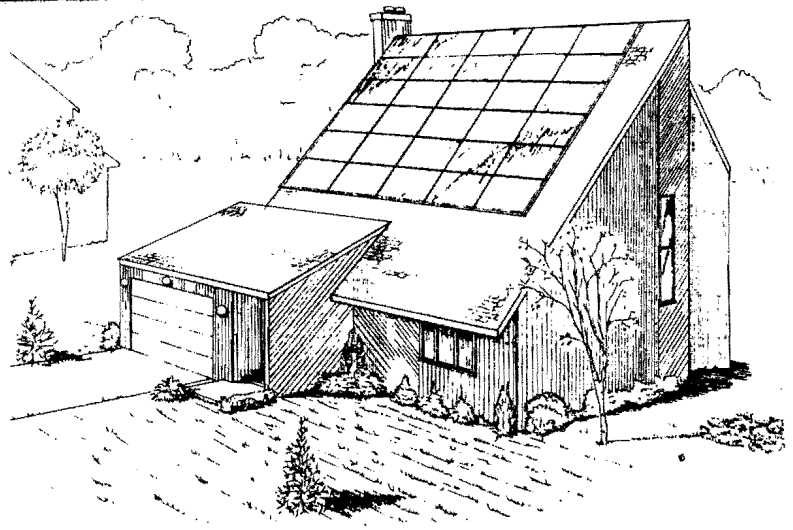
BUILDING DESCRIPTION/ENERGY CONCERNS

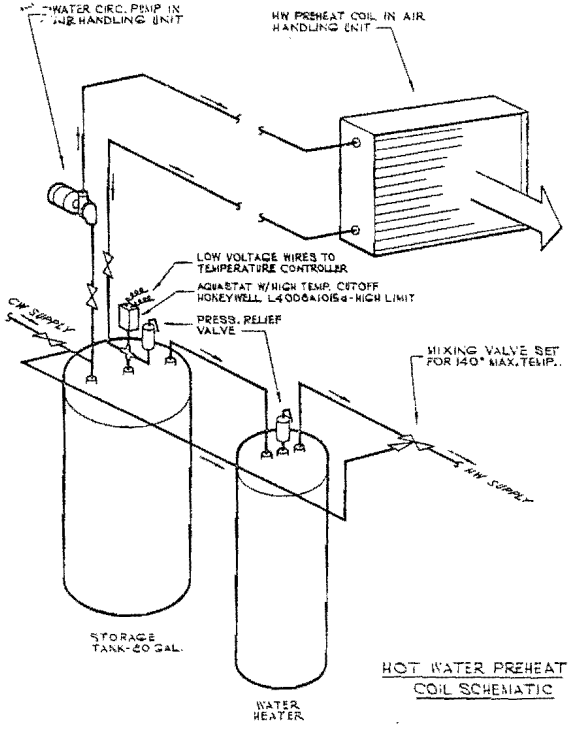
This project is a small development of 5 new single family detached homes of approximately 2,000 sq. ft. each and including 3 bedrooms. 6" of batt insulation in the walls, and heavy roof insulation are included as energy conservation features. Window area is minimized and carefully placed. All entrances, including the sliding glass doors, have air locks to preserve temperature control.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49%

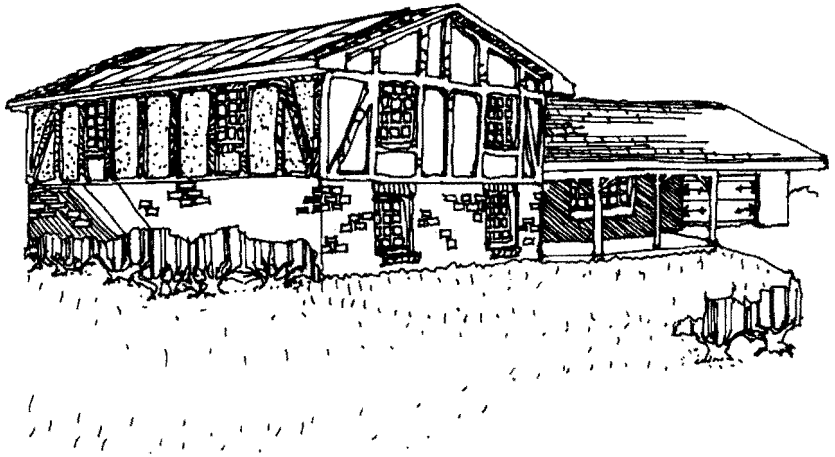
COLLECTOR: 585 sq. ft. of Solaron flat plate air collectors are mounted directly onto each roof at a 45° tilt, facing due south. Air is drawn through the collectors, and blown to rock storage for solar heating.
STORAGE: 426 cu. ft. of rock storage is contained in a concrete bin wrapped with 1½" of rigid insulation.
DISTRIBUTION: A central air handling unit blows air through the hot rock storage for forced air distribution.
AUXILIARY ENERGY SYSTEM: An electric heat pump supplies auxiliary heat.
DOMESTIC HOT WATER: Cold city water passes through a fin-coil heat exchanger located in the collector to storage air duct, and is preheated on its way to a 52 gallon conventional DHW heater.
MODES OF OPERATION: Collector to storage (via air handler), collector to house (via air handler), storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

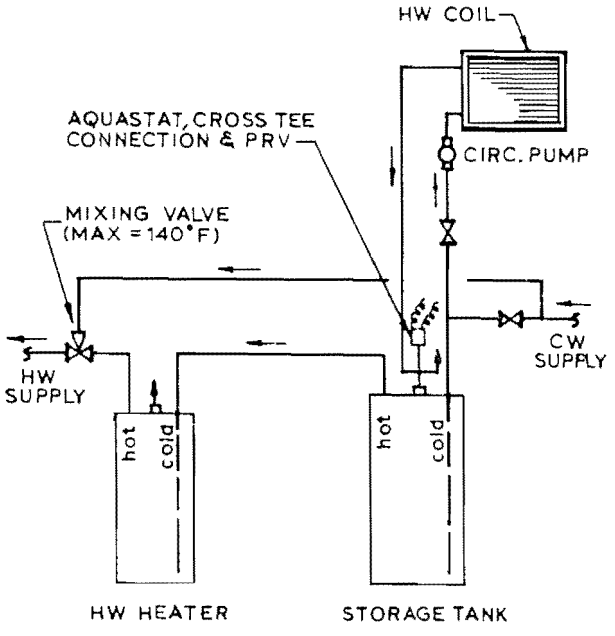




HOT WATER PREHEAT COIL SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6





FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

PROJECT INFORMATION:
BUILDER/APPLICANT: Sims Brothers Builders, Inc.
DESIGNER: Sims Brothers Builders
SOLAR SUB: Ronald Nutter
LOCATION: Marietta, OH
LATITUDE: 40°N
HOUSING TYPE: SFD, 3 Units
AREA: 2,052 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,660
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 370 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 55%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 3 single family detached dwellings with 2,052 sq. ft. of living space in each. The lowest level of each 3-level house is partially underground, reducing heat losses through exposed walls. The garage is located on the north side of the house, where it can block cold northern winds in winter. Each house is well insulated, with 6" of wall insulation and 12" of ceiling insulation. Window areas are eliminated on the north and reduced on the south. All windows are constructed with insulating glass and have storm windows. An attic ventilator dissipates heat from the attic during the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 44%

COLLECTOR: 468 sq. ft. of Solaron collectors, mounted at a 27° tilt, collect solar heat for the homes. The collectors use air to transfer heat to storage.
STORAGE: Heat storage is provided by 234 cu. ft. of fist sized rocks, located in a bin in the basement of the house. The bin is insulated with 3½" of rigid insulation.
DISTRIBUTION: Solar heated air is blown from the storage bin through an air handling unit, for distribution through conventional ductwork.
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy for the hot air heating system in these houses.
ENERGY HOT WATER: City water circulates through a coil in the air handling unit to carry heat to a 42 gallon DHW tank. This tank is joined to another conventional tank which has an electric element to boost the pre-heated water if necessary.
MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, auxiliary to storage to house, storage to auxiliary to house, DHW preheat.

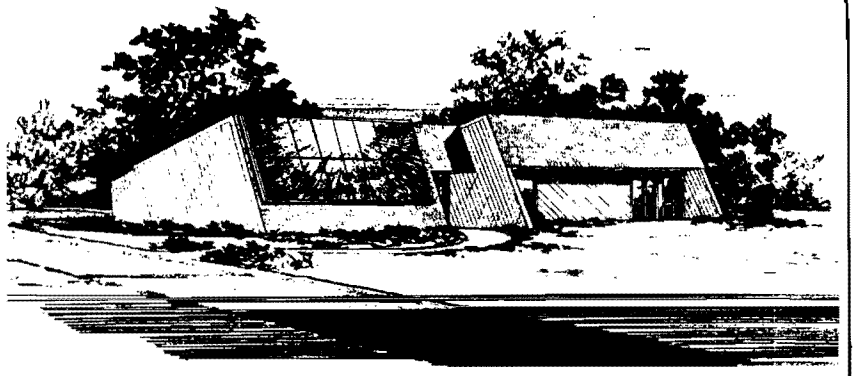
OHIO
5660 DD
3 SFD NEW
ACTIVE HEATING & DHW
53

PROJECT INFORMATION:

BUILDER/APPLICANT: Vernon O. Freeman
DESIGNER: George W. Fox, Arch.
SOLAR SUB: Climate Control Corp.
LOCATION: Muncie, IN
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,699
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 533 BTU/sq. ft.

LATITUDE: 39°12'N
AREA: 2,030 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 59%



BUILDING DESCRIPTION/ENERGY CONCERNS

This home of 2,030 sq. ft. includes 3 bedrooms and a compact floor plan. The garage has been placed to the west, the direction of prevailing winds, in order to act as a wind break. The main entry has a closed vestibule which serves to reduce heat transfer, and the garage provides a vestibule for the back door. Generous overhangs protect southern windows from summer solar gain, and all windows are triple glazed to prevent heat transfer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION:

COLLECTOR: Over 270 sq. ft. of Solaron collectors are integrated into the southern facing garage roof at a 60° tilt. Air heated in the collector system, is circulated directly to the house or into the rock storage bin.

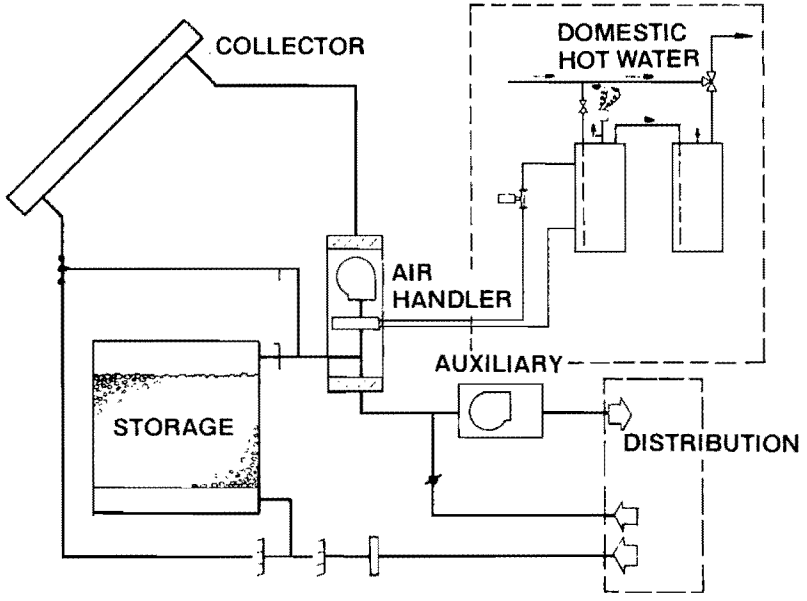
STORAGE: A rock storage bin, with a capacity of 156 cu. ft. is located in the garage to provide solar heat storage.

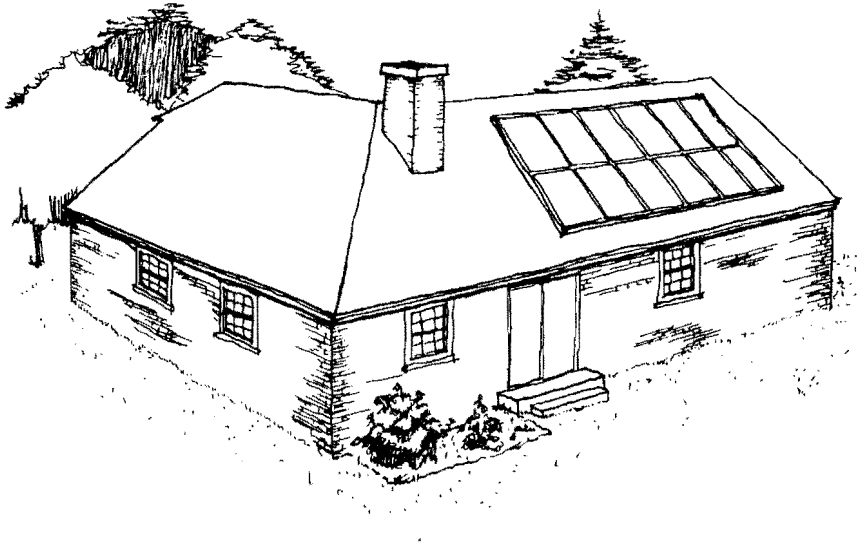
DISTRIBUTION: Return air is heated in rock storage, then blown into the living space by the hot air distribution system.

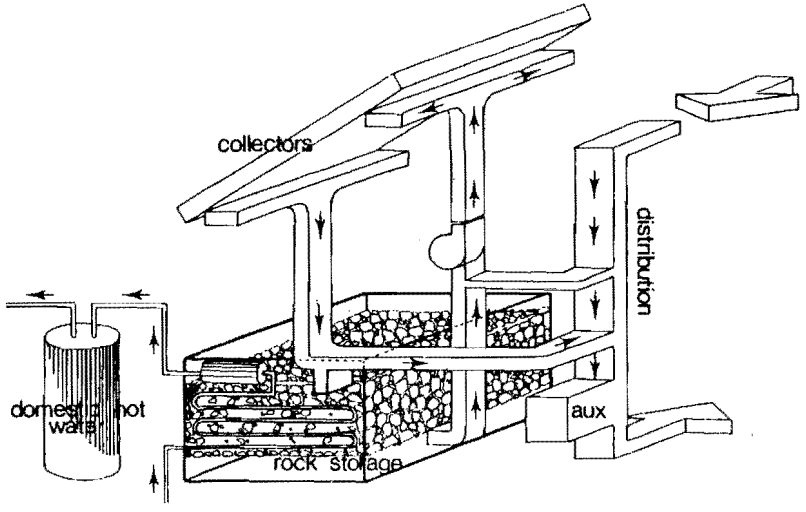
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heat.

DOMESTIC HOT WATER: City water is pumped first into a DHW storage tank and then through a preheat coil in the air handling unit for solar heating. The preheated water is pumped back into storage for conventional distribution and auxiliary heating.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:
BUILDER/APPLICANT: Steinkamp and Company
DESIGNER: Al Vandemeer
SOLAR SUB: Clifford Hildebrand
LOCATION: Batesville, IN — **LATITUDE:** 39°N
HOUSING TYPE: SFD — **AREA:** 1550 sq. ft.
CLIMATIC DATA:
HEATING DD: 5700 — DESIGN TEMP:
DESIGN TEMP: WINTER: 0°F — INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 533 BTU/sq. ft. — % SUN/YR: 58%

BUILDING DESCRIPTION/ENERGY CONCERN

These seven houses comprise a project called "Solar for Indiana" with the same model used at different locations around the state. Each one level 3 bedroom home has 1,550 sq. ft. of living space. Heat loss has been reduced through the use of triple glazing and generous blanket insulation. These factors combine to give the floor a rating of R-19, the ceiling a rating of R-38 and the walls a rating of R-21. An attached garage, located on the north side, protects the main portion of the house from cold winds. In addition, overhangs help to shade the windows and prevent heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 75%

COLLECTOR: 294 sq. ft. of flat plate collectors, manufactured by Solar Energy Products, are mounted onto the roof at a 45° tilt. These collectors, which use air to transfer solar heat gain, are constructed of an aluminum plate covered with tempered glass.

STORAGE: 249 cu. ft. of rock storage is located in a concrete bin, and protected from heat loss by 2" of insulation.

DISTRIBUTION: Solar heated air from the collectors circulates to the rock storage bin and then to an air handler which distributes heated air throughout the house.

AUXILIARY ENERGY SYSTEM: In the event that the solar heated air from the collectors is not warm enough for distribution, an electric heat pump serves as an auxiliary energy system distribution.

DOMESTIC HOT WATER: Cold water is circulated through a heat exchange coil in rock storage and once warmed rises naturally into the 42 gallon preheat tank above. A conventional DHW tank provides for both auxiliary heating and for distribution.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 7 SFD NEW 5700 DD INDIANA

56/61

PROJECT INFORMATION:

BUILDER/APPLICANTS:	DESIGNER:	SOLAR SUB:	LOCATION:
55 Steinkamp and Company	Al Vandemeer	Clifford Hildebrand	Batesville, IN
56 Ron Smith Custom Builder, Inc.	Al Vandemeer	Bryant Allen	Greenwood, IN
57 Graber Homes, Inc.	Al Vandemeer	Hennings Plumbing & Heating	Fort Wayne, IN
58 W. J. Leffel Construction	Al Vandemeer	Jerry Alfrey	Peru, IN
59 Stan Peebles & Company	Al Vandemeer	Stan Peebles	Terre Haute, IN
60 R&R Builders, Inc.	Al Vandemeer	Ralph Dobbs	Fountaintown, IN
61 Miles-Richmond, Inc.	Al Vandemeer	Allen Paddock	Liberty, IN

HOUSING TYPE: SFD

CLIMATIC DATA:

HEATING DD: 5,700

DESIGN TEMP: WINTER: 0° F

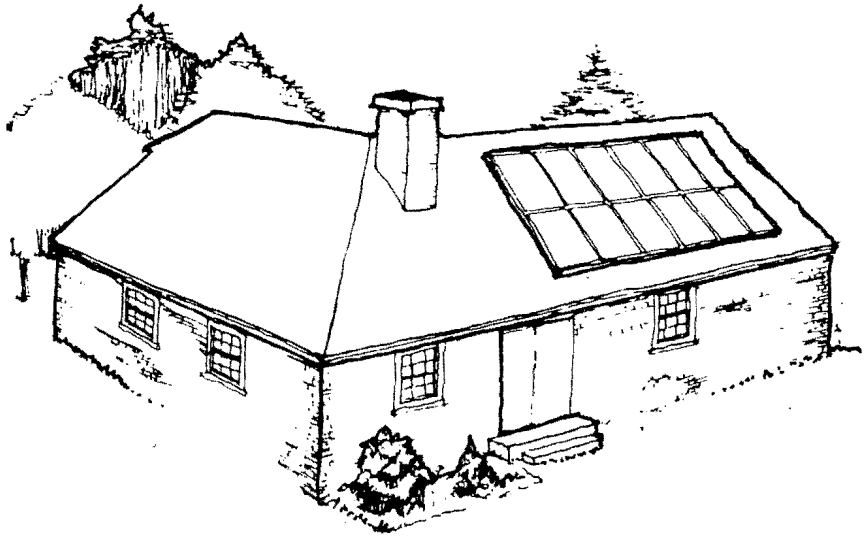
HORIZ. INSOL. JAN. DAY: 533 BTU/sq. ft.

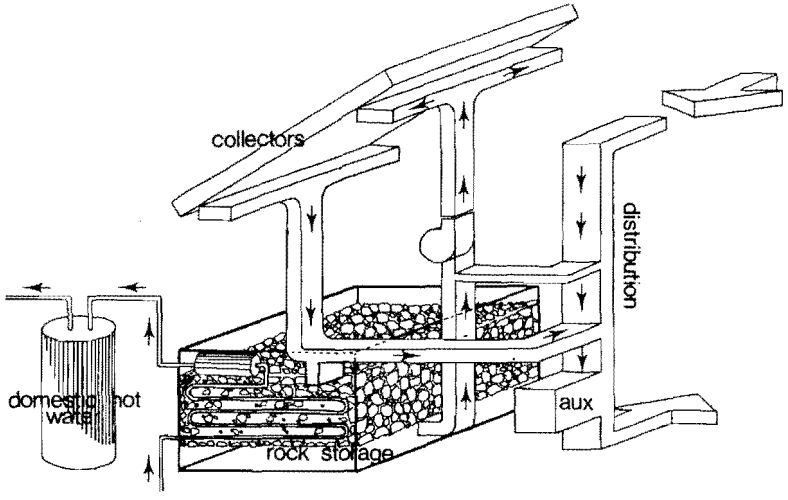
AREA: 1,550 sq. ft./unit

DESIGN TEMP:

INDOOR: 70°F

% SUN/YR: 58%





BUILDING DESCRIPTION/ENERGY CONCERN

These seven houses comprise a project called "Solar for Indiana" with the same model used at different locations around the state. Each one level 3 bedroom home has 1,550 sq. ft. of living space. Heat loss has been reduced through the use of triple glazing and generous blanket insulation. These factors combine to give the floor a rating of R-19, the ceiling a rating of R-38 and the walls a rating of R-21. An attached garage, located on the north side, protects the main portion of the house from cold winds. In addition, overhangs help to shade the windows and prevent heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 75%

COLLECTOR: 294 sq. ft. of flat plate collectors, manufactured by Solar Energy Products, are mounted onto the roof at a 45° tilt. These collectors, which use air to transfer solar heat gain, are constructed of an aluminum plate covered with tempered glass.

STORAGE: 249 cu. ft. of rock storage is located in a concrete bin, and protected from heat loss by 2" of insulation.

DISTRIBUTION: Solar heated air from the collectors circulates to the rock storage bin and then to an air handler which distributes heated air throughout the house.

AUXILIARY ENERGY SYSTEM: In the event that the solar heated air from the collectors is not warm enough for distribution, an electric heat pump serves as an auxiliary energy system distribution.

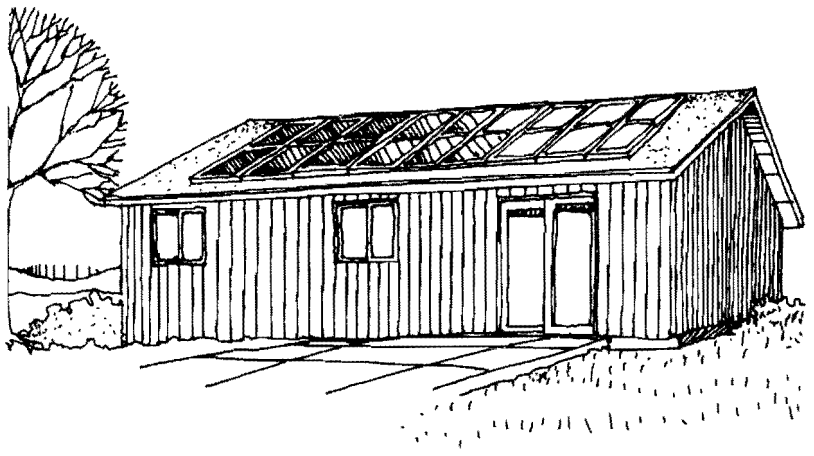
DOMESTIC HOT WATER: Cold water is circulated through a heat exchange coil in rock storage and once warmed rises naturally into the 42 gallon preheat tank above. A conventional DHW tank provides for both auxiliary heating and for distribution.

MODES OF OPERATION: Collector to house, collector to storage storage to auxiliary to house, auxiliary to house, DHW preheat.

NEBRASKA 5864 DD 1 SFD NEW ACTIVE HEATING & DHW

62

PROJECT INFORMATION:
BUILDER/APPLICANT: Peterson Construction Co.
DESIGNER: Don Everly
SOLAR SUB: Ionic Solar Co.
LOCATION: Lincoln, NE
LATITUDE: 41°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,920 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,864
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 696 BTU/sq. ft.
DESIGN TEMP: INDOOR: 75° F
% SUN/YR: 64%



BUILDING DESCRIPTION/ENERGY CONCERNS

This three bedroom home contains 1,920 sq. ft. of space. It makes use of various insulating techniques, including the use of triple glazed windows and increased wall and roof insulation. In addition, the basement wall is protected by 1" of insulation. Windows on the north side of the house are small in order to reduce heat loss, while those to the south are large, thereby allowing heat gain. Roof overhangs prevent unwanted summertime heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 60%

COLLECTOR: Liquid flat plate collectors, manufactured by MIROMIT are mounted at a 23° tilt and oriented due south. 450 sq. ft. of an antifreeze composed of 50% water and 50% propylene glycol circulates through the system.

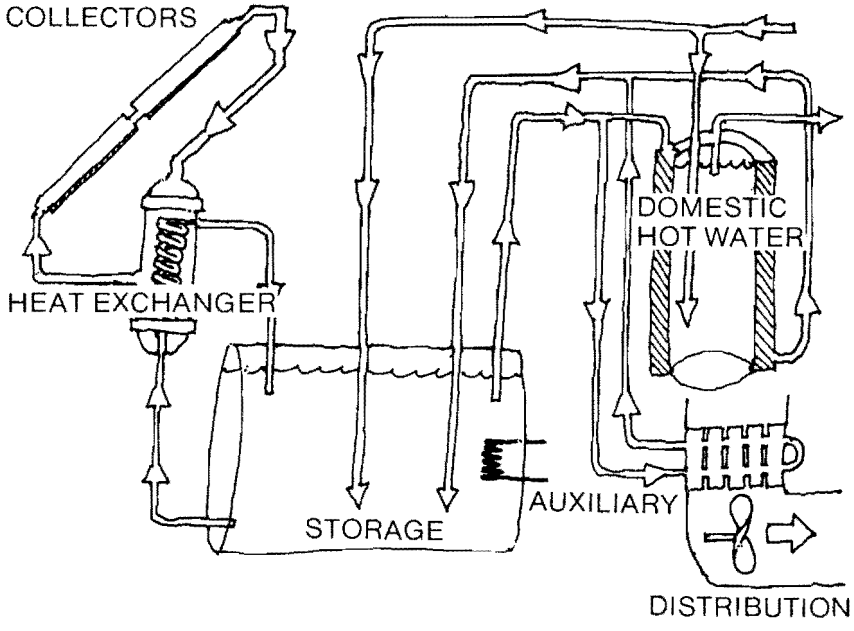
STORAGE: Solar heat is transferred from the antifreeze to the water storage media in a central heat exchanger.

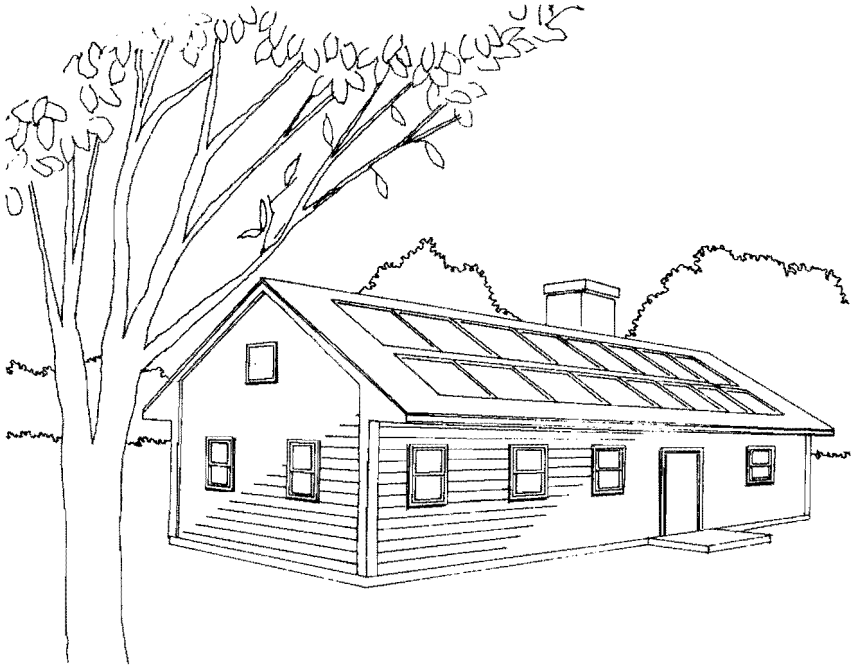
DISTRIBUTION: Heated water from solar storage, is circulated through the air ducts for hot air distribution.

AUXILIARY ENERGY SYSTEM: A high resistance electric coil is located in the main storage tank to provide auxiliary energy when solar energy proves to be inadequate.

DOMESTIC HOT WATER: Heated water from storage is pumped to a heat exchange jacket which surrounds the DHW tank. Heat is transferred through the walls to preheat the domestic water. An electric coil serves as auxiliary.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to storage to house, DHW preheat.



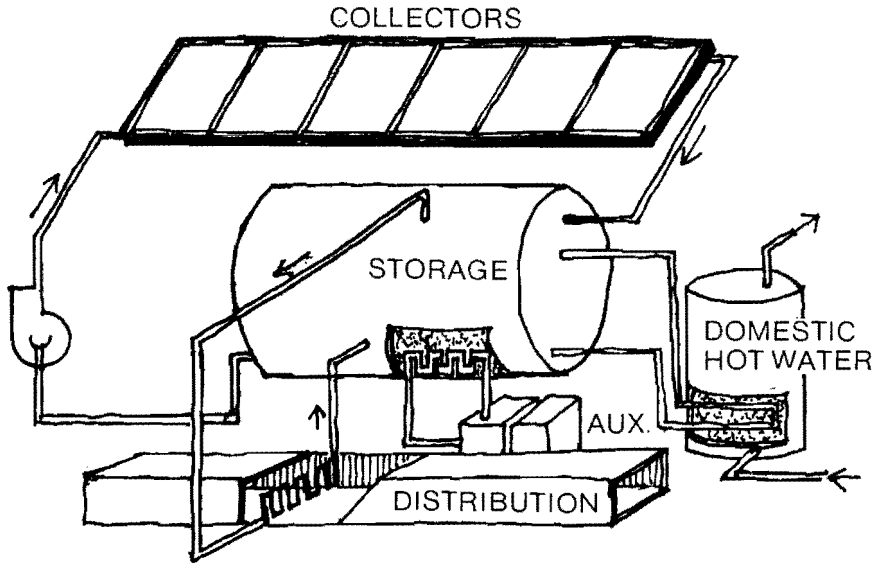


PROJECT INFORMATION:

BUILDER/APPLICANT: M. F. Smith Associates
DESIGNER: Michael F. Smith
SOLAR SUB: Michael F. Smith
LOCATION: Jamestown, RI
LATITUDE: 41°30'N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,240 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,954
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 574 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 71%

BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Rhode Island, this 3-bedroom home, designed by Solar Homes, Inc. represents the integration of numerous energy conserving features with an active solar system. The home, which contains 2,240 sq. ft. of space, is constructed of 2" x 6" studs with 12" of batt insulation in the roof and 6" in the walls. Furthermore, all windows are triple-glazed and doorways are protected by storm doors. Attic venting encourages natural ventilation during warm periods.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 82%

COLLECTOR: These site-built collectors, designed by Solar Homes, Inc., contain a copper absorption plate and several translucent cover plates. Water circulates through the collectors and then to a large storage tank. A drain-down system has been provided in order to prevent freeze damage.
STORAGE: A concrete storage tank, with batt insulation, provides for 5,000 gallons of water storage.
DISTRIBUTION: From the storage tank, solar heated water is pumped to air ducts for hot air distribution to the living space.
AUXILIARY ENERGY SYSTEM: An electric heat pump is used to auxiliary heat the solar storage water. In warmer weather, the heat pump may be reversed in order to cool the living space.
DOMESTIC HOT WATER: A hot water coil from the main solar storage is contained in the bottom of a conventional hot water tank for DHW preheat.
MODES OF OPERATION: Collector to storage, storage to house, auxiliary to storage to house, DHW preheat.

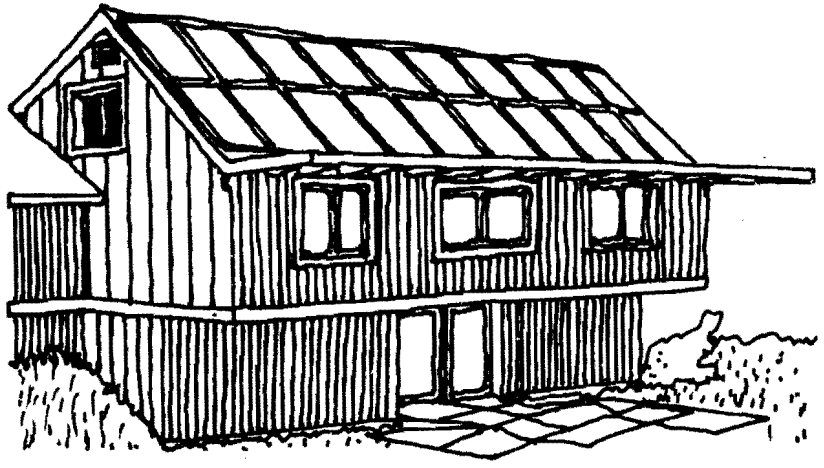
RHODE ISLAND 5954 DD 1 SFD NEW ACTIVE HEATING & DHW

63

PROJECT INFORMATION:
BUILDER/APPLICANT: Walnut Ridge Inc.
DESIGNER: David G. Ewing
SOLAR SUB: Richard H. Tracey
LOCATION: North Franklin, PA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,987
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 492 BTU/sq. ft.

LATITUDE: 40°0'N
AREA: 2,225 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 49%

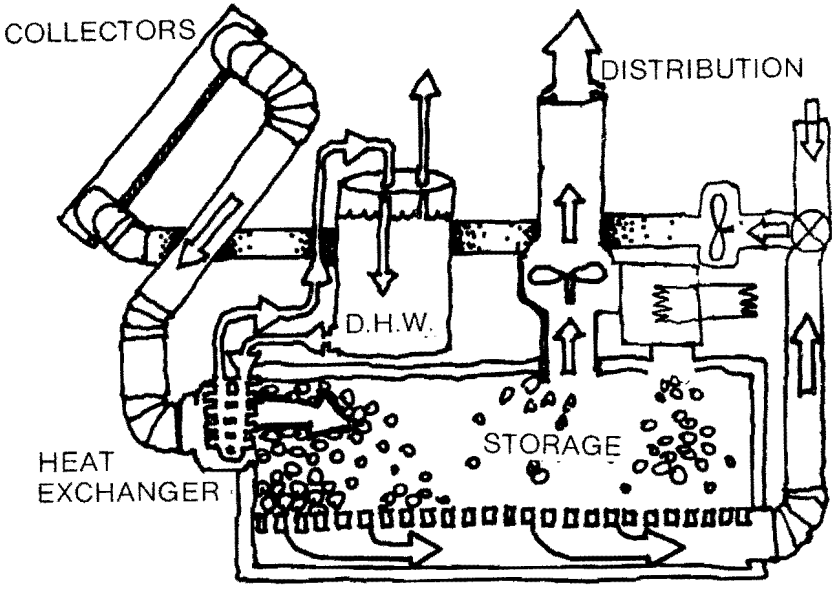


BUILDING DESCRIPTION/ENERGY CONCERNS

This 3-level single family detached home has 2,225 sq. ft. of living space and three bedrooms. The walls, and ceilings are insulated with 6" and 9" of batt insulation. The roof over the attic space used for living is also insulated. There is a 3 ft. overhang on the southern exposure for each floor.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 88%



COLLECTOR: 620 sq. ft. of Kalwall flat plate air collectors are mounted directly onto the roof facing due south at a tilt of 60°. Air is drawn through the collectors and once heated to rock storage.

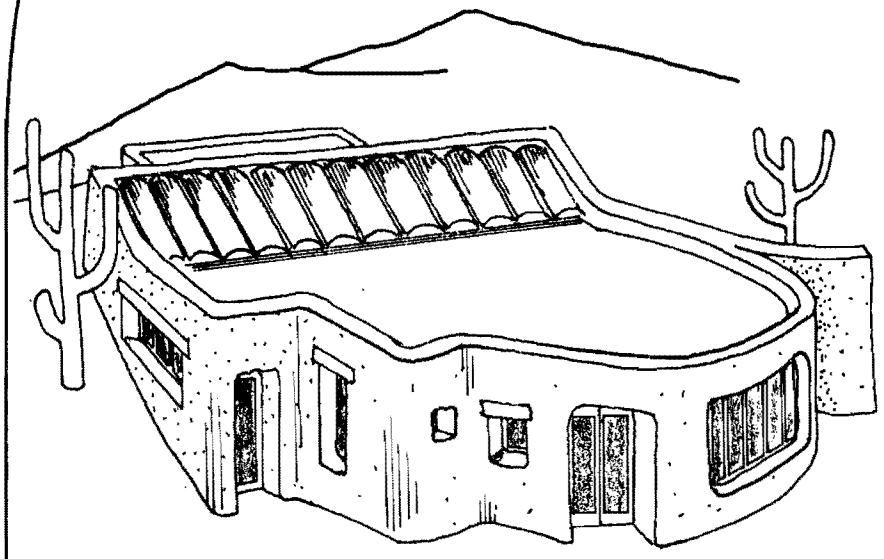
STORAGE: 1,100 cu. ft. of rock storage is located in a concrete bin in the basement. The bin is insulated with 6" of batt insulation and 2" of rigid insulation.

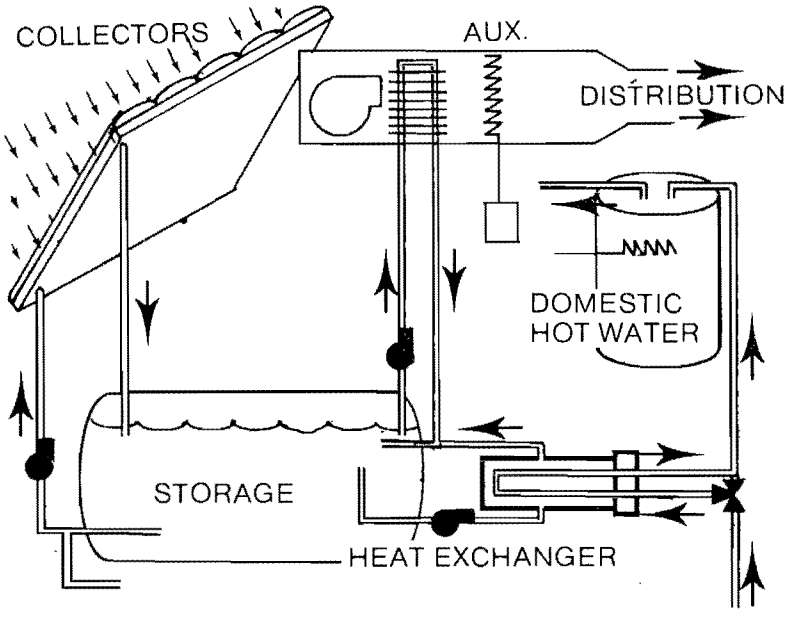
DISTRIBUTION: A central air handling unit blows air through the heated rocks for forced air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heat.

DOMESTIC HOT WATER: City water is preheated in a fin-tube heat exchanger in the collector to storage duct before being routed to the conventional hot water heater.

MODES OF OPERATION: Collector to house, collector to storage, storage to house, storage to auxiliary to house, DHW preheat.





PROJECT INFORMATION:
BUILDER/APPLICANT: Schepps Construction Co.
DESIGNER: Joe Schepps
SOLAR SUB: Joe Schepps
LOCATION: Santa Fe, NM **LATITUDE:** 35°N
HOUSING TYPE: SFD, 1 Unit **AREA:** 2,100 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,077 DESIGN TEMP:
DESIGN TEMP: WINTER: 7° F INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 1,121 BTU/sq. ft. % SUN/YR: 77%

BUILDING DESCRIPTION/ENERGY CONCERNS

Indigenous construction and design methods are used in this 3 bedroom, 2,100 sq. ft. house to reduce energy consumption. The house is constructed of 14" adobe bricks faced with 3" of insulation and stucco. This wall construction prevents daily heat gain, yet allows the wall to hold some heat and re-radiate it at night. The roof and floor are also well insulated. No windows are oriented to the north, where heat loss due to winds is a design factor. The compact plan, almost semi-cylindrical, has a large amount of floor area with the minimum of exposed wall surface, providing protection from rapid heat exchange.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTOR: 215 sq. ft. of Northrup collectors are located on the roof of the house at a 35° tilt. The collectors concentrate the sun's rays by use of focussing cover plates and are mechanized to track the sun as the day progresses. Water flows through the collectors to transfer heat to storage. The collectors can be drained to prevent freezing.
STORAGE: A 500-gallon insulated water tank stores the solar heated water.
DISTRIBUTION: Hot water is pumped from the storage tank to a water to air heat exchange coil located in the air supply duct, for hot air distribution.
AUXILIARY ENERGY SYSTEM: An electric auxiliary heater can be used to heat the house air supply.
DOMESTIC HOT WATER: Incoming cold water flows through a central heat exchanger along with water from the solar storage. Thus incoming water is preheated, before reaching the conventional DHW tank for auxiliary heating and distribution.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

NEW MEXICO 6007 DD 1 SFD NEW ACTIVE HEATING & DHW

66

PROJECT INFORMATION:
BUILDER/APPLICANT: Stanley Associates
DESIGNER: Francis E. Stanley
SOLAR SUB: Jasper Conners
LOCATION: Santa Fe, NM
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,007
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 1,121 BTU/sq. ft.

LATITUDE: 35°N
AREA: 1,390 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 76%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home has 1,390 sq. ft. of living space and three bedrooms. There is minimal window surface with the maximum window area facing south. A two-car garage located at the northwest corner blocks wind. A greenhouse window serves as a small heat source. Larger overhangs protect all openings from the summer sun.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTOR: 208 sq. ft. of Solaron flat plate air collectors are mounted directly to the south roof at a tilt of 45°. Air is heated in the collectors and then blown to rock storage or directly to the living space by a central air handler.

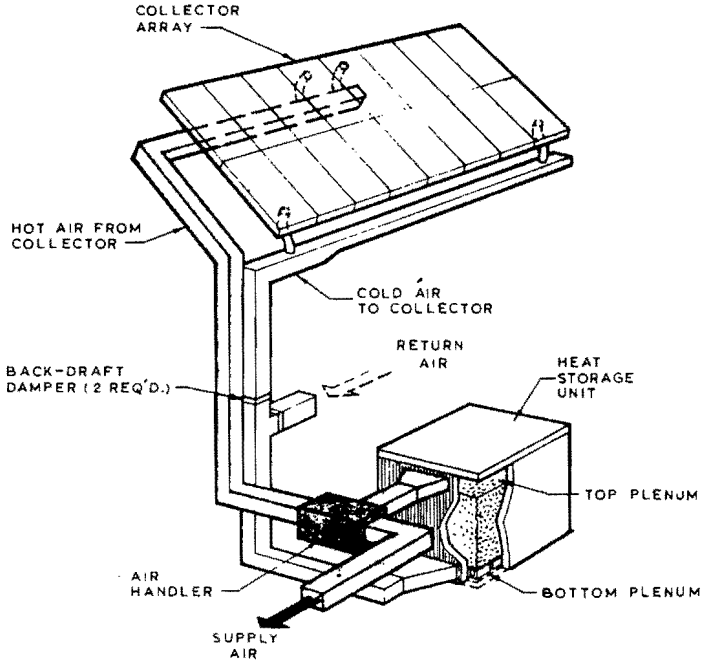
STORAGE: 117 cu. ft. of rock storage is located in the mechanical room. The wood storage bin is insulated with 3 in. of batt insulation and 2 in. of rigid insulation. The bin sits on a concrete bed.

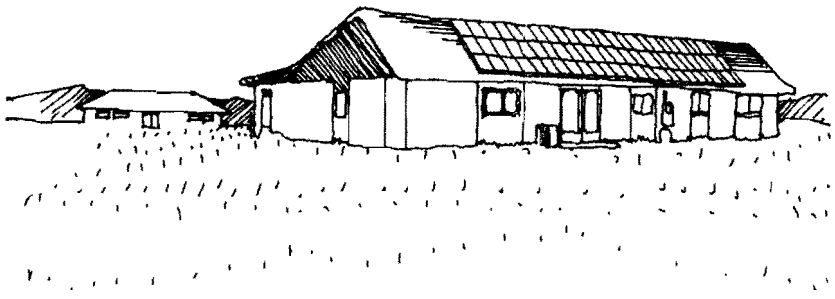
DISTRIBUTION: Solar heated air is drawn from rock storage or from the collectors for forced air distribution.

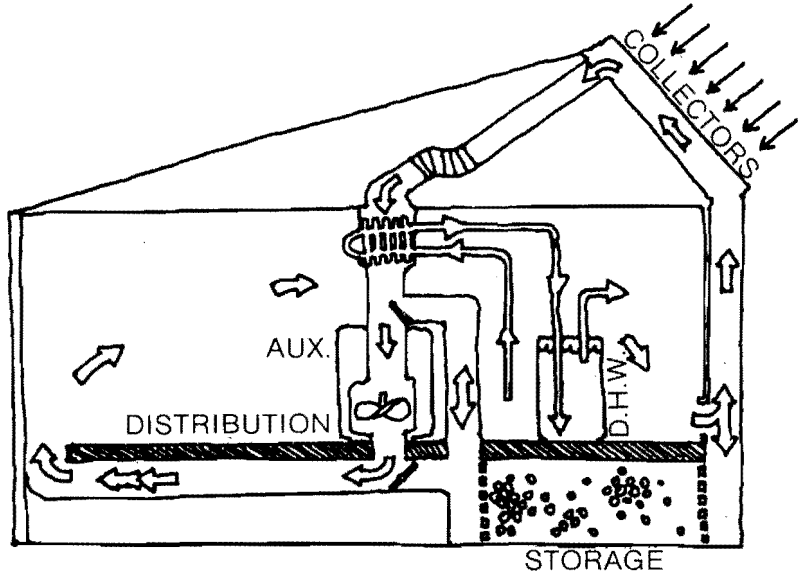
AUXILIARY ENERGY SYSTEM: A gas fired furnace provides auxiliary energy.

DOMESTIC HOT WATER: Cold city water is preheated in a coil located in the air handler before going to a conventional hot water heater for auxiliary heating and distribution.

MODES OF OPERATION: Collector to house, collector to storage, auxiliary to house, storage to auxiliary to house, DHW preheat.







PROJECT INFORMATION:
BUILDER/APPLICANT: Frontier Development Co.
DESIGNER: Al Throckmorton
SOLAR SUB: Frontier Development Co.
LOCATION: Silver Knolls, NV **LATITUDE:** 40°N
HOUSING TYPE: SFD, 5 Units **AREA:** 1,552 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,037 DESIGN TEMP:
DESIGN TEMP: WINTER: −5° F INDOOR: 68° F
HORIZ. INSOL. JAN. DAY: 1,024 BTU/sq. ft. % SUN/YR: 80%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 5 detached houses with 1,552 sq. ft. and 3 bedrooms each. They are all heavily insulated to retain heat in the winter, and to remain cool in the summer. The walls have 6" of foam insulation and the ceilings have 12" batt insulation. The window areas, which are subject to great heat losses and gains, are double glazed.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

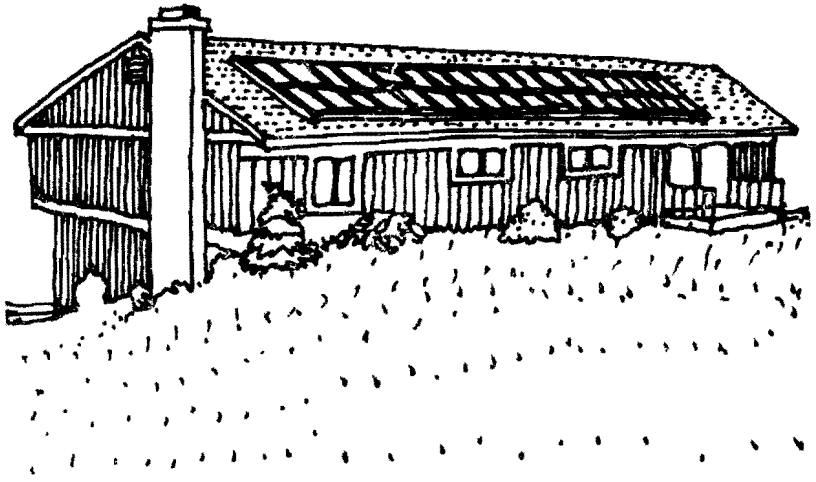
COLLECTOR: 525 sq. ft. of flat plate collectors are located on the south-facing roof at a tilt of 50°. They are manufactured on the site by Frontier Development Co. Air is used as the heat transfer medium.
STORAGE: A storage bin, with 394 cu. ft. of rocks, is used to store collected heat. The bin is located under the house.
DISTRIBUTION: Solar heated air is blown to the living space from solar storage or from the collectors by a fan in the auxiliary system.
AUXILIARY ENERGY SYSTEM: An oil furnace supplies auxiliary heat for the hot air distribution system.
DOMESTIC HOT WATER: An air to water heat exchanger is located in the duct between the collectors and the storage bin. Incoming cold water flows through this coil, picking up heat, after which it is circulated to a 52 gallon preheat tank. When needed, water flows from this preheat tank to a 30 gallon conventional DHW heater, and is boosted to operating temperature for distribution.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, DHW preheat.

NEVADA
6037 DD
5 SFD NEW
ACTIVE HEATING & DHW
67

BUILDER/APPLICANT: Alpha Construction Co.
DESIGNER: Barry R. Braucher
SOLAR SUB: C. R. Kurtz Co.
LOCATION: Canton, OH
HOUSING TYPE: SFD, 4 Units
CLIMATIC DATA:
HEATING DD: 6,037
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 463 BTU/sq. ft.

LATITUDE: 40°0'N
AREA: 1,850 sq. ft.

DESIGN TEMP:
INDOOR: 75° F
% SUN/YR: 58%



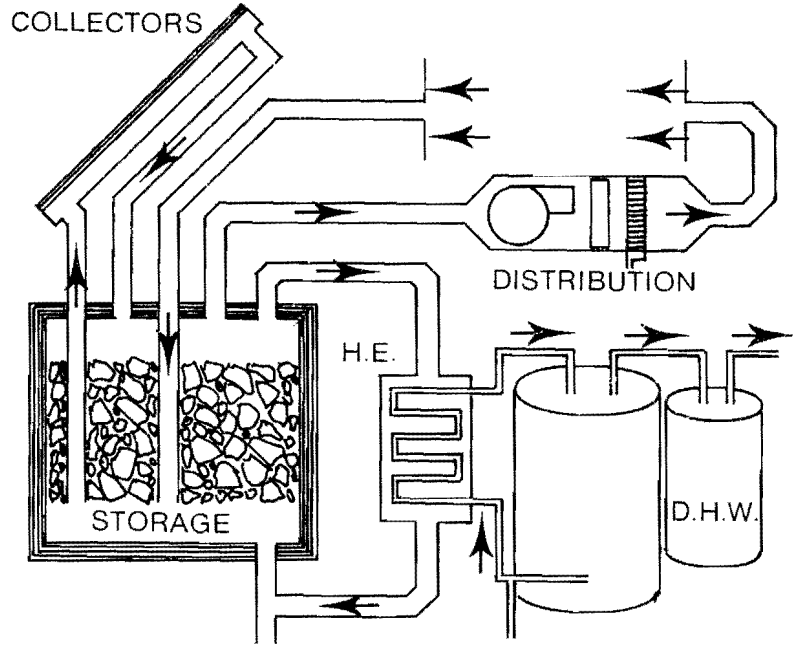
BUILDING DESCRIPTION/ENERGY CONCERNS

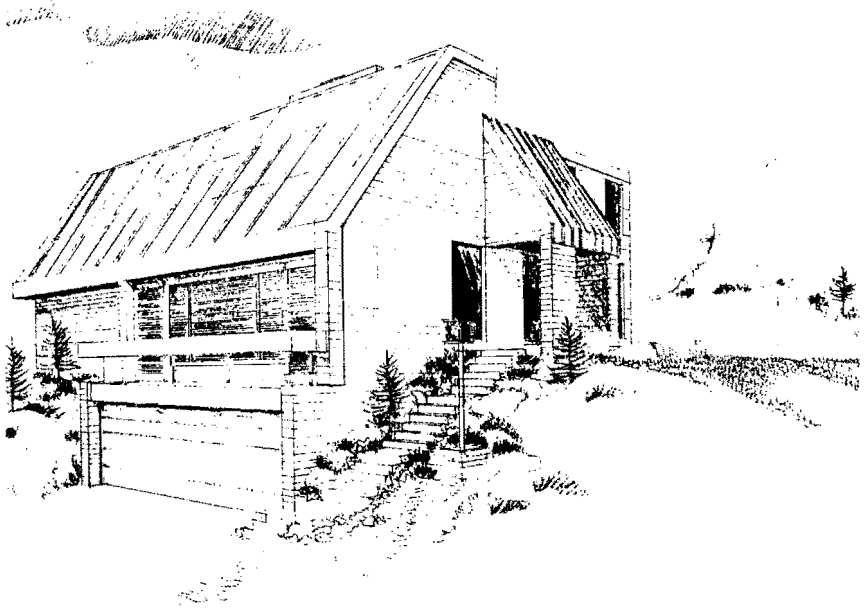
Four single family detached homes ranging in area from 1,450 sq. ft. to 1,970 sq. ft. are included in this project. The houses vary in style and in plan but have the same type of system. In one case, the house is partially buried, which reduces heat loss in winter. The houses also feature increased insulation.

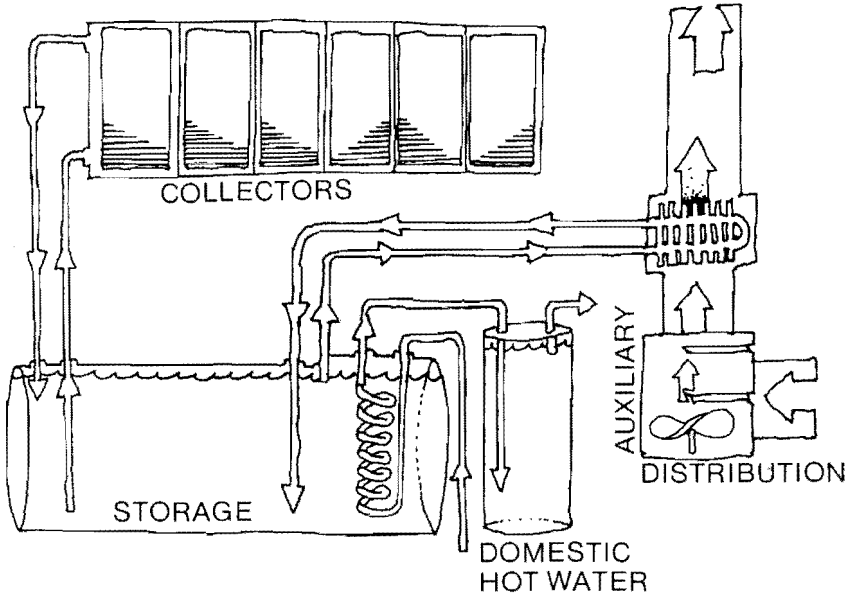
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 51-73%

COLLECTOR: The Rom-aire flat plate collectors are integrally mounted on the roof of each house, and their areas range from 357 sq. ft. to 504 sq. ft. The roof slopes are from 27° to 37°, and the building orientations vary from 20° east of south to 10° west of south. The collectors use air to transfer collected heat to storage.
STORAGE: A rock-filled bin located in the basement of each unit serves as solar storage. The volumes range from 357 cu. ft. to 500 cu. ft., and the bins are insulated with 4" of rigid insulation.
DISTRIBUTION: Air is forced through storage to distribute heat to the living spaces.
AUXILIARY ENERGY SYSTEM: An electric heat pump system provides auxiliary heat.
DOMESTIC HOT WATER: Incoming cold water passes through a coil located in the duct between the collector and the storage bin. The preheated water then passes into a tempering tank, where it is stored. When needed, it is pumped into the conventional DHW system for distribution and auxiliary heating.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Tios Corporation
DESIGNER: Tios Team
SOLAR SUB: Tios Corporation
LOCATION: Salt Lake City, UT
LATITUDE: 40°46'N
HOUSING TYPE: SFD, 1 Unit
AREA: 3,773 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,052
DESIGN TEMP: WINTER: −5° F
HORIZ. INSOL. JAN. DAY: 653 BTU/sq. ft.
DESIGN TEMP: INDOOR: 73° F
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Salt Lake City, this 4 bedroom, 3,773 sq. ft. house is oriented to take advantage of the sun. The building is zoned so that part of its area may be closed off to reduce the heating load. The main living areas receive direct solar heat from large south facing windows. These windows are protected against summer time heat gain by roof overhangs. In contrast, the north facade of the building has very few windows. Also a massive fireplace positioned against the north wall, helps to further protect that surface of the building, which is partially buried. The air lock entry prevents heat from escaping, again reducing heat losses.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 77%

COLLECTOR: Manufactured by Lennox Industries, these liquid flat plate collectors cover 600 sq. ft. of the roof surface. They are mounted at a 55° tilt. Water circulates through the collectors and then to a storage tank. The system is protected against damage from freezing by a drain down capability.
STORAGE: The main storage tank contains 1,580 gallons of water. It is protected against heat loss by 12" of insulation.
DISTRIBUTION: A coil, from the main storage tank, is contained within the air supply duct. Heated water circulates from the storage tank to this coil for hot air distribution.
AUXILIARY ENERGY SYSTEM: An electric heat pump may be used to supplement heat from the solar storage system.
DOMESTIC HOT WATER: City water is preheated by pumping it through a coil in the main storage tank. It is then stored in a conventional DHW tank until needed.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

UTAH
6052 DD
1 SFD NEW
ACTIVE HEATING & DHW
69

COLORADO 6132 DD 10 SFD NEW ACTIVE HEATING & DHW

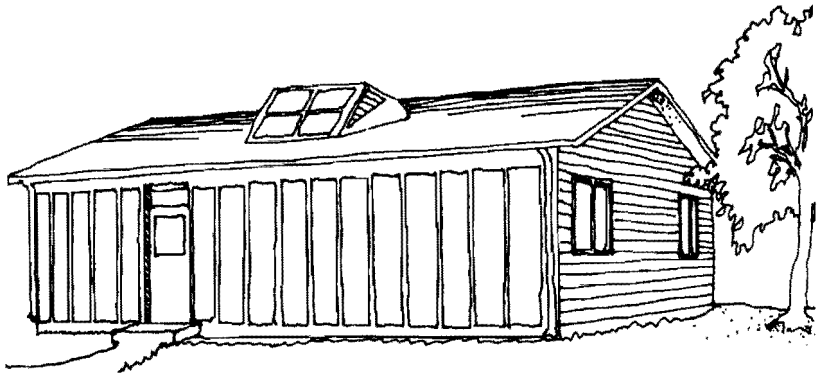
70

PROJECT INFORMATION:

BUILDER/APPLICANT: Colorado Rural Housing Development Corp.
DESIGNER: John Freeman
SOLAR SUB:
LOCATION: Ft. Lupton, CO
HOUSING TYPE: SFD, 10 Units
CLIMATIC DATA:
HEATING DD: 6,132
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.

LATITUDE: 40°40'
AREA: 1,196 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 67%



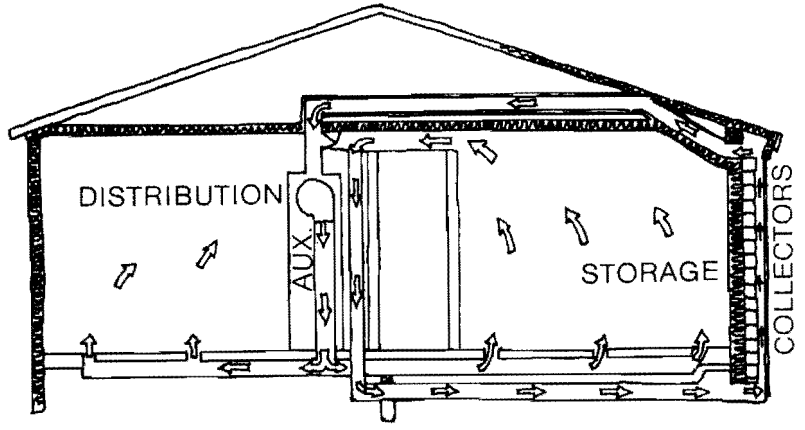
BUILDING DESCRIPTION/ENERGY CONCERNS

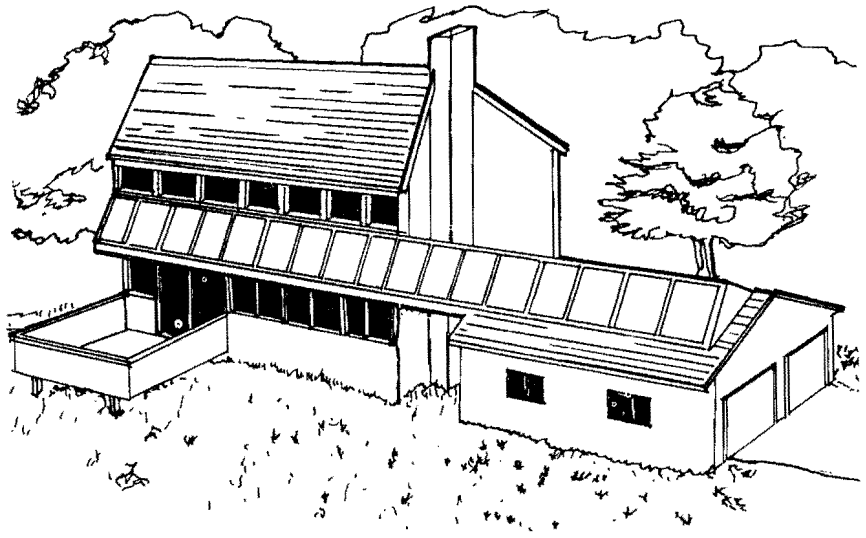
This project consists of 10 single family residences with 1,196 sq. ft. of area and 3 bedrooms. Heat loss is minimized by the small window area on the north, and heavy insulation throughout. The walls have 2x6 studs allowing for 5½" of batt insulation; the ceilings have 12" of batt insulation, and the foundation is also heavily insulated.

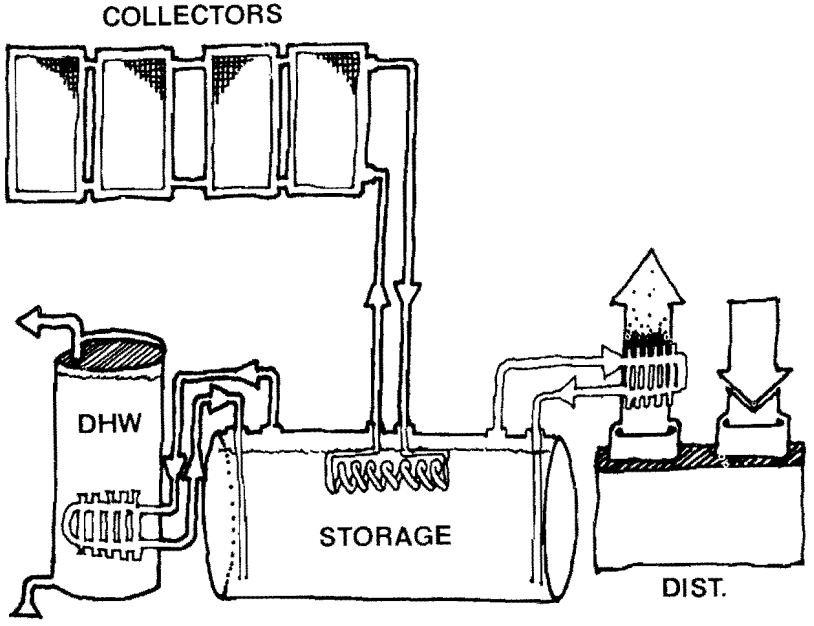
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%

COLLECTOR: The entire southwall of the house is used as a collector. A massive block wall is painted black and covered with clear fiberglass glazing panels. A fan pulls air through the 1" air space between the wall and the glazing, collecting heat for transfer to storage. The block wall has 5½" of insulation behind it to isolate the heat.
STORAGE: The heavy masonry wall serves as a storage bin with a volume of 88 cu. ft.
DISTRIBUTION: A fan pulls air from this collector-storage system to a central furnace, where the solar heated air enters the ductwork of the conventional air distribution system.
AUXILIARY ENERGY SYSTEM: A gas-fired furnace, with a capacity of 55,000 BTU/hr. is the auxiliary heat source.
DOMESTIC HOT WATER: A separate solar system is used to preheat domestic hot water. 41 sq. ft. of Miromit flat plate collectors are mounted at 35° on the south facing roof. A mixture of antifreeze and water flows through the collectors to an annular jacket surrounding a 66 gallon preheat tank. Heat is conducted through the walls of the tank to preheat the domestic water supply before it enters the conventional DHW tank.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: William Francini
DESIGNER: Daniel Wright
SOLAR SUB: Frank O. Vonasek
LOCATION: Unionville, CT
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,172
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 592 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,660 sq. ft.

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 3 bedroom, 1,660 sq. ft. detached house is designed to protect the living areas from severe winter conditions. This is accomplished by placing the service spaces (bathrooms, kitchen, closets) to the north of the house, with minimal window area. The living spaces are located on the south, with ample windows to take advantage of winter sun. All windows are shaded by the overhang in the summer. The walls are heavily insulated with 6" batt and the ceiling with 12" blown.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

COLLECTOR: Manufactured by Daystar, the 294 sq. ft. of flat-plate collectors are located on the roof area exposed between the first and second floor. Antifreeze and water (mixed in a 60/40 proportion) flows through the collectors, carrying heat to a heat exchanger immersed in the water storage tank.
STORAGE: The 500 gallon water storage tank is buried under the floor of the garage. The tank is insulated with 2" of urethane insulation and 3½" of batt insulation.
DISTRIBUTION: Heated water from storage is pumped through a coil in the return duct of the forced air heating system. Collected solar heat is thus transferred to air and blown to the living space.
AUXILIARY ENERGY SYSTEM: An oil-fired furnace provides auxiliary energy. Its capacity is 75,000 BTUH.
DOMESTIC HOT WATER: To preheat DHW, a water coil runs from the solar storage tank, through a heat exchanger in the bottom of an 80 gallon conventional water heater.
MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 6172 DD CONNECTICUT

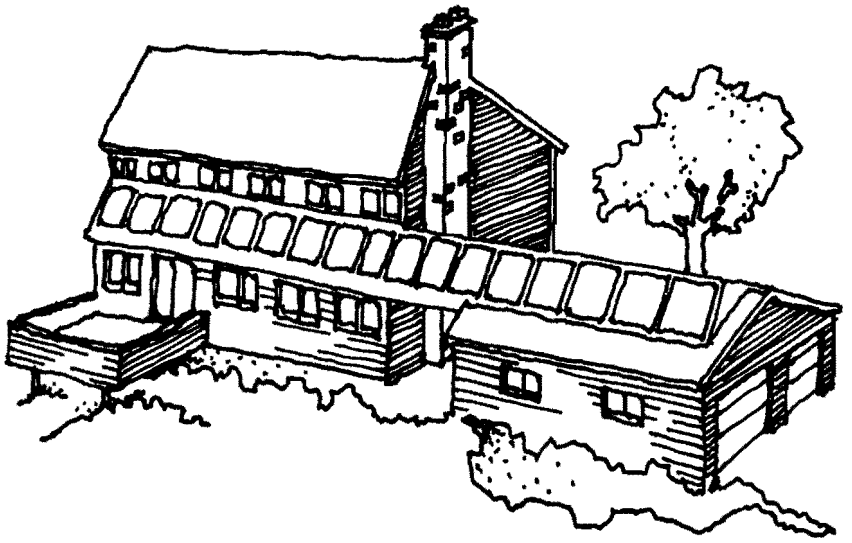
72

PROJECT INFORMATION:

BUILDER/APPLICANT: The Madrid Corporation
DESIGNER: Daniel Wright
SOLAR SUB: Frank O. Vonasek
LOCATION: Tolland, CT
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,172
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 592 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,660 sq. ft.

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves the same house model as the previous report. The 3 bedroom, 1,660 sq. ft. detached house is designed to protect the living areas from excessive winter heat losses. This is accomplished by placing the service spaces (bathrooms, kitchen, closets) to the north of the house, with minimal window area. The living spaces are located on the south, with ample windows to take advantage of winter sun. All windows are shaded by the overhang in the summer. The walls are heavily insulated with 6" batt and the ceiling with 12" blown.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

COLLECTOR: Manufactured by Daystar, the 294 sq. ft. of flat-plate collectors are located on the roof area exposed between the first and second floor. Antifreeze and water (mixed in a 60/40 proportion) flows through the collectors, carrying heat to a heat exchanger immersed in the water storage tank.

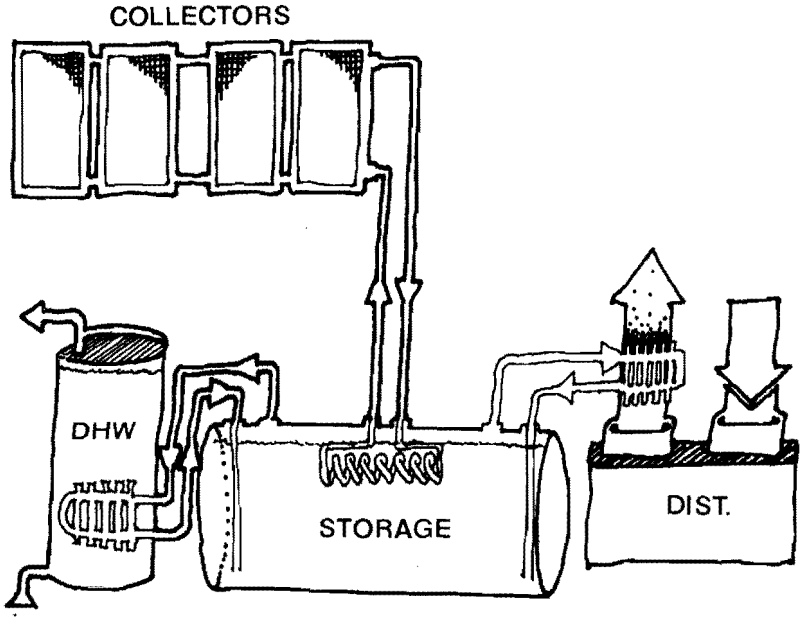
STORAGE: The 500 gallon water storage tank is buried under the floor of the garage. The tank is insulated with 2" of urethane insulation and 3½" of batt insulation.

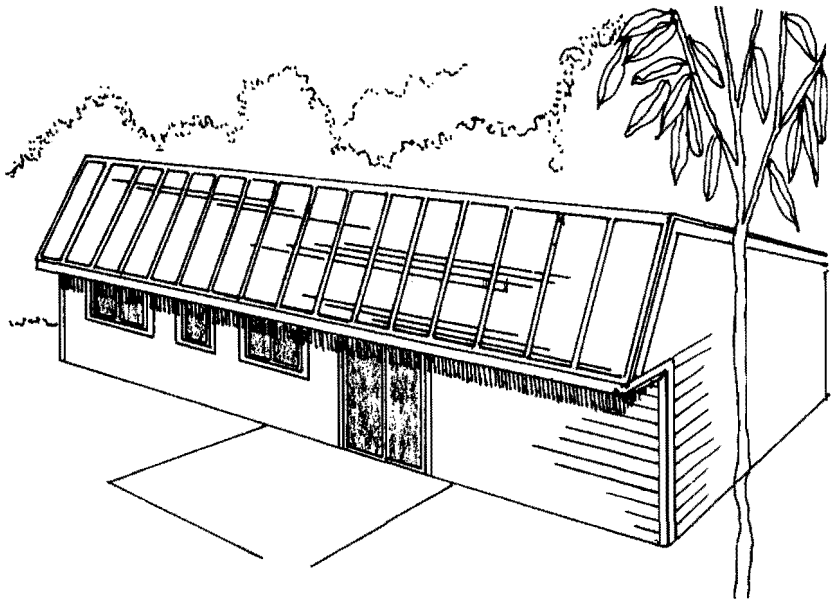
DISTRIBUTION: Heated water from storage is pumped through a coil *in the return duct of the forced air heating system. Collected solar heat* is thus transferred to air and blown to the living space.

AUXILIARY ENERGY SYSTEM: An oil-fired furnace provides auxiliary energy. Its capacity is 75,000 BTUH.

DOMESTIC HOT WATER: To preheat DHW, a water coil runs from the solar storage tank, through a heat exchanger in the bottom of an 80 gallon conventional water heater.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.





PROJECT INFORMATION:

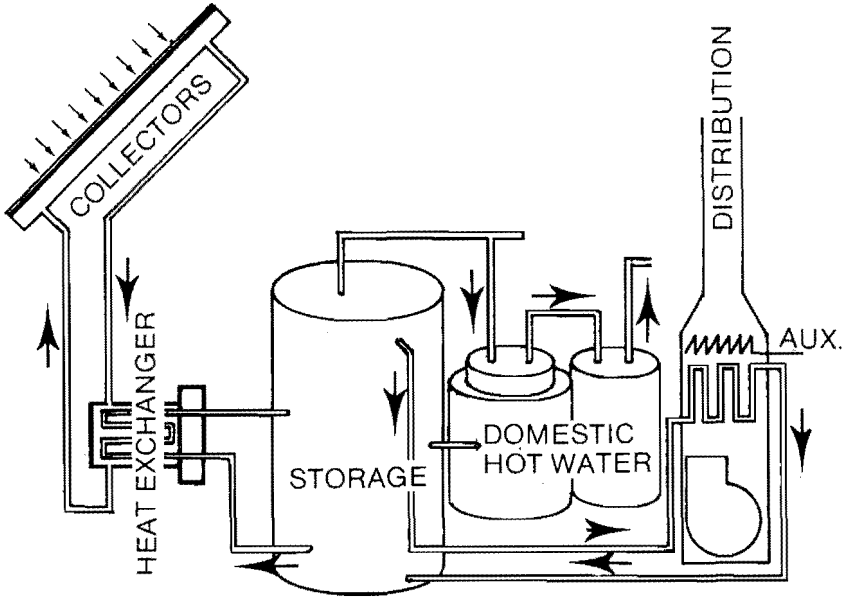
BUILDER/APPLICANT: Witkin Homes, Inc.
DESIGNER: Witkin Homes, Inc.
SOLAR SUB: Louis C. Tepe
LOCATION: Denver, CO
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,283
DESIGN TEMP: WINTER: −5° F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.

LATITUDE: 30°46'N
AREA: 1,120 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 67%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home consists of 1,120 sq. ft. of living space, including 3 bedrooms. Walls have 4 inch batt insulation; the roof has 10 inch batt insulation; and the perimeter foundation is also insulated. Window surface area is minimal to reduce heat losses. An overhang on the south side shades the wall and windows to reduce heat gain and facilitate cooling.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 61%

COLLECTOR: 245 sq. ft. of Grumman Sunstream collectors are mounted directly on the south facing roof, at a tilt of 45°. An antifreeze liquid is heated in the flat plate panels, and pumped to a central heat exchanger.
STORAGE: Water from a 490 gallon storage tank is also pumped through the heat exchanger where the heat from the antifreeze is transferred to the storage water.
DISTRIBUTION: Heated water from storage goes to a water-to-air heat exchange in the supply duct for forced air distribution.
AUXILIARY ENERGY SYSTEM: A gas-fired forced air furnace provides auxiliary heating.
DOMESTIC HOT WATER: Incoming cold water enters a preheat tank which is surrounded by an annular jacket heat exchanger. Heated water from storage is circulated through the annular jacket, preheating water for domestic use.
MODES OF OPERATION: Collector to storage, auxiliary to house, storage to auxiliary to house, DHW preheat.

COLORADO
6283 DD
1 SFD NEW
ACTIVE HEATING & DHW
73

COLORADO 6283 DD 1 SFD NEW ACTIVE HEATING & DHW

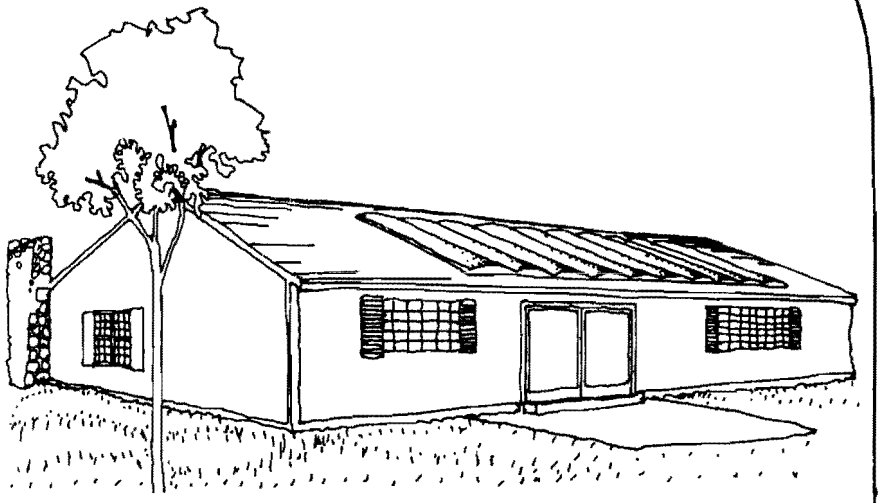
74

PROJECT INFORMATION:

BUILDER/APPLICANT: Gutrich Development Co., Inc.
DESIGNER: Lawrence H. Finn
SOLAR SUB: Marvin Estes
LOCATION: Aurora, CO
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,283
DESIGN TEMP: WINTER: −5° F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.

LATITUDE: 40°18'N
AREA: 1,530 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 67%

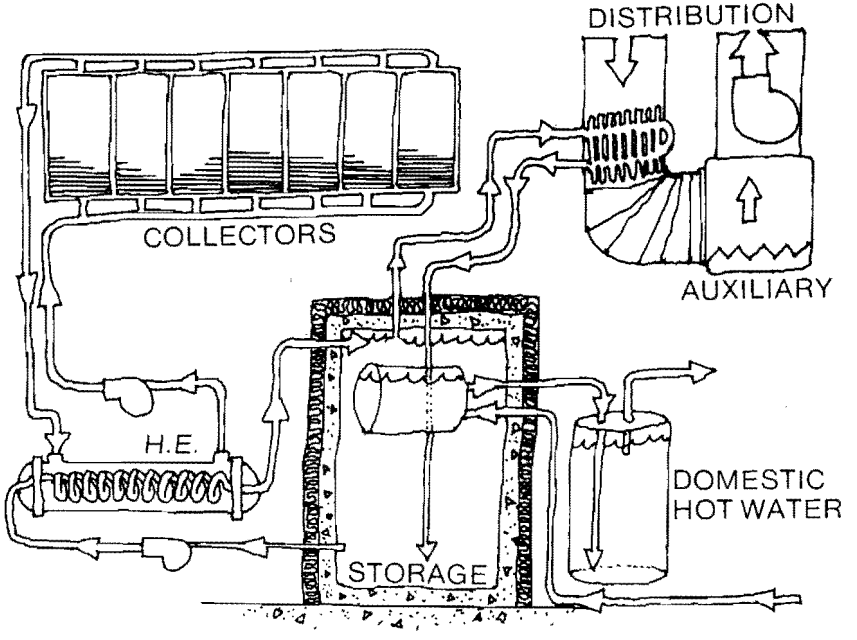


BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home consists of 1,530 sq. ft. of living space including 3 bedrooms. The roof has 12" blown insulation and the walls have 6" batt insulation for reduced heat losses.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 58%



COLLECTOR: 245 sq. ft. of Grumman collectors are mounted directly to the roof facing due south at a tilt of 45°. A glycerol and water solution is pumped through the collectors, heated, and pumped to a heat exchanger.

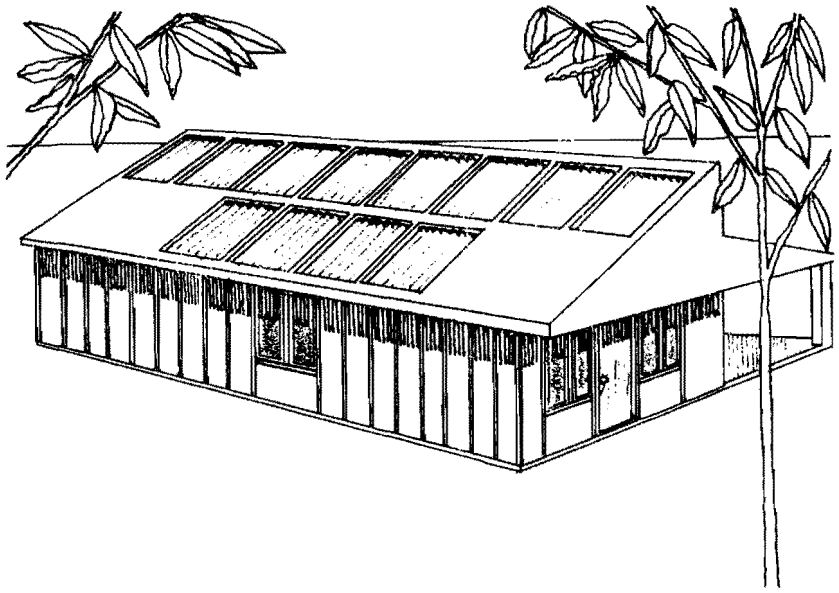
STORAGE: Water from a 490 gallon concrete storage tank flows through the heat exchanger, where the collected heat is transferred to storage water. The tank is insulated with 6" of batt insulation.

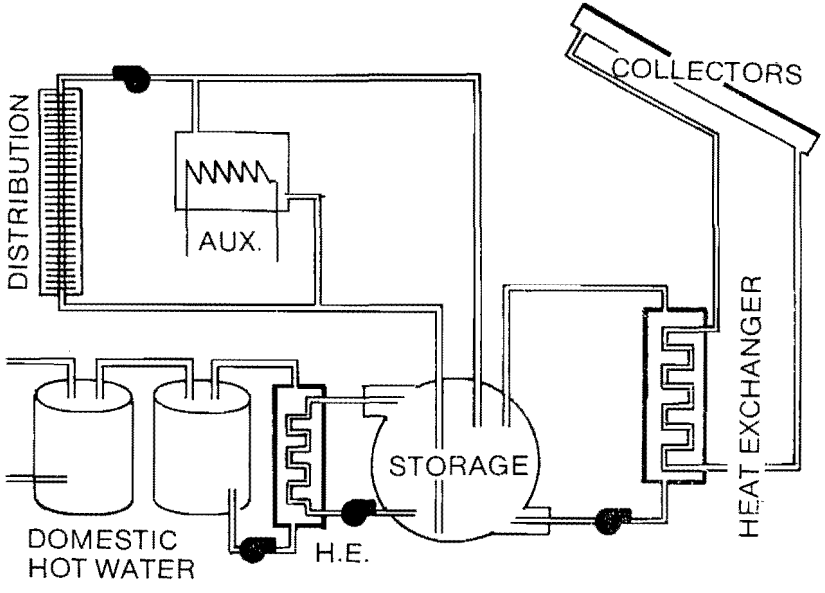
DISTRIBUTION: *Heated water is pumped from the storage tank to a* water-to-air coil in the heating ducts for forced air distribution.

AUXILIARY ENERGY SYSTEM: A gas-fired forced air furnace supplies auxiliary heat.

DOMESTIC HOT WATER: Incoming water flows to a tank submerged in the storage tank. DHW is preheated here before entering a 40 gallon conventional DHW heater.

MODES OF OPERATION: Collector to storage, auxiliary to house, storage to auxiliary to house, DHW preheat.





PROJECT INFORMATION:

BUILDER/APPLICANT: Douglas E. Myers
DESIGNER: R. Gasperson Energy Engineering Group
SOLAR SUB: Robert Nalman
LOCATION: Boulder, CO
LATITUDE: 40°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,056 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,283
DESIGN TEMP: WINTER: −5° F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.
DESIGN TEMP: INDOOR: 65° F
% SUN/YR: 70%

BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Boulder, Colorado, this efficiently planned 3 bedroom home has 1,056 sq. ft. of living space. The walls are built using 2" x 6" construction and are insulated by 6" of batt insulation. Windows to the north have been minimized and all windows are double glazed in order to further protect against heat loss. A carport to the north shields the house from the cold winter winds while a roof overhang to the south reduces summer heat gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 91%

COLLECTOR: Evacuated tube collectors, manufactured by the KTA Corporation, cover 318 sq. ft. of the roof surface. These collectors are mounted parallel to one another at a 55° tilt. Each collector contains a copper tube within a double layer of glass tubing. Half of the outer tube is silver coated which serves to concentrate the sun's rays. Antifreeze serves as the heat transfer media.
STORAGE: Collected heat is transferred from antifreeze to water in a central heat exchanger, then to a 500 gallon steel water tank, wrapped with 6" of insulation.
DISTRIBUTION: The preheated water circulates through baseboard units throughout the house for radiant distribution.
AUXILIARY ENERGY SYSTEM: A boiler, which uses an electric immersion coil may supplement the heat provided by the water in solar storage or it may be used independently of the solar system.
DOMESTIC HOT WATER: Water from the main storage tank transfers its heat to the DHW supply by circulating through a central heat exchange unit. The preheated water then circulates to two conventional DHW tanks.
MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

OHIO

6417 DD

1 SFD NEW

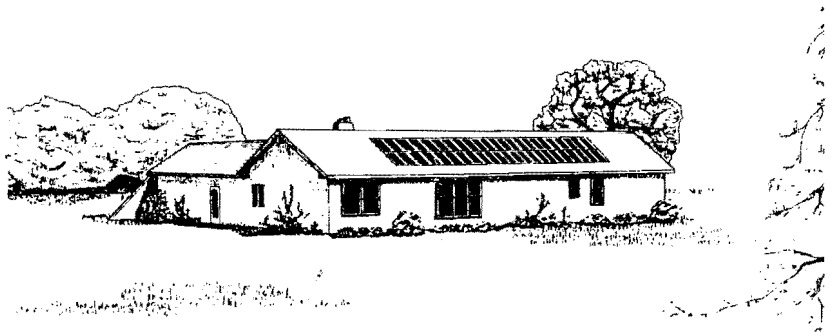
ACTIVE HEATING & DHW

76

PROJECT INFORMATION:
BUILDER/APPLICANT: Volpini & Sorice Builders
DESIGNER: Solar Energy Engineering
SOLAR SUB: Solar Energy Engineering
LOCATION: Poland, OH
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,417
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 348 BTU/sq. ft.

LATITUDE: 41°14'N
AREA: 2,000 sq. ft.

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 50%



BUILDING DESCRIPTION/ENERGY CONCERNS

This home of 2,000 sq. ft. is sited to minimize shading of the collectors by exterior obstructions. Activities have been zoned so that all living areas are in the southern portion of the house while all sleeping areas are in the northern portion. Furthermore, window openings have been kept to 7% of the total wall area with storm windows to further reduce heat transfer. Finally, substantial amounts of insulation have been used in the basement (R-4), the walls (R-23) and the ceiling (R-30).

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 53%

COLLECTOR: 509 sq. ft. of Solaron, flat plate collectors are integrally mounted into the south side of the roof. Air is circulated through the collectors to a rock storage bin.

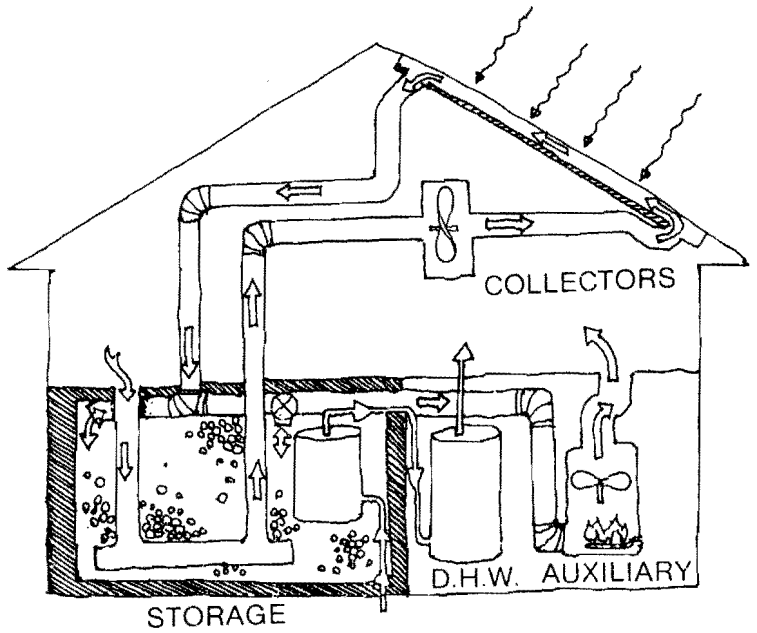
STORAGE: 400 cu. ft. of rock storage is located in a bin constructed of concrete block. The bin has 2" of polystyrene on the bottom and sides, with an additional 6" of fiberglass on the top.

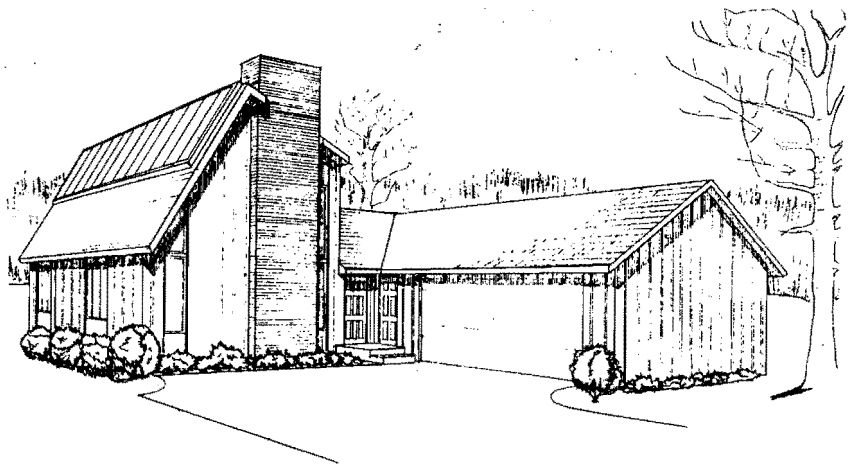
DISTRIBUTION: Solar heated air is drawn from storage, through the conventional hot air distribution system, to the living space.

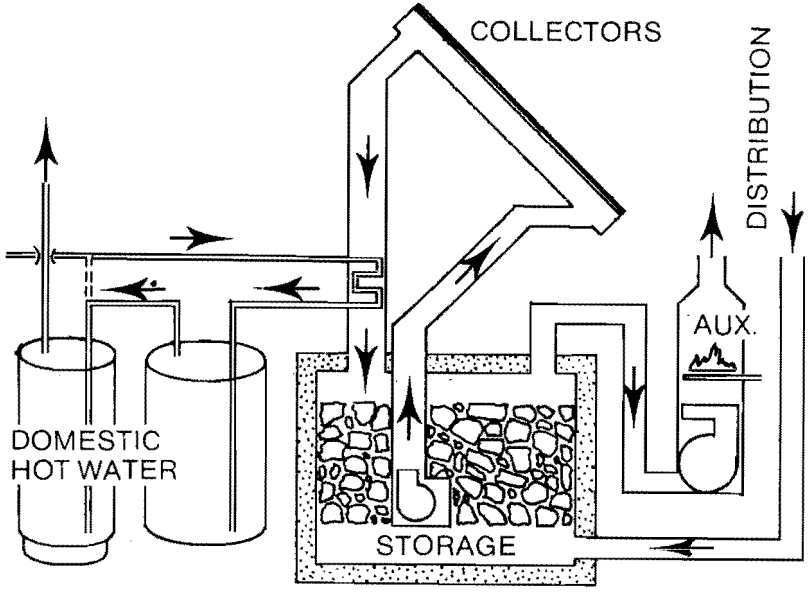
AUXILIARY ENERGY SYSTEM: Auxiliary heat is provided by an oil fired furnace.

DOMESTIC HOT WATER: A 120 gallon DHW preheat tank is located in the rock storage. From this tank preheated water may be pumped into the house through an auxiliary tank. This conventional DHW tank provides electric auxiliary heating and distribution as necessary.

MODES OF OPERATION: Collector to storage, collector to house, storage to auxiliary to house.







PROJECT INFORMATION:
BUILDER/APPLICANT: Sanford & Son
DESIGNER: Glenn F. Groth
SOLAR SUB: Sanford Peck
LOCATION: Benton Harbor, MI
LATITUDE: 42°6'N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,300 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,668
DESIGN TEMP: WINTER: 6° F
HORIZ. INSOL. JAN. DAY: 448 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 31%

BUILDING DESCRIPTON/ENERGY CONCERNS

This 2 level single family detached home has 1,600 sq. ft. of living space and two bedrooms. The walls are insulated with 6" of batt insulation and the ceiling with 12" of blown insulation. Window area is reduced on the northern exposure to minimize heat loss and increased on the southern to optimize solar gain.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 51%

COLLECTOR: 198 sq. ft. of Sunstone flat plate air collectors are mounted directly onto the roof, facing south at a tilt of 50°. Air is drawn through the collectors, heated, and blown to a rock storage bin.

STORAGE: 200 cu. ft. of rock storage is located in the basement in a concrete bin. The bin is insulated with 2" of rigid insulation.

DISTRIBUTION: Air is blown through the heated rock storage into the house ductwork for forced air distribution.

AUXILIARY ENERGY SYSTEM: An oil fired hot air furnace provides auxiliary heating.

DOMESTIC HOT WATER: Cold water is preheated in a fin-coil heat exchanger in the collector to storage ducts, before going to a hot water storage tank and the conventional DHW heater.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, DHW preheat.

MICHIGAN 6668 DD 1 SFD NEW ACTIVE HEATING & DHW

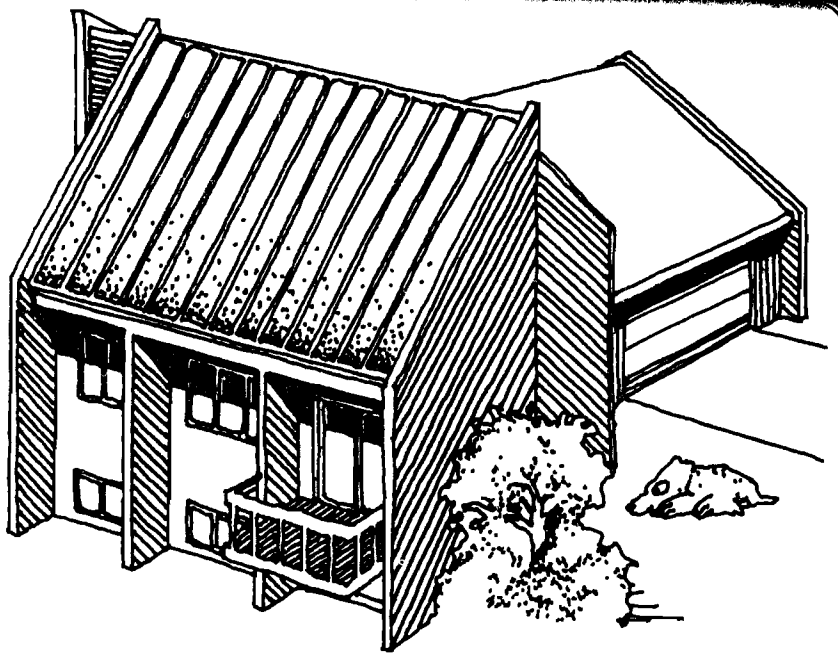
77

ILLINOIS 6845 DD 1 SFD NEW ACTIVE HEATING & DHW

78

PROJECT INFORMATION:

BUILDER/APPLICANT: Sungate Construction Co.
DESIGNER: Richard Hunes
SOLAR SUB: Sungate Construction
LOCATION: Kingston, IL
LATITUDE: 42°12'N
HOUSING TYPE: SFD, 2 Units
AREA: 1,680 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,845
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 355 BTU/sq. ft.
DESIGN TEMP:
INDOOR: 75° F
% SUN/YR: 57%

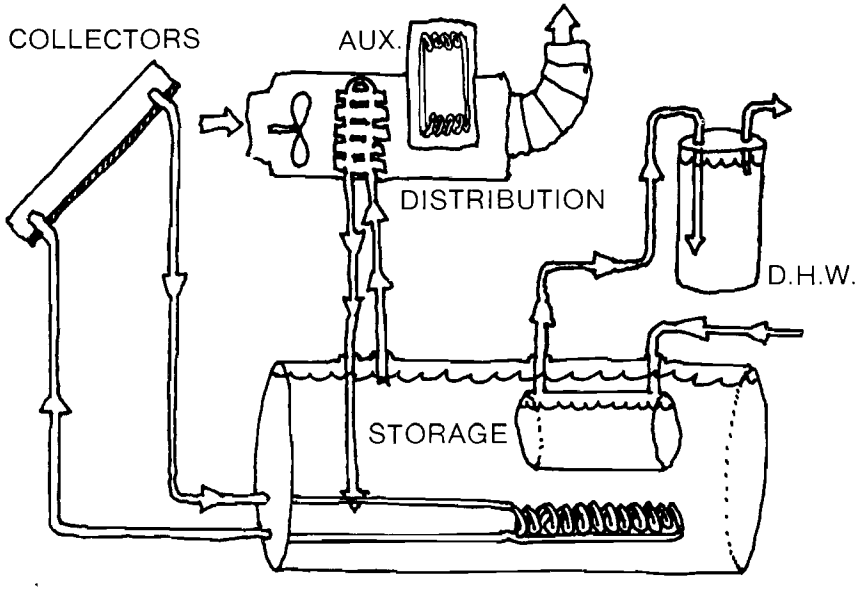


BUILDING DESCRIPTION/ENERGY CONCERNS

This two level single family detached home has 2,000 sq. ft. of living space and 3 bedrooms. The southern exposure is designed with large, shaded windows to admit the winter sun but exclude the summer sun. There are no windows on the north side. The ceilings are insulated with 9" of batt, the walls and floors with 6", and the foundation with 1¼" of rigid perimeter insulation.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 76%



COLLECTOR: 585 sq. ft. of Sungate Construction Co. flat plate collectors are mounted directly onto the roof. The panels face due south at a tilt of 45°. Antifreeze is drawn through the panels, heated, and pumped to a heat exchange coil in storage.

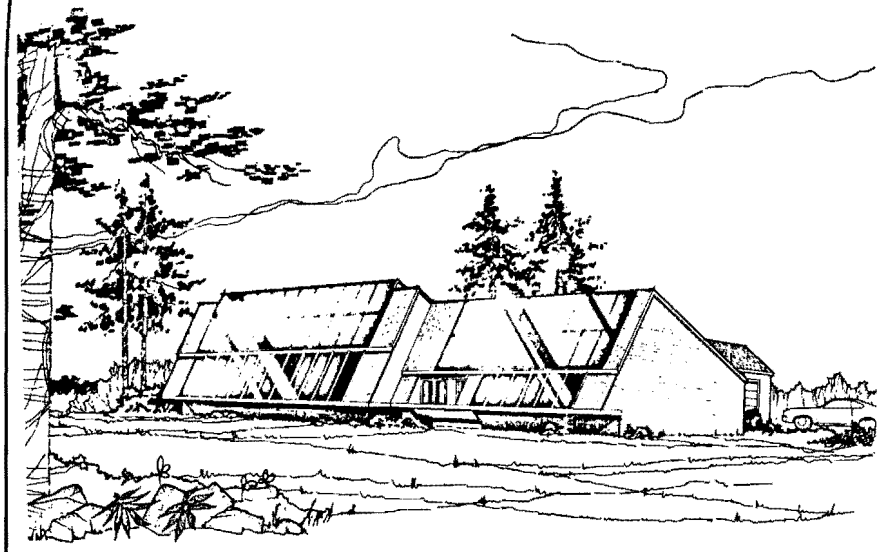
STORAGE: A 1,170 gallon water storage tank is located in the basement. The tank is insulated with 6" of batt on the top and 1¼" of rigid insulation on the sides and bottom.

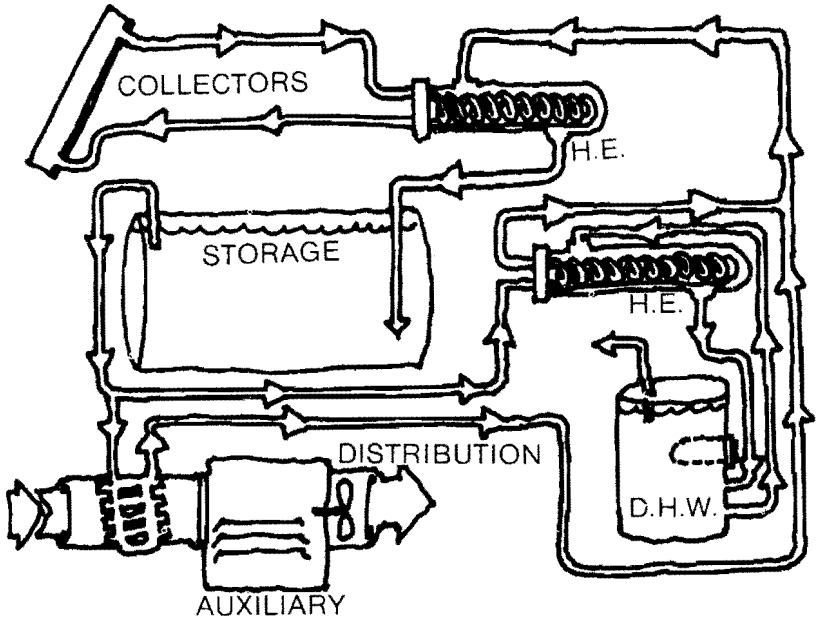
DISTRIBUTION: Heated water from the storage tank circulates through a fin-coil heat exchanger in the return air duct for forced air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump, with 35,000 BTUH capacity supplies auxiliary heat.

DOMESTIC HOT WATER: City water supply enters a domestic hot water preheat tank located in the solar storage tank. Domestic water supply is thus preheated before going to the conventional DHW heater.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.





PROJECT INFORMATION:
BUILDER/APPLICANT: Sam Eyde Construction Co.
DESIGNER: B. Chadwick Walter, AIA
SOLAR SUB: Clyde E. Jenks. Jr.
LOCATION: East Lansing, MI
LATITUDE: 42°42'N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,300 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,928
DESIGN TEMP:
DESIGN TEMP: WINTER: 6° F
INDOOR: 72° F
HORIZ. INSOL. JAN. DAY: 448 BTU/sq. ft.
% SUN/YR: 31%

BUILDING DESCRIPTION/ENERGY CONCERNS

In the cold Michigan climate, the compact massing and layout of this 3 bedroom house helps to conserve energy. The garage is located on the north side of the house and deflects cold north winds, as does the long slope of the north roof. The walls have a total of 6½" of insulation and the ceiling has 12". The window areas on the north, east, and west, have been minimized. Insulating interior doors can be closed to reduce the necessary living space to 3 rooms which can be heated by the fireplace alone during an energy emergency. To replace some heating demand, the living spaces are oriented south to take advantage of passive solar gain from the large glass surfaces.

In the summer, venetian blinds block out the hot sun, and fans draw extra heat from the window surfaces. The attic is also vented for summer cooling.

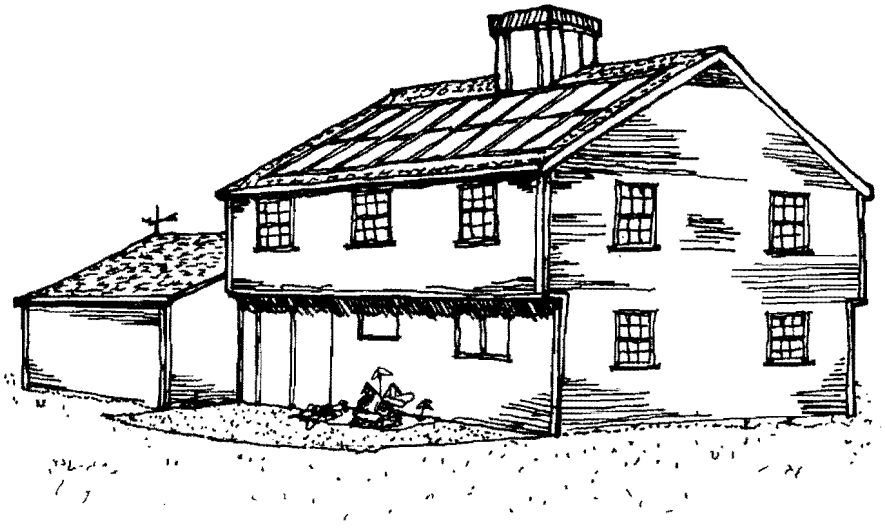
SOLAR ENERGY SYSTEM: ACTIVE (HY)

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%
COLLECTOR: 688 sq. ft. of Revere flat-plate collectors are located on the 50° tilt of the south facing roof. An antifreeze and water solution carries the heat from the collector to a heat exchanger. There the heat is transferred to water which is pumped to the storage tank.
STORAGE: A 500 gallon water storage tank is located in the basement to store the solar heated water.
DISTRIBUTION: Hot water is pumped through a water coil in the return air duct of the hot air distribution system. The air picks up heat from the heated storage water and is blown to the living space.
AUXILIARY ENERGY SYSTEM: A gas fired furnace is the source of auxiliary heat.
DOMESTIC HOT WATER: Incoming cold water circulates through a heat exchanger in the storage to collector piping. It picks up heat from the solar antifreeze solution, pre-heating the water. It then passes to a 52 gallon DHW heater for auxiliary heating and distribution.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 6928 DD MICHIGAN
79

PROJECT INFORMATION:

BUILDER/APPLICANT: Gerholz Community Homes, Inc.
DESIGNER: Richard Pollman
SOLAR SUB: Robert W. Eagleson
LOCATION: Flint, MI
LATITUDE: 43° N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,160 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,041
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 448 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 54%

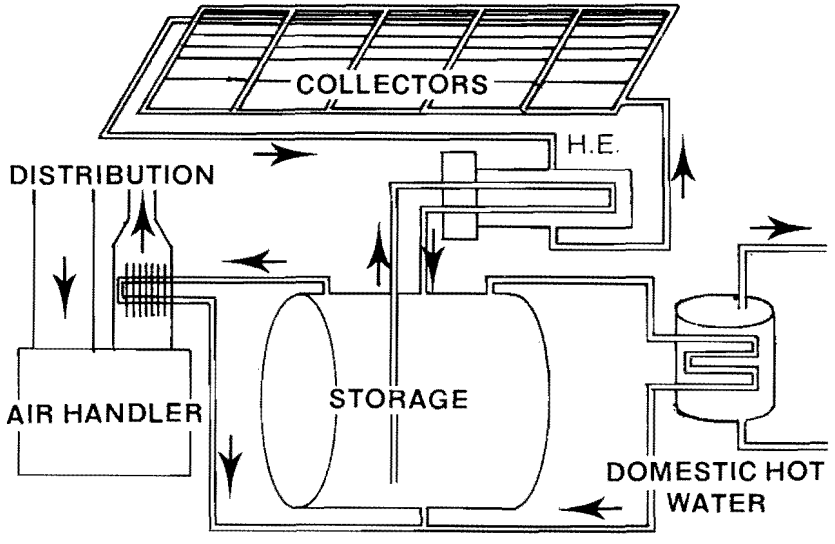


BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Flint, Michigan, this four bedroom home contains 2,160 sq. ft. of living space. Efficient planning has produced a compact building which minimizes surface exposure and, therefore heat loss. The use of 6" studs, with 6" sidewall insulation, insulated sheathing and double glazing, are among the energy conservation features in the home. A ridge vent and attic fan provide natural ventilation in warm weather.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%



COLLECTOR: 567 sq. ft. of Daystar collectors provide energy for the heating and domestic hot water system. Mounted at a 58° tilt, 27 of these collectors have been used. An antifreeze is used to transfer heat from the panels to solar storage. Heat dump panels protect the system from overheating.

STORAGE: A steel tank, insulated with sprayed urethane foam, provides 1,000 gallons of liquid storage.

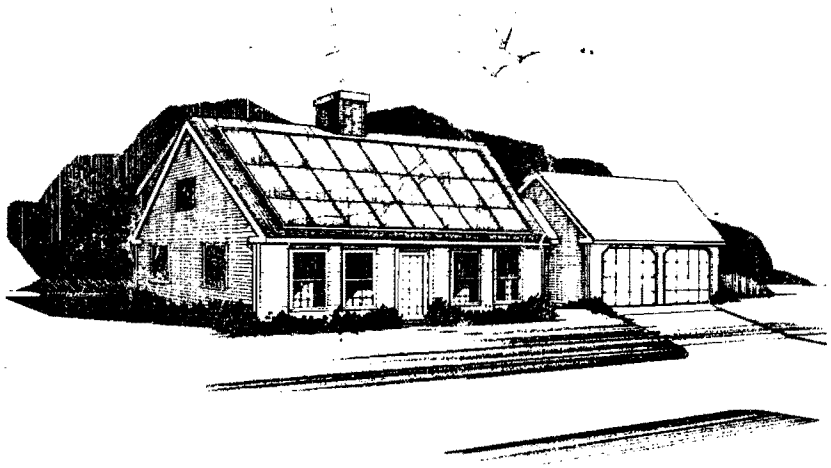
DISTRIBUTION: Solar heated liquid is circulated through a heat exchange coil in the supply air duct for hot air distribution.

AUXILIARY ENERGY SYSTEM: A gas-fired furnace provides auxiliary heat when the solar system proves to be inadequate.

DOMESTIC HOT WATER: A closed loop from the main storage tank passes through the bottom of the conventional DHW tank in order to preheat domestic water supply.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.

80



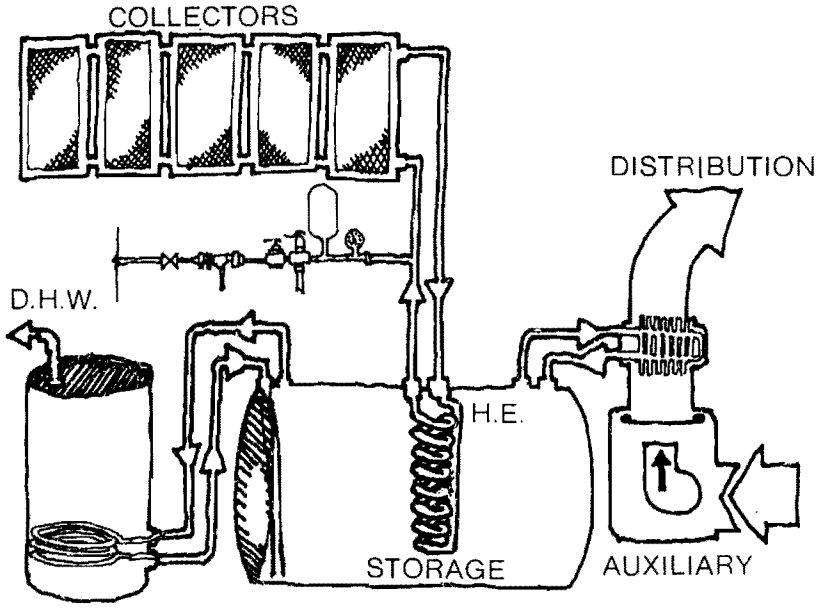
PROJECT INFORMATION:
BUILDER/APPLICANT: Hammerhead Construction Inc.
DESIGNER: Roy S. Brown
SOLAR SUB: Kemball & Cary Fuel Corp.
LOCATION: Westfield, MA
HOUSING TYPE: SFD, 2 Units
CLIMATIC DATA:
HEATING DD: 6,256
DESIGN TEMP: WINTER: −5° F
HORIZ. INSOL. JAN. DAY: 429 BTU/sq. ft.

LATITUDE: 42°N
AREA: > 1,536 sq. ft.

DESIGN TEMP:
INDOOR: 65° F
% SUN/YR: 58%

BUILDING DESCRIPTION/ENERGY CONCERNS

These two single-family detached homes contain 3 bedrooms each. Energy conserving features include careful attention to weatherstripping and insulation, as demonstrated by the R-19 insulation used in the walls and the R-38 used in the roof.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49-55%

COLLECTOR: Both of these homes are equipped with 441 sq. ft. of "Daystar 20" liquid flat-plate collectors. This system uses antifreeze as a transfer media, and a heat dump panel in order to prevent overheating.

STORAGE: The solar heated liquid travels from the collectors to a steel storage tank where energy is transferred through a heat exchanger to 750 gallons of water storage.

DISTRIBUTION: Storage heat is transferred through a hot water coil in the supply air duct for hot air distribution to the living space.

AUXILIARY ENERGY SYSTEM: Auxiliary energy is supplied by an oil burning furnace.

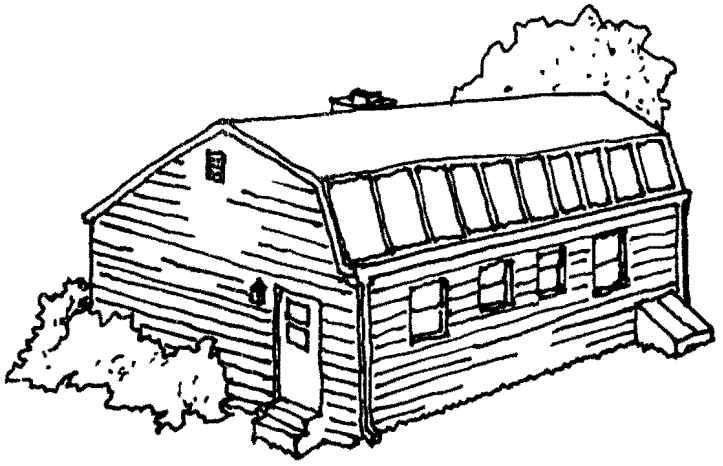
DOMESTIC HOT WATER: A coil from the main solar storage is located in the bottom of a conventional hot water tank for DHW preheat.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 2 SFD NEW 6256 DD MASSACHUSETTS

81

PROJECT INFORMATION:
BUILDER/APPLICANT: Landgraf Associates, Inc.
DESIGNER: Landgraf Associates
SOLAR SUB: Punderson Solar Systems
LOCATION: Springfield, MA
LATITUDE: 42°N
HOUSING TYPES: SFD, 2 Units
AREA: 1,019 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 7,053
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 429 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project includes two single family detached homes which are built on adjacent lots. Each of these homes contain 3 bedrooms and 1,019 sq. ft. of space. The buildings are sited so as to eliminate possible collector shading. The facades are designed to minimize eastern and western exposures thereby reducing heat gain, while attic vents help to encourage natural ventilation in the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 52%

COLLECTOR: Each of these homes has 9 Daystar collector panels (189 sq. ft.) mounted directly on the roof. A non-toxic antifreeze solution, consisting of 60% glycerol and 40% water, circulates through the collector and then transports solar heat to a heat exchange coil in storage.

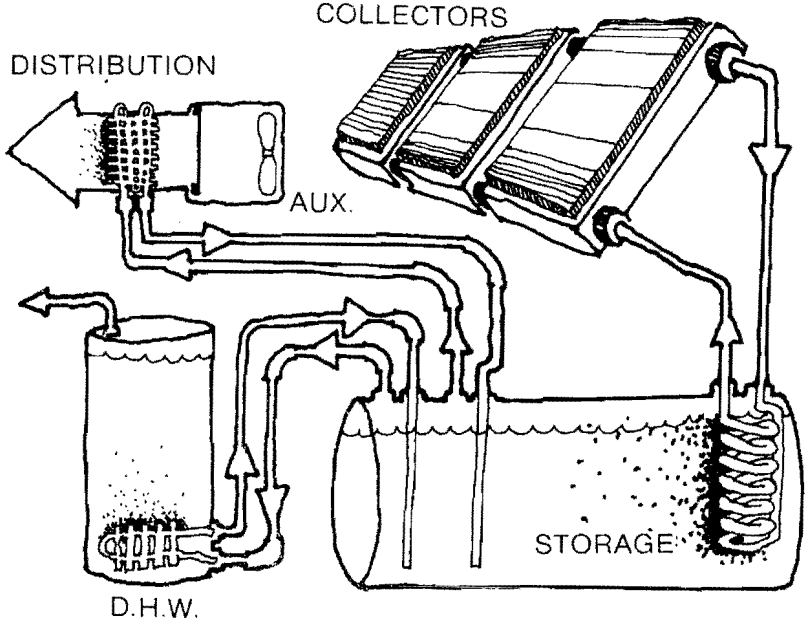
STORAGE: 350 gallons of water storage are contained in an insulated, steel tank.

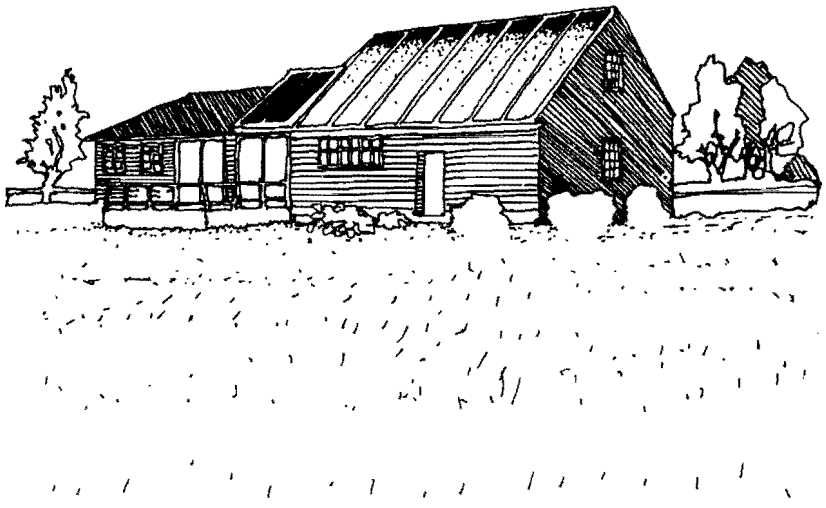
DISTRIBUTION: The solar heated water in storage is piped through a coil in the supply air duct for hot air distribution.

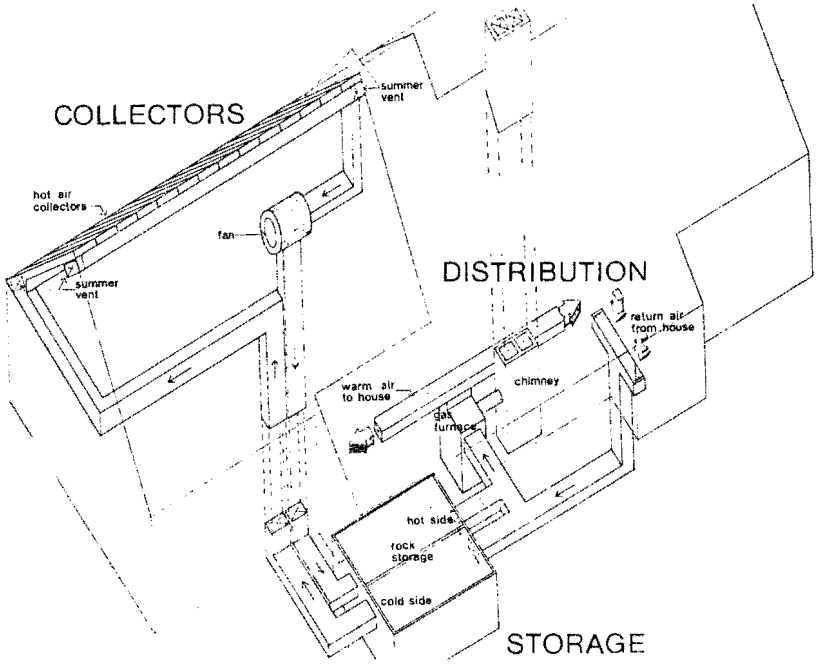
AUXILIARY ENERGY SYSTEM: A gas-fired furnace provides auxiliary heat for the hot air heating system.

DOMESTIC HOT WATER: A coil, containing heated water from the solar storage tank, preheats the water in the bottom of a conventional DHW heater.

MODES OF OPERATION: Collector to storage, storage to building, storage to auxiliary to building, DHW preheat.







PROJECT INFORMATION:
BUILDER/APPLICANT: Joseph Real Estate & Development Co.
DESIGNER: Dan Scully
SOLAR SUB: Paul Giammalvo
LOCATION: West Springfield, MA
LATITUDE: 42°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,200 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,851
DESIGN TEMP:
DESIGN TEMP: WINTER: −5° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 429 BTU/ sq. ft.
% SUN/YR: 56%

BUILDING DESCRIPTION/ENERGY CONCERNS

This ranch house design, with 3 bedrooms and 1,200 sq. ft. of floor area, incorporates many energy conserving features. The garage provides a thermal buffer on the northwest side of the house. Insulation thickness in the ceiling is 12", and an additional insulating sheathing is used on the walls. The basement walls are also insulated. The windows are double-glazed in wooden frames, and insulating panels slide over the large windows on the south. The entry foyer serves as an airlock to prevent heat loss. The open interior plan is organized to orient the living spaces to the south for winter warmth and to permit cross-ventilation in the summer. A wood stove provides additional heat, reducing the load on the heating systems.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 48%

COLLECTOR: Space heating is provided by 426 sq. ft. of flat-plate air collectors directly mounted on the 45° slope of the south-facing roof. They are manufactured by Contemporary Systems, Inc.
STORAGE: Solar heated air is blown to 426 cu. ft. of rock storage located in a bin in the basement. The bin is insulated with 3½" of glass fiber and 2" of rigid foam insulation.
DISTRIBUTION: Solar heated air from storage is blown to the living space by a forced hot air system.
AUXILIARY ENERGY SYSTEM: A gas-fired furnace with a capacity of 80,000 BTU/hr. provides the auxiliary heat.
DOMESTIC HOT WATER: A separate set of collectors provides heat for the DHW system. 37 sq. ft. of Sunworks flat-plate collectors are located adjacent to the space heating collectors. An antifreeze solution is circulated through these collectors and then to a finned-tube heat exchanger adjacent to the hot water heater. Heat is then transferred to potable water and distributed through a conventional DHW system.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 6851 DD MASSACHUSETTS

83

PROJECT INFORMATION:
BUILDER/APPLICANT: Barrett Mountain
DESIGNER: David F. Jaquith
SOLAR SUB: Pierce Plumbing
LOCATION: New Ipswitch, NH
HOUSING TYPE: SFD, 2 Units
CLIMATIC DATA:
HEATING DD: 7,237
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 433 BTU/sq. ft.
LATITUDE: 43°N
AREA: 2,000/2,400 sq. ft.
DESIGN TEMP:
INDOOR: 65° F
% SUN/YR: 54%

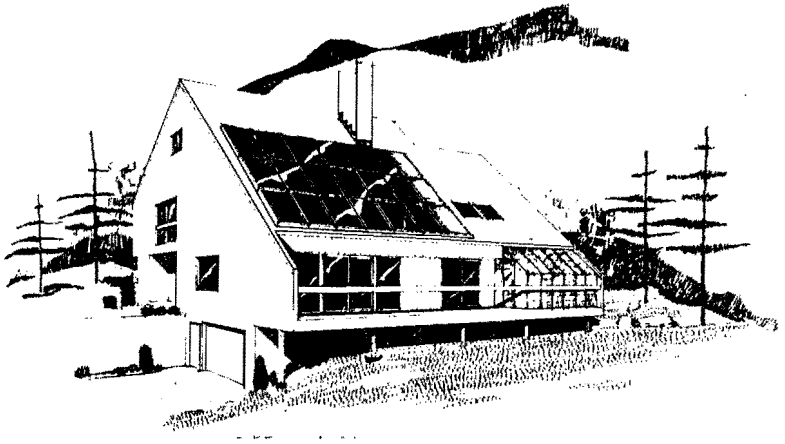
BUILDING DESCRIPTION/ENERGY CONCERNS

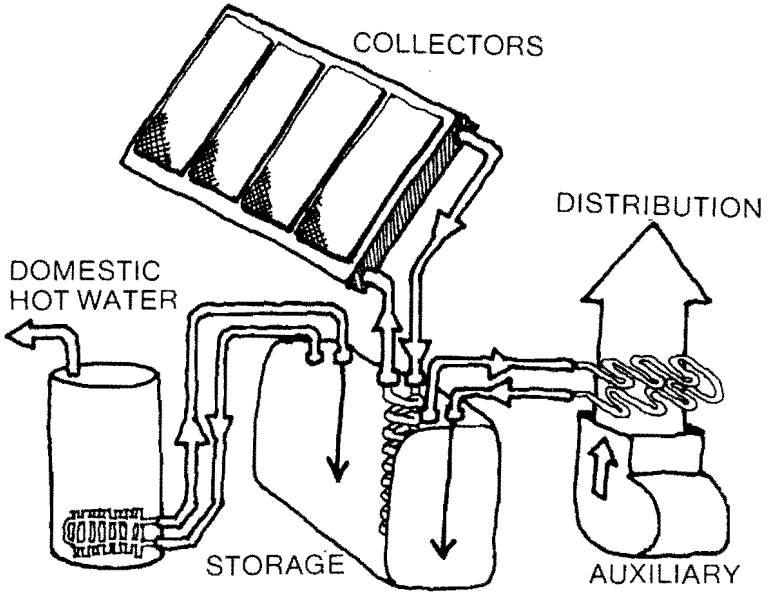
These two single-family detached homes are sited and designed to minimize energy usage during the cold New Hampshire winters. The 3-bedroom houses are located on south-facing slopes below a hill which blocks the cold winter winds. Evergreens planted to the north also serve as wind breaks. The houses are heavily insulated, with 6" of batt insulation in the walls and floor, and 10" in the ceiling. Windows are minimized on the north wall, while living spaces and a greenhouse are oriented south, with large windows to capture the winter sun. Insulating curtains which cover the windows at night and air lock entries prevent winter heat loss. During the summer, an attic fan induces ventilation through the house.

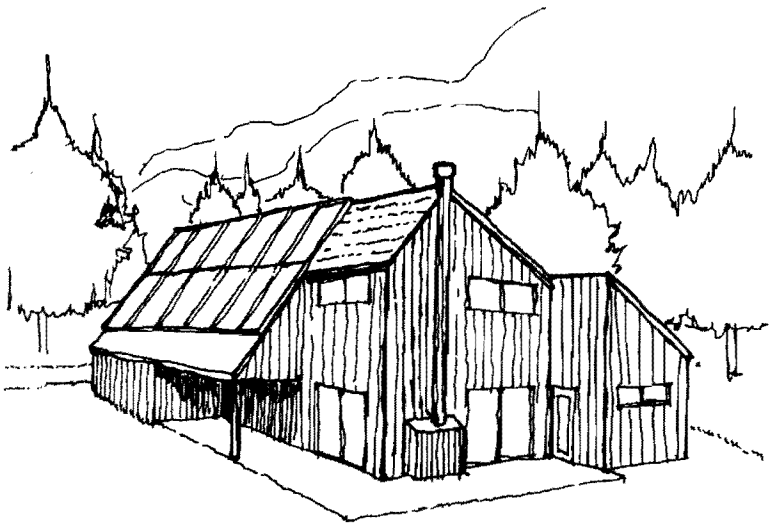
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 47-56%

COLLECTOR: The 45° south-sloping roof of each house is the location of the Daystar flat-plate collectors which supply solar heat for heating and DHW. The collector areas are 378 sq. ft. and 441 sq. ft. An antifreeze and water solution is pumped through the collectors to a tube and shell heat exchanger. There, the collected heat is transferred to water storage.
STORAGE: In the basement of each house is an insulated water storage tank. The tanks are 750 gallons and 1,000 gallons in volume.
DISTRIBUTION: The heated storage water is pumped through a water to air heat exchanger in the return duct of the hot air distribution system. The solar heat is transferred to the air and blown to the living spaces.
AUXILIARY ENERGY SYSTEM: An oil-fired furnace supplies auxiliary heat, along with a wood burning stove which can supply 15,000 BTU/hr.
DOMESTIC HOT WATER: Heated water is pumped from storage through a heat exchanger in the bottom of a conventional DHW tank to provide DHW preheat.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



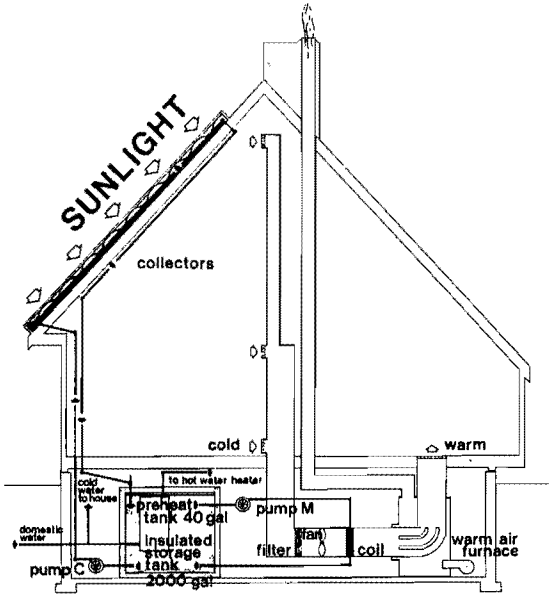




PROJECT INFORMATION:
BUILDER/APPLICANT: First Fidelity Service Corp.
DESIGNER: Martin U. Michaelis, AIA
SOLAR SUB: Acorn Structures
LOCATION: Nashua, NH
LATITUDE: 42°N
HOUSING TYPE: SFD, 3 Units
AREA: 1,400 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,383
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 433 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 53%

BUILDING DESCRIPTION/ENERGY CONCERNS

This single-family detached home has 1,400 sq. ft. of living space and three bedrooms. Window area is minimized and all windows are double-glazed to prevent heat loss. Wood burning stoves or fireplaces augment the active heating system.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 39%

COLLECTOR: Six "Acorn Structures" flat-plate water collectors, totalling 418 sq. ft. are mounted directly onto the roof facing south at a 45° tilt. Water is pumped through the collectors and directly to a storage tank.

STORAGE: The 2,000 gallon "Acorn Structures" water storage tank of plywood and steel band construction around a vinyl lining, has been insulated with 3½" batt insulation.

DISTRIBUTION: Solar heated water from storage is pumped to a fin-coil heat exchanger in the supply duct of the hot air distribution system.

AUXILIARY ENERGY SYSTEM: An electric air to air heat pump in series with the solar heating system provides auxiliary energy.

DOMESTIC HOT WATER: City water is preheated in a small preheat tank immersed in the hot water storage before being fed into a conventional electric water heater.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

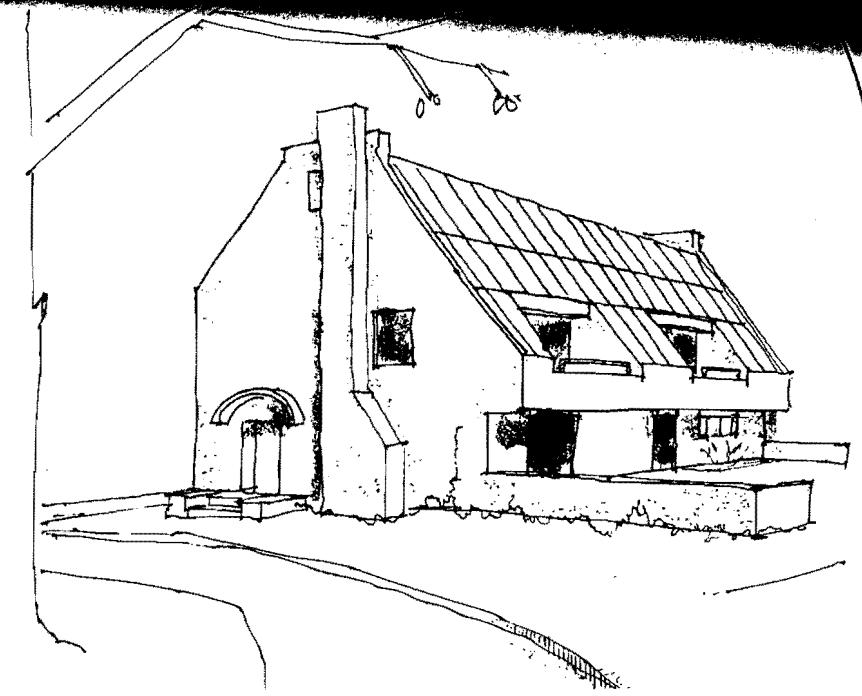
ILLINOIS 7268 DD 1 SFD NEW ACTIVE HEATING & DHW

86

PROJECT INFORMATION:
BUILDER/APPLICANT: Robert M. Roloson, Architect
DESIGNER: Robert M. Roloson
SOLAR SUB: L. R. Gregory & Son
LOCATION: Lake Forest, IL
LATITUDE: 42°N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,160 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,268
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 355 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 22%

BUILDING DESCRIPTION/ENERGY CONCERNS

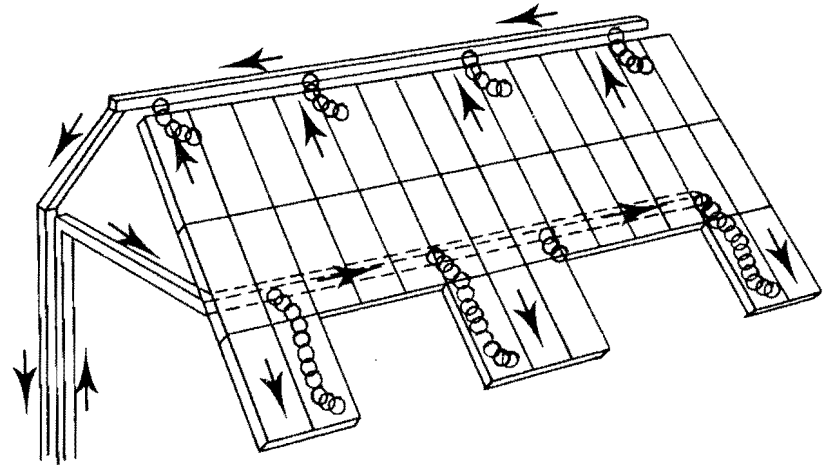
This single family home has 3 bedrooms and 2,160 sq. ft. of living space. The house is zoned to expose the living spaces to maximum winter sun exposure, while lining the north wall with service spaces to provide protection from the cold winter winds. The placement of the garage on the north provides an additional wind buffer. Glass surfaces have been minimized on the north, east and west, and are well shaded in summer by overhangs on the south. The walls, ceiling and foundation are very well insulated, and windows are double glazed.



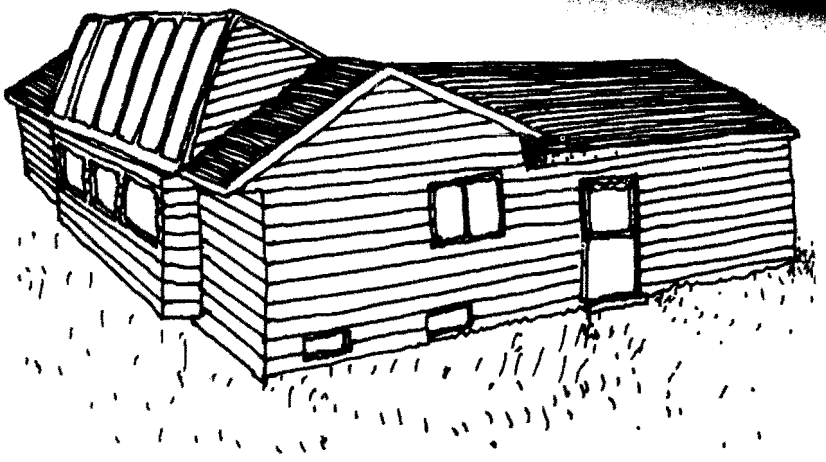
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: Integrated into the structure of the south facing roof, 609 sq. ft. of Solaron flat plate collectors are placed at a 53° tilt. Air circulates through the collectors, carrying heat to rock storage.
STORAGE: A 300 cu. ft. insulated bin, located in the basement, holds fist-sized rock to store collected heat. The heated air which is pulled from the collector, is blown either to storage or to the house by air handling unit.
DISTRIBUTION: The air handling unit draws solar heated air from storage or from the collectors and blows it to the house for hot air distribution.
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy.
DOMESTIC HOT WATER: Cold water is pumped from a water storage tank through a coil located in the air handling unit. The preheated water returns to the tank, and is drawn into the conventional DHW heater as needed.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

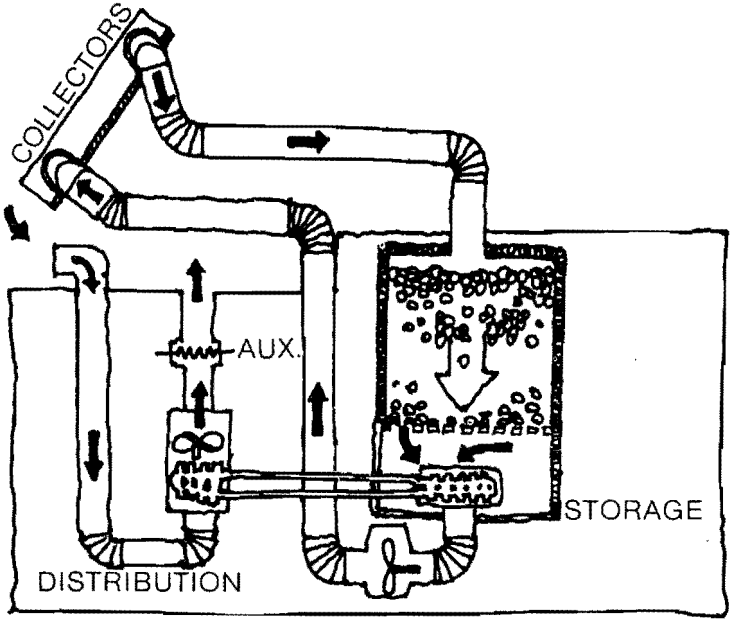


LOCATION: [illegible]
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:

HEATING DD: 7,444	DESIGN TEMP:
DESIGN TEMP: WINTER: −10° F	INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 548 BTU/sq. ft.	% SUN/YR: 44%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one level single family detached home has 1,731 sq. ft. of living space and 3 bedrooms. The walls and ceiling are heavily insulated with batt insulation. In summer, the attic is vented and there is a two foot roof overhang to prevent solar overheating.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 44%

COLLECTOR: 342 sq. ft. of Solaray flat plate air collectors and 72 sq. ft. of flat plate water collectors are mounted to the roof of the house, facing due south at a 53° tilt.

STORAGE: The solar heated air is blown to a rock storage bin in the basement. The steel storage bin has 2" of rigid insulation.

DISTRIBUTION: Solar heated air is drawn from the heated rocks across refrigerant coils in a heat pump auxiliary. The refrigerant draws heat from the solar heated air, boosting the temperatures as necessary and blowing heated air to the living spaces for forced air distribution.

AUXILIARY ENERGY SYSTEM: The electric heat pump provides auxiliary heating.

DOMESTIC HOT WATER: 72 sq. ft. of State Industries flat plate water collectors are mounted separately at a 53° tilt for domestic hot water preheat. The solar heated water goes to a steel shell and tube heat exchanger where incoming cold water is preheated for DHW supply.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, DHW preheat.

WIS 7444 DD 1 SFD NEW ACTIVE HEATING & DHW

87

MAINE

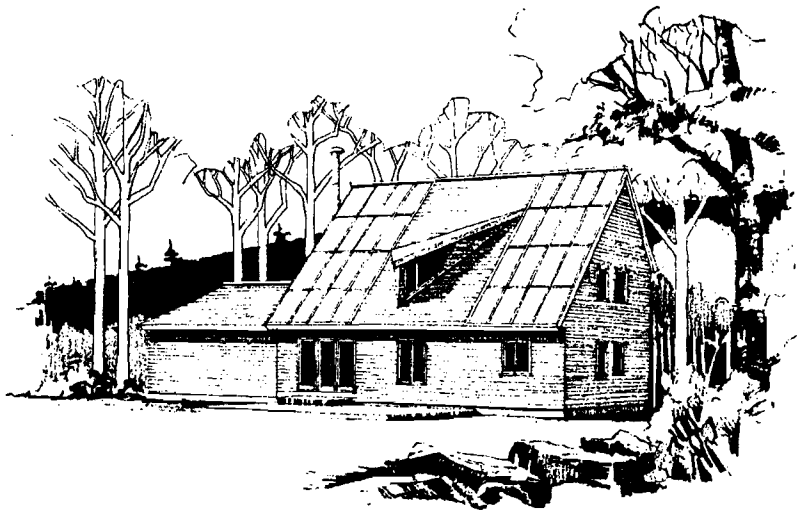
7511 DD

1 SFD NEW

ACTIVE HEATING & DHW

88

BUILDER/APPLICANT: Aidco Maine Corp.
DESIGNER: R. K. Multer & D. Richmond
SOLAR SUB: Aidco Maine Corp.
LOCATION: Harpswell, ME
LATITUDE: 44°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,837 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,511
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 562 BTU/sq. ft.
DESIGN TEMP: INDOOR: 68° F
% SUN/YR: 59%

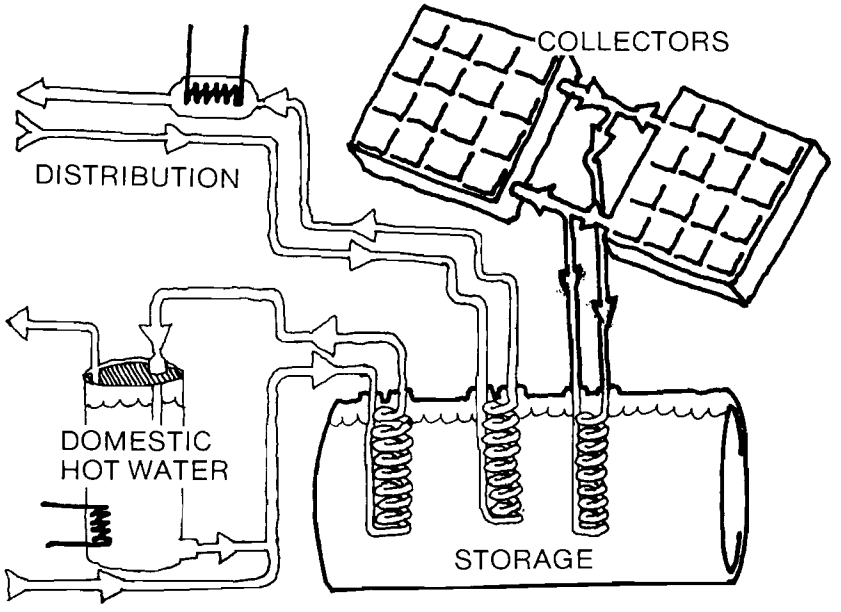


BUILDING DESCRIPTION/ENERGY CONCERNS

This New England saltbox style house is oriented to accommodate solar panels on the long 45° sloped roof. The 1,837 sq. ft. of floor space includes 3 bedrooms and 2 baths. Window openings have been minimized and placed east and south. The garage has been placed on the northwest to act as a wind and thermal buffer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 84%



COLLECTOR: 592 sq. ft. of collector area is composed of 32 standard Sunworks flat-plate panels. The panels are mounted on the roof facing south at a 45° tilt. An antifreeze liquid is heated in the collectors and circulated in storage through a 180 ft. exchange loop of 1½" copper tubing.

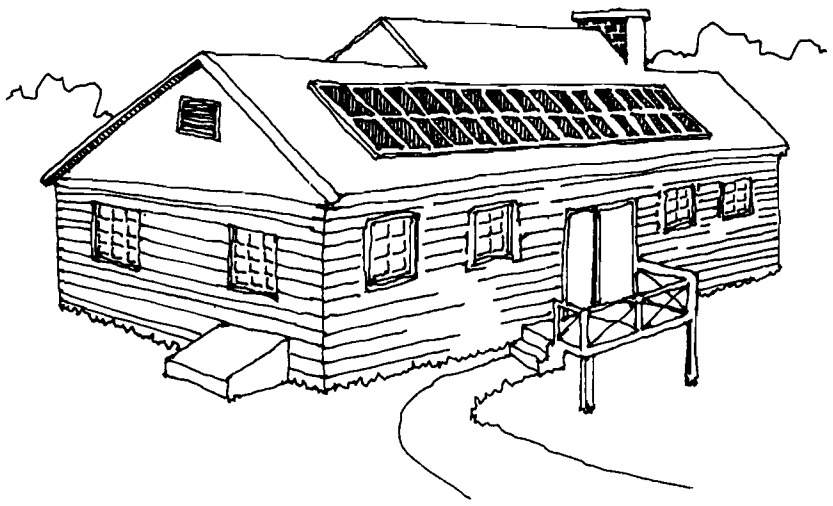
STORAGE: 1,140 cu. ft. of water is stored in an insulated reinforced concrete tank in the basement of the house.

DISTRIBUTION: The water circulated in the conventional hydronic heating system is preheated in solar storage through an extended coil.

AUXILIARY ENERGY SYSTEM: A back-up electric boiler is activated when water in solar storage falls below 90°. A wood-burning stove will also heat a large part of the house.

DOMESTIC HOT WATER: Incoming city water is preheated in a coil located in the solar storage tank.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, DHW preheat.



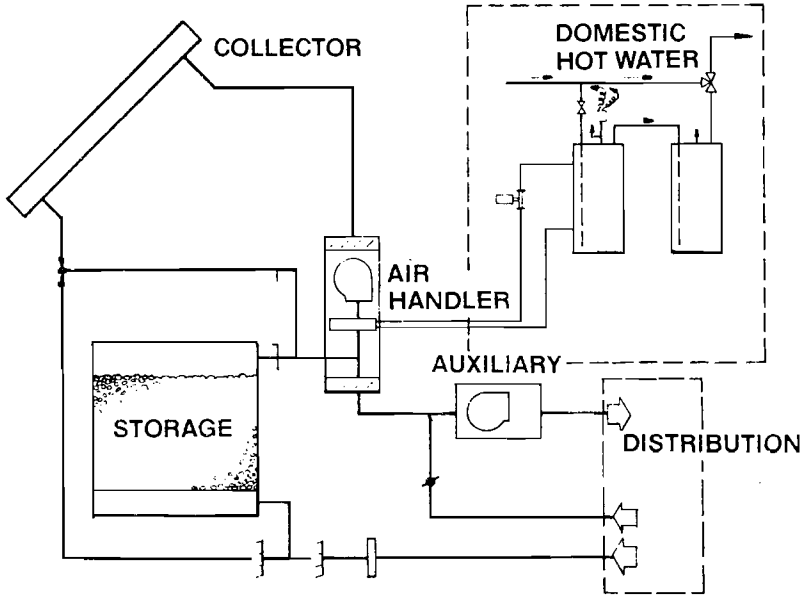
PROJECT INFORMATION:
BUILDER/APPLICANT: Plantation Valley Homes, Inc.
DESIGNER: Marvin Catler
SOLAR SUB: Richard J. Ziemba
LOCATION: Amherst, MA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 7,519
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 429 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,244 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 50%

BUILDING DESCRIPTION/ENERGY CONCERNS

This one-level single-family home has 1,244 sq. ft. of living space and three bedrooms. The walls have 6" of batt insulation, the roof 12" of blown insulation, and the floors contain 3½" of batt insulation.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 60%

COLLECTOR: 556 sq. ft. of "Solaron 2,000" flat-plate air collectors are mounted directly onto the roof facing due south at a tilt of 53°. Air is drawn through the collector and blown to rock storage.

STORAGE: 312 cu. ft. of rock storage is located in a concrete bin within 1½" of rigid insulation.

DISTRIBUTION: A central air handling unit blows air across rock storage for forced hot air distribution.

AUXILIARY ENERGY SYSTEM: Electric baseboard heaters provide back-up and auxiliary energy.

DOMESTIC HOT WATER: Cold water enters a storage tank, then passes through a fin-coil heat exchanger located in the collector to storage air duct. Thus, city water is preheated on its way to a conventional 52-gallon electric hot water heater.

MODES OF OPERATION: Collector to storage, collector to house, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

ACTIVE HEATING & DHW 1 SFD NEW 7519 DD MASSACHUSETTS

89

UTAH

7582 DD

1 SFD NEW

ACTIVE HEATING & DHW

90

PROJECT INFORMATION:

BUILDER/APPLICANT: Villatek
DESIGNER: W. D. Thornley
SOLAR SUB: Kirk Nelson
LOCATION: Logan, UT
LATITUDE: 41°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,400 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,582
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 603 BTU/sq. ft.
DESIGN TEMP: INDOOR: 68° F
% SUN/YR: 67%

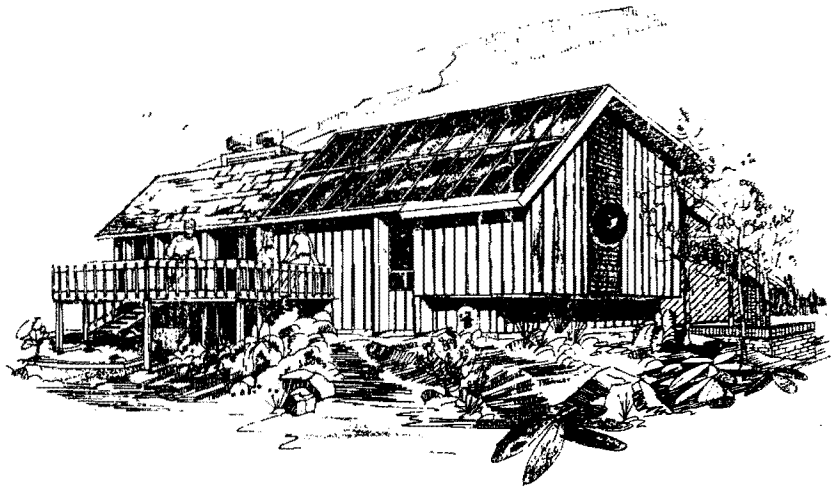
BUILDING DESCRIPTION/ENERGY CONCERNS

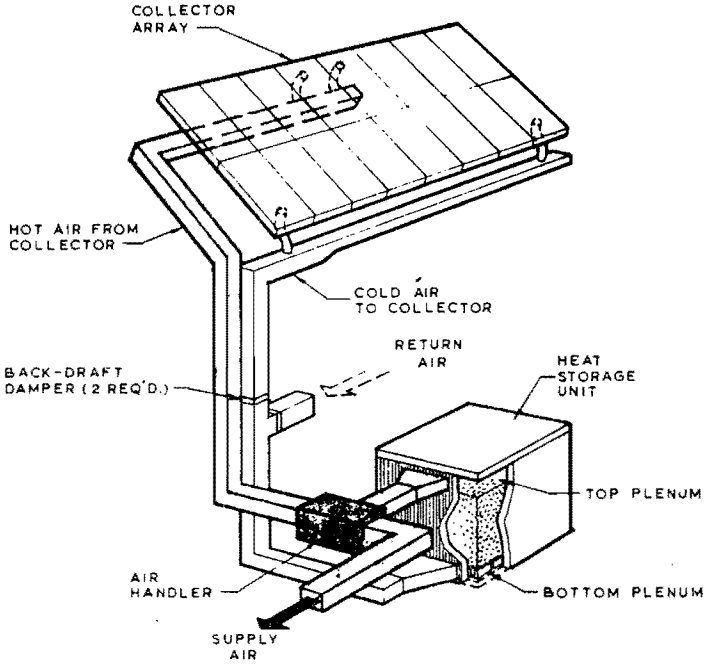
This project involves one single family home with 3 bedrooms and an area of 1,400 sq. ft. The energy consumption of the house is reduced by thick insulation, with 11" of cellulose insulation in the ceiling and 6" in the walls. The floor between the living areas and the basement is also insulated with 10" of cellulose. Heat losses through the foundation are minimized by 2" of rigid insulation on the outside of the concrete blocks. Window areas are small, and are all double glazed. Overhangs shade the windows and the walls in summer to prevent heat gain. For additional warmth in winter, the fireplace re-circulates heat to the house spaces, reducing the demand on the heating system.

SOLAR ENERGY SYSTEM: ACTIVE

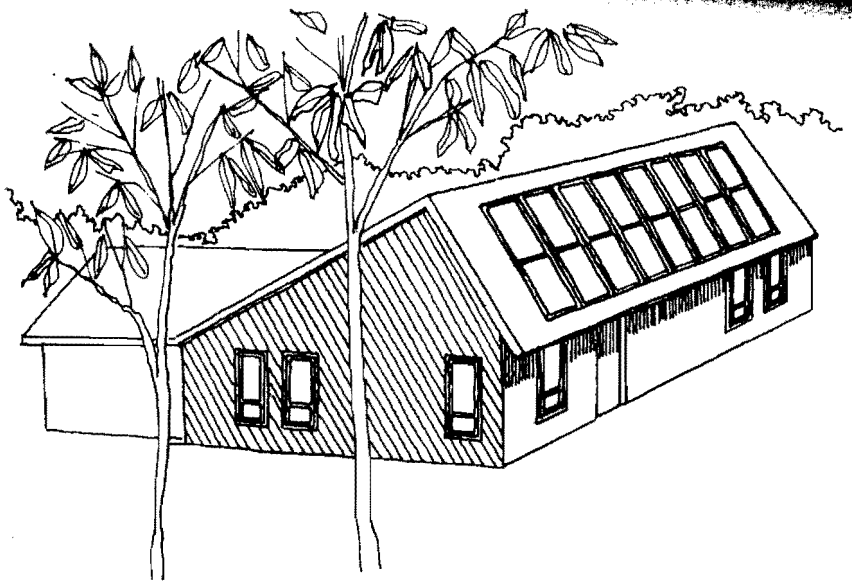
SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 44%

COLLECTOR: 347 sq. ft. of Solaron flat plate collectors are located on the roof with an orientation 10° west of south. The collector panels are mounted at a 50° tilt and use air to transfer the collected heat.
STORAGE: The central air handler pulls air from the collectors into the living space or into a storage bin which is filled with 195 cu. ft. of small rocks. The bin is located in the basement and is insulated with 2" of rigid insulation.
DISTRIBUTION: The air handler draws heated air from solar storage or directly from the collectors for hot air distribution.
AUXILIARY ENERGY SYSTEM: Electricity is used to provide auxiliary heat for the hot air system.
DOMESTIC HOT WATER: Cold water flows from a preheat tank through an air to water coil in the air handling unit for domestic hot water preheat. Hot water is drawn from the preheat tank, on demand, into a conventional DHW tank, where it is raised to operating temperatures for distribution.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house (all via air handling unit), auxiliary to house, DHW preheat.





FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6



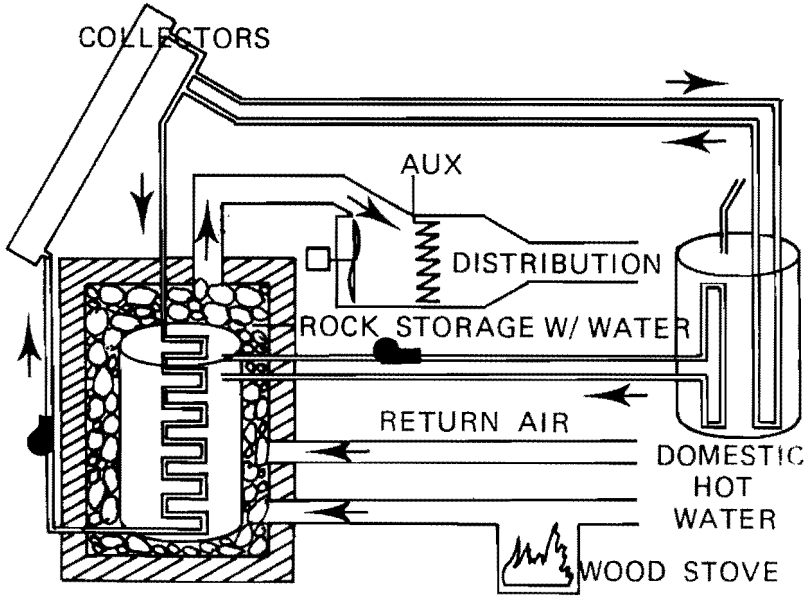
DESIGNER: Mark Nelson
SOLAR SUB: Stockers, Inc.
LOCATION: Osceolo, WI
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 7,589
DESIGN TEMP: WINTER: −25° F
HORIZ. INSOL. JAN. DAY: 621 BTU/sq. ft.

LATITUDE: 45° 30'
AREA: 1,224 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 56%

BUILDING DESCRIPTION/ENERGY CONCERNS

This home of 1,224 sq. ft. contains 3 bedrooms. Generous insulation and minimal windows are used to prevent heat transfer, and a garage, attached to the north side of the house, provides protection from the winter winds. Roof overhangs shade the windows to minimize summer solar gain. The building has been carefully sited so as to avoid shading of the collectors.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 68%

COLLECTOR: 347 sq. ft. of Solaron collectors have been mounted directly to the south facing roof at a 45° tilt. These flat plate collectors use air as the heat transfer media.

STORAGE: A 175 cu. ft. rock storage bin, protected with both rigid and blanket insulation, provides for solar storage.

DISTRIBUTION: Solar heated air, from the collectors, may be circulated directly to the storage bin or directly to the house by means of an air handling unit.

AUXILIARY ENERGY SYSTEM: An electric heat pump, with a supplementary electric resistance strip, provides auxiliary energy.

DOMESTIC HOT WATER: A domestic hot water preheat coil, located in the air handling unit, preheats incoming water, which is then stored until demanded.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

WISCONSIN 7589 DD 1 SFD NEW ACTIVE HEATING & DHW

91

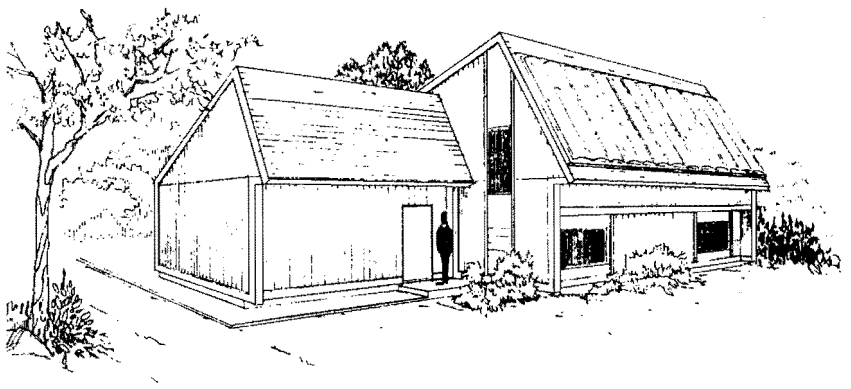
IDAHO | 7591 DD | 1 SFD NEW | ACTIVE HEATING & DHW

92

PROJECT INFORMATION:
BUILDER/APPLICANT: Cascade Construction Ltd.
DESIGNER: W. D. Weston
SOLAR SUB: Cascade Construction, Ltd.
LOCATION: Rexburg, ID
LATITUDE: 45°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,626 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,591
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 603 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 83%

BUILDING DESCRIPTION/ENERGY CONCERNS

Designed to be energy efficient, this four-bedroom home contains 1,626 sq. ft. of space. The building plan is compact in an effort to minimize surface area and heat loss. Also, only small amounts of window area are used. 2"x6" construction with 6" wall insulation and 12" ceiling insulation helps to conserve energy. Activities are zoned so that living spaces are in the southern portion of the house while sleeping areas are in the northern portion. This zoning takes advantage of solar gain through southern exposures. Heat from a wood burning stove is used to heat the space and can be used to heat the rocks in storage. In summer, roof overhangs provide protection against solar gain.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 95%

COLLECTOR: Concentrating collectors, manufactured by Northrup, cover 200 sq. ft. of the south side of the roof. These collectors make use of a tracking mechanism which insures that the copper absorption plate always receives direct solar rays. In addition, each collector has a cover plate which serves to focus these rays. An antifreeze solution circulates through the collectors to a heat exchanger.

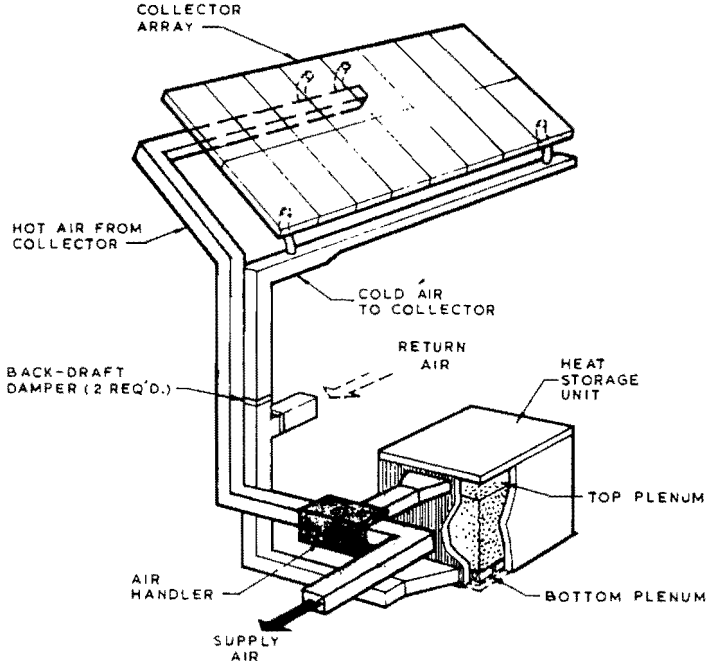
STORAGE: Warmed antifreeze circulates through a heat exchanger where it transfers its heat to the water storage. A 1,500 gallon steel tank, imbedded in rock, provides storage. Collected heat is also transferred to the rocks which surround the tank.

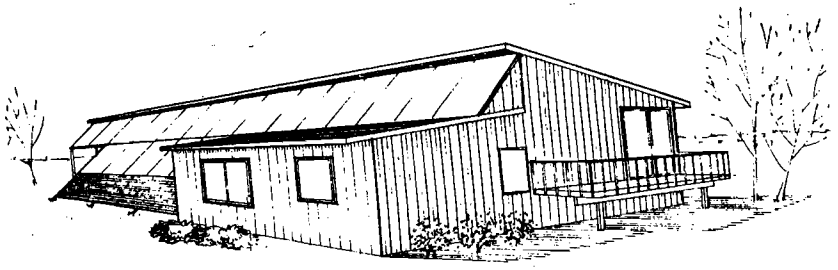
DISTRIBUTION: Air is drawn from the heated rocks and blown to the house.

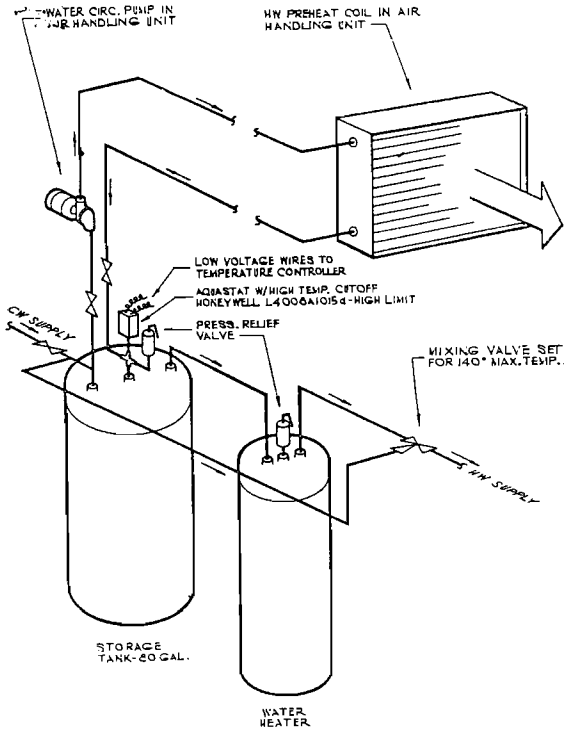
AUXILIARY ENERGY SYSTEM: A wood burning fireplace is connected, by way of an air duct, to the rock portion of the storage bin. This system may provide supplementary energy to heat the storage. In addition, an electric furnace is included in the home.

DOMESTIC HOT WATER: A coil is immersed in the DHW tank. During the winter, water from the main storage tank circulates through this coil while during the summer, transfer fluid directly from the collectors is used. This mechanism serves to preheat water for domestic use.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.







FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

LOCATION: Kalispell, MT
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 6,475
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 518 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 53%

BUILDING DESCRIPTION/ENERGY CONCERNS

This home has 3 bedrooms in 1,590 sq. ft. of living space. The entry, positioned on the west side of the building, is protected from heat gain by shading from the carport and from heat loss by an airlock. A portion of the building is below ground level which serves to further conserve energy. Also included in the design is a wood burning stove which serves as a supplementary heating system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 52%

COLLECTOR: Solaron air flat plate collectors, placed at a 53° tilt, have been used in this project. The 347 sq. ft. of collectors help to provide energy for both space heating and hot water. The heated air is blown from the collectors to the storage or to the house by a central air handler.

STORAGE: A rock bin, accommodating approximately 175 cu. ft. of space, provides storage for the system. Both glass and batt insulation have been used to protect the bin against heat loss.

DISTRIBUTION: Air circulates through an air handler which can distribute heat directly from the collectors or can pull stored heat from the rock bin for distribution.

AUXILIARY ENERGY SYSTEM: A heat pump, powered by electricity, serves as an auxiliary energy system.

DOMESTIC HOT WATER: Incoming water flows to a preheat tank, and is then pumped through an air to water coil in the air handler. The preheated water returns to the tank and is stored until needed.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to building, auxiliary to building, DHW preheat.

MO 6475 DD 1 SFD NEW ACTIVE HEATING & DHW

93

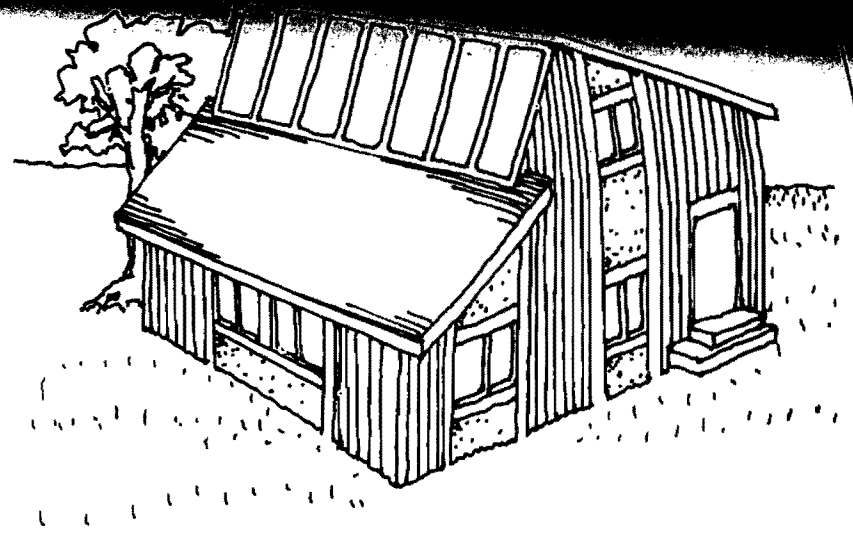
MONTANA 7650 DD 5 SFD NEW ACTIVE HEATING & DHW

94

DESIGNER: John H. Meyer
SOLAR SUB:
LOCATION: Harlem, MT
HOUSING TYPE: SFD, 5 Units
CLIMATIC DATA:
HEATING DD: 7,650
DESIGN TEMP: WINTER: −30° F
HORIZ. INSOL. JAN. DAY: 518 BTU/sq. ft.

LATITUDE: 48°N
AREA: 1,222 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 67%



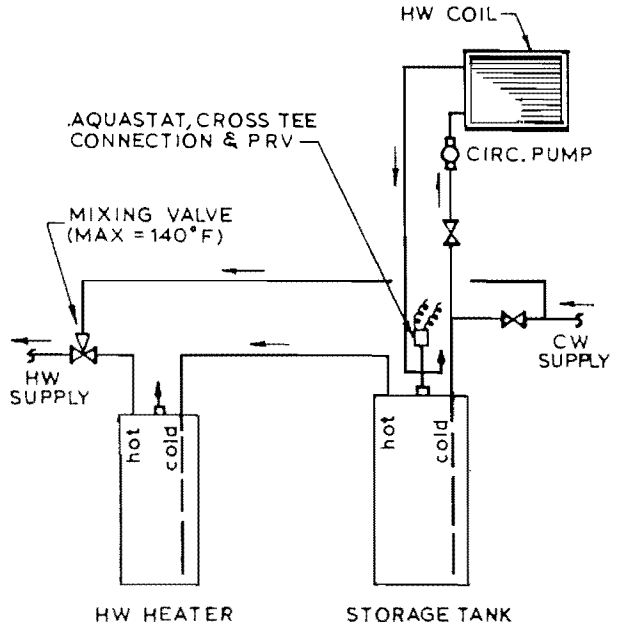
BUILDING DESCRIPTION/ENERGY CONCERNS

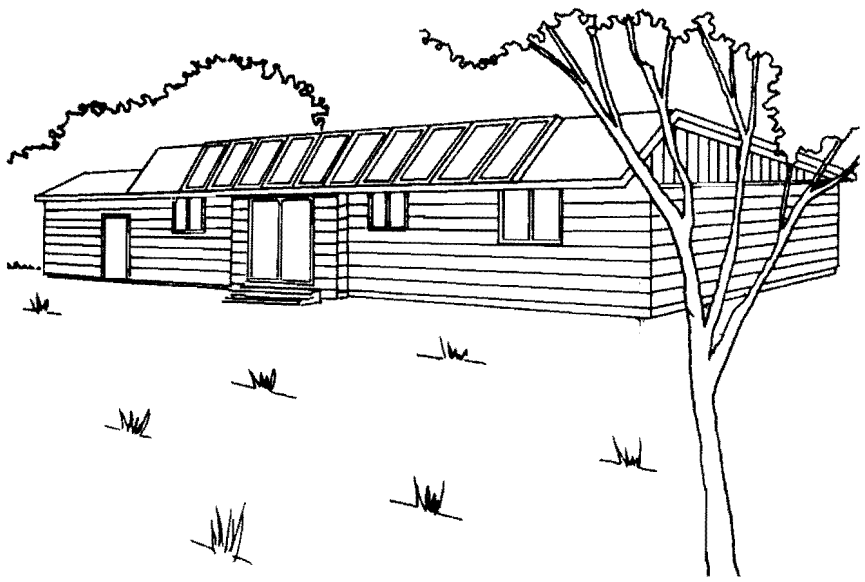
The 5 houses in this project each have 3 bedrooms and 1,222 sq. ft. of living area. The compact plan reduces the amount of wall area exposed to the exterior, thereby reducing heat loss and gain. The north wall, subject to high heat loss due to cold winter winds, has no glass surfaces. The house is very well insulated with more than 18" of batt insulation in the ceiling and 5½" in the walls. The wide eaves shade the wall surfaces in the summer to reduce heat gain.

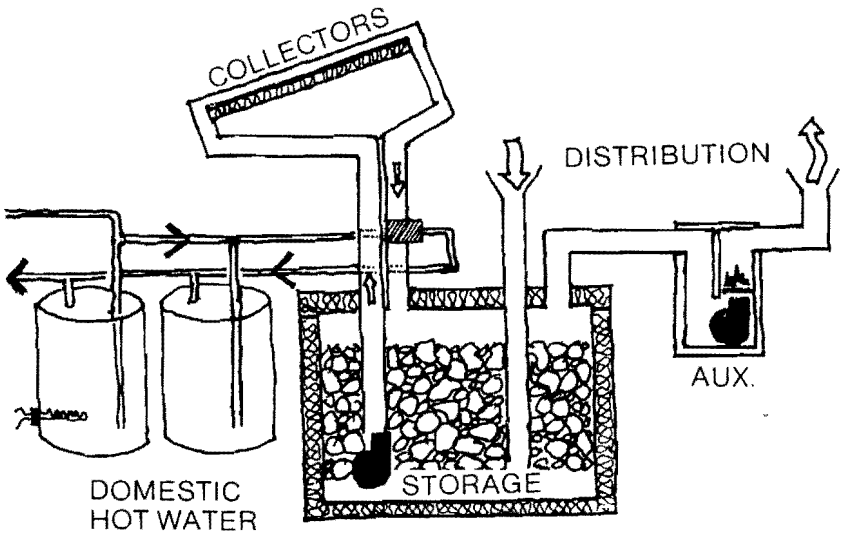
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 64%

COLLECTOR: The Solaron collectors are mounted at a 63° angle and have an effective collector surface of 347 sq. ft. Air flowing between the cover sheets and the black absorber plate is heated by the sun. The hot air is pulled from the collector to rock storage or the living space by a central air handler.
STORAGE: Under the house, a concrete storage bin holds 175 cu. ft. of rocks in order to store the collected heat.
DISTRIBUTION: The central air handler pulls heat from either the collector or from the storage bin and blows it into the house for hot air distribution.
AUXILIARY ENERGY SYSTEM: A gas-fired furnace provides auxiliary heat as necessary.
DOMESTIC HOT WATER: Air heated from the collectors is transferred to the hot water system through an air-to-water coil located in the air handler. A pre-heat tank stores the solar heated water until it enters the conventional DHW tank. The system volume is 80 gallons.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house (all via air handler), auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: J. A. Verthein Const. Co.
DESIGNER: Glenn F. Groth
SOLAR SUB: Lynn A. Lamphiear
LOCATION: Baraboo, WI
LATITUDE: 43°24'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,008 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,723
DESIGN TEMP: WINTER: −15° F
HORIZ. INSOL. JAN. DAY: 548 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 55%

BUILDING DESCRIPTION/ENERGY CONCERNS

This ranch style single family home has 1,008 sq. ft. of living area and 3 bedrooms. The window surfaces on the south and west are minimal to prevent heat gains, along with overhangs which block direct sun from walls and windows.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

COLLECTOR: Manufactured by Sun Stone, the flat plate collector for this house cover 198 sq. ft. of the south facing roof. They are mounted to a 54° angle. Air is passed through the collector to carry heat to storage.

STORAGE: A 200 cu. ft. bin filled with rocks stores the heat transferred by the air from the collector. The bin is surrounded by 2" of rigid insulation.

DISTRIBUTION: The hot air is forced from storage through conventional ductwork by a fan.

AUXILIARY ENERGY SYSTEM: Electric resistance heaters provide the auxiliary heat source.

DOMESTIC HOT WATER: A coil located in the duct between the collector and the storage bin transfers heat from the warmed air to water in the DHW system. The preheated water is stored in one tank and pumped through a conventional DHW tank which raised the water to operating temperature.

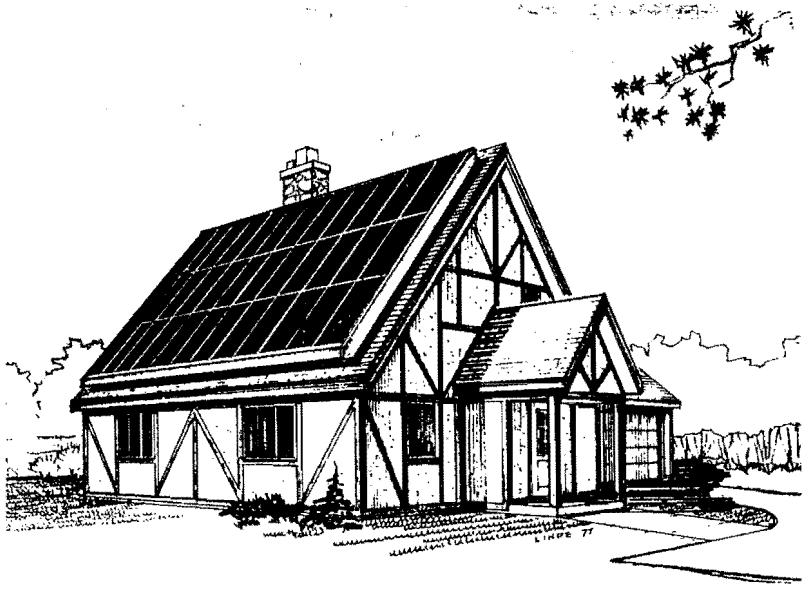
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

WISCONSIN 7748 DD 1 SFD NEW ACTIVE HEATING & DHW

96

PROJECT INFORMATION:

BUILDER/APPLICANT: Robert J. Zimmerman
DESIGNER: Glenn F. Groth
SOLAR SUB: Robert J. Roltgen
LOCATION: Eldorado, WI
LATITUDE: 43°45'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,500 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,748
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 548 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 50%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves one single family unit with 1,500 sq. ft. of living area and 3 bedrooms. The north wall is sheltered by the garage to reduce convective heat loss on that surface, and windows are minimized and triple glazed. To further ensure that space heat is not wasted, the walls have 6" of insulation, and the floors, foundation and ceiling have also been heavily insulated.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 84%

COLLECTOR: The solar collectors, mounted at a 50° angle, are manufactured by Sun Stone Solar Energy Equipment and cover an area of 594 sq. ft. Air is used to carry heat to rock storage.

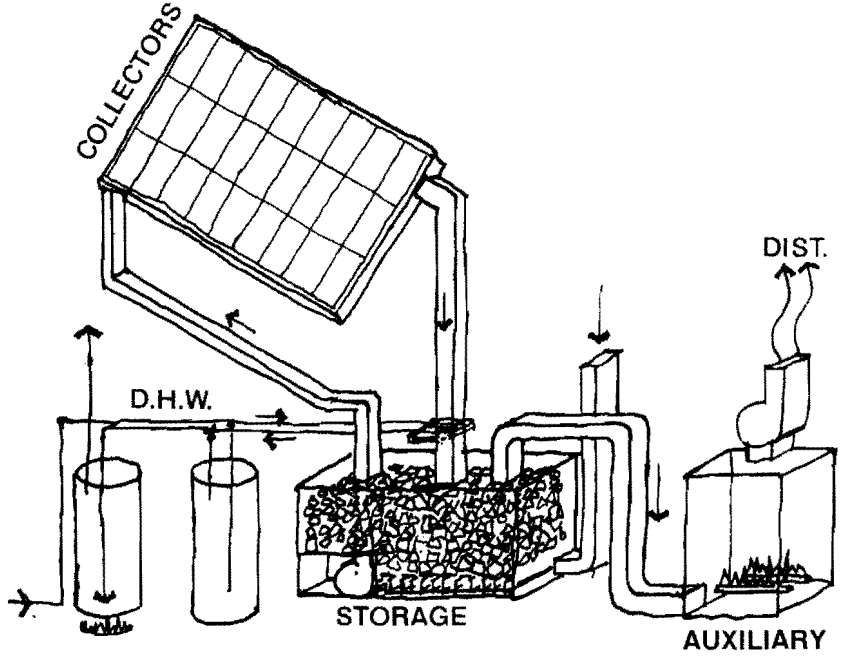
STORAGE: 600 cu. ft. of rocks are held in an insulated bin in the basement of the house, to store solar heat.

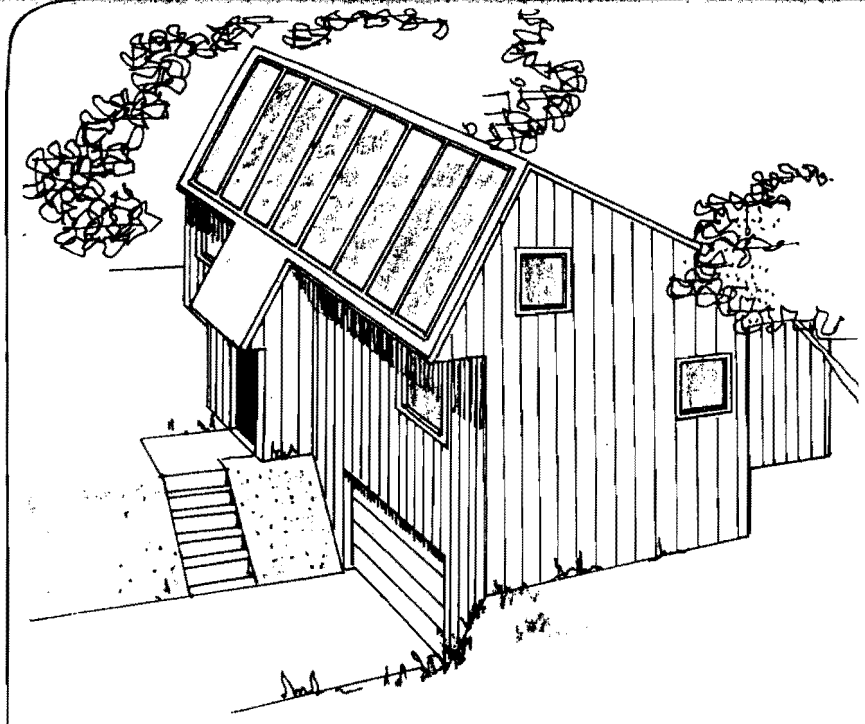
DISTRIBUTION: A fan blows hot air from storage to a hot air furnace for conventional distribution.

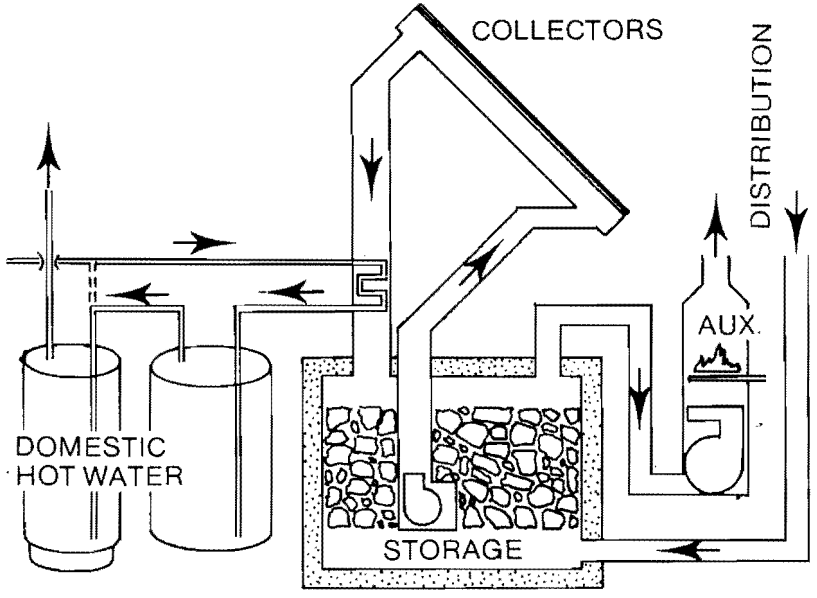
AUXILIARY ENERGY SYSTEM: An oil burner supplies auxiliary heat to the furnace.

DOMESTIC HOT WATER: Incoming cold water is preheated in a coil located in the collector storage air duct, and then stored in a 50 gallon hot water tank. On demand, solar heated water is pumped to conventional DHW tank for auxiliary heating distribution.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Family Homes United Inc.
DESIGNER: Rodney Wright, Arch.
SOLAR SUB: Bob Roltgen
LOCATION: Winneconne, WI
LATITUDE: 44°N
HOUSING TYPE: SFD, 5 Units
AREA: 1,152 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,863
DESIGN TEMP:
DESIGN TEMP: WINTER: −12° F
INDOOR: 65° F
HORIZ. INSOL. JAN. DAY: 548 BTU/sq. ft.
% SUN/YR: 55%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 5 homes, with 2 different models. The homes have been designed to integrate solar energy with energy conserving features in order to provide as self-sufficient a home as possible. Each home contains 3 bedrooms; one model has 1,224 sq. ft. of living space and the other has 1,152 sq. ft. The exposed surface area of the building and the amount of window area in each home has been minimized in order to reduce heat loss. Substantial amounts of insulation have been used: 6" in the walls, 9" under the floor and 12" in the roof. To further reduce heat loss, the windows have been triple glazed, earth berming has been used and air locks have been incorporated for the entrances.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%

COLLECTOR: Sun Stone has manufactured the flat plate air collectors used in both models. 363 sq. ft. and 296 sq. ft. of collectors have been mounted directly to the roof at a 60° tilt.

STORAGE: Air circulates directly from the collectors to 363 cu. ft. and 297 cu. ft. of rock storage located in the basement of each unit.

DISTRIBUTION: Solar heated air is drawn from the storage unit and distributed throughout the house for hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric auxiliary unit provides back up energy.

DOMESTIC HOT WATER: A heat exchange coil in the collector to storage duct preheats incoming cold water. Preheated water is stored then distributed by a second conventional electric DHW tank.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, DHW preheat.

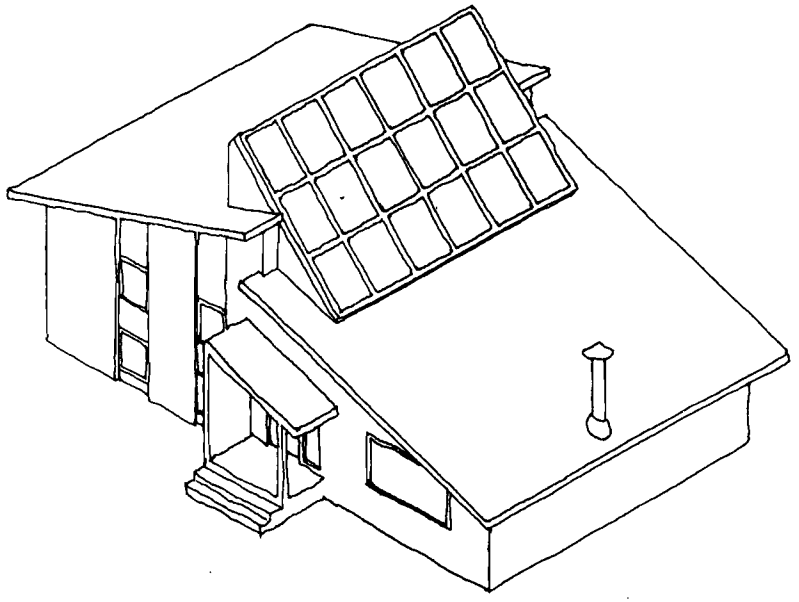
WISCONSIN 7863 DD 5 SFD NEW ACTIVE HEATING & DHW

97

98 ACTIVE HEATING & DHW 5 SFD NEW 7870 DD MONTANA

PROJECT INFORMATION:

BUILDER/APPLICANT: Northern Cheyenne Indian Housing Authority
DESIGNER: Ray O. Leland
SOLAR SUB:
LOCATION: Lame Deer, MT
LATITUDE: 43°N
HOUSING TYPE: SFD, 5 Units
AREA: 1,160 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,870
DESIGN TEMP:
DESIGN TEMP: WINTER: −10° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 451 BTU/sq. ft.
% SUN/YR: 69%



BUILDING DESCRIPTION/ENERGY CONCERNS

Each of these 5 single family, detached homes consist of 1,160 sq. ft. of living space including three bedrooms. The roof has R-30 batt insulation and the walls have R-19 batt insulation. A fireplace is designed to be an auxiliary heating system. Substantial overhangs provide shade and facilitate cooling in the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 50%

COLLECTOR: 278 sq. ft. of Solaron flat plate air collector are mounted directly onto the roof. The panels face directly south at a tilt of 55°. Air is drawn through the panels, heated, and blown to a rock storage.

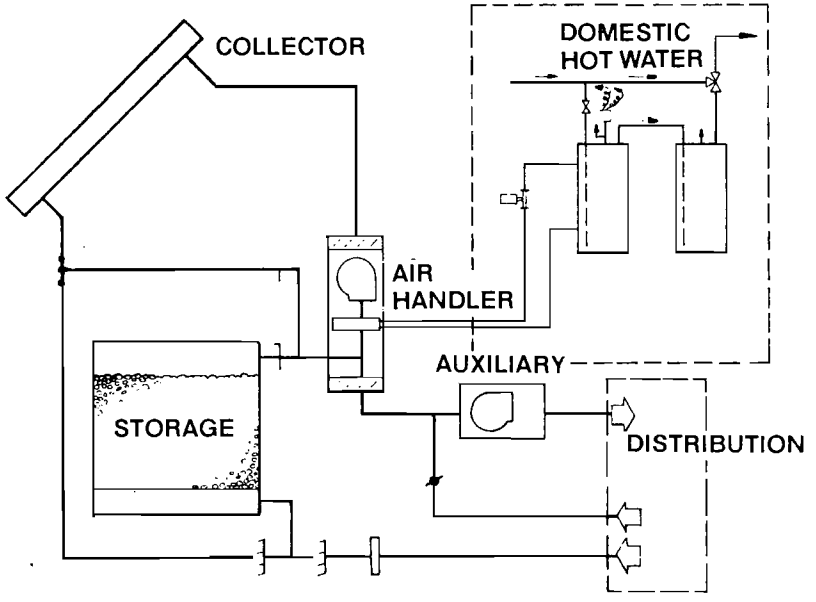
STORAGE: 139 cu. ft. of rock storage is located in a concrete bin in the basement. The bin has 3½" batt insulation.

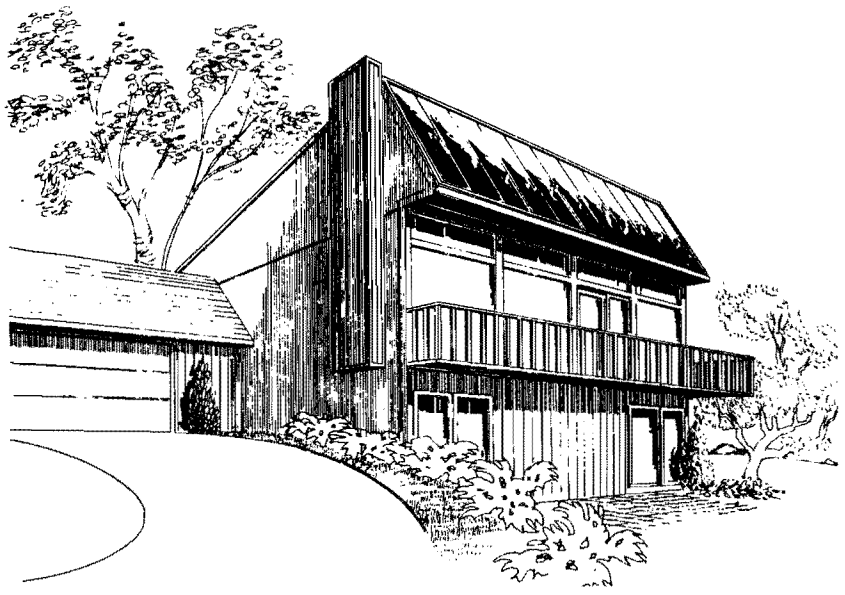
DISTRIBUTION: Heated air is blown directly from panels to living space, or air is blown through heated storage rocks to living space for forced air distribution.

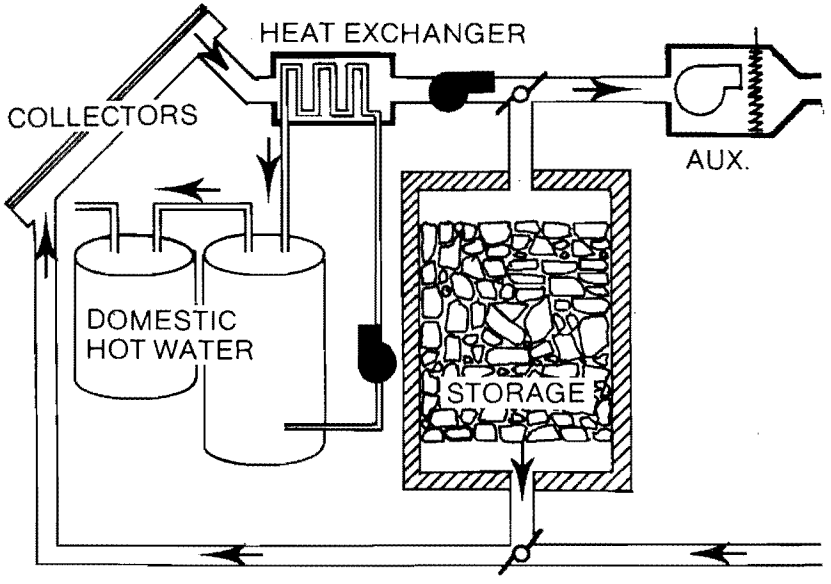
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heating.

DOMESTIC HOT WATER: Cold water is preheated in a coil type heat exchanger located in the air handler. The preheated water is stored in a tank before being pumped to a conventional DHW tank.

MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Hobmar Homes, Inc.
DESIGNER: Nell Weber & John Kopecky
SOLAR SUB: Del Strandberg
LOCATION: Minnetonka, MN
LATITUDE: 44°42'N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,100 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,944
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 622 BTU/sq. ft.
DESIGN TEMP: INDOOR: 65° F
% SUN/YR: 55%

BUILDING DESCRIPTION/ENERGY CONCERNS

There are many energy conservation techniques in this 2 bedroom, 2,100 sq. ft. house. Since cold winds are a predominant condition in Minnesota, the garage is placed to the Northwest and the roof is long and sloping to carry the north winds over the house. Earth, a natural insulator, is bermed up to the north wall. The 2" x 6" wall construction allows for heavy insulation, and the ceilings and floors have 10" of batt insulation. Most of the triple glazed windows are oriented south to take advantage of maximum passive gain, and a fan circulates the air from the warmer south rooms to the cooler north rooms. In the summer overhangs shade these southern windows.

SOLAR ENERGY SYSTEM: ACTIVE (HY)

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 71%

COLLECTOR: 330 sq. ft. of Honeywell flat plate collectors are mounted at an angle of 60° and orientation 5° East of South. Air is the heat transfer media.
STORAGE: Solar heated air is blown into a 380 cu. ft. rock storage bin located on the lower floor.
DISTRIBUTION: The distribution fan can draw solar heated air directly from the collectors or from the top of rock storage.
AUXILIARY ENERGY SYSTEM: A gas fired hot air furnace supplies auxiliary heat as necessary.
DOMESTIC HOT WATER: An air-to-water heat exchange coil in the duct between collector and storage allows cold city water to be pre-heated before being stored. Distribution and auxiliary heating is provided by a conventional DHW heater. The system has a total volume of 120 gallons.
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

99 ACTIVE HEATING & DHW 1 SFD NEW 7944 DD MINNESOTA

PROJECT INFORMATION:
BUILDER/APPLICANT: Professional Builders, Inc.
DESIGNER: T. Hoskens & J. Kosmas
SOLAR SUB: Daniel N. Hanka
LOCATION: Hutchinson, MN
LATITUDE: 45°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,024 sq. ft.
CLIMATIC DATA:
HEATING DD: 8,816
DESIGN TEMP: WINTER: 19° F
HORIZ. INSOL. JAN. DAY: 622 BTU/sq. ft.
DESIGN TEMP: INDOOR: 68° F
% SUN/YR: 56%

BUILDING DESCRIPTION/ENERGY CONCERNS

The massing and the sitting of this 3 bedroom single family detached home demonstrate strong energy conservation features. The long, low sloping roof deflects the cold winter winds over the house, and the garage and storage areas are located on the north to act as thermal buffers. Vegetation and berming on the north and west also reduce heat losses, and help cool in the summer. The building is heavily insulated (12" of batt insulation in the ceiling, 6" in the wall, along with rigid insulation on the walls below grade). The windows are triple glazed, and are shaded by overhangs in the summer. Using the cool temperature of the ground to cool the living space in summer, the house also employs high ceiling vents to induce natural ventilation and an attic fan to exhaust hot air.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: 381 sq. ft. of Solaron flat plate collectors are mounted at a 53° tilt to gather solar energy. The collectors use air to transfer solar heat to storage.

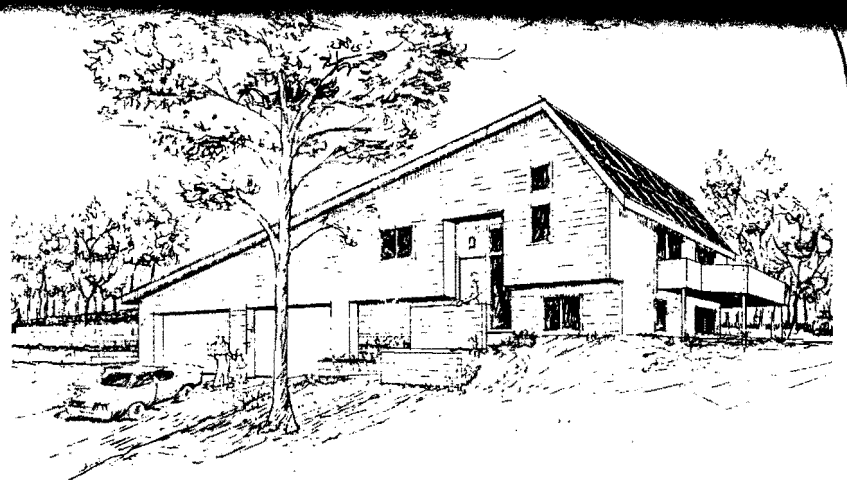
STORAGE: A rock storage bin, 760 cu. ft. in volume, is located in the first floor utility room. The bin is of wooden construction with 3½" of insulation to prevent loss of heat.

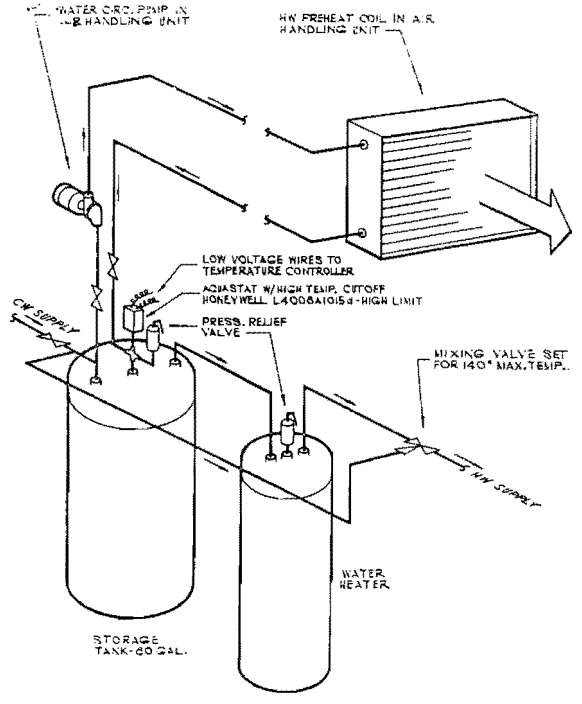
DISTRIBUTION: An air handling unit on the first floor draws hot air from the collector or from rock storage for forced air distribution to the living space.

AUXILIARY ENERGY SYSTEM: A gas furnace with a 44,000 BTU/hr. capacity acts as the auxiliary system, while a fireplace with an exposed chimney flue provides some additional heat.

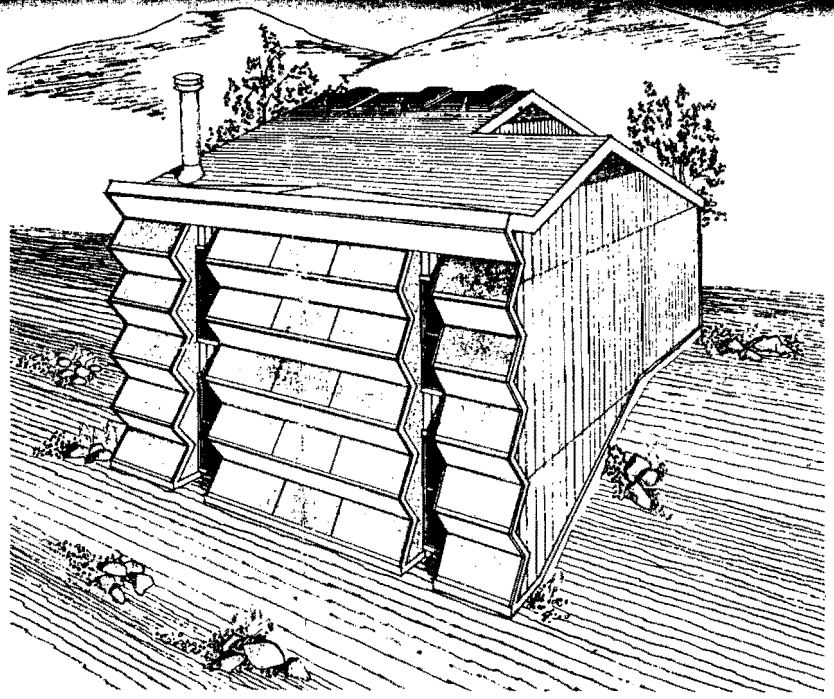
DOMESTIC HOT WATER: An air-to-water heat transfer coil in the air handling unit absorbs solar heat to preheat incoming cold water.

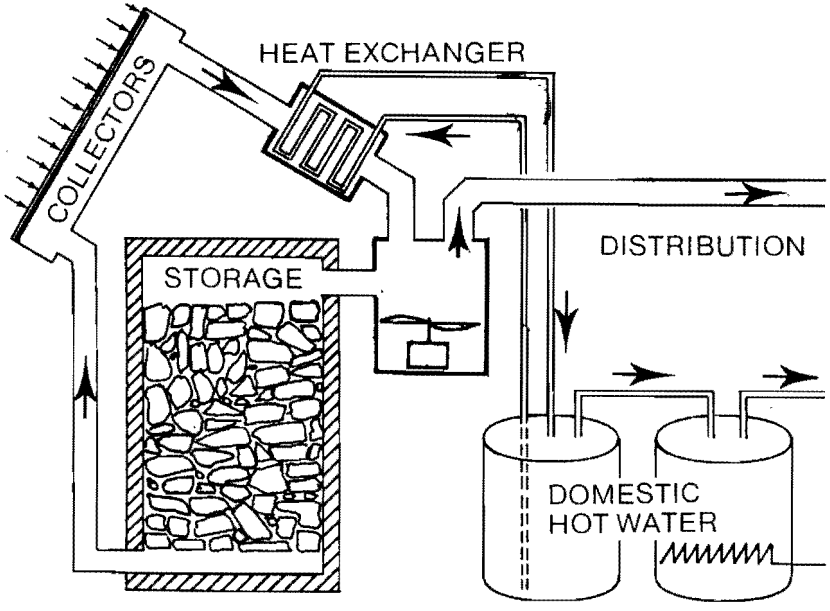
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.





FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6





PROJECT INFORMATION
BUILDER/APPLICANT: Grand County Fuel & Supply Co.
DESIGNER: Daniel W. Dixon
SOLAR SUB: Jerry Bickle
LOCATION: Granby, CO — **LATITUDE:** 40°N
HOUSING TYPE: SFD, 1 Unit — **AREA:** 1,000 sq. ft.
CLIMATIC DATA:
HEATING DD: 10,800 — DESIGN TEMP:
DESIGN TEMP: WINTER: −40° F — INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 484 BTU/sq. ft. — % SUN/YR: 43%

BUILDING DESCRIPTION/ENERGY CONCERNS

This 2 bedroom, 1,000 sq. ft. home has many features which conserve energy in a cold climate. The garage is located on the north, providing a buffer from the cold winter winds, and an airlock entry prevents the infiltration of cold air. The walls are constructed to minimize heat losses, with double 2x4 construction which eliminates "thermal bridges." The walls and ceilings are insulated to a value of R-30. Window surfaces are small and have 2 double-pane sashes, resulting in 4 thicknesses of glass. High vents recirculate warm air from the ceilings of the rooms back to the floor, increasing the effectiveness of the system. These same high vents can induce ventilation to cool the space in the summer.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 79%

COLLECTOR: 224 sq. ft. of Rocky Mountain Products collectors are mounted on the south-facing facade of the house at an angle of 55°. Reflectors are used to increase the incident radiation on the surface of the collectors, providing a collection surface of 224 sq. ft. Air circulates through the collectors to an air handling unit, then into the living space or into rock storage.
STORAGE: 180 cu. ft. of rocks are contained in a bin in the basement to store the collected heat.
DISTRIBUTION: The central air handler draws hot air from the collector or from the storage bin for hot air distribution.
AUXILIARY ENERGY SYSTEM: Electric baseboard units supply auxiliary heat.
DOMESTIC HOT WATER: An air-to-water heat exchange coil is located in the duct between the collector and the air handler. Water flows from an 80 gallon preheat tank through this coil for DHW preheat. On demand, the preheated water is distributed through a 40 gallon conventional DHW heater.
MODES OF OPERATION: Collector to house, collector to storage, storage to house (all via air handler), auxiliary to house, DHW preheat.

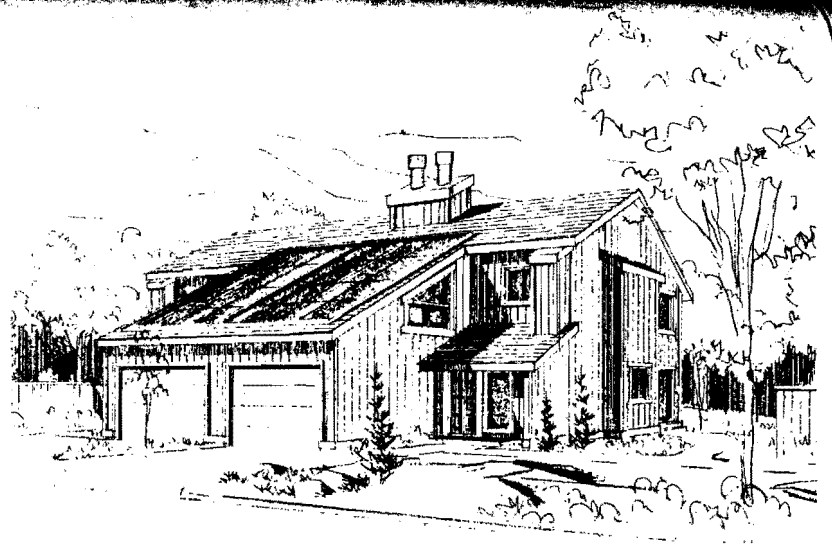
ACTIVE HEATING & DHW — 1 SFD NEW — 10,800 DD — COLORADO

101

ACTIVE HEATING & DHW 20 SFD & 8 SFA NEW 10926 DD COLORADO

102

PROJECT INFORMATION:
BUILDER/APPLICANT: JMC Co. & Charles Schiffer Assoc.
DESIGNER: Downing & Leach Associates
SOLAR SUB: Charles Schiffer Associates
LOCATION: Silverthorne, CO **LATITUDE:** 39°30'N
HOUSING TYPE: SFD, 20 Units; SFA, 8 Units **AREA:** 990-1,487 sq. ft./unit
CLIMATIC DATA:
HEATING: 10,926 DESIGN TEMP:
DESIGN TEMP: WINTER: −25° F INDOOR: 68° F
HORIZ. INSOL. JAN. DAY: 784 BTU/sq. ft. % SUN/YR: 67%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 4 duplex buildings and 20 single family detached units. Floor areas range from 990 sq. ft. per unit to 1,487 sq. ft. There are 2 and 3 bedroom units involved. In each unit, the roof has 12" of blown insulation and the walls have 6" of batt insulation. The floors are also insulated, resulting in a thermally sealed building.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49%

COLLECTOR: Solaron flat plate air collectors are built into the roof of each unit. 2 bedroom units use 273 sq. ft. and 3 bedrooms use 312 sq. ft. of collector area. They face 9° East of South at a tilt of 23°. Air is drawn through the collectors and blown to the living space or to rock storage by a central air handler.

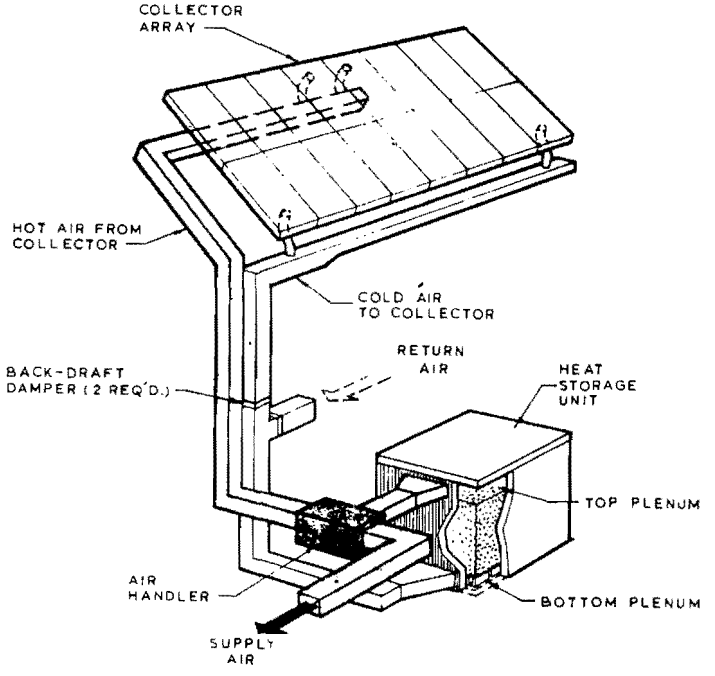
STORAGE: 122 cu. ft. of rock storage is located in a concrete bin in the basement. The bin has 2" of rigid insulation.

DISTRIBUTION: Air is blown from the solar heated rocks or directly from the collectors to the living space for forced air distribution.

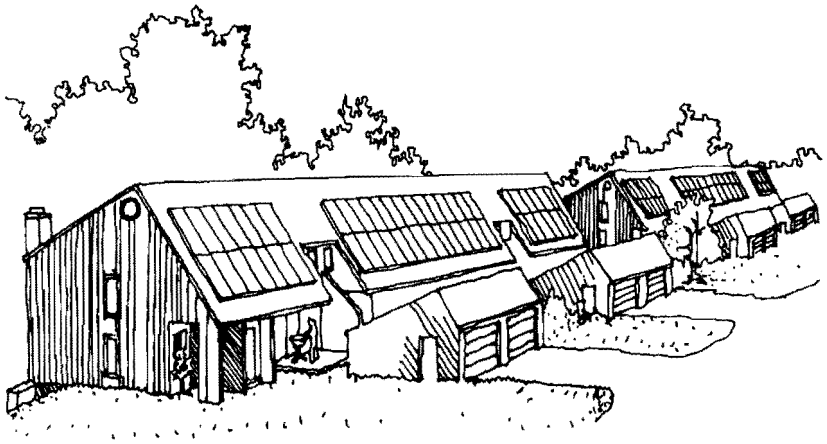
AUXILIARY ENERGY SYSTEMS: Electric heat pumps provide auxiliary energy.

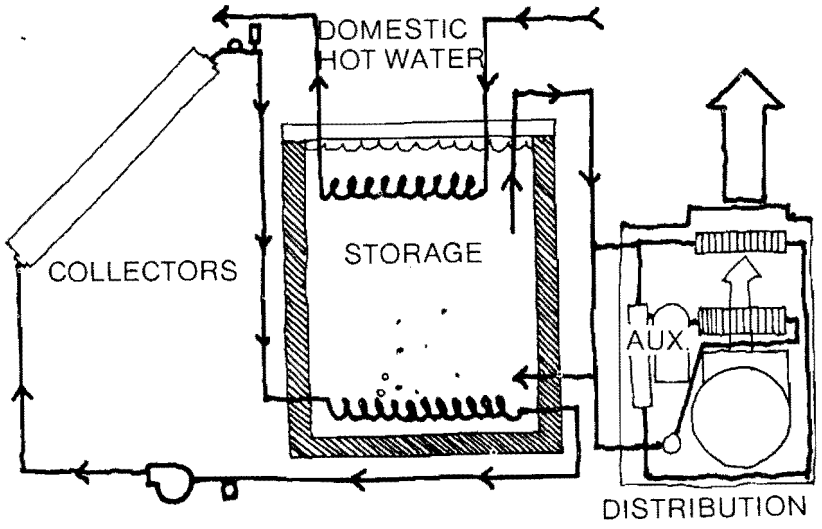
DOMESTIC HOT WATER: Cold water is preheated in a coil in the air handling unit before going to a conventional hot water heater for distribution.

MODES OF OPERATION: Collector to house, collector to storage to auxiliary to house, auxiliary to house, DHW preheat.



FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6





PROJECT INFORMATION:
BUILDER/APPLICANT: Trica Corporation
DESIGNER: Ronald L. Camp
SOLAR SUB: Solar Design Associates
LOCATION: Newburgh, IN
LATITUDE: 38°N
HOUSING TYPE: SFA, 8 Units
AREA: 2,080 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,435
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 533 BTU/sq. ft.
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

These single family garden apartments are grouped with 4 units per building. Each unit has 2,080 sq. ft. of living space in 3 levels. Window area has been minimized. Party walls eliminate unwanted east and west exposures.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: 262 sq. ft. of collector surface is mounted directly onto the roof facing due south at a tilt of 53°. There are 56 Sunworks flat plate liquid collectors on each building. Antifreeze is pumped through the collectors, as the heat transfer medium, and then circulated through a heat exchanger.

STORAGE: A 1,074 gallon water storage tank is insulated with 2" rigid insulation to provide solar storage.

DISTRIBUTION: Solar heated water, from storage, is pumped to a water-to-air heat exchanger in the hot air distribution system.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy.

DOMESTIC HOT WATER: City cold water circulates through a heat exchange coil in the hot water storage tank, and is preheated on its way to a conventional DHW heater.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.

MARYLAND 4654 DD 15 SFA NEW ACTIVE HEATING & DHW

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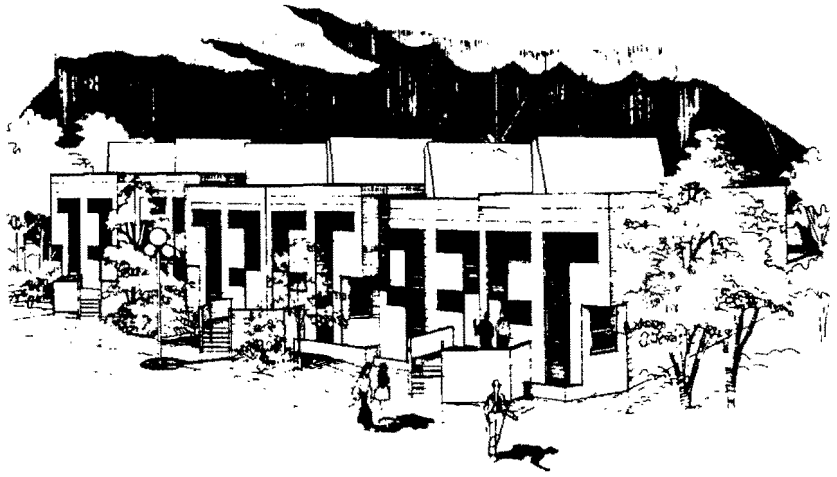
PROJECT INFORMATION:
BUILDER/APPLICANT: Centennial Dev. & Bldg. Corp.
DESIGNER: Clarence Jackson, Arch.
SOLAR SUB: Applied Solar Technology
LOCATION: Baltimore, MD
HOUSING TYPE: SFA, 15 Units
CLIMATIC DATA:
HEATING DD: 4,654
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 585 BTU/sq. ft.

LATITUDE: 48°N
AREA: 1,624 sq. ft.
1,728 sq. ft.
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 38%



BUILDING DESCRIPTION/ENERGY CONCERNS

Fifteen townhouses, with 8 three bedroom units (1,624 sq. ft.) and 7 four bedroom units (1,728 sq. ft.), are included in this project. Heat loss from the building has been minimized through the use of party walls, berms and generous insulation. The designers have attempted to reduce costs by standardizing the solar equipment used. Therefore, all houses have an identical solar system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 39%

COLLECTORS: Each house has an array of Revere collectors. These panels, which circulate water as a transfer media, are mounted at a 45° tilt. A copper absorption plate, with a selective surface is used for solar collection. The drain down method provides freeze prevention for the system.

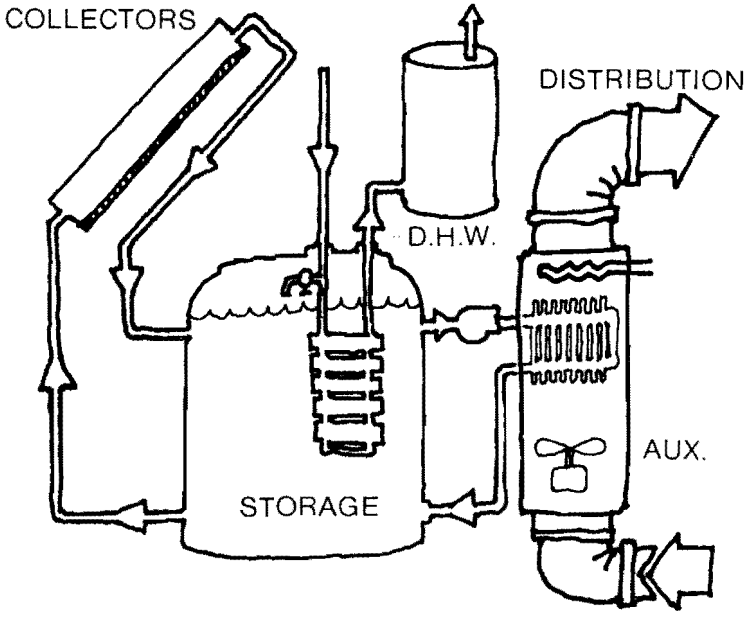
STORAGE: A 500 gallon water storage tank is contained within each townhouse. The tank is protected against heat loss by 8" of insulation.

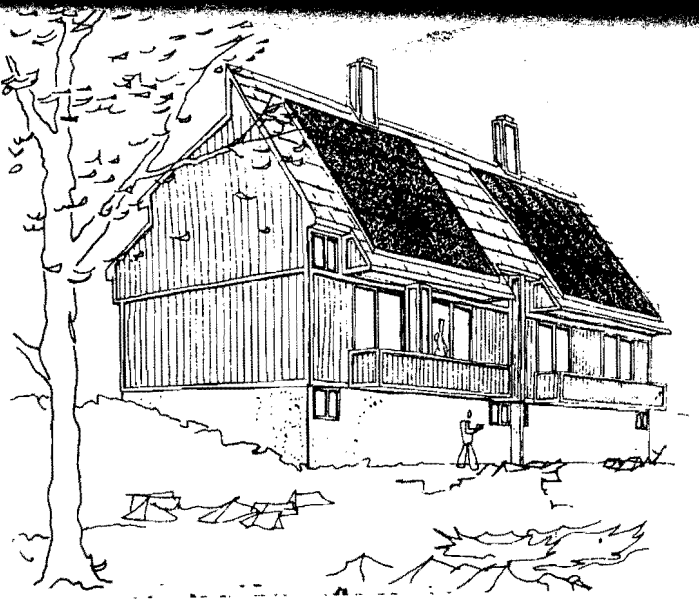
DISTRIBUTION: A water to air heat exchange coil, contained within the supply ductwork, is used to heat the air for hot air distribution to the house.

AUXILIARY ENERGY SYSTEM: An electric heat pump is included in the system as an auxiliary heat generator.

DOMESTIC HOT WATER: City water is pumped through a heat exchanger, which is contained in the main solar storage tank, and then to the conventional DHW tank for auxiliary heating.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.





SOLAR SUB: A. C. Rose Co.
LOCATION: Lexington, KY
HOUSING TYPE: SFA, 2 Units
CLIMATIC DATA:
HEATING DD: 4,683
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 636 BTU/sq. ft.

LATITUDE: 38°N
AREA: 1,980 sq. ft.

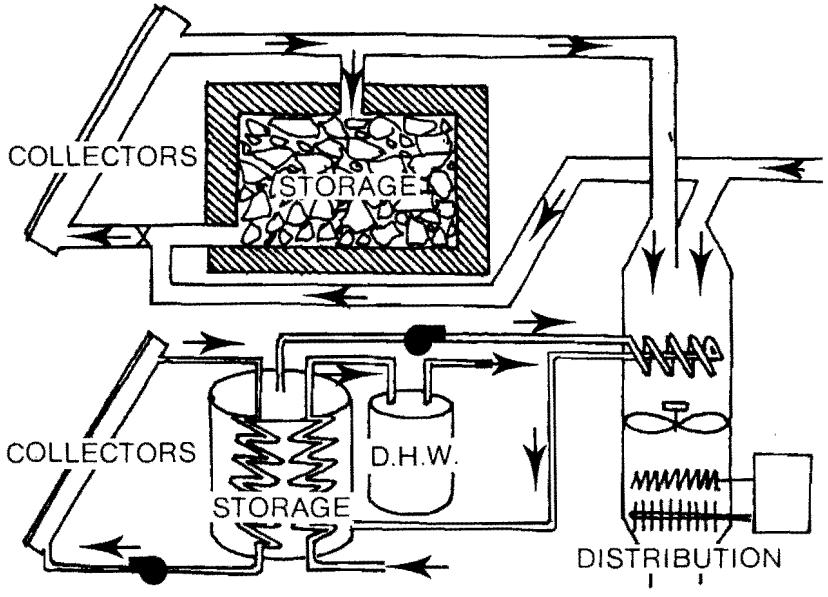
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 72%

BUILDING DESCRIPTION/ENERGY CONCERNS

These two new single family attached units have been designed to incorporate a solar heating system and a separate solar domestic hot water system. Energy conserving features include windowless or shared east and west walls. Overhangs protect south facing windows from the high summer sun. Berming on the north protects much of that building surface from winter heat loss due to winds.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating, DHW (separate systems)
PREDICTED SOLAR CONTRIBUTION: 73%



COLLECTORS: 351 sq. ft. of Solaron flat plate air collectors are mounted directly onto the roof facing 6° East of South at a tilt of 45°.
STORAGE: 175 cu. ft. of shared rock storage is located in a concrete bin, insulated with 3½" of batt insulation.
DISTRIBUTION: Air is blown directly from the collectors or through rock storage for forced hot air distribution to both houses.
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary energy as necessary.
DOMESTIC HOT WATER: 373 sq. ft. of separate Solar Development solar panels, mounted in the same manner as the Solaron panels, provide for domestic hot water.*
MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.

*Preheating. Glycerol acts as the heat collection medium and transfers heat via a heat exchanger to a 150 gallon water storage tank with 3" of rigid insulation. Cold city water is preheated in a coil in this storage tank and taken to a conventional DHW tank for distribution. The heated storage water may also be supplied to a water to air heat exchanger in the hot air distribution system for an auxiliary boast.

KENTUCKY 4683 DD 2 SFA NEW ACTIVE HEATING & DHW

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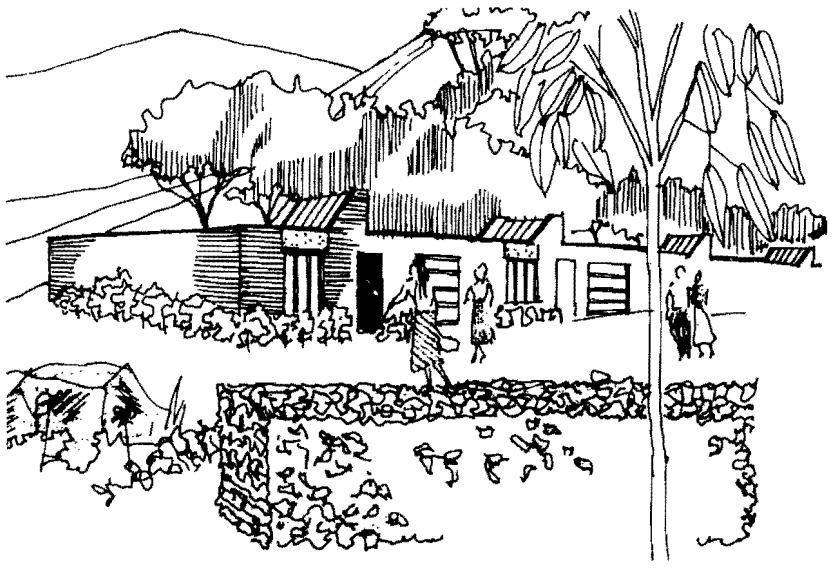
ACTIVE HEATING & DHW 5 SFA NEW 5630 DD MASSACHUSETTS

106

PROJECT INFORMATION:
BUILDER/APPLICANT: Laura L. Baker
DESIGNER: J. Paley & S. Strong
SOLAR SUB: Edward White
LOCATION: Falmouth, MA
HOUSING TYPE: SFA, 5 Units
CLIMATIC DATA:
HEATING DD: 5,630
DESIGN TEMP: WINTER: 1° F
HORIZ. INSOL. JAN. DAY: 518 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,592 sq. ft./unit

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

Each of these five single family attached units contains 2 bedrooms and 1,592 sq. ft. of floor area. The designer's use of a party wall system aids energy conservation as it reduces the total amount of exposed surface area. Planting to the south has been minimized, in order to avoid shading of the collectors while it has been maximized to the east and west in order to provide shading.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%

COLLECTOR: The Daystar flat-plate liquid collectors have been stand-off mounted on metal channels. Contained in a closed loop, a non-toxic antifreeze transfers heat from the collector to a main water storage tank.

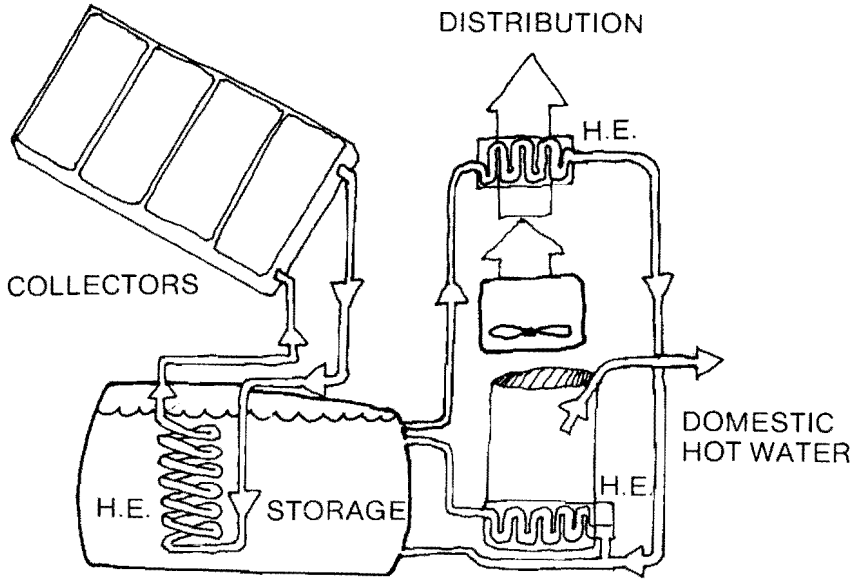
STORAGE: The storage tank which has a 500 gallon capacity, is constructed of steel and insulated with 3" of urethane foam.

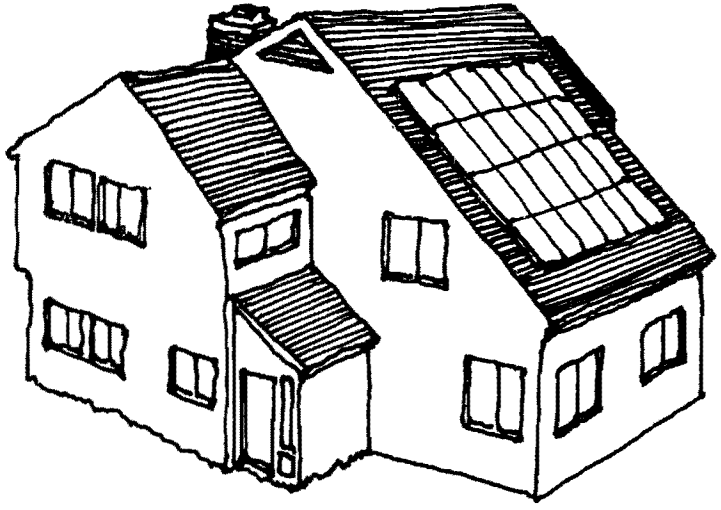
DISTRIBUTION: The solar heated water is pumped from storage to a heat exchanger in the air handler unit for hot air distribution.

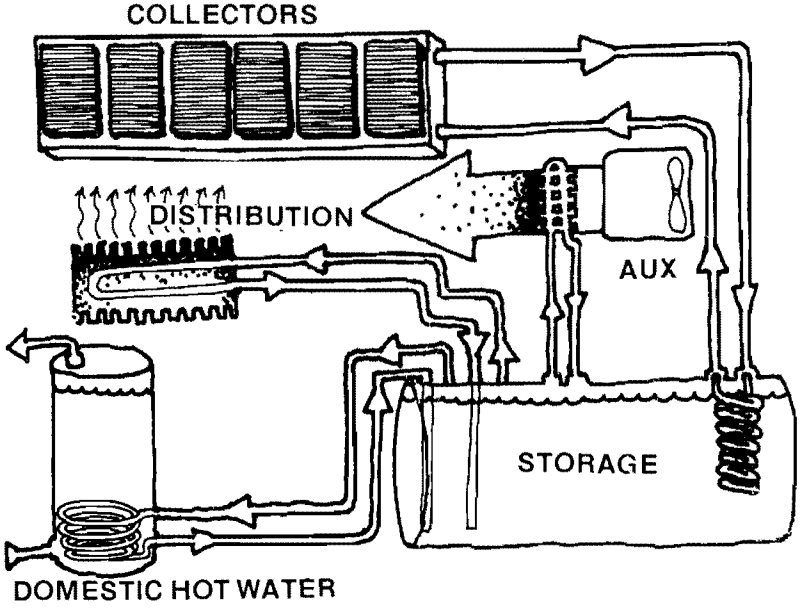
AUXILIARY ENERGY SYSTEM: A gas-fired furnace is coupled with the air handler to provide auxiliary heating.

DOMESTIC HOT WATER: A copper coil containing heated water from the main storage tank travels through the bottom of the DHW tank to preheat the water. This 80 gallon domestic hot water tank is also the conventional heater with an electric resistance coil providing auxiliary heat as necessary.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, storage to auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Corcoran Mullins Jennison Inc.
DESIGNER: Kenneth Demay
SOLAR SUB: Clifton C. Smith
LOCATION: Brewster, MA
HOUSING TYPE: SFA, 2 Units
CLIMATIC DATA:
HEATING DD: 5,630
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 477 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,556 sq. ft./unit

DESIGN TEMP:
INDOOR: 65° F
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

These new duplex units have 1,556 sq. ft. of living space each. They are well-sealed to prevent heat loss. The foundation walls have 1" rigid insulation; the walls employ a rigid foam sheathing system in addition to 6" of batt insulation. The ceilings have 12" of batt insulation. The sliding glass doors are double-glazed and the windows are triple-glazed.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49%

COLLECTOR: The 37° sloped south-facing roof of the duplex unit supports 420 sq. ft. (210 for each unit) of Daystar flat-plate collectors. A 60% antifreeze/40% water solution transfers heat from the collectors to storage, via a heat exchanger immersed in the storage tank.

STORAGE: The 500 gallon water storage tank is located underground. It is insulated with rigid foam to a value of R-11.

DISTRIBUTION: Two methods of heat distribution are used. For the first floor, heated storage water is pumped through pipes embedded in the floor slab, radiating heat to the living space. For the second floor spaces, a water coil in the supply air duct transfers heat from water storage to a hot air distribution system.

AUXILIARY ENERGY SYSTEM: Electricity supplies the heat for the forced hot air auxiliary system.

DOMESTIC HOT WATER: Heated water from storage passes through a heat exchanger in the bottom of the conventional DHW heater, providing a DHW preheat.

MODES OF OPERATION: Collector to storage, storage to space, auxiliary to space, DHW preheat.

ACTIVE HEATING & DHW 2 SFA NEW 5630 DD MASSACHUSETTS

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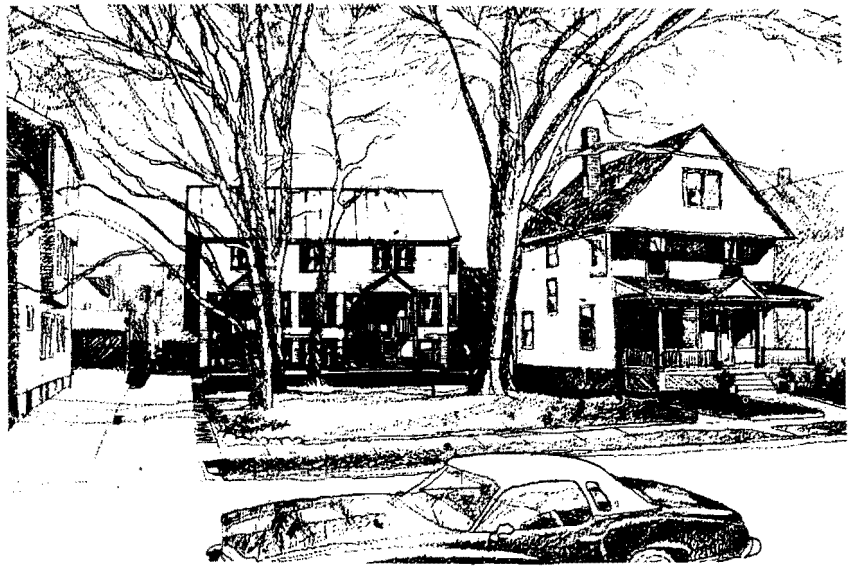
PROJECT INFORMATION:

BUILDER/APPLICANT: Frank Chapman
DESIGNER: F. Chapman & H. Phillips
SOLAR SUB: Solar Energy Structures
LOCATION: New Haven, CT
LATITUDE: 41°N
HOUSING TYPE: SFA, 5 Units
AREA: 1,000 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,897
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 392 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 50%



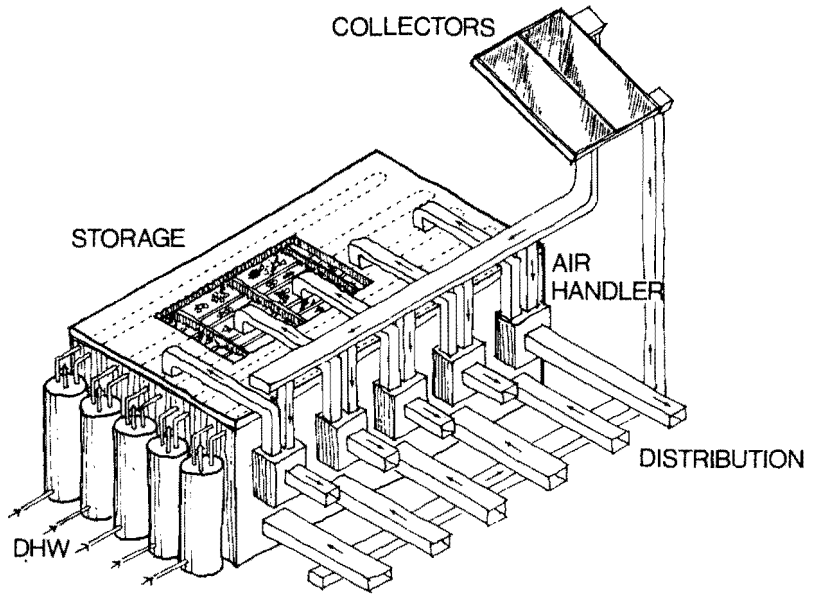
BUILDING DESCRIPTION/ENERGY CONCERNS

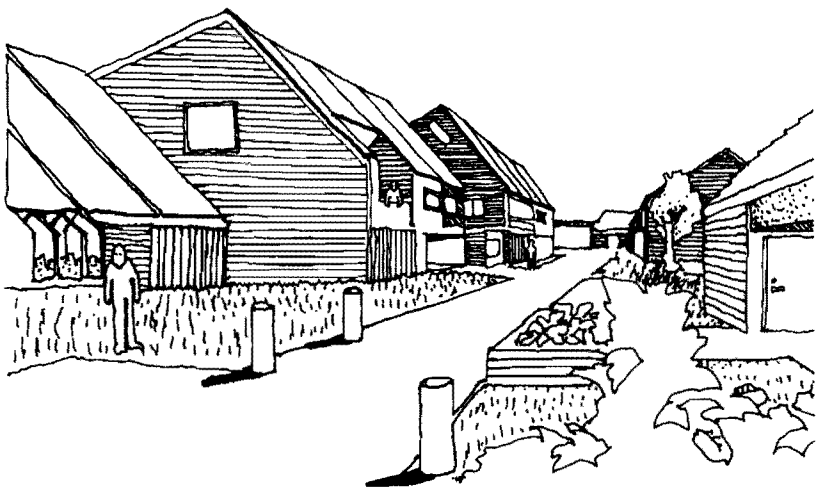
This project involves a new 5-unit building in a single-family neighborhood. The upper 2 floors house 4 apartment units of 1,000 sq. ft. each, and the lower floor consists of 1 efficiency unit and the heat storage area. The hemlock hedge along the north side of the site provides a wind break, reducing convective losses from winter winds. Window areas are minimal on the north, and all windows are triple-glazed. The walls are heavily insulated with 6½" of batt insulation, while the roof has 12" of batt insulation.

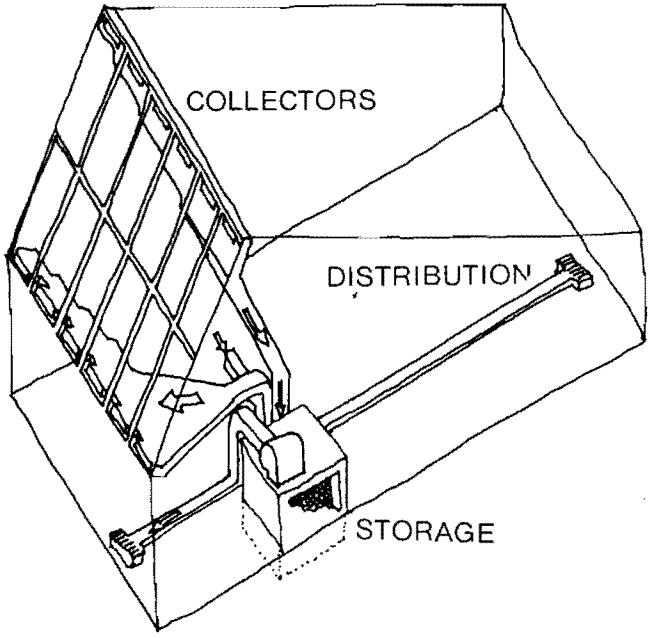
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 73%

COLLECTOR: These flat plate air collectors, which serve as the roof surface, were site built and cover 1,070 sq. ft. The tilt of the roof is 57°. Blown by an air handling unit, cool air enters the bottom of the collector and is heated.
STORAGE: A large compartmentalized rock storage bin is located on the ground floor, serving as solar storage for all 5 units. The volume of the bin is 2,000 cu. ft.
DISTRIBUTION: An air handling unit draws the solar heated air from the collectors to solar storage or directly into the living space.
AUXILIARY ENERGY SYSTEM: An electric boiler provides heated water for hydronic baseboard heating.
DOMESTIC HOT WATER: Incoming city water passes through a coil in rock storage, to preheat the water before it enters the five conventional 80 gallon water heaters.
MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Friends Community Development
DESIGNER: H. Morse Payne
SOLAR SUB: Solaron
LOCATION: North Easton, MA
LATITUDE: 40°N
HOUSING TYPE: SFA, 69 Units
AREA: 720-1,700 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 6,367
DESIGN TEMP:
DESIGN TEMP: WINTER: 0° F
INDOOR:
HORIZ. INSOL. JAN. DAY: 588 BTU/sq. ft.
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

A total of 69 units of elderly housing use solar energy to supply heat and domestic hot water in this project. The townhouse-type apartment units vary from 1 bedroom to 4 bedrooms, and from 720 sq. ft. in area to 1,700 sq. ft. The walls are insulated with 6" of batt insulation, and the townhouse design exposes less wall area to the exterior environment. The north face of the buildings have small glass areas to minimize heat loss. The entry, recessed for protection is on the south, as are the living spaces. Each unit has an independent solar system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 55-66%

COLLECTOR: Each unit uses Solaron flat-plate air collectors, mounted at a 57° angle on the roof, and facing due south. The collector-area-per-unit figures are as follows: 1 bedroom—117 sq. ft.; 2 bedrooms—146 sq. ft.; 3 bedrooms—234 sq. ft.; 4 bedrooms—273 sq. ft.

STORAGE: A rock storage bin stores the heated air after it passes through the collector. Each unit has its own insulated bin, sized according to a proportion of 1 cu. ft. per 1 sq. ft. of collector.

DISTRIBUTION: The Solaron air handling unit draws heated air from storage, for auxiliary heating if necessary before fan distribution to the house.

AUXILIARY ENERGY SYSTEM: The 1 and 2 bedroom units use electric fan coil units for auxiliary heat, while the 3 and 4 bedroom units use electric furnaces.

DOMESTIC HOT WATER: A coil in the air duct between collector and storage picks up enough heat to preheat water for the DHW system. This preheated water is stored in a preheat tank located next to the conventional water heater.

MODES OF OPERATION: (via air handler) Collector to storage, collector to house, auxiliary to house, storage to auxiliary to house; DHW preheat.

ACTIVE HEATING & DHW 69 SFA NEW 6367 DD MASSACHUSETTS

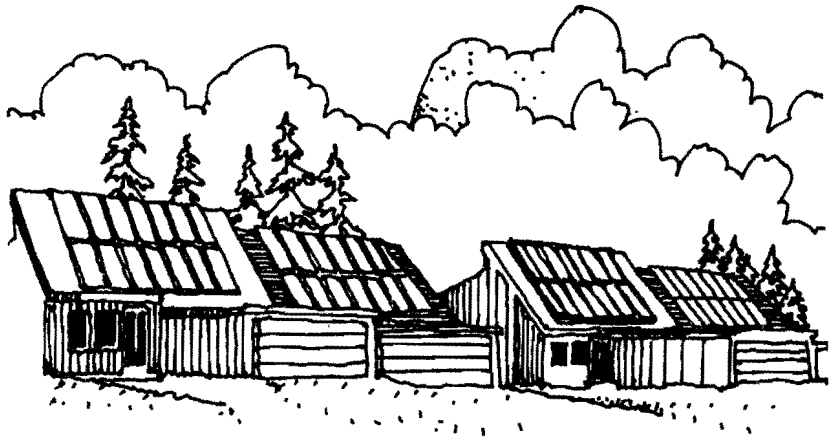
109

ACTIVE HEATING & DHW 9 SFA NEW 6483 DD SOUTH DAKOTA

110

PROJECT INFORMATION:

BUILDER/APPLICANT: Harney Lumber Company
DESIGNER: Marshall Mickley
SOLAR SUB: Whitaker & Mattson, Inc.
LOCATION: Rapid City, SD
LATITUDE: 44°N
HOUSING TYPE: SFA, 9 Units
AREA: 1,600 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,483
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 677 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 70%



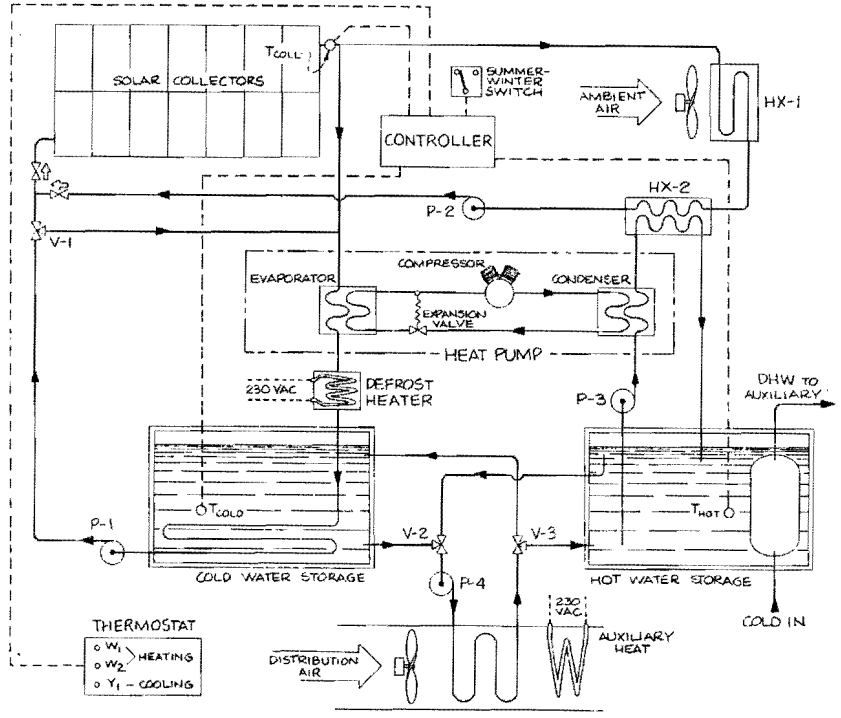
BUILDING DESCRIPTION/ENERGY CONCERNS

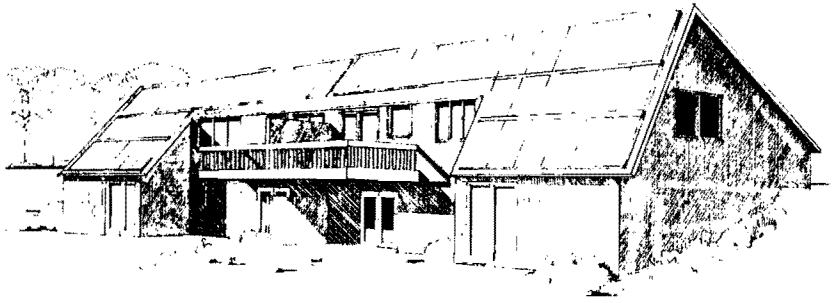
These 9 two-level single family attached homes have 1,600 sq. ft. of living space each including 2 bedrooms. Minimized window area and party wall reduce the amount of exposed wall areas to prevent heat exchange. Outer walls have 3½" of batt insulation and there is 1½" rigid perimeter insulation. The roof has 12" of batt insulation. There are clerestory vent windows in the roof for natural ventilation.

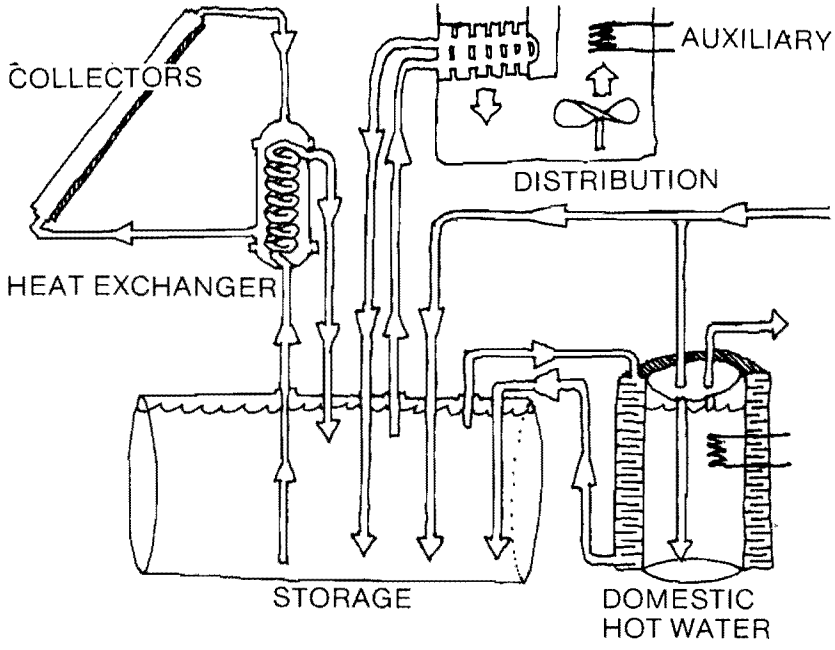
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: 287 sq. ft. of Miromit Ashkelon flat plate liquid collectors are mounted directly to the roof, facing 16°31' west of south at a 50° tilt. To prevent freezing, antifreeze is circulated through the panels, heated, and pumped through two heat exchangers, transferring heat gain directly to hot air distribution and then to solar storage.
STORAGE: 1,800 gallons of hot water storage is located in an epoxy lined concrete tank with 6" of batt insulation. A separate cold water storage is also in use for heat pump cold water production.
DISTRIBUTION: Solar heated water is drawn separately from solar storage through water to air coil for hot air distribution. In summer, with the heat pump in operation, cold storage water can be supplied to this coil for cold air distribution.
AUXILIARY ENERGY SYSTEM: The electric heat pump which can boost storage water temperature and provide chilled water acts as auxiliary when necessary.
DOMESTIC HOT WATER: Incoming cold water is preheated in a preheat tank located in hot water storage before going to the conventional DHW heater for distribution.
MODES OF OPERATION: Collector to house, collector to storage, storage to house, auxiliary to storage to house, DHW preheat.







PROJECT INFORMATION:
BUILDER/APPLICANT: Quadro, Inc.
DESIGNER: Garry D. Harley, AIA
SOLAR SUB: Ionic Solar
LOCATION: Plattsmouth, NE
HOUSING TYPE: SFA, 6 Units
CLIMATIC DATA:
HEATING DD: 6,612
DESIGN TEMP: WINTER: −1° F
HORIZ. INSOL. JAN. DAY: 703 BTU/sq. ft.

LATITUDE: 42°N
AREA: 1,140 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 64° F

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 3 duplex buildings and each of the units has 1,140 sq. ft. of living space, including 2 bedrooms, per unit. Walls have 6" batt insulation, roof has 10" batt insulation. A heat stack vent on the roof pulls warm air from the house. Floor level vents replace this air with cooler outside air. A fireplace with glass doors provides radiant auxiliary heating. An airlock foyer reduces heat loss by preventing escape of inside air.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 70%

COLLECTOR: 507.5 sq. ft. of collector surface consisting of Miromit flat plate liquid panels is mounted directly to the roof of each unit. The panels face due south at a tilt of 60°. A liquid solution of water and glycol is pumped through the panels, heated, and forced through a heat exchanger. Here the heat is transferred to water pumped from the storage tank.
STORAGE: A 548 gallon glass lined steel tank is located in the basement. The tank has 3" batt insulation to prevent heat loss.
DISTRIBUTION: Heated water from storage is pumped through heat exchange coils in the heating ducts for forced air distribution.
AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heating.
DOMESTIC HOT WATER: Heated water from storage is pumped to heat an exchange jacket around the DHW preheat tank. Heat is transferred through the walls of the tank preheating the DHW system.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

IOWA

6612 DD

8 SFA NEW

ACTIVE HEATING & DHW

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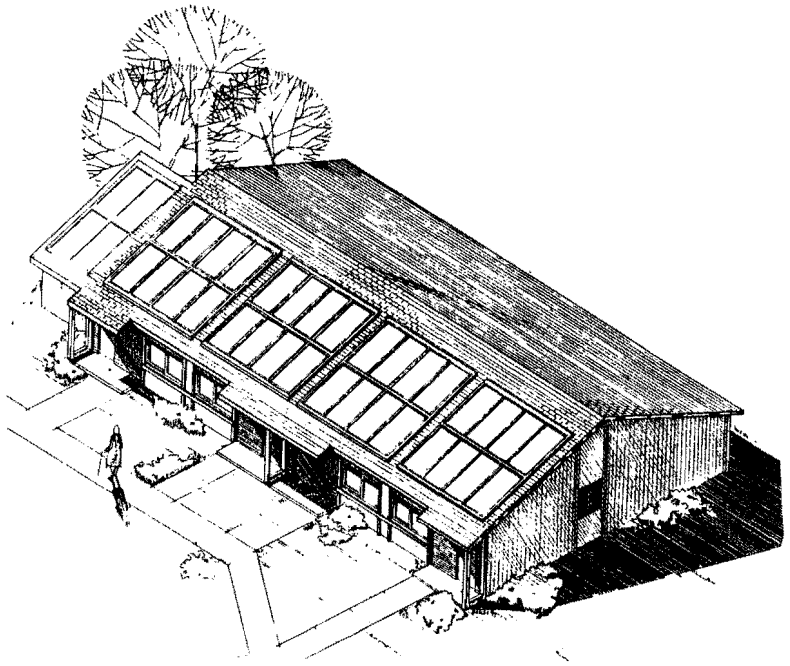
PROJECT INFORMATION:
BUILDER/APPLICANT: Glenwood Housing, Inc.
DESIGNER: John Tewhill, AIA
SOLAR SUB: Ionic Solar
LOCATION: Glenwood, IA
LATITUDE: 42°
HOUSING TYPE: SFA, 8 Units
AREA: 580 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,612
DESIGN TEMP: WINTER: −1° F
HORIZ. INSOL. JAN. DAY: 644 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 64%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 8 single family attached homes in two building complexes located in rural Iowa. Each unit has 1 bedroom and 580 sq. ft. of floor area. Heavy insulation is used in the ceiling (10"-12") and in the walls. The foundation is also insulated with 2" of rigid insulation.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: A total of 1,380 sq. ft. of Miromit flat plate collectors are integrated into the roof at a 26° tilt. An antifreeze and water liquid flows through the collectors to a central heat exchanger, where heat is transferred from the collector fluid to storage water.

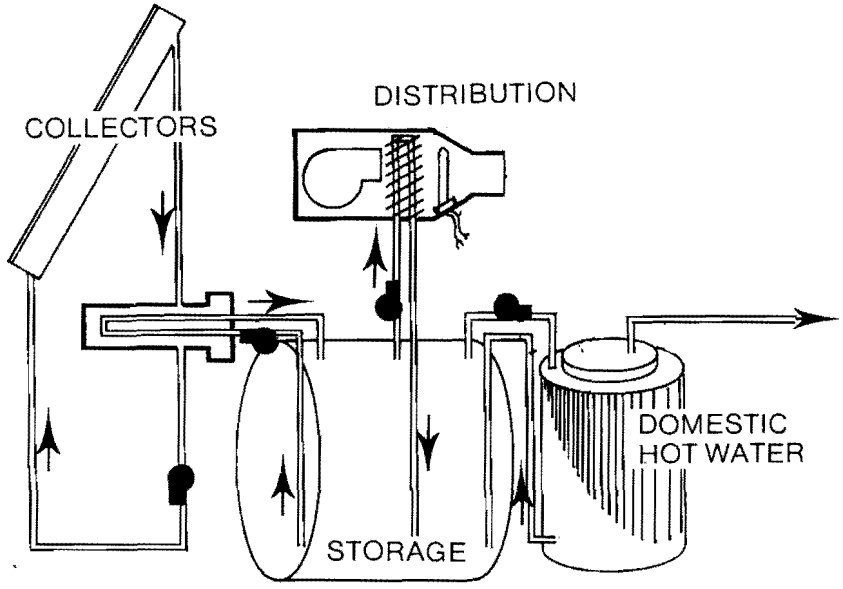
STORAGE: Solar heated water is stored in 1,500 gallon insulated tanks, located in the equipment room attached to each building.

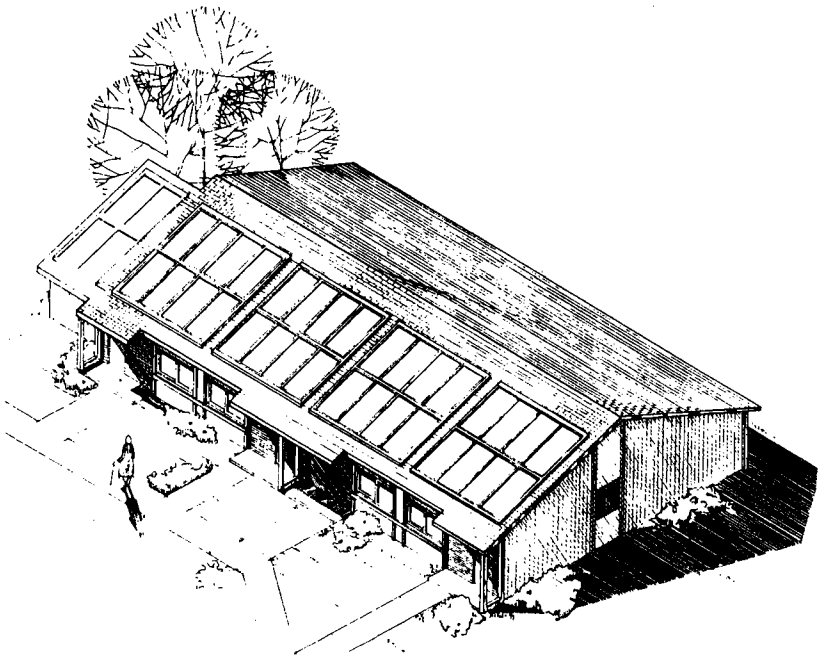
DISTRIBUTION: Solar heated water is pumped through a water-to-air heat exchange coil in the hot air distribution system of each unit.

AUXILIARY ENERGY SYSTEM: An electric furnace provides auxiliary heat and distribution.

DOMESTIC HOT WATER: The 82-gallon water tanks in each unit are surrounded by a jacket heat exchanger. Water is pumped from solar storage through this jacket to pre-heat DHW, so less electrical energy is needed to raise the water to domestic hot water demand temperature.

MODES OF OPERATION: Collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.



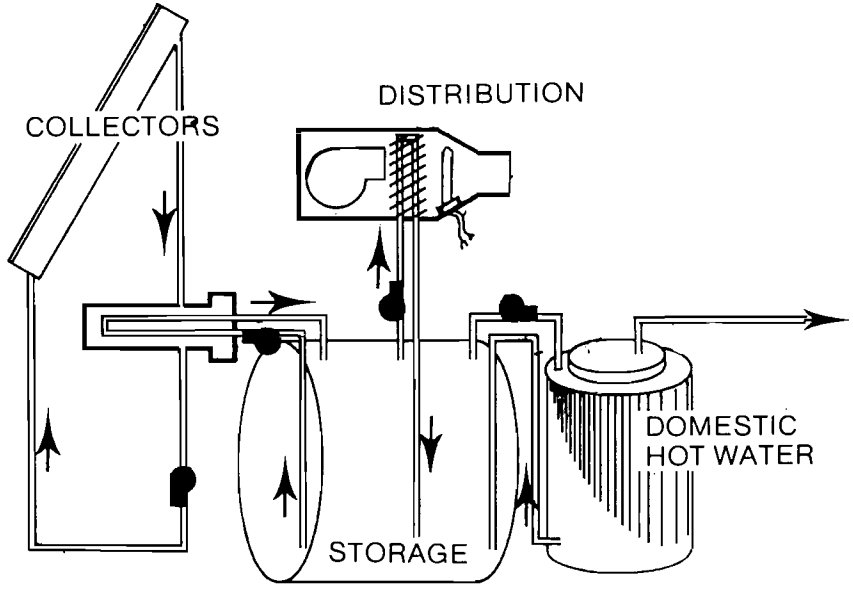


PROJECT INFORMATION:

BUILDER/APPLICANT: Callaway Housing Corp.
DESIGNER: John Tewhill, AIA
SOLAR SUB: Ionic Solar
LOCATION: Callaway, NE
LATITUDE: 42°N
HOUSING TYPE: SFA, 8 Units
AREA: 580 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,673
DESIGN TEMP: WINTER: −1° F
HORIZ. INSOL. JAN. DAY: 694 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 64%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project, consisting of 2 buildings of 4 identical one-bedroom attached homes, similar to those in the preceding project, has 580 sq. ft. of living space including a kitchen and a living room. Walls are insulated with 4" of batt insulation and ¾" rigid siding. The roof has 12" of blown insulation. Floors have 2" rigid perimeter insulation. Substantial overhang facilitates cooling.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: 690 sq. ft. of collector surface consisting of 36 Micromit flat plate liquid panels are mounted directly to the roof of each of the 2 buildings. The collectors face due south at a tilt of 26°30'.

STORAGE: 1,500 gallons of heated water is stored in a glass lined steel tank. The tank has 3" of batt insulation.

DISTRIBUTION: Heated water from storage goes through coils in the heating duct to provide forced air heating.

AUXILIARY ENERGY SYSTEM: Electric heaters provide auxiliary heating.

DOMESTIC HOT WATER: Solar heated water from storage is pumped to a heat exchange jacket which surrounds the DHW tank. Heat is transferred through the walls of the tank, preheating the water before it is conventionally heated.

MODES OF OPERATION: Collector to storage, storage to building, auxiliary to building, DHW preheat.

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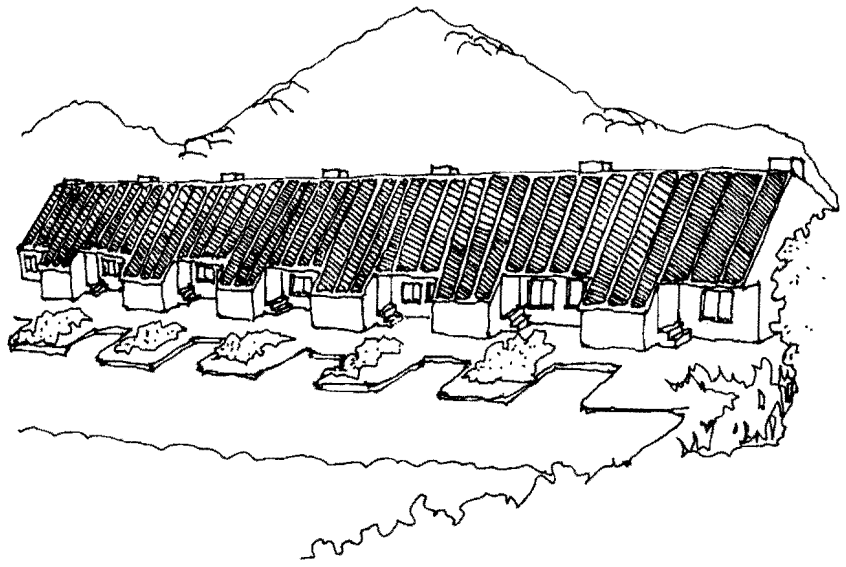
PROJECT INFORMATION:

BUILDER/APPLICANT: Forest Park Village, Inc.
DESIGNER: Steven Strong
SOLAR SUB: Kearsarge Building Co.
LOCATION: North Conway, NH
HOUSING TYPE: SFA, 12 Units
CLIMATIC DATA:
HEATING DD: 7,360
DESIGN TEMP: WINTER: −18° F
HORIZ. INSOL. JAN. DAY: 433 BTU/sq. ft.

LATITUDE: 44°N
AREA: 684 sq. ft./unit

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 50%



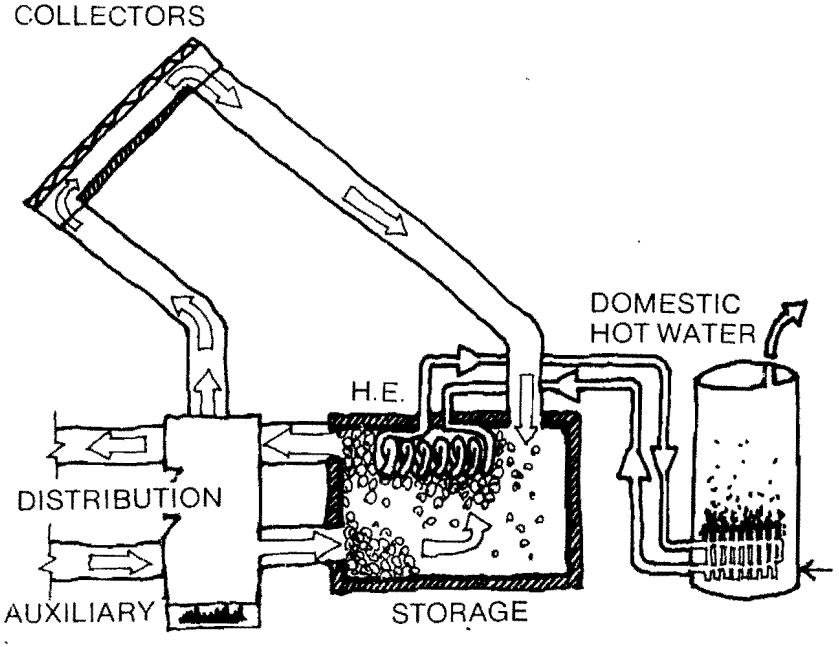
BUILDING DESCRIPTION/ENERGY CONCERNS

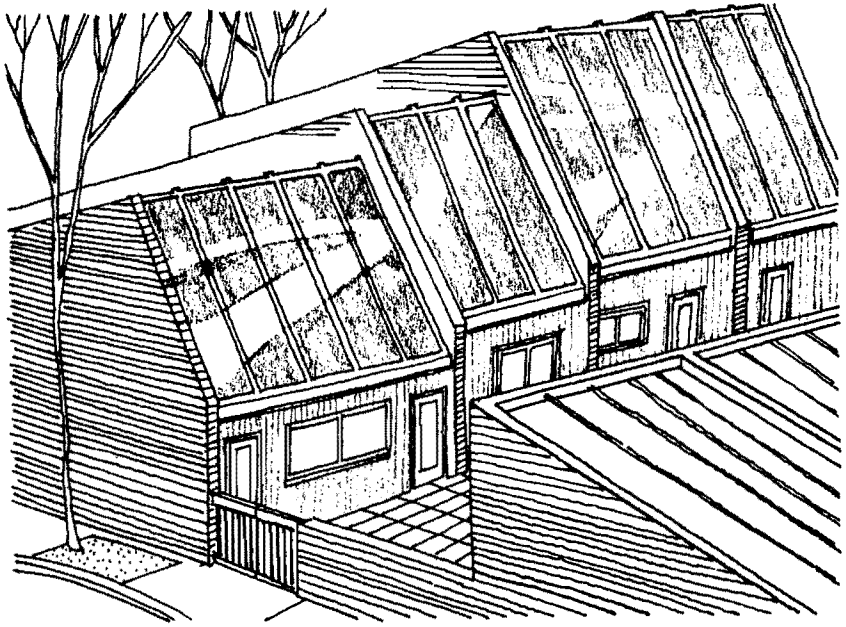
This project involves 12 attached units of housing for the elderly, of 684 sq. ft. each. The long axis of the building is oriented east-west for maximum southern exposure, and the south-facing walls and windows are shaded by overhangs. The walls have 6" of batt insulation, and the ceilings have 12" of batt insulation. The window area has been reduced to minimize heat loss. The entry and vestibule are on the south side of the building as protection from the cold winter winds and excessive heat loss.

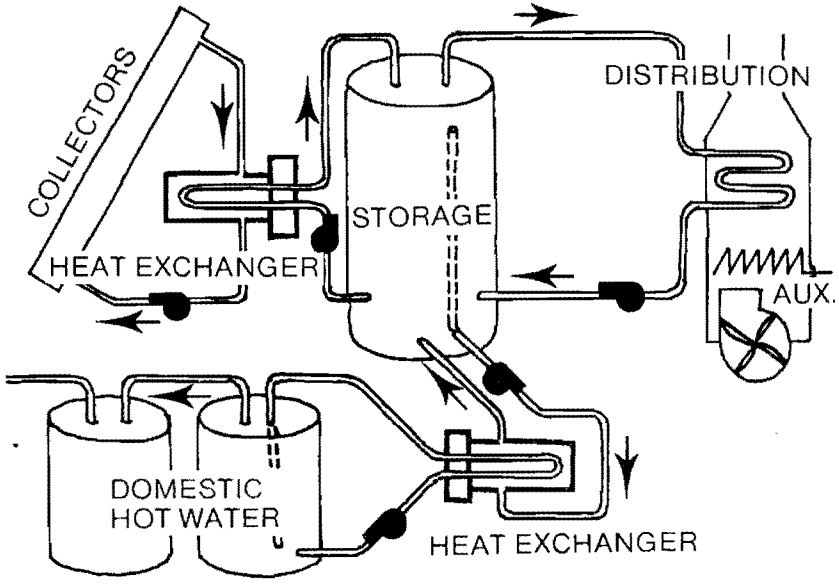
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 86%

COLLECTOR: 3,650 sq. ft. of site-built collectors (304 sq. ft. per unit) are integrally mounted to the 60° sloping south-facing roofs of the building. The collectors are flat-plate and use air to transfer the collected heat.
STORAGE: Heated air is transported to rock storage bins of 1,184 cu. ft. in size. The bins are located in the basement of every unit, and insulated with 2" of urethane and 6" of glass fiber.
DISTRIBUTION: A fan blows warm air from rock storage to the living spaces.
AUXILIARY ENERGY SYSTEM: A gas-fired furnace with a capacity of 50,000 BTU/hr. provides auxiliary energy.
DOMESTIC HOT WATER: An aluminum, fan coil is located at the top of the rock bin and transfers heat from storage to the bottom of the conventional DHW tank, for DHW preheat.
MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, storage to auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Blackfeet Indian Tribe
DESIGNER: John H. Meyer
SOLAR SUB:
LOCATION: Cut Bank, MT
LATITUDE: 48°N
HOUSING TYPE: SFA, 10 Units
AREA: 645 sq. ft.
CLIMATIC DATA:
HEATING DD: 7,650
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 518 BTU/sq. ft.
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 67%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project consists of ten townhouse units with 645 sq. ft. of living space and one bedroom per unit. Heat losses are reduced by the use of party walls with smaller surface area exposed to the exterior and the reduction of window surface area. To further reduce heat demand an air lock entry is used.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 67%

COLLECTOR: 1,500 sq. ft. of collector surface is mounted directly to the roof of the complex. The collectors are Miromit Flat plate water panels and face directly south at a tilt of 63°. Water is pumped through the collectors, where it is heated. It is then pumped to a heat exchanger and transfers collected heat to storage water. When freeze prevention is necessary, a thermostat activates a pump which forces hot water through the collectors.

STORAGE: A 3,000 gallon water storage tank stores the water after it picks up heat in the heat exchanger. The tank is insulated with 2" of batt insulation.

DISTRIBUTION: Heated water from storage is pumped to water to air heat exchange coils in heating ducts for forced air distribution.

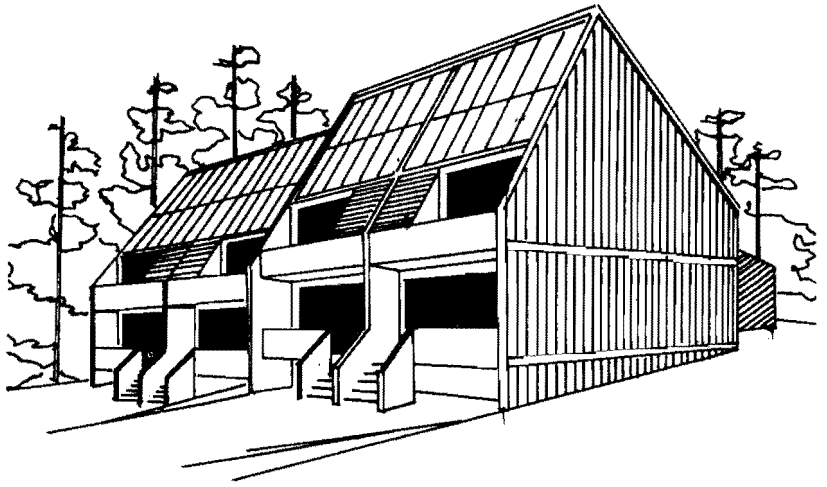
AUXILIARY ENERGY SYSTEM: Gas fired heaters provide auxiliary energy.

DOMESTIC HOT WATER: Water from storage heats cold water in a heat exchange which is forced to a DHW preheat tank.

MODES OF OPERATION: Collector to storage, storage to building, auxiliary to building, DHW preheat.

PROJECT INFORMATION:

BUILDER/APPLICANT: Environmental Contact, Inc.
DESIGNER: Steve Randall, Arch.
SOLAR SUB: Tessier Sheet Metal Works
LOCATION: Sioux Falls, SD
LATITUDE: 43°
HOUSING TYPE: SFA, 4 Units
AREA: 1,200 sq. ft.
CLIMATIC DATA:
HEATING DD: 8,115
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 677 BTU/sq. ft.
DESIGN TEMP:
INDOOR: 70° F
% SUN/YR:



BUILDING DESCRIPTION/ENERGY CONCERNS

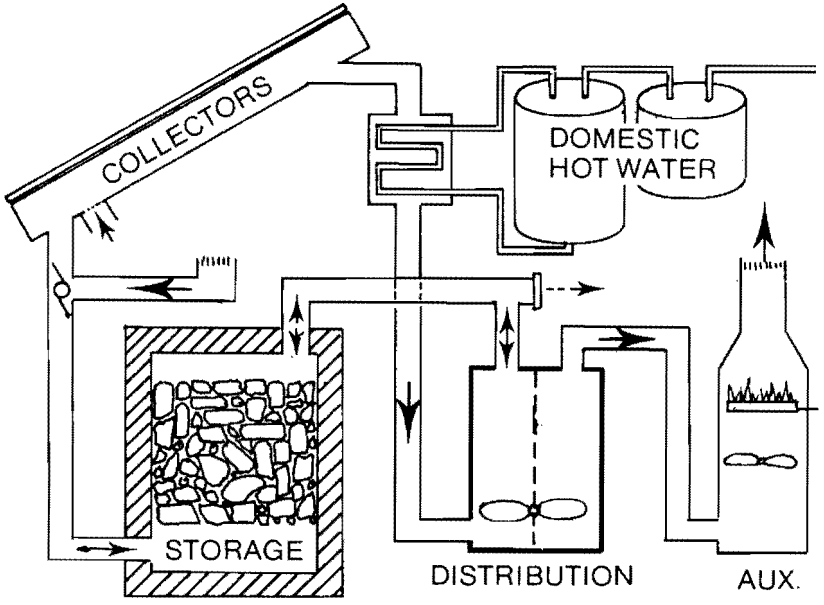
This project includes 4 single family attached units. Each unit is two stories with a full basement. The plan is compact and accommodates 3 bedrooms in 1,200 sq. ft. of space. To maximize energy conserving features, an entry vestibule serves as an air lock. Large, south facing windows maximize winter heat gain, while minimal windows and garages to the north minimize heat loss. All exposed walls are well insulated, and evergreen trees are planted to the north to guard against harsh north winds.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 64%

COLLECTORS: A total of 936 sq. ft. of flat plate air collectors, manufactured by the National Energy Corporation, are directly mounted to the south face of the unit roofs at a 45° tilt. A central air handler transfers solar heat gain to rock storage or directly to the living space.
STORAGE: 468 cu. ft. of rock storage, protected against heat loss by 2" of insulation, provides for solar heat storage.
DISTRIBUTION: Air from the collectors circulates through an air handling unit either to rock storage or directly to the house for hot air distribution.
AUXILIARY SYSTEM: A gas fired, conventional furnace generates auxiliary heat.
DOMESTIC HOT WATER: A coil, located in the collector-to-storage air duct preheats incoming cold water for DHW supply.*
MODES OF OPERATION: Collector to house, collector to storage, storage to auxiliary to house, DHW preheat.

*In the summer, the collector circuit is still in operation; drawing warm attic air through the collectors, preheating DHW supply, then exhausting the collector air to the outside for DHW preheat only.



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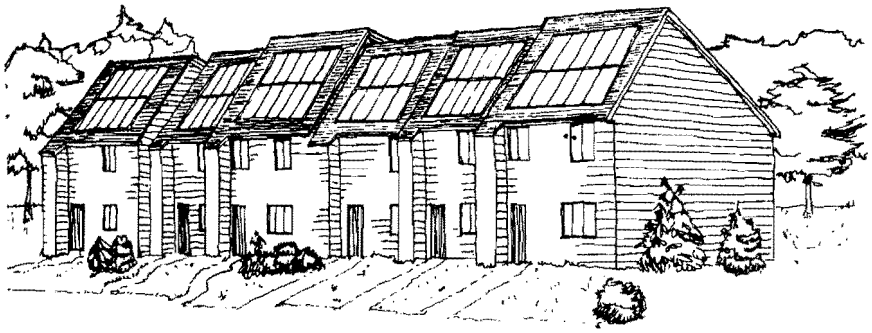
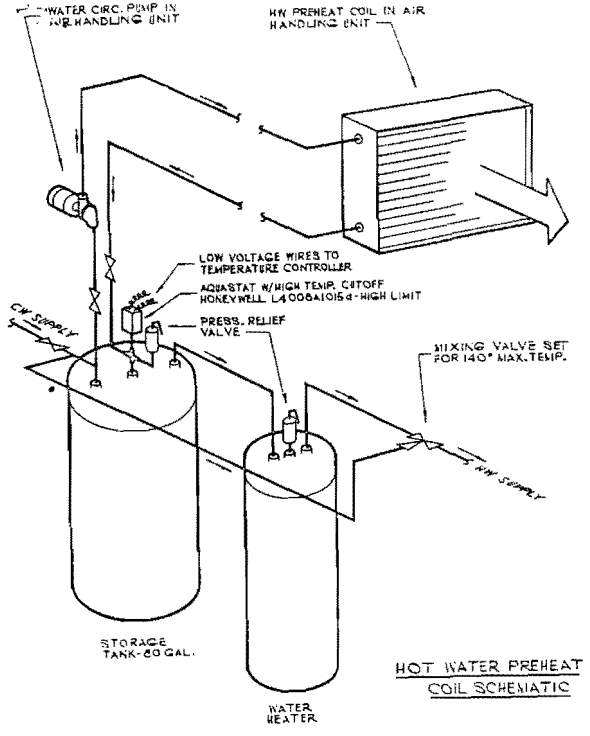




HOT WATER PREHEAT COIL SCHEMATIC

FOR TYPICAL SOLARON HEATING DIAGRAM SEE PROJECT NUMBER 6

PROJECT INFORMATION:
BUILDER/APPLICANT: Liberty Estates Developers
DESIGNER: Gary Johnson
SOLAR SUB: Liberty Estates
LOCATION: Grand Forks, ND
HOUSING TYPE: SFA, 12 Units
CLIMATIC DATA:
HEATING DD: 8,865
DESIGN TEMP: WINTER: −15° F
HORIZ. INSOL. JAN. DAY: 677 BTU/sq. ft.

LATITUDE: 46°48'N
AREA: 864-1,280 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 59%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves 12 single family attached homes. Of the 3 models: Models A and B have 2 bedrooms and 864 sq. ft. and 1,080 sq. ft. of living space respectively; Model C has 3 bedrooms and 1,280 sq. ft. of living space. Each unit has a fireplace to provide supplementary heating. Shared east and west party walls minimize losses.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 54% average

COLLECTOR: 174 sq. ft. and 208 sq. ft. of Solaron flat plate collectors are mounted directly to the roof of each unit. The panels face due south at a tilt of 47°. Air is drawn through the panels, heated, and blown to rock storage.

STORAGE: 94 and 140 cu. ft. of rock storage is located in the basement. The wood storage box is insulated with 3½" of batt insulation.

DISTRIBUTION: Solar heated air is drawn from rock storage and into the living space, by the air handling unit for forced hot air distribution.

AUXILIARY ENERGY SYSTEM: An electric heat pump provides auxiliary heating.

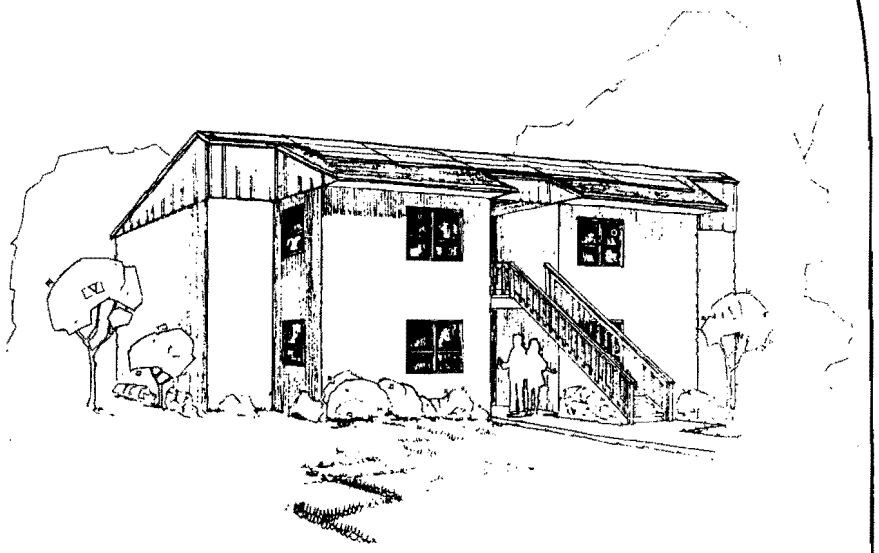
DOMESTIC HOT WATER: Incoming cold water enters a heat exchange coil located in the collector to storage duct, where it is preheated before going to water storage and the conventional DHW heater.

MODES OF OPERATION: Collector to house (via air handler), collector to storage, storage to auxiliary to house, auxiliary to house, DHW preheat.

PROJECT INFORMATION:
BUILDER/APPLICANT: Matt D. Cannon
DESIGNER: R. A. McKellips, Arch.
SOLAR SUB: Apollo Solar Services
LOCATION: Gainesville, FL
HOUSING TYPE: MF Low, 8 Units
CLIMATIC DATA:
HEATING DD: 1,599
DESIGN TEMP: WINTER: 30° F
HORIZ. INSOL. JAN. DAY: 988 BTU/sq. ft.

LATITUDE: 29°N
AREA: 605 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 54%



BUILDING DESCRIPTION/ENERGY CONCERNS

Two buildings in this project, containing 4 one bedroom apartments each, have been designed to include a heating & domestic hot water solar system. To demonstrate an awareness of conservation measures, overhangs and reduced window area help to prevent unwanted heat gain. Additional windows to the north have been placed in order to assist natural ventilation.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 85%

COLLECTOR: 540 sq. ft. of Gulf Thermal liquid flat plate collectors have been used in this project. These collectors, which use water as the heat transfer medium, have been mounted on the roof at a 45° tilt. A drain down system prevents freezing.

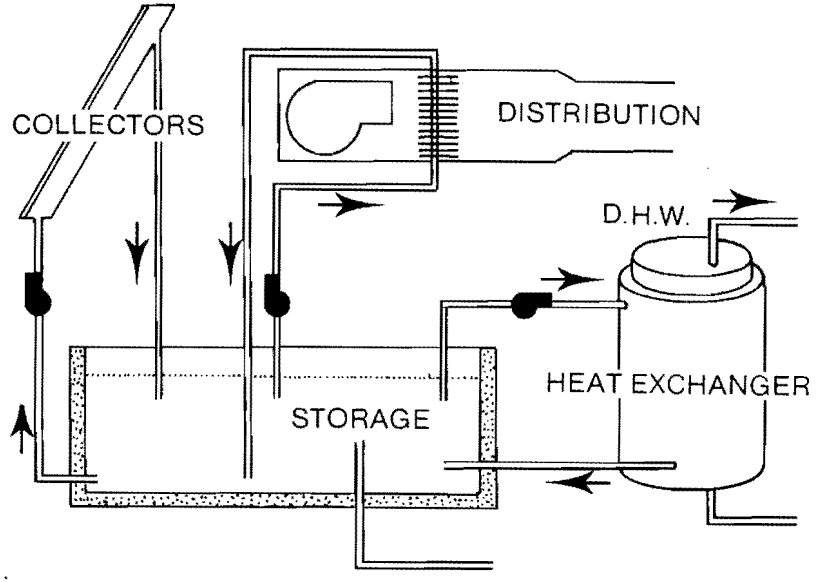
STORAGE: A steel tank, containing 1,000 gallons of water, provides for heat storage. The tank is sheathed in 4" of batt insulation. City water is pumped to this tank and then through the collectors. Once heated it is returned to the top of storage.

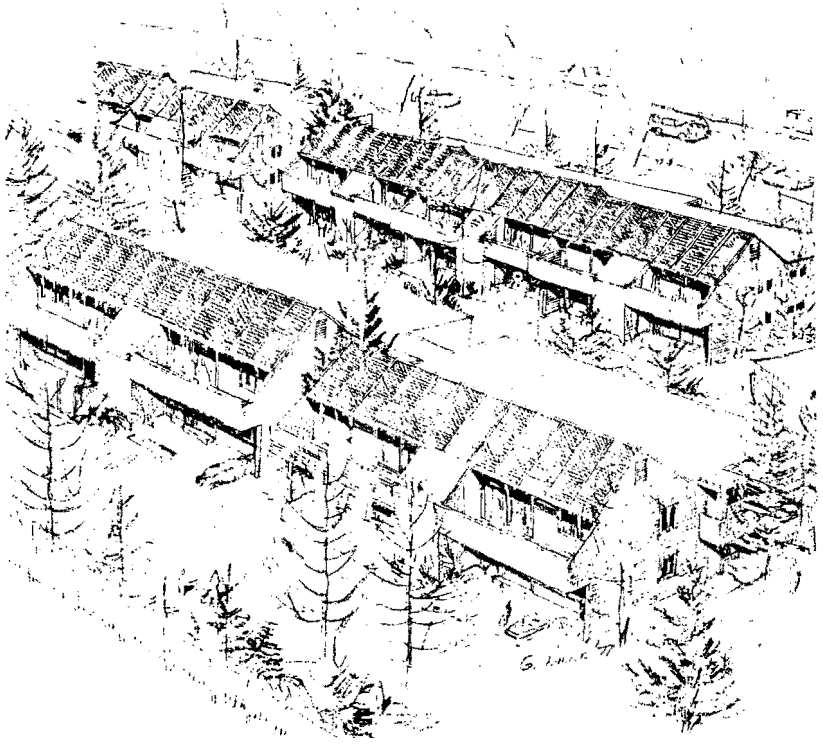
DISTRIBUTION: Solar heated water from the storage is pumped through a water-to-air heat exchanger in the duct work for hot air distribution.

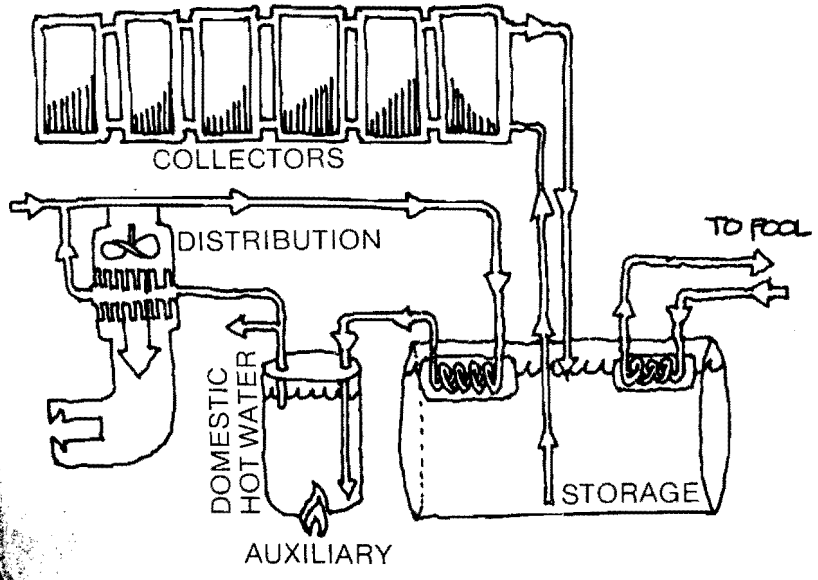
AUXILIARY ENERGY SYSTEM: Electric resistance heating strips provide for auxiliary heating.

DOMESTIC HOT WATER: Heated water from the solar storage tank circulates through a heat exchanger jacket surrounding the conventional DHW tank.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: Montecito Pines
DESIGNER: Gary Jensen
SOLAR SUB: Empire Swift
LOCATION: Santa Rosa, CA
HOUSING TYPE: MF Low, 76 Units
CLIMATIC DATA:
HEATING DD: 2,889
DESIGN TEMP: WINTER: 30° F
HORIZ. INSOL. JAN. DAY: 681 BTU/sq. ft.

LATITUDE: 38°N
AREA: 864-1,000 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 36%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves a new apartment complex with 76 units. Three of the buildings house one-bedroom apartments, with 672 sq. ft. each, and five of the buildings house two bedroom apartments with 864 sq. ft. each. The apartments are insulated with batt insulation, of an R-11 value in the walls and in the floors, and R-19 in the ceiling. Overhangs and decks shade the south facing glass, reducing the heat gain during the summer. The swimming pool is heated with excess heat from the solar system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 67%

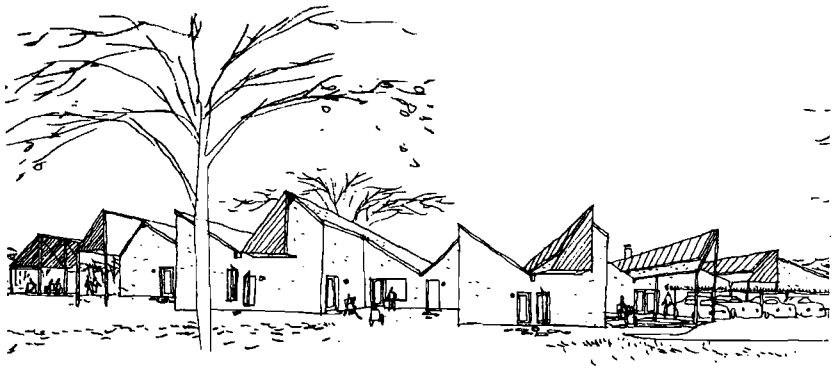
COLLECTOR: Each building has 880 sq. ft. of Sunburst water collectors located on the 45° sloping roof. The buildings vary in orientation, from due south to 22° west of south. Since water is the heat transfer medium, it is drained down to prevent freezing.
STORAGE: Each building has a 2,000 gallon water tank located in the utility room attached to the apartment building. Solar heated water flows from the collector to the top of the tank for solar storage.
DISTRIBUTION: A heat exchanger located in this storage transfers solar heat to the domestic hot water supply. Hot water is then drawn from the DHW tank through fan coil units in each apartment. Air is blown across the heated coils for hot air distribution.
AUXILIARY ENERGY SYSTEM: The gas fired DHW boiler supplies hot water for back-up supply to the fan-coil units.
DOMESTIC HOT WATER: The DHW boiler also distributes the solar heated water to individual DHW tanks in each unit for domestic supply.
MODES OF OPERATION: Collector to storage, storage to auxiliary to house, DHW preheat.

ILLINOIS 6039 DD MF LOW NEW ACTIVE HEATING & DHW

120

PROJECT INFORMATION:

BUILDER/APPLICANT: Foundation for the Handicapped
DESIGNER: B. Weese, Arch.
SOLAR SUB: Dr. G. Hancock
LOCATION: Roselle, IL
LATITUDE: 42°N
HOUSING TYPE: MF Low, 22 Units
AREA: 1,549 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,039
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 355 BTU/sq. ft.
DESIGN TEMP: INDOOR: 75° F
% SUN/YR: 57%



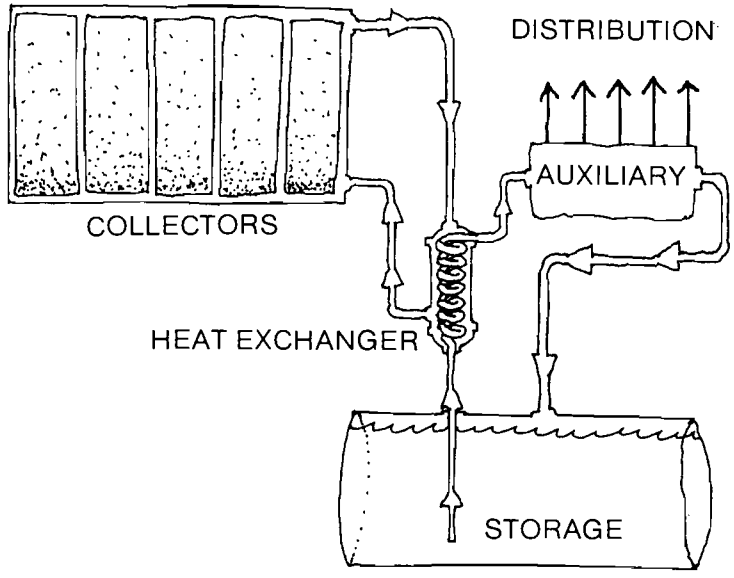
BUILDING DESCRIPTION/ENERGY CONCERNS

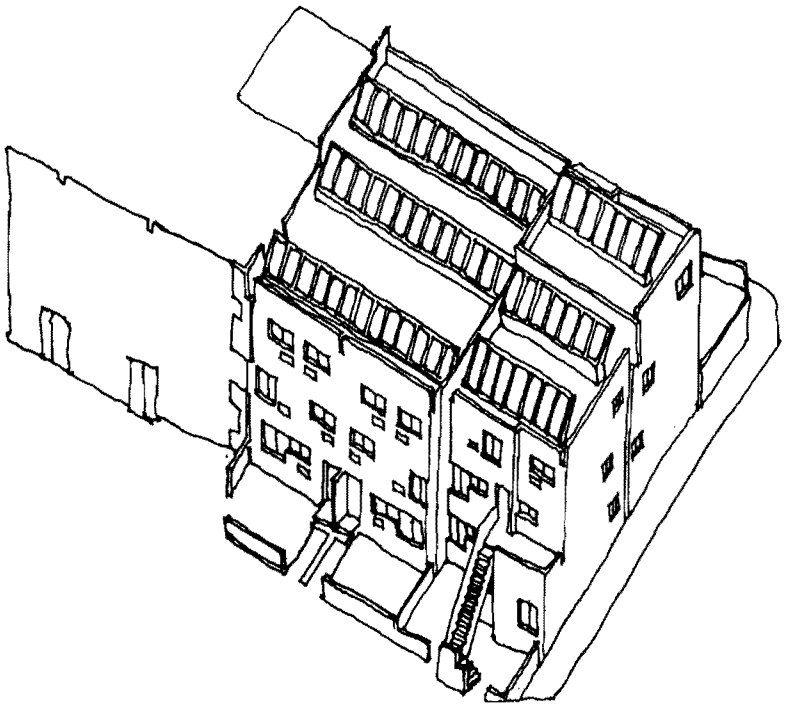
Designed for the Foundation for the Handicapped, this complex provides 11,580 sq. ft. of living space. The building is divided into 5 living units, each containing 4 bedrooms. The walls and floor have increased insulation designed to protect against heat transfer. Roof overhangs have been provided on the east, west and south sides in order to reduce heat gain, and windows and transoms have been carefully placed to provide natural ventilation throughout the building.

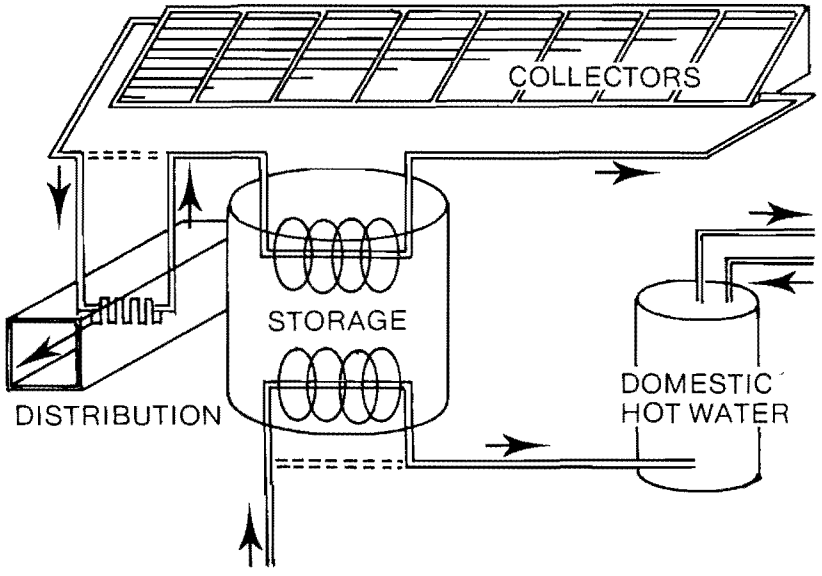
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

COLLECTORS: A total of 4,011 sq. ft. of Chamberlain collectors have been used to provide space heating for the complex. Mounted at a 57° tilt, these flat plate collectors are constructed of steel. An antifreeze transfer medium prevents collector freezing, and the drain down system prevents overheating.
STORAGE: Collected solar heat is transferred from antifreeze to water in a heat exchanger. Heated water is pumped to a central 20,000 gallon water storage tank located underground.
DISTRIBUTION: Solar heated water from the water storage tank is circulated through a series of heat pumps for auxiliary heating and distribution to the house. During the summer, solar storage provides waste heat for the operation of the heat pump cooling cycle.
AUXILIARY ENERGY SYSTEM: A conventional electric heat pump and resistance heater is provided as auxiliary.
DOMESTIC HOT WATER: A second set of Chamberlain flat plate collectors are used for DHW preheat. In this case the antifreeze circulating through the 336 sq. ft. of collectors is taken to a double wall heat exchanger in the DHW tank for auxiliary heating and distribution.
MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.







PROJECT INFORMATION:

BUILDER/APPLICANT: South Bronx Community Housing Corp.
DESIGNER: James Kline
SOLAR SUB: Sandra Roiz Butter
LOCATION: New York, NY
LATITUDE: 41°N
HOUSING TYPE: MF Low
AREA: 556-1,670 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,871
DESIGN TEMP: WINTER: 11° F
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.
DESIGN TEMP: INDOOR: 70° F
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

The Plaza Borinquen complex, located in the South Bronx, consists of 88 townhouse units in eight low rise buildings. One building, containing four 4-bedroom units, two 2-bedroom units and two 1-bedroom units, has been retrofitted with solar collector panels. The solar energy collected provides domestic hot water to all 8 apartments, and solar space heating to four of the apartments.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 60%

COLLECTOR: 1,121 sq. ft. of Sunworks collectors are rack mounted on the existing flat roof at a 50° tilt. These flat plate collectors are constructed of copper, with a selective surface, and use antifreeze as a transfer media.

STORAGE: A steel tank, insulated with 4" of batt and containing 1,000 gallons of water provides solar storage.

DISTRIBUTION: When space heating is demanded, the collector heated antifreeze may go directly to an air handling unit and then to storage. When not demanded, the heated liquid circulates only to the storage tank and back to the collectors.

AUXILIARY ENERGY SYSTEM: The apartments have a conventional gas-fired hydronic baseboard heating system.

DOMESTIC HOT WATER: Water from the city system passes through a coil in the main storage tank and then to an existing hot water heater for distribution.

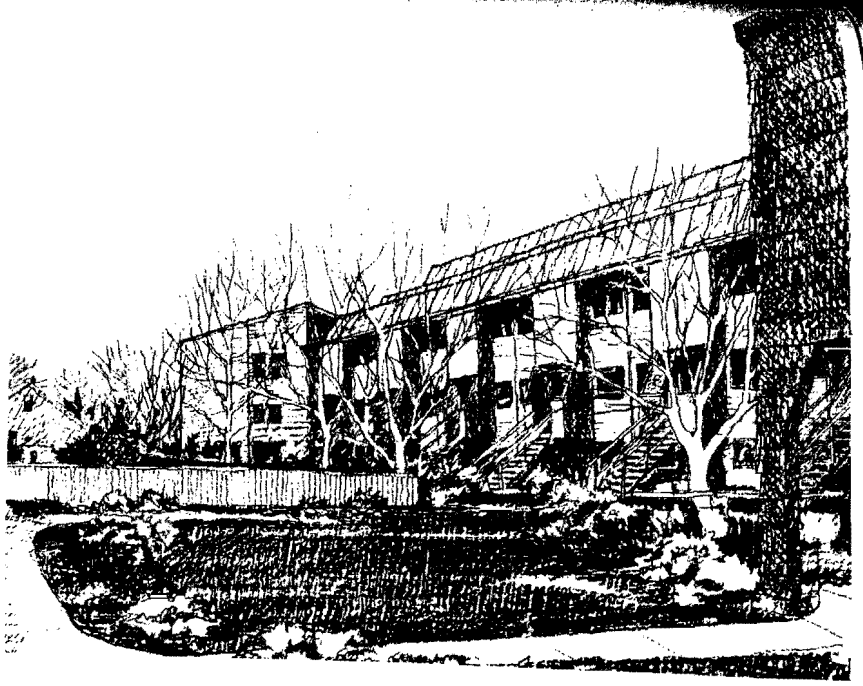
MODES OF OPERATION: DHW preheat. Collector to house, collector to storage, auxiliary to house.

ACTIVE HEATING & DHW MF LOW RETRO 5897 DD CONNECTICUT

122

PROJECT INFORMATION:

BUILDER/APPLICANT: Utility Electrical Contractors
DESIGNER: Harold F. Gorman
SOLAR SUB: Utility Electrical Contractor
LOCATION: Hamden, CT
LATITUDE: 42°N
HOUSING TYPE: MF Low, 52 Units
AREA: 1,000 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,897
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 592 BTU/sq. ft.
DESIGN TEMP: INDOOR: 68° F
% SUN/YR: 60%



BUILDING DESCRIPTION/ENERGY CONCERNS

This 52-unit apartment complex, consisting of 2 midrise buildings, has been retrofitted with a solar system for space heating and domestic hot water. The one and two bedroom apartments range from 500 sq. ft. to 1,000 sq. ft., and are mostly occupied by students. The owner plans to increase the roof insulation to reduce heat loss and heat gain. Storm windows are also being added.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: Each of the two apartment buildings has 4,595 sq. ft. of Sunworks flat-plate collectors rack-mounted at a 57° angle on the roof. An antifreeze/water solution flows through the collectors to a heat exchanger immersed in the storage tanks.

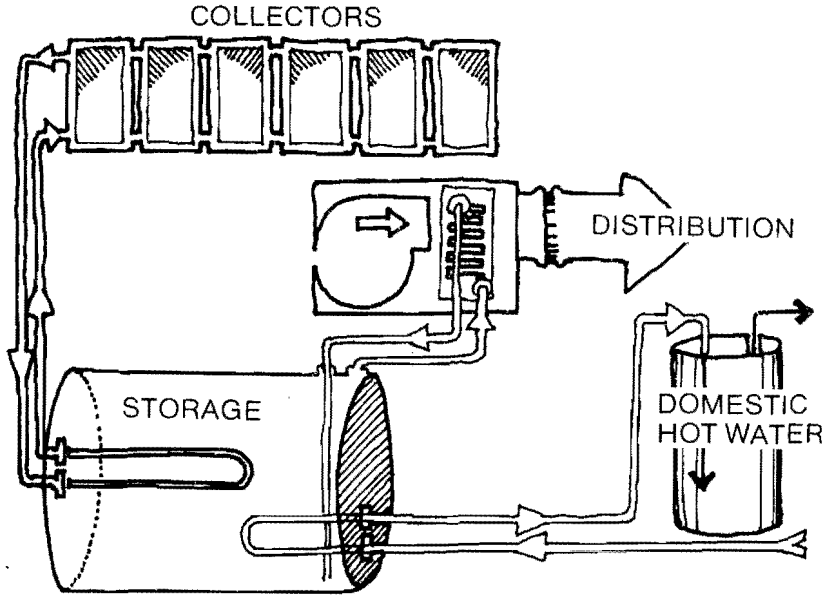
STORAGE: On the ground floor of each building, two 4,000 gallon water tanks store the heat collected. The tanks are insulated with 8" of vermiculite insulation.

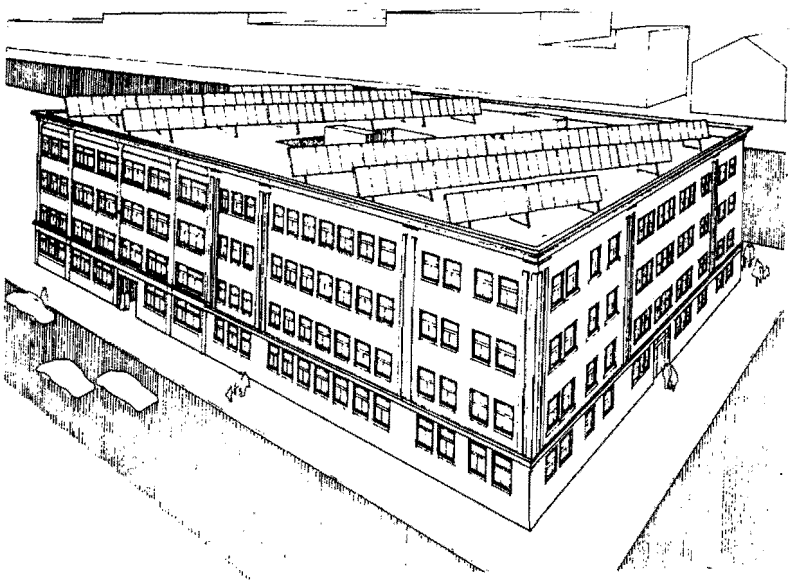
DISTRIBUTION: Heated storage water is then pumped to fan coil units in each apartment. Air is blown across the water to air heat exchangers in the unit in order to heat the apartment.

AUXILIARY ENERGY SYSTEM: Electric baseboards provide auxiliary heating.

DOMESTIC HOT WATER: Incoming city water passes through a heat-exchanger in the solar storage tanks, before entering the two conventional DHW tanks which supply hot water to each building.

MODES OF OPERATION: Collector to storage, storage to house, auxiliary to house, DHW preheat.





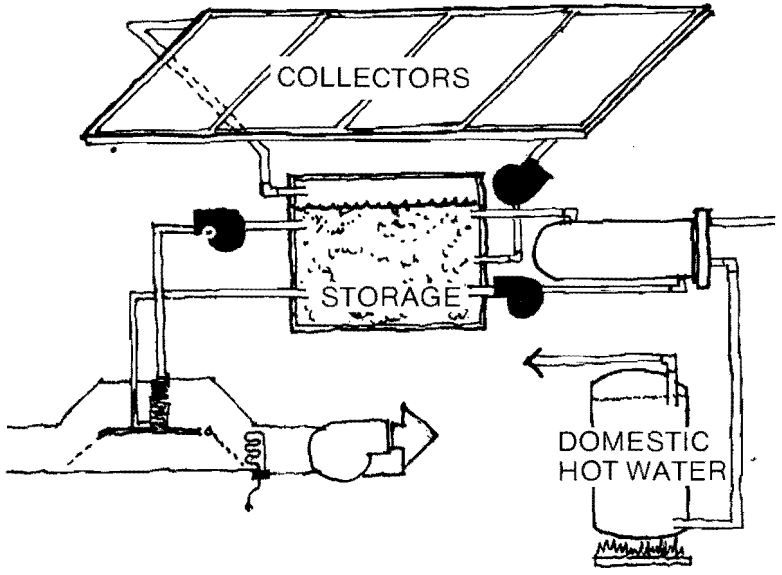
PROJECT INFORMATION:
BUILDER/APPLICANT: Oak Street Associates
DESIGNER: Mass Design & Architects
SOLAR SUB:
LOCATION: Lewiston, ME
HOUSING TYPE: MF MID, 91 Units
CLIMATIC DATA:
HEATING DD: 7,511
DESIGN TEMP: WINTER: −20° F
HORIZ. INSOL. JAN. DAY: 555 BTU/sq. ft.

LATITUDE: 44°N
AREA: 630 sq. ft.

DESIGN TEMP:
INDOOR: 75° F
% SUN/YR: 58%

BUILDING DESCRIPTION/ENERGY CONCERNS

These existing mill buildings are being renovated in order to accommodate housing for the elderly. The housing includes a combination of one (630 sq. ft.) and two bedroom (850 sq. ft.) units.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 21%

COLLECTOR: 3,108 sq. ft. of Sunworks liquid flat-plate collectors are rack-mounted at a 45° angle onto the flat roof. Water is pumped through the collector for solar heating, and then circulated to storage.

STORAGE: A 15,000 gallon tank, insulated with 3" of foam and 6" of batt, is used to store the heated water.

DISTRIBUTION: Heated water is pumped from the storage tank through a heat exchange coil in the return air duct of the hot air distribution system.

AUXILIARY ENERGY SYSTEM: An electric resistance coil and a heat pump provide auxiliary energy for hot air distribution.

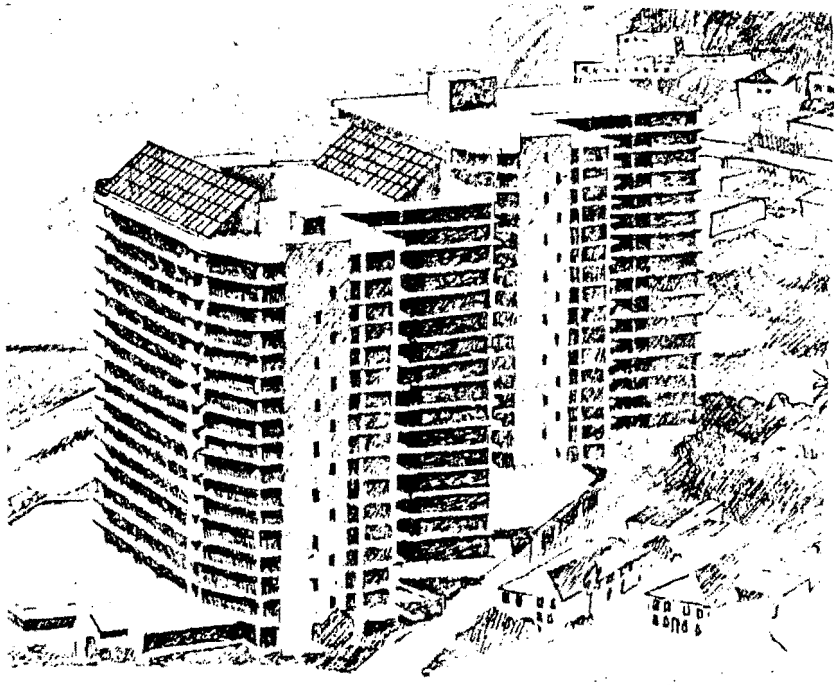
DOMESTIC HOT WATER: Hot water from storage is circulated in a preheat coil in the bottom of the conventional hot water tank for DHW preheat.

MODES OF OPERATION: Collector to storage, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

BUILDER/APPLICANT: L&S Operating Co.
DESIGNER: Krisel-Shapiro Associates
SOLAR SUB: Solar Resources, Inc.
LOCATION: Santa Monica, CA
HOUSING TYPE: MF High, 317 Units
CLIMATIC DATA:
HEATING DD: 1,390
DESIGN TEMP: WINTER: 43° F
HORIZ. INSOL. JAN. DAY: 917 BTU/sq. ft.

LATITUDE: 34°N
AREA:

DESIGN TEMP:
INDOOR: 72° F
% SUN/YR: 81%



BUILDING DESCRIPTION/ENERGY CONCERNS

This luxury high rise apartment complex will be retrofitted with solar collector panels to assist in space heating and domestic hot water preheat. The complex is 17 stories in height and consists of 317 units. 160 units will have both solar heating and DHW preheat and the other 157 will have only solar assisted domestic hot water.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Heating & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 34%

COLLECTOR: 3,500 sq. ft. of Daystar flat-plate collector panels are mounted on racks on the roof. The panel arrays face directly south at a tilt of 45°. Water is pumped through the collectors, heated, and pumped to a storage tank.

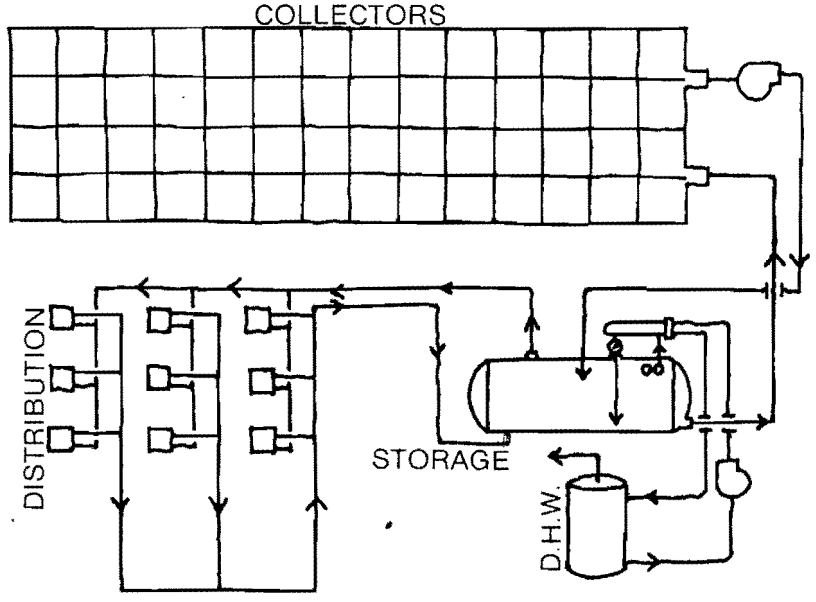
STORAGE: A 5,000 gallon steel tank is used for storage and is insulated with 2 in. batt insulation.

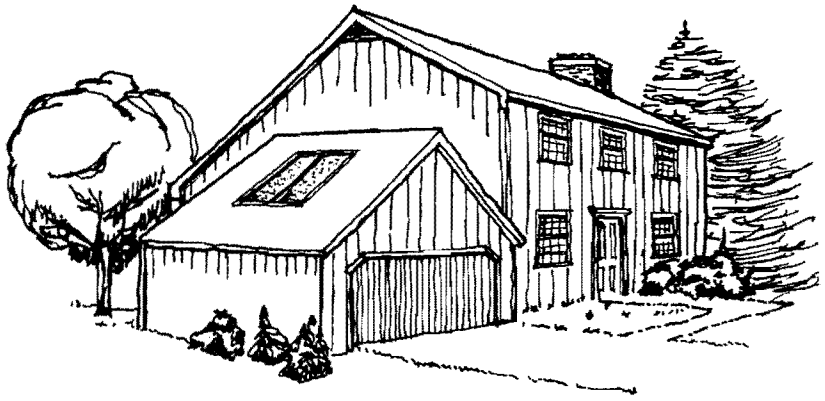
DISTRIBUTION: Heated water from storage is pumped to an individual water to air heat exchanger in each unit for forced air distribution.

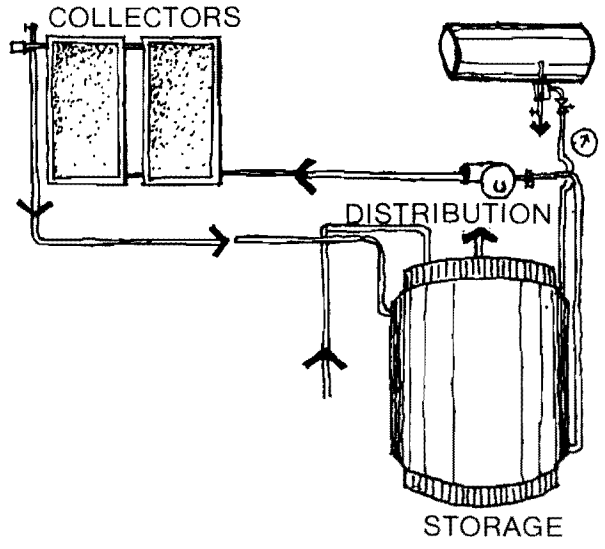
AUXILIARY ENERGY SYSTEM: Electric space heaters provide back up heating.

DOMESTIC HOT WATER: Incoming water passes through a heat exchanger where it is preheated by water from solar storage before going to a 750 gallon water heating system.

MODES OF OPERATION: Collector to storage, storage to auxiliary to building, auxiliary to building, DHW preheat.







PROJECT INFORMATION:
BUILDER/APPLICANT: Bond Construction Co.
DESIGNER: W. M. Owens
SOLAR SUB: Ionic Solar
LOCATION: Gladstone, MO
HOUSING TYPE: SFD, 1 unit
CLIMATIC DATA:
HEATING DD: 4,900
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 629 BTU/sq. ft.

LATITUDE: 39°N
AREA: 2,828 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 65%

BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Gladstone, Missouri, this 3 bedroom home contains 2,800 sq. ft. of space. The building has been well protected against heat loss through the use of 2" x 6" stud construction with R-19 insulation in the walls as well as R-30 insulation in the ceiling. All windows use ½" thick insulated glass. Furthermore, steel hollow core doors filled with urethane are incorporated.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 49%

COLLECTORS: Mounted directly to the roof at a 37° angle, 40 sq. ft. of Miromit liquid flat plate collectors have been used to collect heat for domestic hot water for this dwelling. An antifreeze, containing 50% water and 50% propylene glycol, circulates through the panels. Each panel is composed of a steel absorption plate covered with a single sheet of tempered glass.

STORAGE: Heated liquid flows from the collector to an annular jacket tank surrounding the DHW tank. Heat from the liquid in the jacket is transferred to the water through the steel walls of the tanks. Warmed, potable water remains in the tank until needed. This 82 gallon storage tank is constructed of steel and is protected with 3" of insulation.

DISTRIBUTION: When demanded, the heated potable water is pumped directly from the DHW tank into the house.

AUXILIARY ENERGY SYSTEM: An electric coil, contained in the DHW tank, serves as an auxiliary heating element.

MISSOURI
4900 DD
1 SFD NEW
ACTIVE DHW
125

FLORIDA

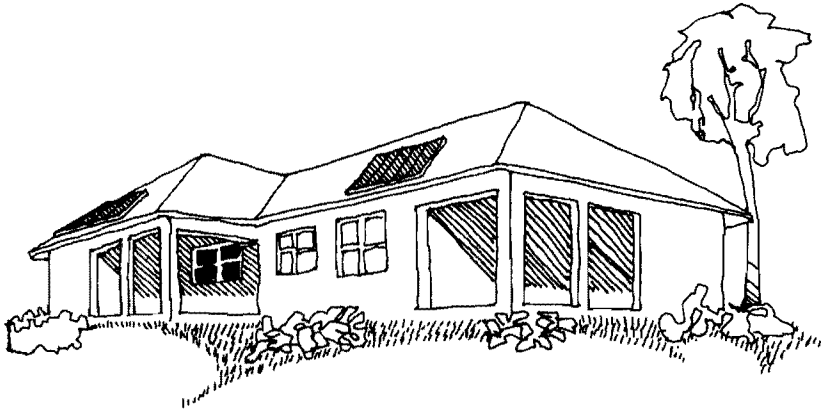
141 DD

25 SFD RETRO

ACTIVE DHW

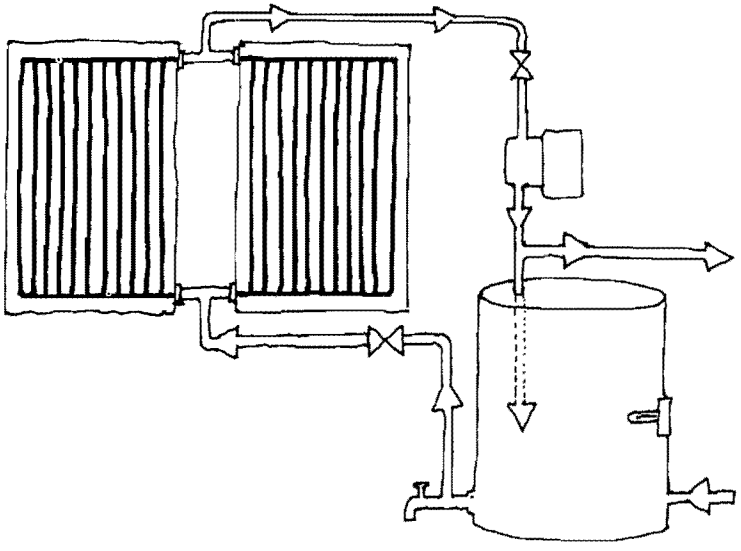
126

PROJECT INFORMATION:
BUILDER/APPLICANT: Hialeah Housing Authority
DESIGNER: Irbye Giddens
SOLAR SUB: Solar Products
LOCATION: Hialeah, FL
LATITUDE: 18°N
HOUSING TYPE: SFD, 25 Units
AREA: 1,504 sq. ft.
CLIMATIC DATA:
HEATING DD: 141
DESIGN TEMP:
DESIGN TEMP: WINTER: −40° F
INDOOR:
HORIZ. INSOL. JAN. DAY: 1,271 BTU/sq. ft.
% SUN/YR:



BUILDING DESCRIPTION/ENERGY CONCERNS

This development consists of 41 buildings including 4 one bedroom duplexes, 6 two bedroom duplexes, 17 three bedroom detached homes, 10 four bedroom detached homes, and 3 five bedroom detached homes. Solar panels are to be added to each of these already existing buildings to provide Domestic Hot Water preheat.



SOLAR ENERGY SYSTEM: ACTIVE

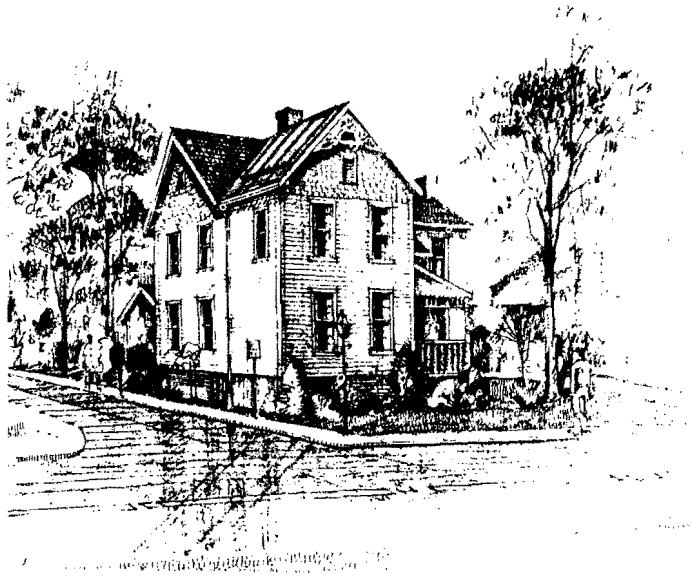
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 84%

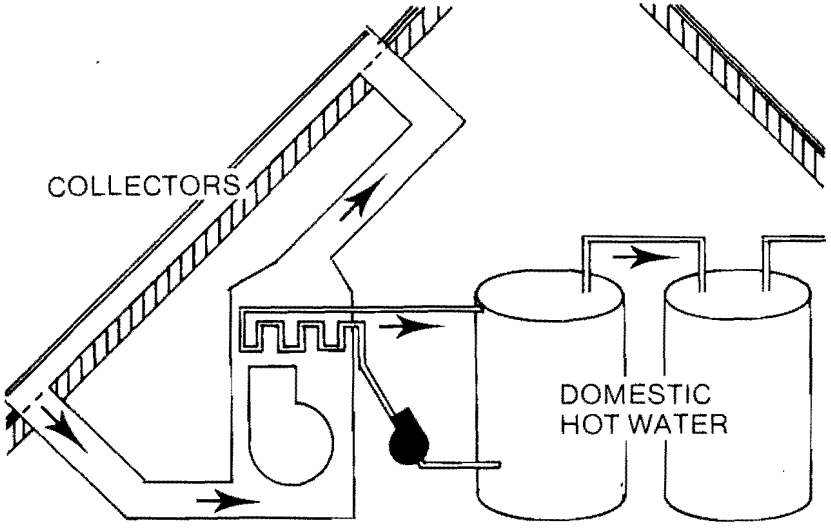
COLLECTOR: 33 sq. ft. of collector surface, consisting of one Solar Products Sun Tank Solar panel is to be mounted directly onto the roof of each unit. The panels will face due south at a tilt of 30°. Water is circulated through the panels, and once heated pumped to a storage hot water tank.

STORAGE: In one and two bedroom models there is a 40 gallon steel tank with 2" of batt insulation. In three, four and five bedroom units a 66 gallon storage tank is used.

DISTRIBUTION: Solar heated water in the DHW storage tanks is drawn directly, to meet domestic hot water demand.

AUXILIARY ENERGY SYSTEM: A thermostatically controlled electric element in the storage tank provides auxiliary energy.





PROJECT INFORMATION:
BUILDER/APPLICANT: Historic Landmarks Foundation of Indiana
DESIGNER: Terry Bradbury
SOLAR SUB: Modern Heating & Cooling
LOCATION: Indianapolis, IN
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,699
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 533 BTU/sq. ft.

LATITUDE: 40°N
AREA: 1,725 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

The existing dwelling is a balloon-framed wooden structure of two stories, containing 3 bedrooms, living/family space, and dining/kitchen space. All exterior walls have foam insulation and the doors and window openings are equipped with storm doors and storm windows. 6" fiberglass insulation was installed in the rafters and 6" cellulose fiber was blown-in in the second floor ceiling joists. 3½" fiberglass insulation was installed in the floor joists over existing crawl spaces. The approximately 2' overhang provides some shading in summer.

COLLECTOR: 87 sq. ft. of Rom-Aire flat plate air collector panels are mounted directly to the roof of the house, facing due south at a tilt of 45°. A blower forces solar heated air across a heat exchange coil to transfer air heat to the water medium in storage.

STORAGE: Water preheated in the coil is pumped to a 42 gallon storage tank wrapped with 2" of batt insulation.

AUXILIARY: A second, conventional 42 gallon DHW heater acts as additional solar storage and also provides auxiliary electric resistance heating as necessary.

INDIANA
5699 DD
1 SFD RETRO
ACTIVE DHW
127

DELAWARE

4930 DD

14 SFA NEW

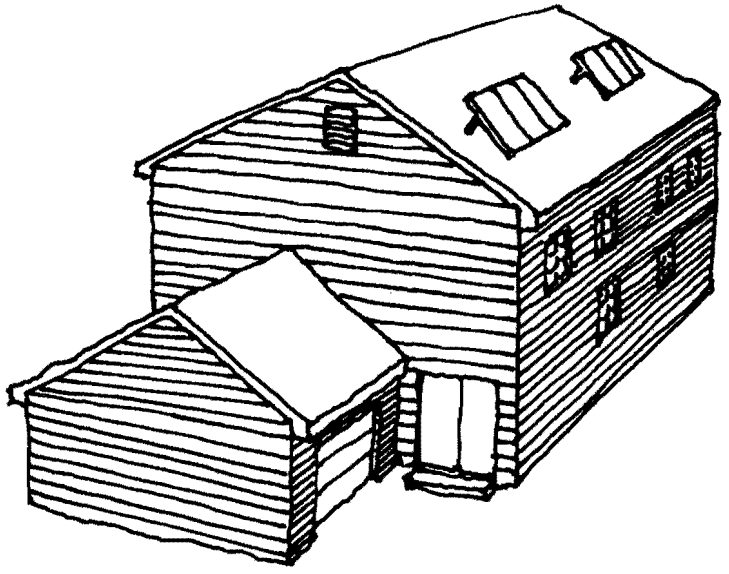
ACTIVE DHW

128

PROJECT INFORMATION:
BUILDER/APPLICANT: Bestfield Builders
DESIGNER: Samuel Kursh
SOLAR SUB: Pat Diossi
LOCATION: Wilmington, DE
HOUSING TYPE: SFA, 14 Units
CLIMATIC DATA:
HEATING DD: 4,930
DESIGN TEMP: WINTER: 5° F
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft.

LATITUDE: 39°N
AREA: 1,200 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

Fourteen new single family attached homes, each containing 1,200 sq. ft. space, have been equipped with solar collectors for domestic hot water heating. In order to conserve energy, the units have been oriented to the south, thereby protecting the east and west sides from summer heat gain and winter heat loss.

SOLAR ENERGY SYSTEM: ACTIVE

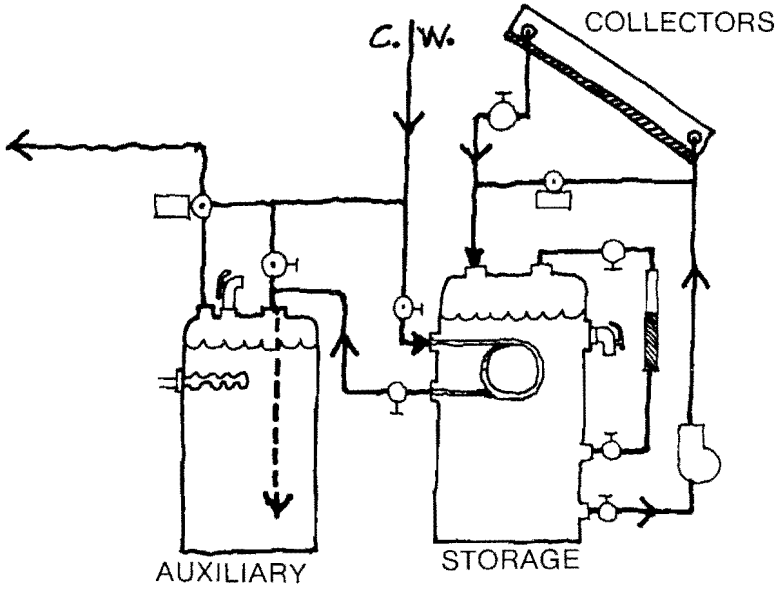
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

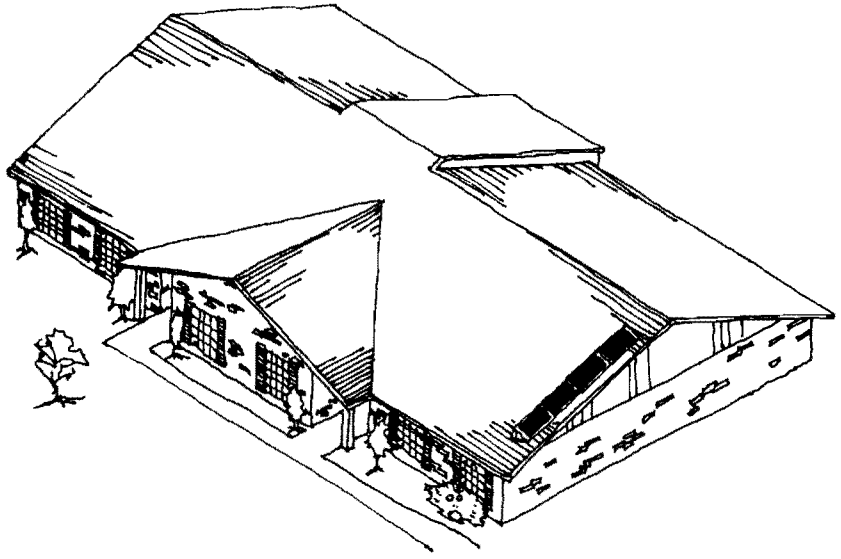
COLLECTOR: Solar energy is collected within 52 sq. ft. of Revere liquid flat plate panels. The panels are rack mounted at a 45° tilt and face due south. Water circulates through the closed collector/storage system, and is drained down to prevent freezing.

STORAGE: A 65 gallon water tank, protected against heat loss by 6" of blanket insulation, provides for heat storage.

DISTRIBUTION: City water is pumped through a coil in the solar storage tank. There it is heated and returned to the DHW tank for conventional distribution.

AUXILIARY ENERGY SYSTEM: An electric unit, located in the DHW tank, provides auxiliary heat when necessary for hot water demand.

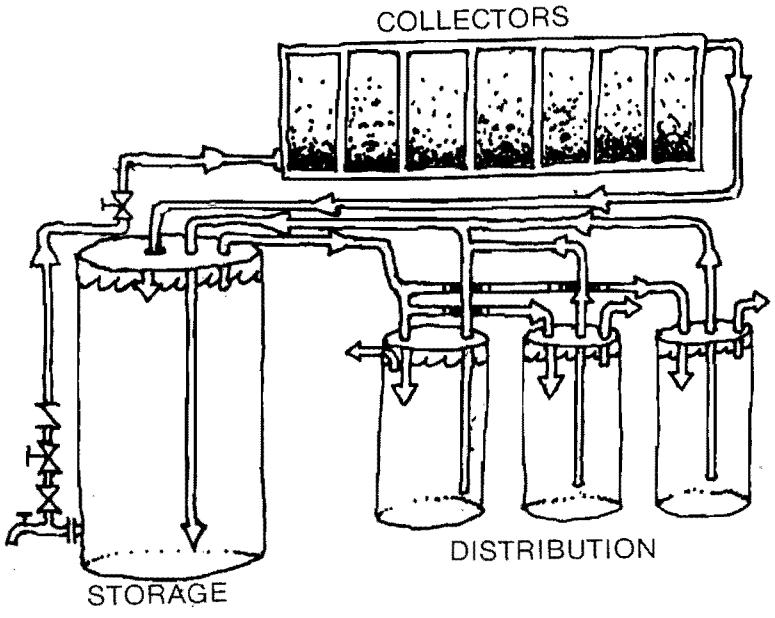




PROJECT INFORMATION:
BUILDER/APPLICANT: Starr Homes
DESIGNER: Daniel J. Dotson
SOLAR SUB: Southwest Solar Systems
LOCATION: Lago Vista, TX
LATITUDE: 30°2'N
HOUSING TYPE: SFA, 3 Units
AREA: 930 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 1,549
DESIGN TEMP:
DESIGN TEMP: WINTER:
INDOOR:
HORIZ. INSOL. JAN. DAY: 1,032 BTU/sq. ft.
% SUN/YR: 61%

BUILDING DESCRIPTION/ENERGY CONCERNS

This single family attached complex contains 3 housing units with 3 bedrooms each. The building is all on one level and garage space for each unit is included.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 63%

COLLECTOR: 54 sq. ft. of Solargenics flat plate water collectors are mounted with brackets on the roof for each unit. The panels face directly south at a tilt of 30°. Incoming cold water is preheated in the collectors then pumped to one central storage tank.

STORAGE: 120 gallons of water storage are located in a glass lined, steel, preheat tank. The storage is insulated with 2½" of rigid insulation.

DISTRIBUTION: Solar heated water is forced from the preheat tank to three conventional DHW tanks for auxiliary heating and for distribution.

AUXILIARY ENERGY SYSTEM: The electric DHW tanks provide auxiliary energy.

TEXAS
1549 DD
3 SFA RETRO
ACTIVE DHW
129

NEW YORK

4871 DD

4 SFA RETRO

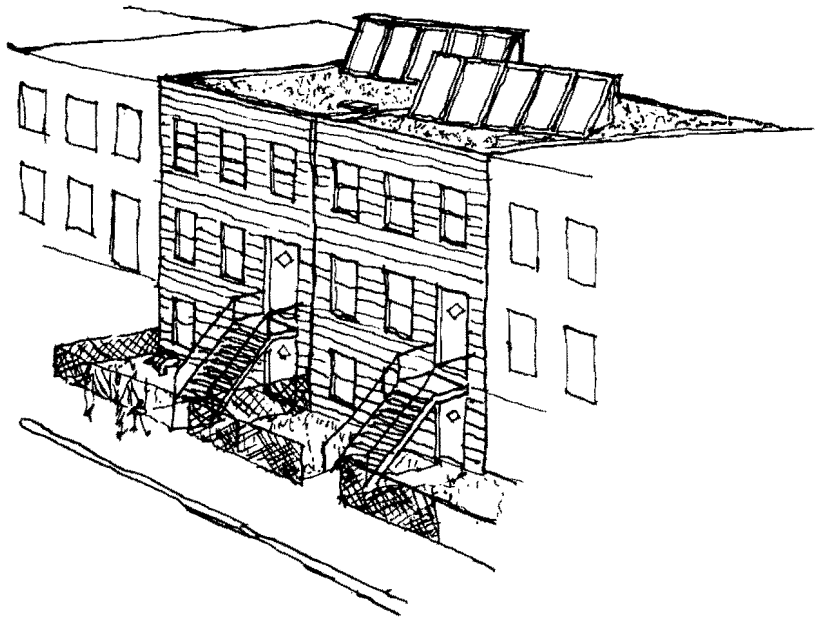
ACTIVE DHW

130

PROJECT INFORMATION:
BUILDER/APPLICANT: Sunset Park Redevelopment Committee
DESIGNER: John Gallagher
SOLAR SUB: Das-Solar Systems
LOCATION: New York, NY
HOUSING TYPE: SFA, 4 Units
CLIMATIC DATA:
HEATING DD: 4,871
INDOOR:
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.

LATITUDE: 40°45'N
AREA: 1,000 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves refurbishing 2 duplex units and fitting them with solar domestic hot water systems. The duplexes are 3 stories high, with two apartments of 1,000 sq. ft. each on the first and second floors, and a 1 bedroom apartment of 500 sq. ft. on the third floor. The three apartments in each duplex share a centralized DHW system.

SOLAR ENERGY SYSTEM: ACTIVE

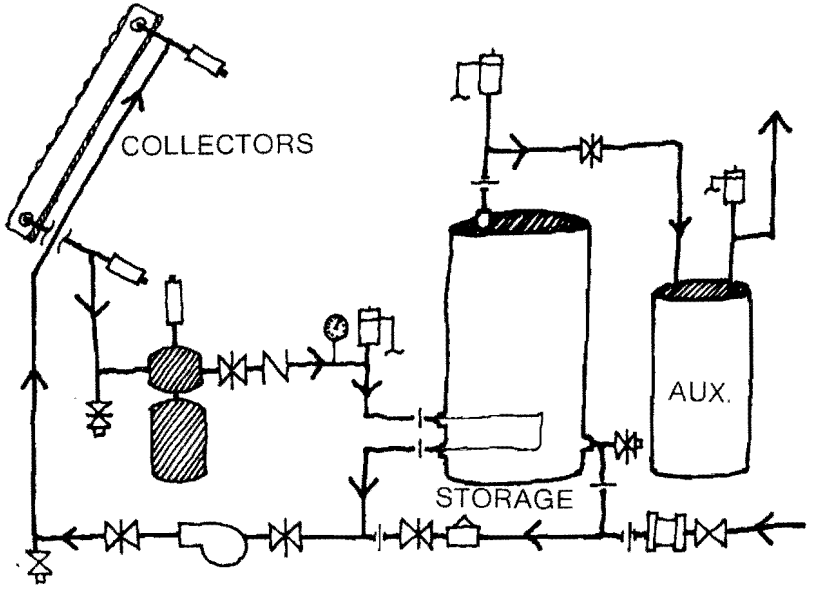
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 66%

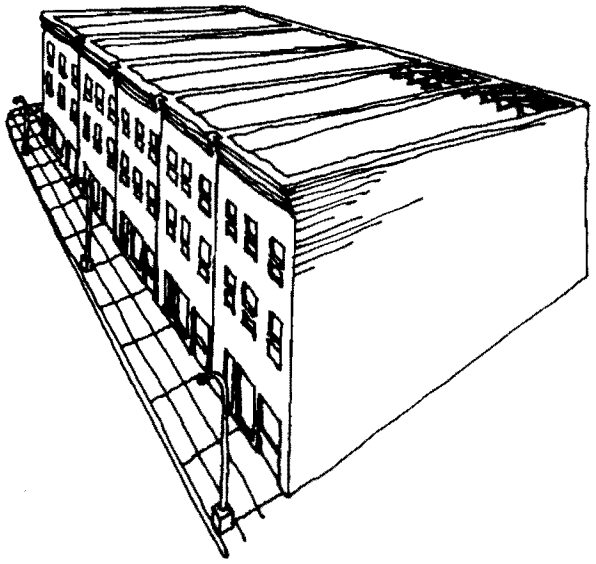
COLLECTOR: Incoming water is fed directly into the Sunworks flat plate collectors to absorb solar heat. Each unit has 5 panels, covering 105 sq. ft., rack mounted at a 40° tilt on the roof. A mixture of antifreeze and water carries heat from the collector and transfers heat to water storage via a heat exchanger.

STORAGE: A 120 gallon storage tank is located in the cellar of each unit.

DISTRIBUTION: Pumped from solar storage, preheated water is brought up to usable temperature in a 50 gallon quick recovery DHW tank when required. Domestic hot water is distributed through the conventional water system, and aerators are used to conserve hot water flow.

AUXILIARY ENERGY SYSTEM: A gas-fired boiler serves as auxiliary energy for domestic hot water supply.





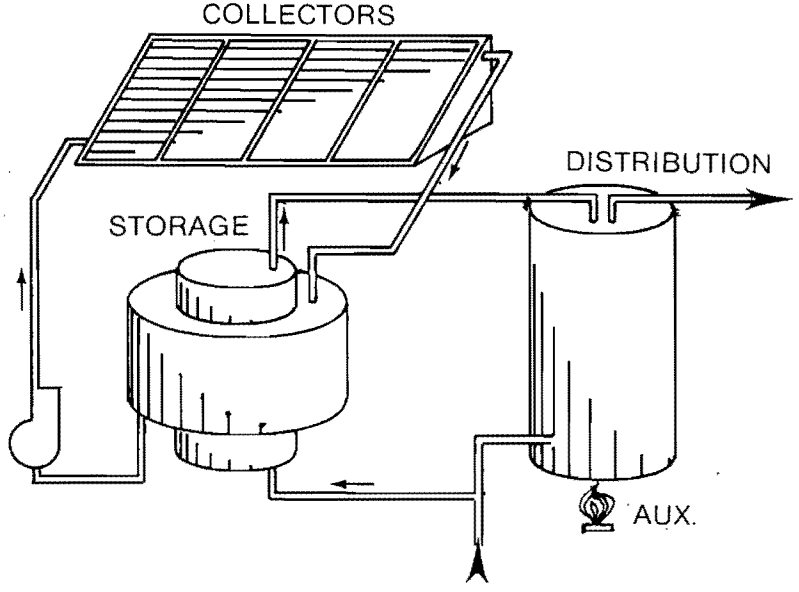
PROJECT INFORMATION:
BUILDER/APPLICANT: Bedford-Stuyvesant Restoration Corp.
DESIGNER: Ralph Vivo
SOLAR SUB: Restoration Construction Corp.
LOCATION: New York, NY
HOUSING TYPE: SFA, 10 Units
CLIMATIC DATA:
HEATING DD: 5,219
DESIGN TEMP: WINTER: 11° F
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.

LATITUDE: 40°
AREA: 558 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

These two existing buildings, each containing 5 efficiency apartments, are located in the Bedford Stuyvesant area of New York. Each apartment occupies 558 sq. ft. of space. The buildings have been retrofitted with a solar system for domestic hot water heating.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 48%

COLLECTOR: 74 sq. ft. of flat plate collectors, manufactured by Grumman Energy Corporation, have been rack mounted at a 35° tilt to the roof of each building. An antifreeze solution is heated in the collectors and then circulated through heat exchange coils in the storage tanks.

STORAGE: Each building has two 82 gallon water storage tanks, which are protected by 3½" of batt insulation.

DISTRIBUTION: The solar heated water in storage is pumped into a conventional hot water tank, where a gas-fired auxiliary unit can provide additional heat before distribution to the apartments.

AUXILIARY ENERGY SYSTEM: The existing gas-fired conventional hot water tanks serve as the auxiliary system.

NEW YORK
5219 DD
10 SFA RETRO
ACTIVE DHW
131

FLORIDA

766 DD

MF LOW RETRO

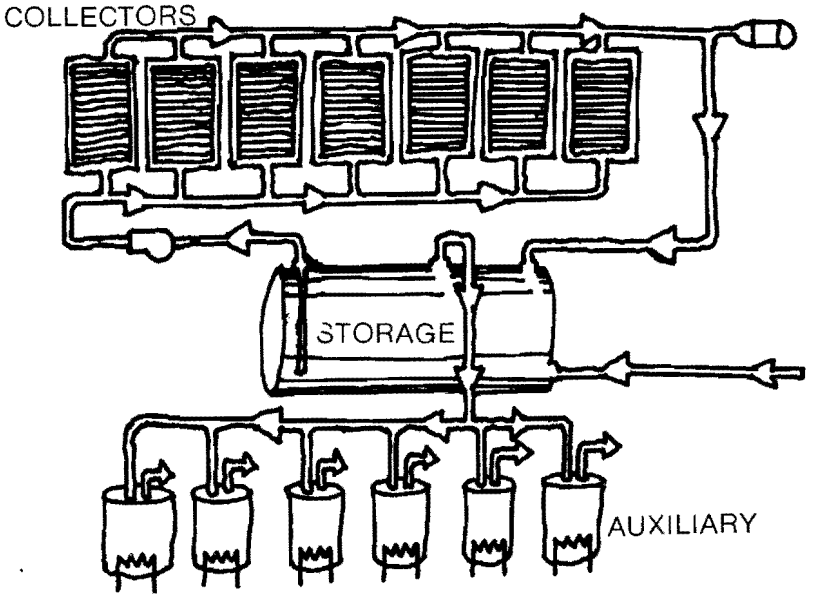
ACTIVE DHW

132

PROJECT INFORMATION:
BUILDER/APPLICANT: Kissimmee Court Apts.
DESIGNER: Ernest Rapp, Arch.
SOLAR SUB: Abrams Construction Co.
LOCATION: Kissimmee, FL — **LATITUDE:** 28°N
HOUSING TYPE: MF Low, 87 Units — **AREA:**
CLIMATIC DATA:
HEATING DD: 766 — DESIGN TEMP:
DESIGN TEMP: WINTER: — INDOOR:
HORIZ. INSOL. JAN. DAY: 788 BTU/sq. ft. — % SUN/YR: 77%

BUILDING DESCRIPTION/ENERGY CONCERNS

Solar collectors have been added to these 87 garden apartments to provide DHW preheat for all units. In order to aid their efficiency, the surrounding landscape has been modified so as to eliminate any obstructions which would shade the collectors.



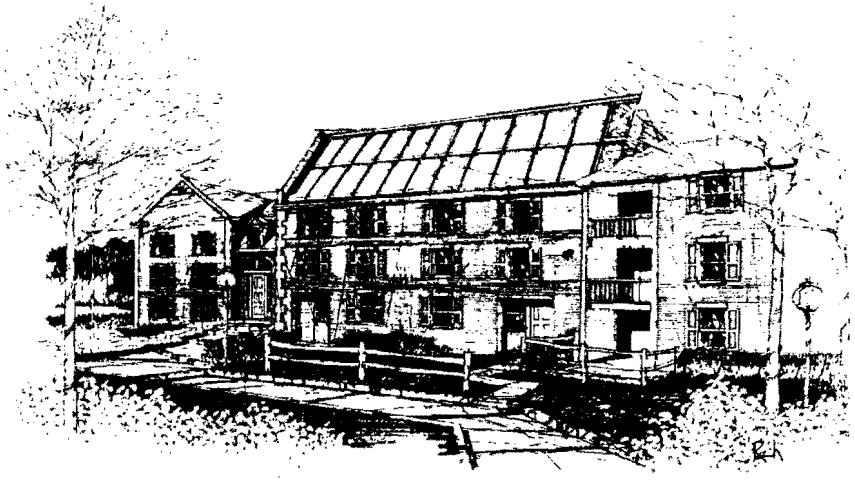
SOLAR ENERGY SYSTEM: ACTIVE

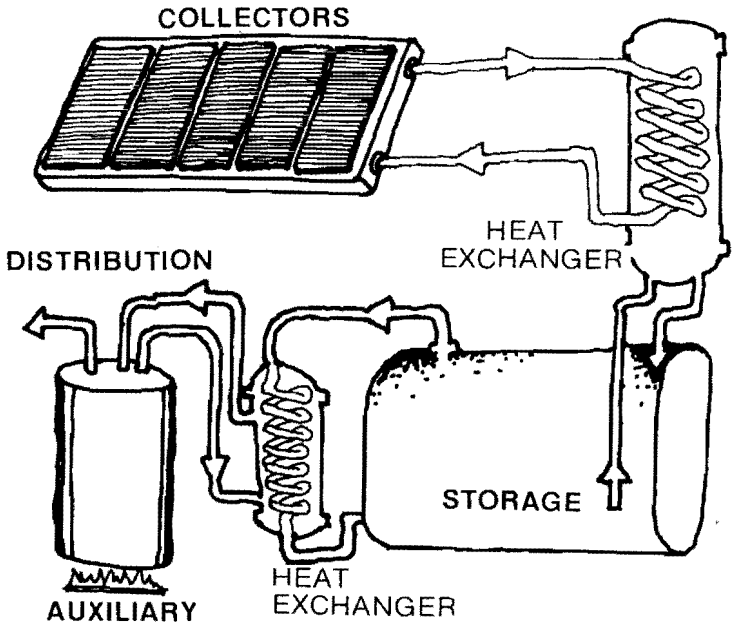
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 61%

COLLECTOR: City water is pumped first into the storage tank and then through Aztec Solar Collectors to preheat DHW. The units are serviced by a total of 3,085 sq. ft. of flat plate collectors and water is the collector medium. Warm water can be circulated to prevent freezing.

STORAGE: A 6,300 gallon central insulated storage tank provides solar heated water to the individual DHW tanks in the living unit.

AUXILIARY ENERGY SYSTEM: An electric resistance element has been placed in the individual DHW tanks to provide auxiliary heat.





PROJECT INFORMATION:
BUILDER/APPLICANT: John M. Corcoran & Co.
DESIGNER: Claude Miquelle
SOLAR SUB: John Corcoran
LOCATION: Saugus, MA
HOUSING TYPE: MF Mid, 24 Units
CLIMATIC DATA:
HEATING DD: 6,368
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 566 BTU/sq. ft.

LATITUDE:
AREA: 672-1,008 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 60%

BUILDING DESCRIPTION/ENERGY CONCERNS

The Saugus Commons building, an addition to an existing apartment complex, will contain 24 garden apartments. These apartments include one-bedroom (672 sq. ft.) and two-bedroom (1,008 sq. ft.) units. The building has been carefully sited so as to eliminate any shading of the collectors. An entry vestibule, which serves as an air and thermal lock, has been included as an additional energy conserving feature.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: "Daystar 20" collectors have been mounted on the south side of the roof at a 45° tilt. The liquid flat-plate collectors cover 420 sq. ft. of surface area. A non-toxic antifreeze, composed of 60% glycerol and 40% water, is used as a transfer media.

STORAGE: Solar heated antifreeze is circulated through a heat exchanger where heat is transferred to water for storage. A 750 gallon water tank, insulated with 3" of batt is used for storage.

DISTRIBUTION: Heat is transferred from solar storage to the conventional DHW tank by way of another heat exchanger, and then distributed to the individual units.

AUXILIARY ENERGY SYSTEM: An oil burner provides auxiliary energy to the DHW tank.

MASSACHUSETTS

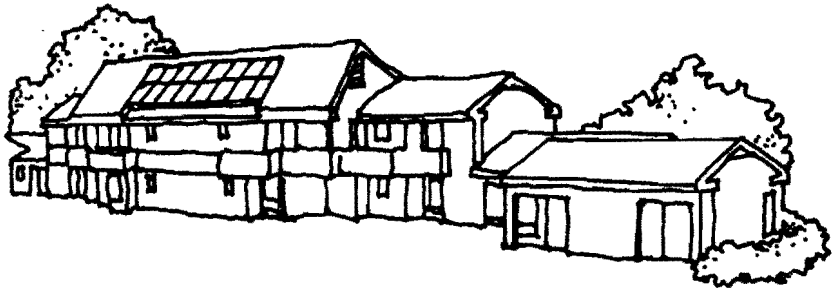
6612 DD

MF LOW NEW

ACTIVE DHW

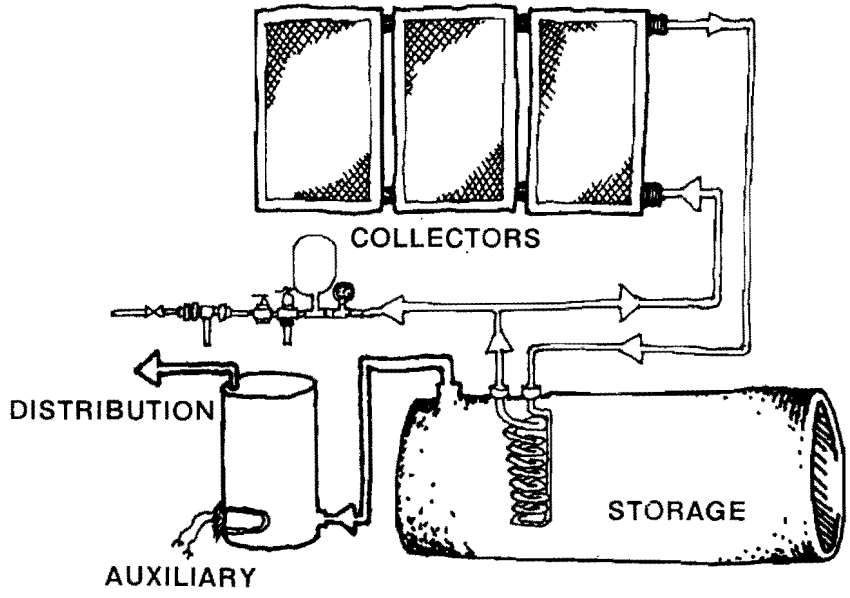
134

PROJECT INFORMATION:
BUILDER/APPLICANT: Raynham Housing Authority
DESIGNER: John J. Tewhill
SOLAR SUB: Ionic Solar Construction
LOCATION: Raynham, MA
LATITUDE: 42°N
HOUSING TYPE: MF Low, 62 Units
AREA: 500 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 6,612
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 566 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 64%



BUILDING DESCRIPTION/ENERGY CONCERNS

This complex of garden apartments for the elderly consists of nine buildings including a total of 62 units of one and two bedroom apartments. The buildings are oriented to the south with the majority of windows also facing in that direction. Window area has been minimized, while the attic area can be ventilated.



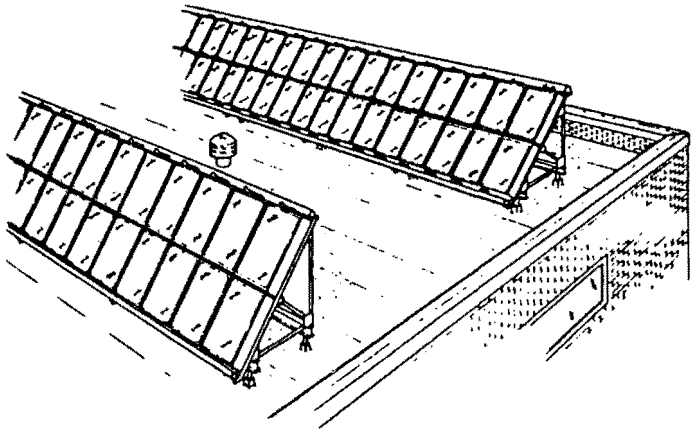
SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 62-72%

COLLECTOR: A total of 2,020 sq. ft. of collector area consisting of 91 "Daystar 20" flat-plate liquid collectors assist in providing domestic hot water for the complex. The collectors are mounted directly onto the roof and face due south at a tilt of 52°. Solarguard G antifreeze carries collected heat to a fin tube and shell heat exchanger immersed in water storage.

STORAGE: 475 gallons of water storage is located in each building.

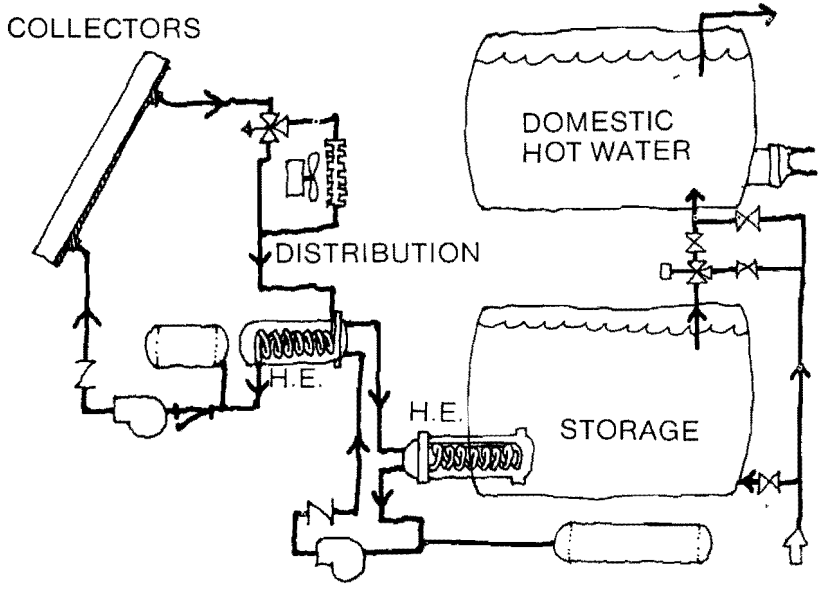
DISTRIBUTION: Preheated water is drawn from each solar storage to conventional electric domestic hot water heaters, for auxiliary heating and distribution.



PROJECT INFORMATION:
BUILDER/APPLICANT: Willow Creek II, Ltd. Partnership
DESIGNER: Phil Kruger
SOLAR SUB: Eldon Penney
LOCATION: Kalamazoo, MI
LATITUDE: 42°30'N
HOUSING TYPE: MF Low, 71 Units
AREA: 650 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,909
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 488 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 77%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project includes 2-three story garden apartment buildings. There are 47 two bedroom apartments of 930 sq. ft. each and 24 one bedroom apartments of 650 sq. ft. each.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water

COLLECTOR: 979 sq. ft. of Lennox flat plate liquid collectors are located on the smaller buildings and 1,285 sq. ft. on the larger building for solar domestic hot water heating. The collectors are mounted with brackets onto the flat roof, facing due south at a tilt of 45°. A 50% ethylene glycol and 50% water solution is drawn through the collectors, heated, and pumped to a central heat exchanger. Water is the second heat transfer media, taking solar heat to a second heat exchanger located in the water storage tank.

STORAGE: 1,000 gallons of water storage in the small building and 1,500 gallons in the large building are contained in steel, vented tanks. The tanks are insulated with 2" of blown insulation.

DISTRIBUTION: Preheated water is drawn from the solar storage tank and pumped via the conventional domestic hot water heater for distribution.

AUXILIARY ENERGY SYSTEM: The gas-fired conventional DHW tanks provide auxiliary energy for domestic water supply.

FLORIDA

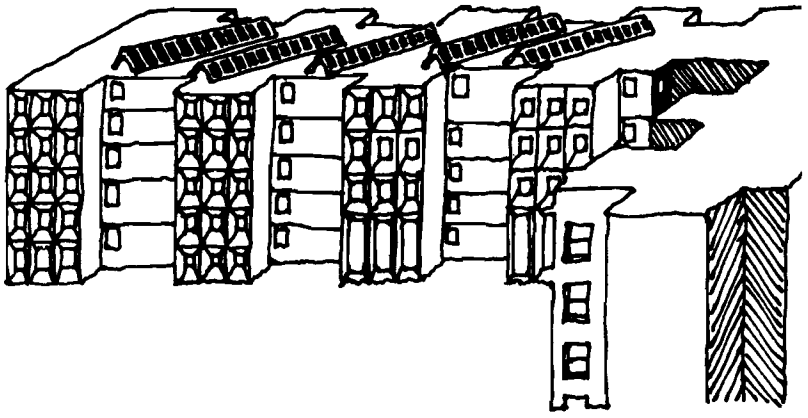
1599 DD

MF LOW RETRO

ACTIVE DHW

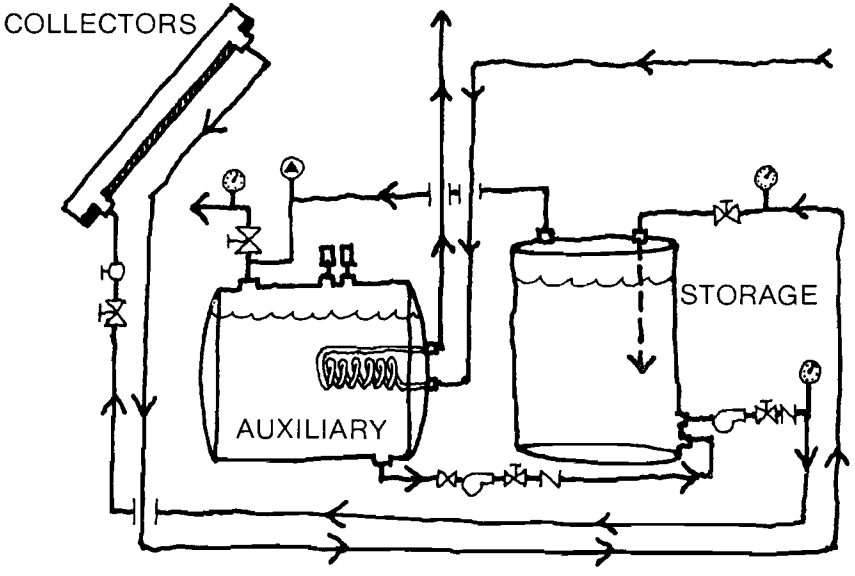
136

PROJECT INFORMATION:
BUILDER/APPLICANT: Univ. of Florida/Housing Div.
DESIGNERS: N. Cope & R. Reinhardt
SOLAR SUB:
LOCATION: Gainesville, FL
LATITUDE: 28°N
HOUSING TYPE: MF Low, 8 Units
AREA:
CLIMATIC DATA:
HEATING DD: 1,599
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 988 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 48%



BUILDING DESCRIPTION/ENERGY CONCERNS

Solar panels have been added to this already existing student housing garden apartment building. The two-story building has 8 apartments and houses 20 people.



SOLAR ENERGY SYSTEM: ACTIVE

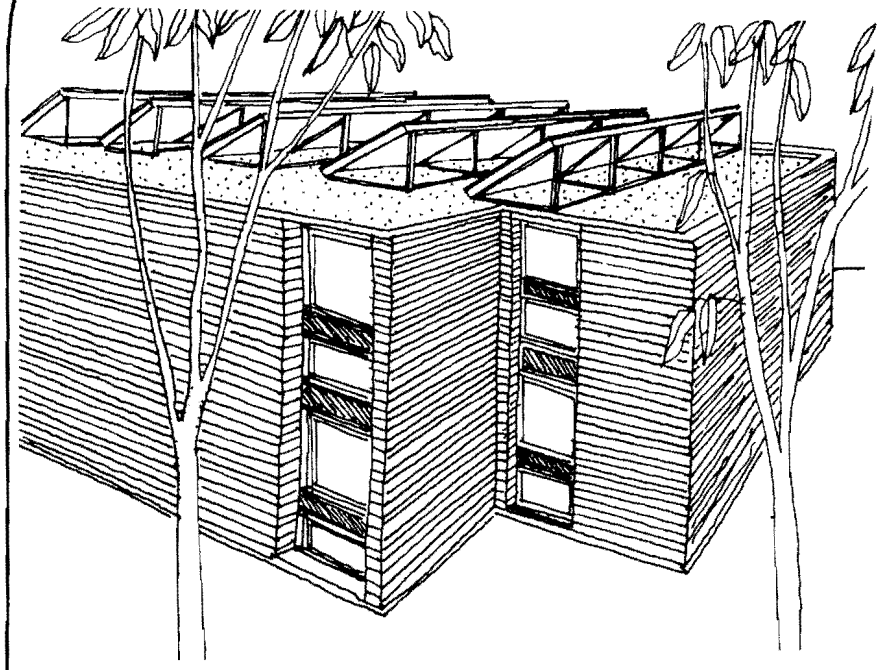
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 90%

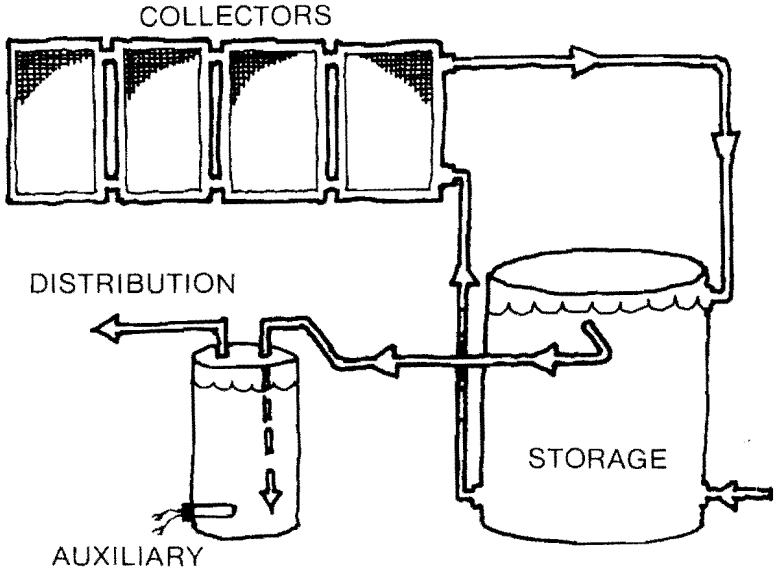
COLLECTOR: 300 sq. ft. of solar collectors manufactured by Union County Correctional Institute are frame-mounted to the roof facing due south at a tilt of 40°. Water is used as the heat transfer medium with the drain down method used to prevent freezing.

STORAGE: A 450 gallon water storage tank rests on a concrete pad in a storage shed near the building. The tank is galvanized metal with 2" of rigid insulation.

DISTRIBUTION: Solar heated water from the 450 gallon water storage tank is drawn into a conventional DHW heater for distribution.

AUXILIARY ENERGY SYSTEM: The electric conventional DHW heater provides auxiliary heat.





PROJECT INFORMATION:
BUILDER/APPLICANT: Embry-Riddle Aeronautical Univ.
DESIGNER: Joe Hacker
SOLAR SUB:
LOCATION: Daytona Beach, FL
HOUSING TYPE: MF Low, 186 Units
CLIMATIC DATA:
HEATING DD: 879
DESIGN TEMP: WINTER: 40° F
HORIZ. INSOL. JAN. DAY: 968 BTU/sq. ft.

LATITUDE: 29°N
AREA:
DESIGN TEMP:
INDOOR:
% SUN/YR: 50%

BUILDING DESCRIPTION/ENERGY CONCERNS

This dormitory, which contains 186 rooms, has been retrofitted to include a solar domestic hot water system.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 97%

COLLECTOR: This installation incorporates 2,965 sq. ft. of collector surface, using 100 Gulf Thermal panels. These flat plate panels, which have been mounted at a 40° tilt, use water as a heat transfer medium.

STORAGE: Two storage tanks, one existing and the other new, contain a total of 6,000 gallons of water. City water is pumped directly to the new tank and then to the collectors. Once warmed, the water returns to the same storage tank. The older tank provides for the additional hot water solar storage, and for conventional distribution.

DISTRIBUTION: City water is circulated through a heat exchange coil in the old storage tank for DHW preheat and distribution.

AUXILIARY ENERGY SYSTEM: The existing system, which uses a gas fired boiler to heat the water in the old storage tank, provides auxiliary heat.

FLORIDA
879 DD
MF LOW RETRO
ACTIVE DHW
137

COLORADO

6283 DD

MF LOW RETRO

ACTIVE DHW

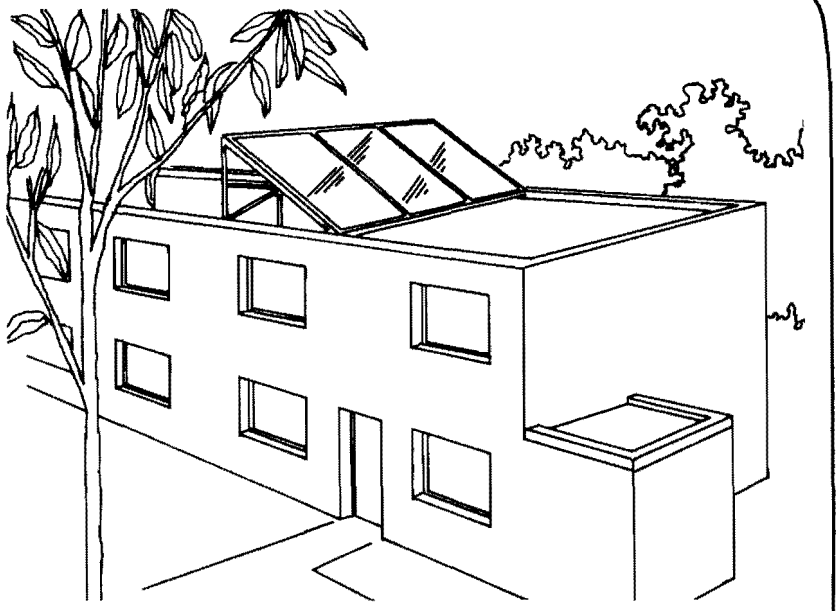
140

PROJECT INFORMATION:

BUILDER/APPLICANT: Denver Housing Authority
DESIGNER: F. Remmers
SOLAR SUB:
LOCATION: Denver, CO
HOUSING TYPE: MF Low, 8 Units
CLIMATIC DATA:
HEATING DD: 6,283
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 744 BTU/sq. ft.

LATITUDE: 39°40'N
AREA: 800-1,000 sq. ft.

DESIGN TEMP:
INDOOR: 68° F
% SUN/YR: 67%



BUILDING DESCRIPTION/ENERGY CONCERNS

The Denver Housing Authority has installed domestic hot water solar energy systems at the Authority's Westwood Apartment Complex. This complex contains 32 buildings with 8 garden apartments in every building. One of the buildings has been retrofitted with a solar system.

SOLAR ENERGY SYSTEM: ACTIVE

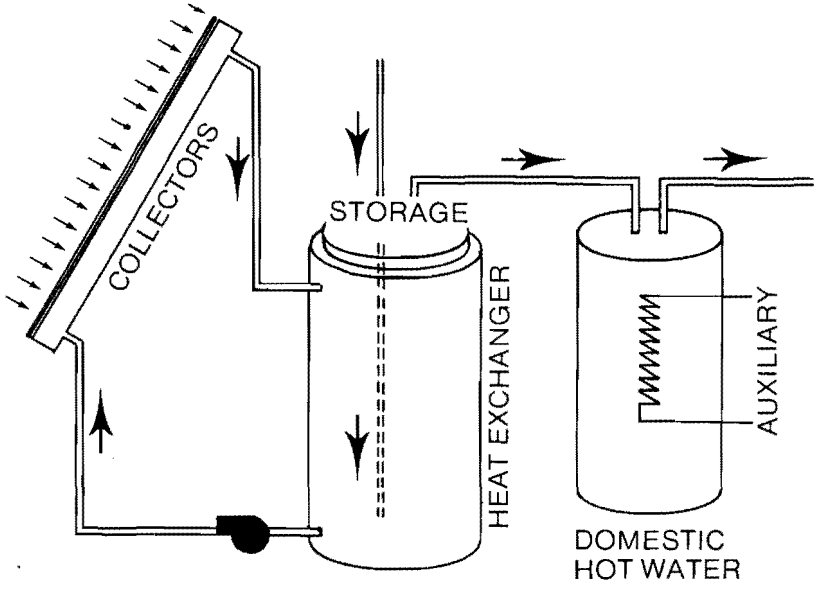
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 86%

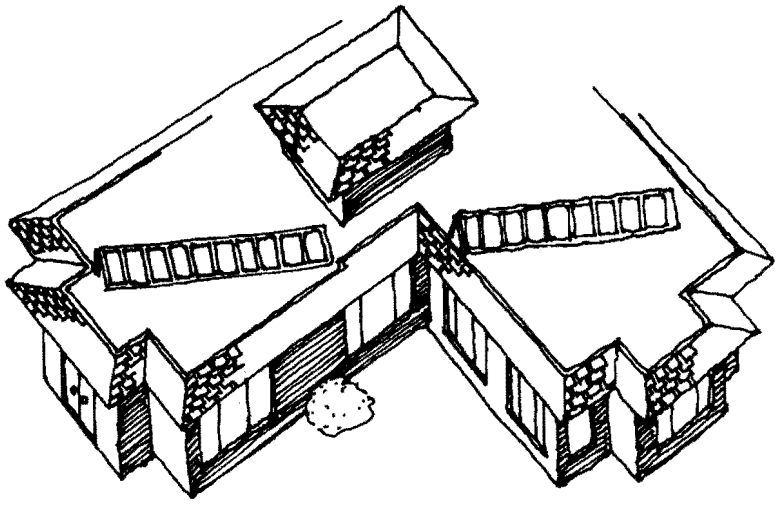
COLLECTOR: Miromit collectors have been used on the building. Each unit has its own system, with 60 sq. ft. of collector area. They are rack mounted on the roof at a 35° tilt, and an antifreeze and water solution is used as a transfer media.

STORAGE: Antifreeze flows from the collector to an annular jacket which surrounds the 66 gallon DHW tank in each unit. Heat is transferred through the walls of the jacket to the potable water.

DISTRIBUTION: The preheated water flows to a conventional DHW tank for distribution.

AUXILIARY ENERGY SYSTEM: An electric heating coil in the conventional DHW tank raises the water to operating temperature.



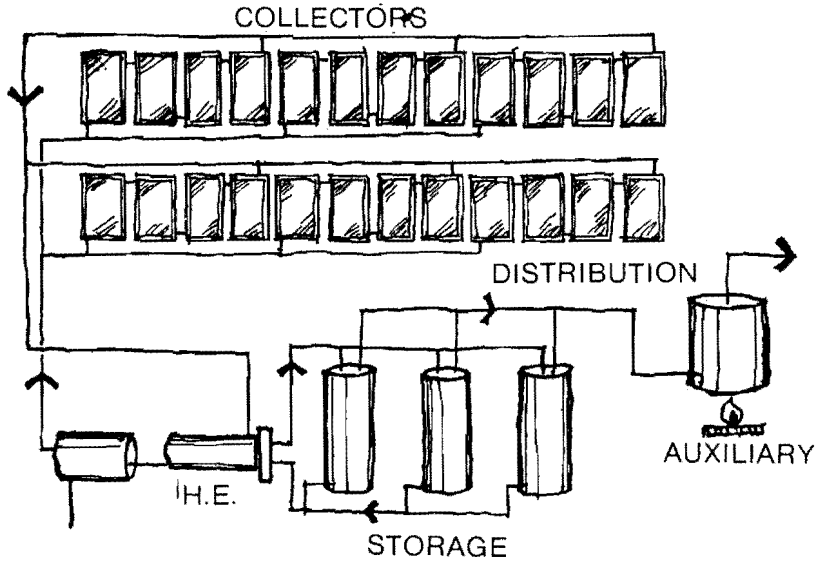


PROJECT INFORMATION:

BUILDER/APPLICANT: Lincoln Lutheran, Racine, Wisconsin
DESIGNER: R. Ernst & P. E. Sodel
SOLAR SUB: Solar System, Inc.
LOCATION: Racine, WI
LATITUDE: 42°42'N
HOUSING TYPE: MF Low, 50 Units
AREA:
CLIMATIC DATA:
HEATING DD: 7,635
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 548 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

This existing 5-story building for the elderly is being retrofitted with a solar domestic hot water system. The project involves 50 units of housing.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 80%

COLLECTOR: 1,032 sq. ft. of Revere flat-plate collectors are rack-mounted at a 55° angle on the roof of the building. The antifreeze and water solution heated in the collectors is pumped to a central heat exchanger, transferring solar heat to a water storage medium.

STORAGE: A total of 1,044 gallons of water in 3 storage tanks acts as solar storage. Two inches of fiberglass insulation protect the tanks from heat loss.

DISTRIBUTION: The solar heated water is distributed through the existing DHW system.

AUXILIARY ENERGY SYSTEM: The existing gas-fired DHW heaters provide auxiliary energy for the hot water supply.

ACTIVE HEATING & DHW — MF LOW RETRO — 7635 DD — WISCONSIN

141

VERMONT

8269 DD

MF MID RETRO

ACTIVE DHW

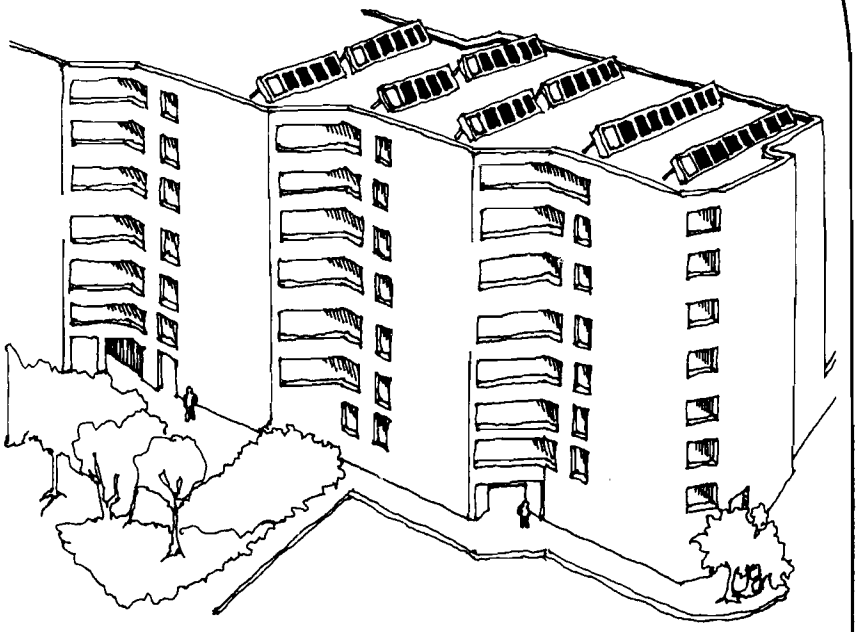
142

PROJECT INFORMATION:

BUILDER/APPLICANT: Cathedral Square Corp.
DESIGNER: Anthony Adams
SOLAR SUB: Robert Wheeler
LOCATION: Burlington, VT
HOUSING TYPE: MF MID, 100 Units
CLIMATIC DATA:
HEATING DD: 8,269
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 433 BTU/sq. ft.

LATITUDE: 44°N
AREA: 500 sq. ft.

DESIGN TEMP:
INDOOR:
% SUN/YR: 51%



BUILDING DESCRIPTION/ENERGY CONCERNS

Cathedral Square Apartments is an existing medium-rise eight-story building. The 100 apartments are mostly 1 bedroom units of 500 sq. ft. each. The building is being designed to include a solar domestic hot water preheat system.

SOLAR ENERGY SYSTEM: ACTIVE

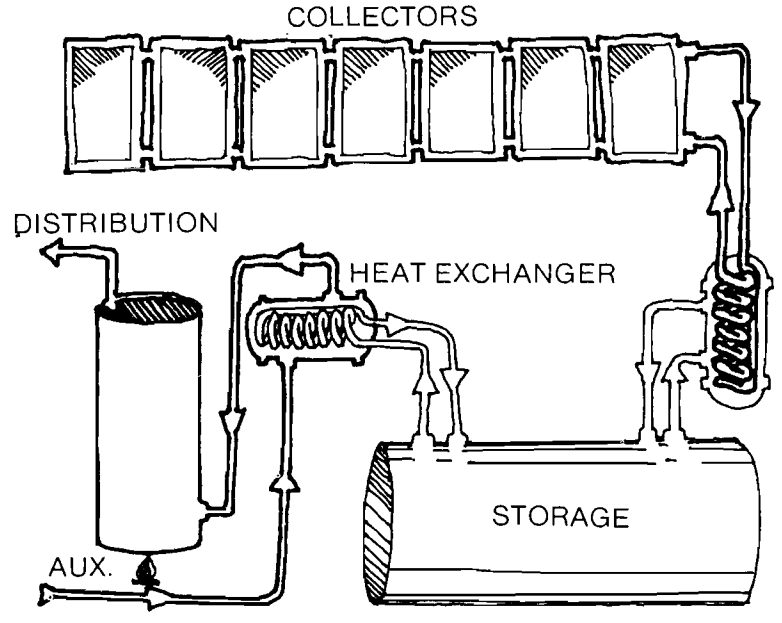
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 48%

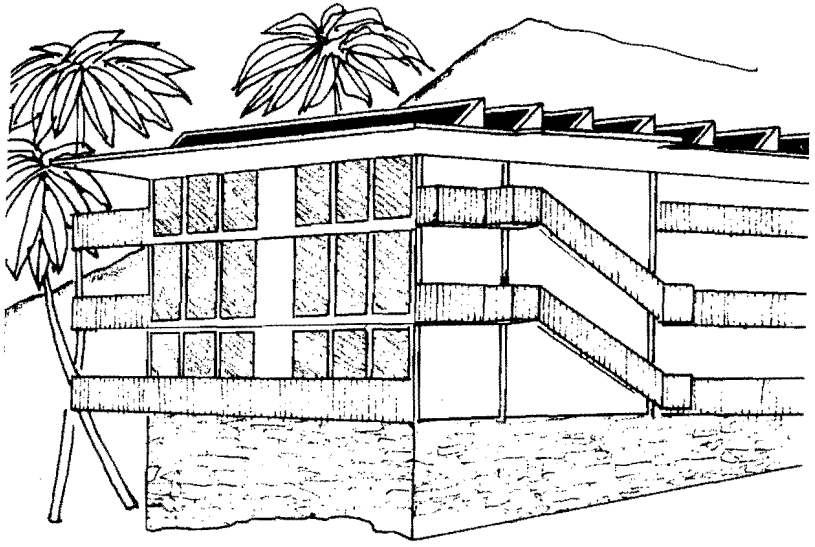
COLLECTOR: 1,071 sq. ft. of collector surface consisting of 81 "Day-star 20" solar panels are mounted with brackets onto the roof. The panels face due South at a 44° tilt. A 60% glycerol/40% water solution collects solar heat and transfers it to storage water in a shell and tube heat exchanger.

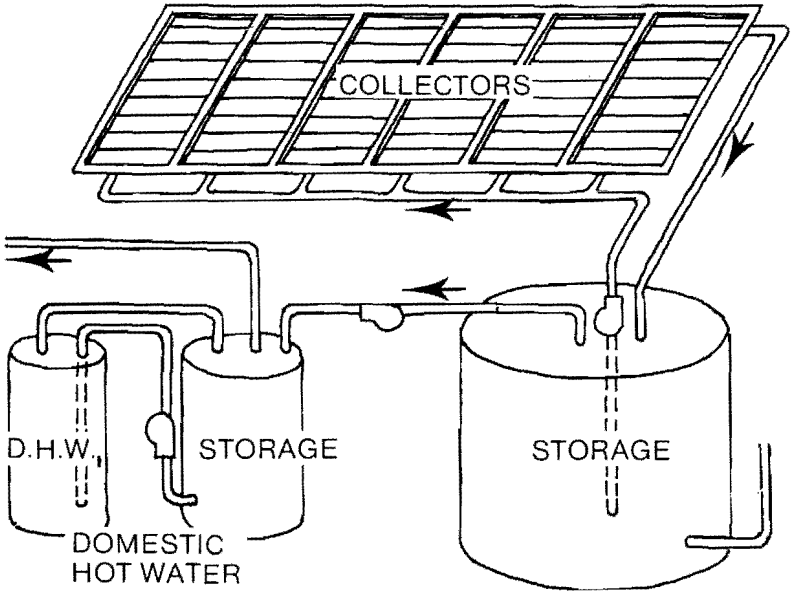
STORAGE: A 3,000 gallon tank, with 2" of batt insulation, stores the solar heated water.

DISTRIBUTION: Heated water from the storage tank is circulated through a shell and tube heat exchanger where heat is transferred to the incoming city water for domestic hot water preheat.

AUXILIARY: A 4,000 gallon gas-fired domestic hot water tank provides auxiliary heating and conventional distribution.







PROJECT INFORMATION:

BUILDER/APPLICANT: Diamond Head Alii Corp.
DESIGNER: D. Alldredge & M. Bean
SOLAR SUB: Fafco Hawaii
LOCATION: Honolulu, HI — **LATITUDE:** 21°N
HOUSING TYPE: MF Mid, 54 Units — **AREA:**
CLIMATIC DATA:
HEATING DD: 0 — DESIGN TEMP:
DESIGN TEMP: WINTER: — INDOOR:
HORIZ. INSOL. JAN. DAY: 1,343 BTU/sq. ft. & SUN/YR: 65%

BUILDING DESCRIPTION/ENERGY CONCERNS

An already existing multi-family medium rise apartment building is to be retrofitted with solar panels for hot water heating. The building is 3 floors in height and consists of 55 units.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 97%

COLLECTOR: 1,914 sq. ft. of collector surface consisting of 110 Raypak flat plate water collector panels are mounted with brackets onto the roof. The panels face 25° east of south at a tilt of 24°. Water is pumped through the collectors, heated, and pumped to a central storage tank.

STORAGE: A 3,435 gallon glass lined steel tank is insulated with 2" of rigid insulation.

DISTRIBUTION: Water heated in the preheat storage tank is pumped through the existing DHW system.

AUXILIARY ENERGY SYSTEM: The existing gas fired water heater provides backup heating and distribution.

TEXAS

1549 DD

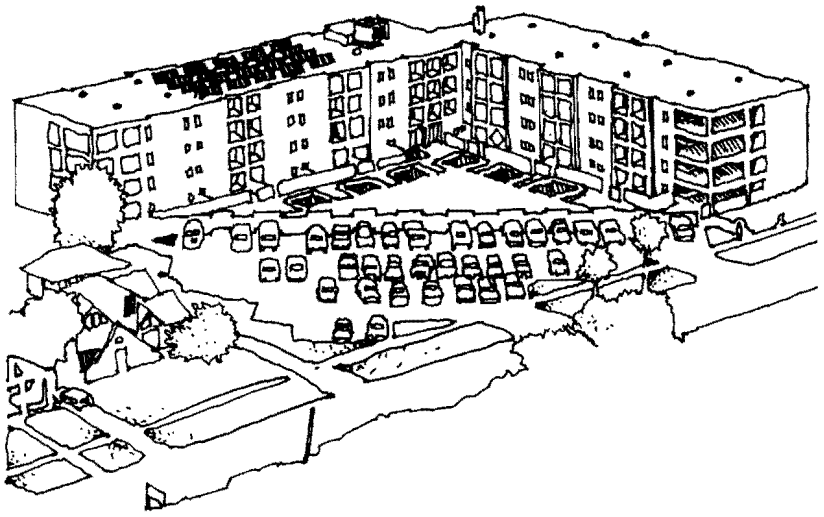
MF MID RETRO

ACTIVE DHW

144

PROJECT INFORMATION:

BUILDER/APPLICANT: Housing Authority of San Antonio
DESIGNER: K. M. Anderson & S. Huck
SOLAR SUB: Jud Plumbing & Heating
LOCATION: San Antonio, TX
LATITUDE: 30°N
HOUSING TYPE: MF Mid, 100 Units
AREA: 950 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 1,549
DESIGN TEMP:
DESIGN TEMP: WINTER:
INDOOR:
HORIZ. INSOL. JAN. DAY: 1.032 BTU/sq. ft.
% SUN/YR: 62%

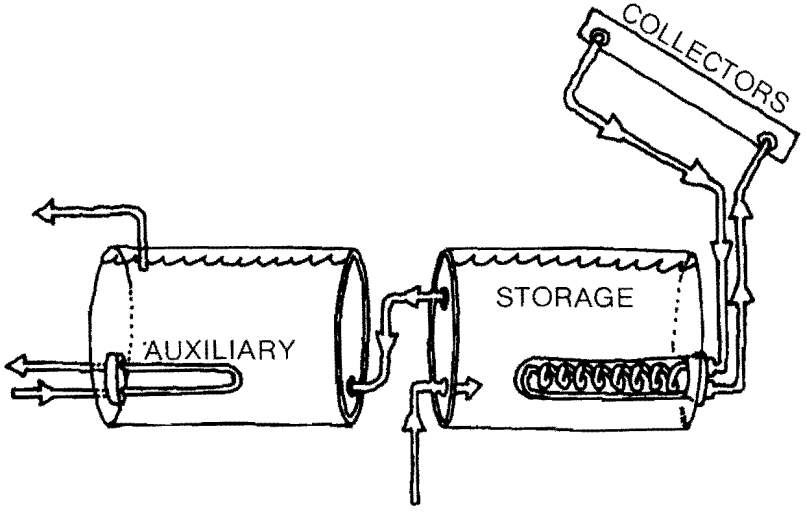


BUILDING DESCRIPTION/ENERGY CONCERNS

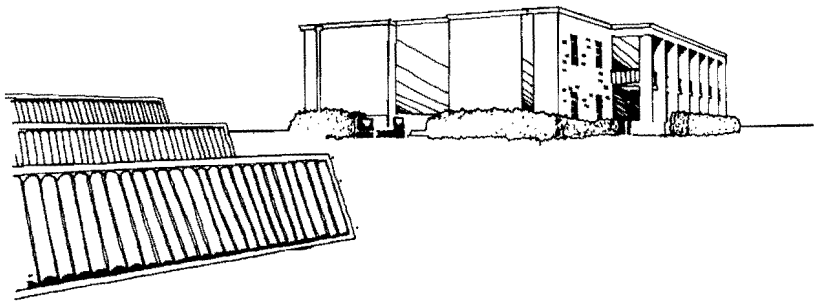
The Blanco Apartments, a 100 unit housing development, have been retrofitted with collectors to provide energy for domestic water preheating. This 4 story building is located in the northwest section of San Antonio, Texas.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 76%



COLLECTOR: Liquid flat plate collectors, manufactured by Sunworks, have been rack mounted on the roof at a 36° tilt. These collectors, which are oriented directly south, use a copper absorption plate, surfaced with a selective coating, and covered with 2 sheets of tempered glass. A total of 1,868 sq. ft. of collector surface is used. An antifreeze, containing water, propylene glycol and a corrosion inhibiting agent, is used as the transfer medium.
STORAGE: Three tanks, each containing 1,100 gallons of water, provide storage for the system. Each tank contains a heat exchange coil containing heated antifreeze in order to preheat water for domestic use. Each tank is protected against heat loss by 4" of insulation.
DISTRIBUTION: Water from the solar heated tanks circulates to a conventional DHW tank and then to the individual living units.
AUXILIARY ENERGY SYSTEM: A gas fired heater, in the conventional DHW tank, provides auxiliary energy for the system.

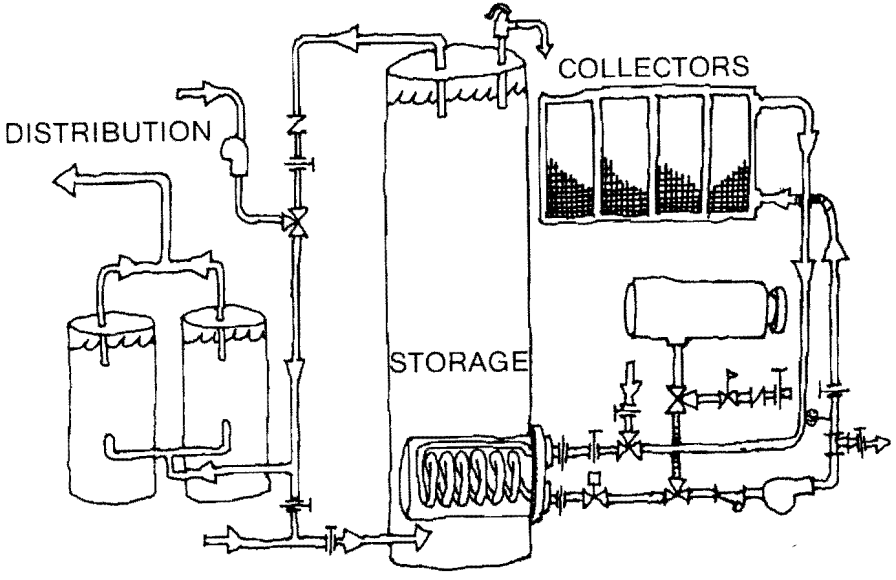


PROJECT INFORMATION:

BUILDER/APPLICANT: Housing Authority San Antonio
DESIGNER: K. M. Anderson & S. Huck
SOLAR SUB: Jud Plumbing & Heating Co.
LOCATION: San Antonio, TX **LATITUDE:** 30°0'N
HOUSING TYPE: MF Mid, 100 Units **AREA:**
CLIMATIC DATA:
HEATING DD: 1,549 DESIGN TEMP:
DESIGN TEMP: WINTER: INDOOR:
HORIZ. INSOL. JAN. DAY: 1,032 BTU/sq. ft. % SUN/YR: 62%

BUILDING DESCRIPTION/ENERGY CONCERNS

In this retrofit project, a 25-room college dormitory will use solar energy to heat domestic hot water. In order to further conserve energy, the operating temperature of the system is being lowered and the flow rate to the fixtures is being reduced.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 85%

COLLECTOR: 720 sq. ft. of Northrup tracking, concentrating collectors are rack mounted on the ground next to the dormitory. They are tilted at a 32° angle for maximum exposure to the sun in all seasons. Antifreeze is used as the heat transfer media.

STORAGE: A 1,500 gallon steel storage tank is located on the north side of the building and is insulated with 6" of urethane foam. Solar heated antifreeze, from the collectors, transfers the collected heat to storage water through a heat exchanger in the bottom of the storage tank.

DISTRIBUTION: The pre-heated water is pumped to existing DHW heater for auxiliary heating and distribution.

AUXILIARY ENERGY SYSTEM: Gas-fired DHW heaters supply auxiliary energy.

VIRGINIA

4224 DD

MF MID RETRO

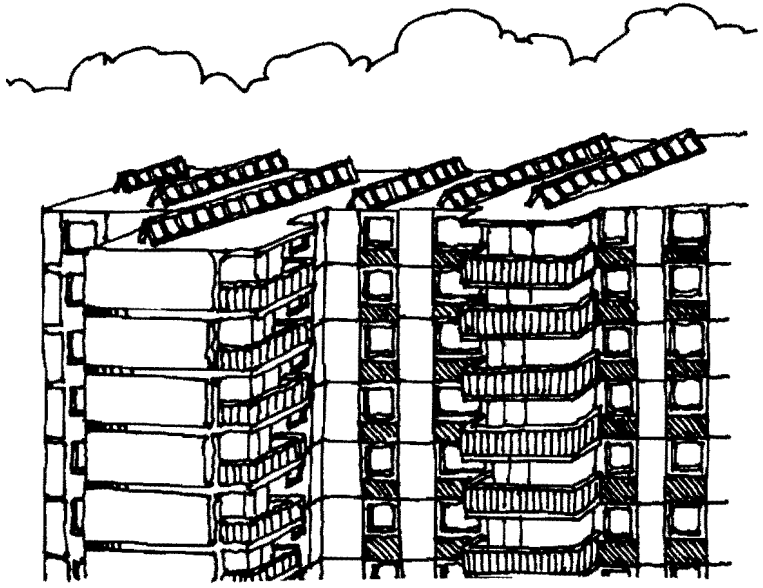
ACTIVE DHW

146

PROJECT INFORMATION:

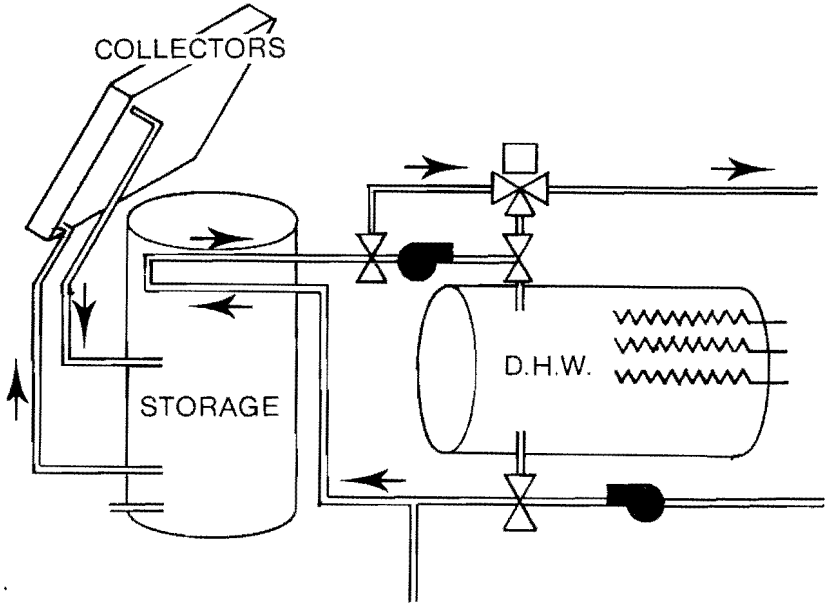
BUILDER/APPLICANT: Barcroft Hills Council-Co-Owners
DESIGNER: Daniel H. Lufkin
SOLAR SUB: J. Allan Dickson
LOCATION: Falls Church, VA
HOUSING TYPE: MF MID, 140 Units
CLIMATIC DATA:
HEATING DD: 4,224
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 584 BTU/sq. ft.

LATITUDE: 38°N
AREA:
DESIGN TEMP:
INDOOR:
% SUN/YR: 50%



BUILDING DESCRIPTION/ENERGY CONCERNS

Solar collection panels have been added to this existing medium rise, multi-family condominium to provide domestic hot water. The condominium contains 140 units.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: 2,800 sq. ft. of Solara flat-plate collectors are mounted with brackets onto the roof of the mid-rise building. They are oriented due south at a tilt of 60°. Water is circulated through the flat plate copper absorber panels then pumped to solar storage.

STORAGE: A 3,000 gallon galvanized steel tank is sheathed with 2" of insulation to serve as water storage.

DISTRIBUTION: Cold water is preheated in a copper tube fin in solar storage. If necessary, the water temperature is boosted by the existing DHW heater before being supplied to the living unit.

AUXILIARY ENERGY SYSTEM: The already existing electric domestic hot water heater provides auxiliary heat.

PROJECT INFORMATION:

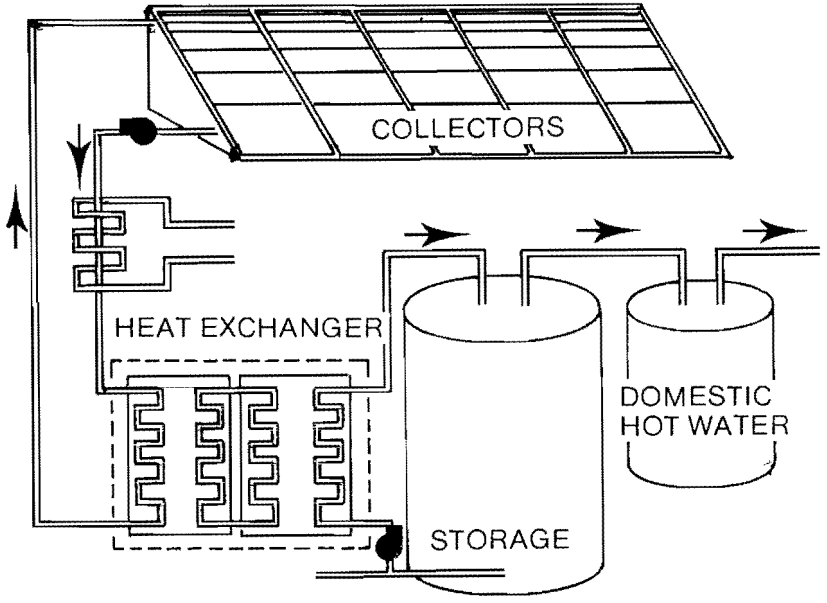
BUILDER/APPLICANT: Pantheon Corp.
DESIGNER: W. Cargal & A. Swift
SOLAR SUB: Jess Menton
LOCATION: St. Louis, MO
HOUSING TYPE: MF MID, 112 Units
CLIMATIC DATA:
HEATING DD: 4,900
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 640 BTU/sq. ft.

LATITUDE: 39°N
AREA: 800 sq. ft./unit

DESIGN TEMP:
INDOOR:
% SUN/YR: 61%

BUILDING DESCRIPTION/ENERGY CONCERNS

Two existing buildings in downtown St. Louis are being rehabilitated and will use solar energy to heat domestic water. The two buildings have 112 one-bedroom units, and will be used as elderly housing.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 55%

COLLECTOR: The collectors for the system are rack mounted on the roof of the two 6-story buildings at a tilt of 54°. An antifreeze solution runs through the collector and transfers heat from the antifreeze to distilled water in a double heat exchanger. The distilled water then flows through another heat exchanger, transferring the heat to water.

STORAGE: A 3,000 gallon hot water storage tank, located on the ground floor serves as a preheat tank. Insulated with 2" of foam insulation, heated water is stored until demand.

DISTRIBUTION: The solar heated water is pumped from the preheat tank to the existing distribution system.

AUXILIARY ENERGY SYSTEM: An existing gas-fired boiler provides auxiliary heating for the DHW system.

PENNSYLVANIA

5101 DD

MF MID RETRO

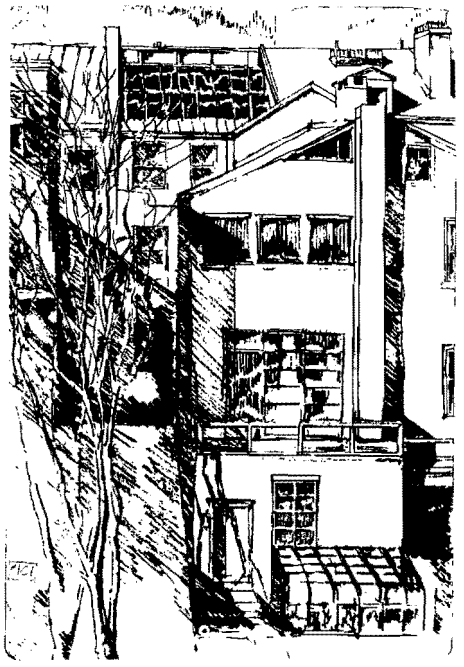
ACTIVE DHW

148

PROJECT INFORMATION:
BUILDER/APPLICANT: The Fumo-Manfredi Partnership
DESIGNER: Donald Prowler
SOLAR SUB: I. H. English
LOCATION: Philadelphia, PA
HOUSING TYPE: MF Mid, 9 Units
CLIMATIC DATA:
HEATING DD: 5,101
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 581 BTU/sq. ft.

LATITUDE: 40°N
AREA:

DESIGN TEMP:
INDOOR:
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

A solar energy system preheats domestic hot water for the 9 apartments being constructed in this fire-gutted building shell. The apartments vary in floor area from 430 sq. ft. to 1,170 sq. ft., some with greenhouses. The building is located in a historical area of the city of Philadelphia.

SOLAR ENERGY SYSTEM: ACTIVE

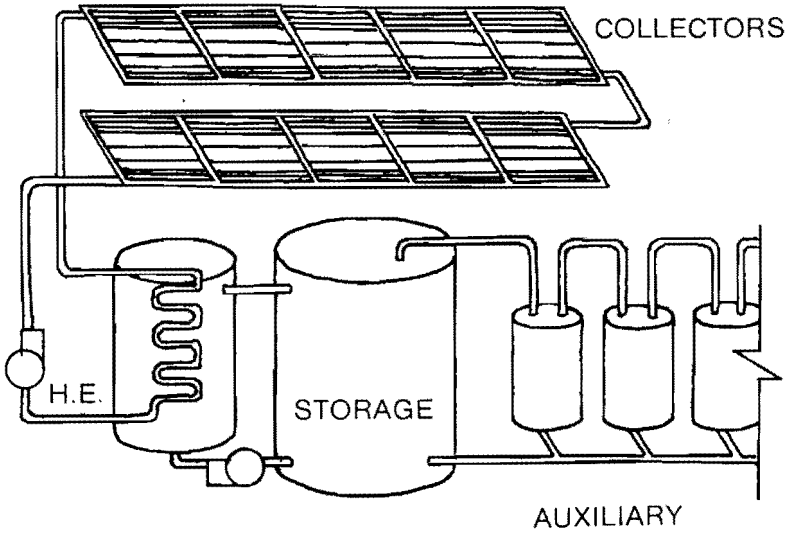
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 75%

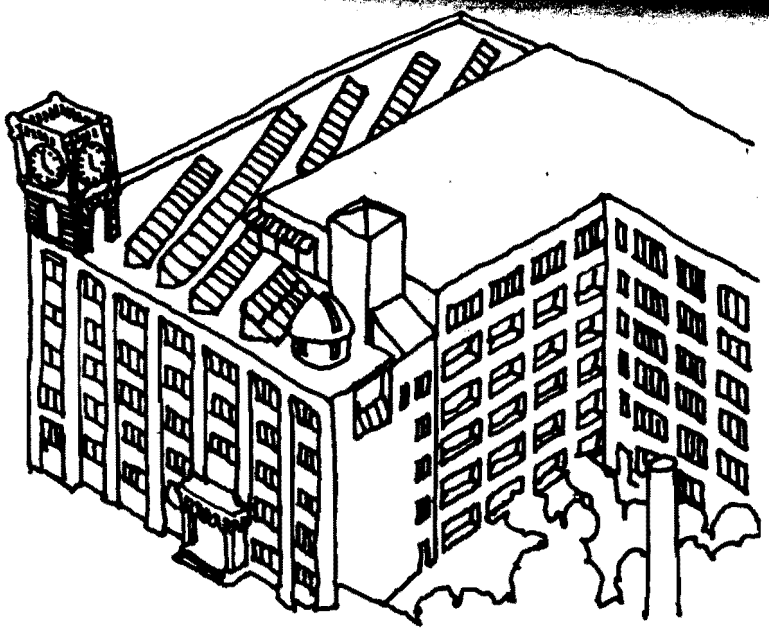
COLLECTOR: A total of 277 sq. ft. of Sunearth flat-plate collectors are mounted at a 50° degree angle on the roof, facing 10° west of south. A 50/50 mix of ethylene glycol and water circulates through the collectors, then carries heat to a central heat exchanger.

STORAGE: Collected heat is transferred in the heat exchanger to water and carried to a 300 gallon water tank, located in the basement of the building.

DISTRIBUTION: The preheated storage water is pumped to conventional DHW heaters in the individual apartments for distribution.

AUXILIARY ENERGY SYSTEM: The DHW heaters in the apartments have electrical heaters to boost the water supply to operating temperatures.

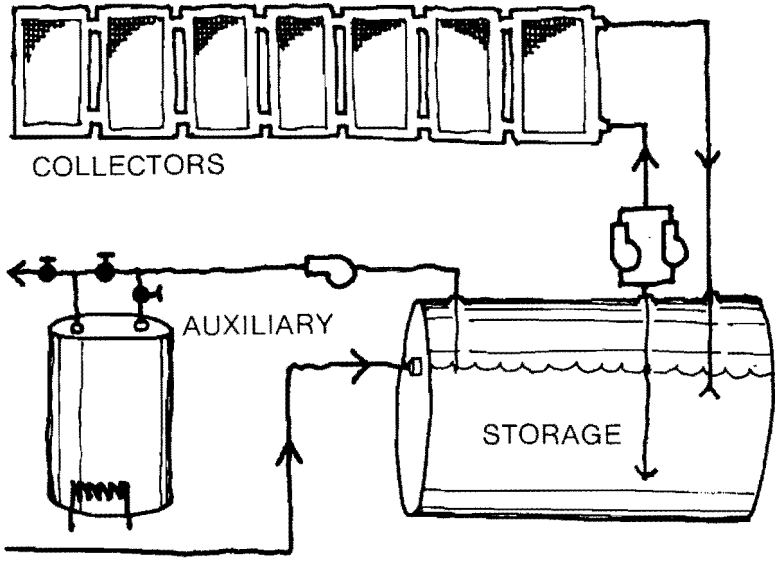




DESIGNER: George Lange
SOLAR SUB: Sidney Silverstein
LOCATION: Hoboken, NJ
LATITUDE: 40°45'N
HOUSING TYPE: MF Mid, 172 Units
AREA:
CLIMATIC DATA:
HEATING DD: 5,219
DESIGN TEMP: WINTER:
DESIGN TEMP: INDOORS:
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.
% SUN/YR: 47%

BUILDING DESCRIPTION/ENERGY CONCERNS

This factory is being rehabilitated for 172 moderately-sized apartments and redesigned to include a solar collection system to heat domestic hot water. The building includes efficiency, 1, 2, 3 and 4 bedroom apartments.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 39%

COLLECTOR: Almost 4,000 sq. ft. of Sunworks flat-plate collectors are located on the roof of the building. They are rack-mounted at a 40° tilt. Water is used to collect heat, so the collectors drain down to holding tanks in order to prevent freezing.

STORAGE: A 7,500 gallon water tank is buried next to the building for solar storage. Incoming water is pumped to this tank before being pumped to the collector. After collecting solar heat, the water returns to the tank.

DISTRIBUTION: This preheated water is then pumped to the existing boiler where it is auxiliary heated to bring it up to operating DHW temperature.

AUXILIARY ENERGY SYSTEM: The auxiliary DHW boiler is fired by oil.

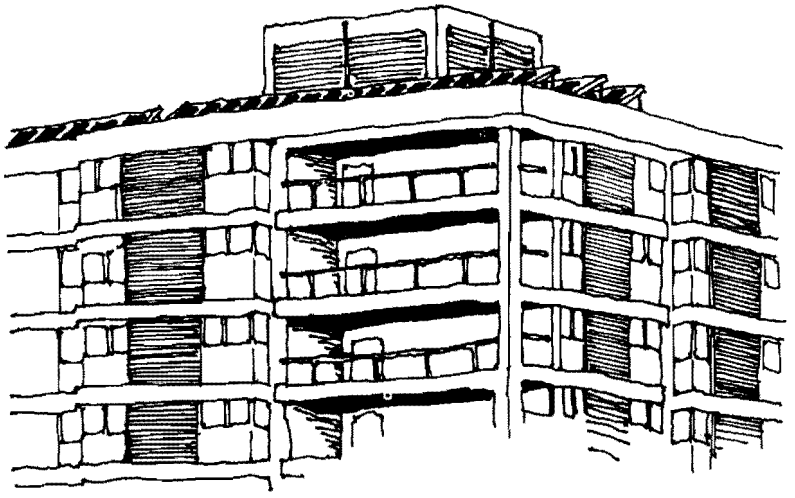
ACTIVE DHW | MF LOW RETRO | 5634 DD | MASSACHUSETTS

150

PROJECT INFORMATION:
BUILDER/APPLICANT: Gloucester Housing Authority
DESIGNER: James A. Fitzgerald, AIA
SOLAR SUB: New England Solar Systems
LOCATION: Gloucester, MA
HOUSING TYPE: MFM, 97 Units
CLIMATIC DATA:
HEATING DD: 5,634
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 585 BTU/sq. ft.

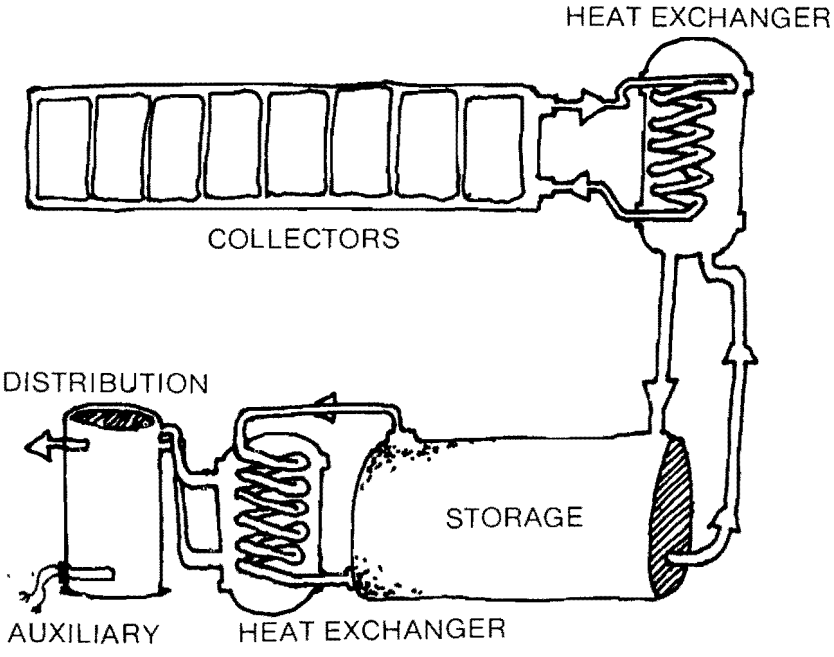
LATITUDE: 42°N
AREA: 473 sq. ft./unit

DESIGN TEMP:
INDOOR:
% SUN/YR: 57%



BUILDING DESCRIPTION/ENERGY CONCERNS

This existing multi-unit medium rise building will demonstrate a solar domestic hot water heating system. The apartment building consists of 97 units for the elderly.



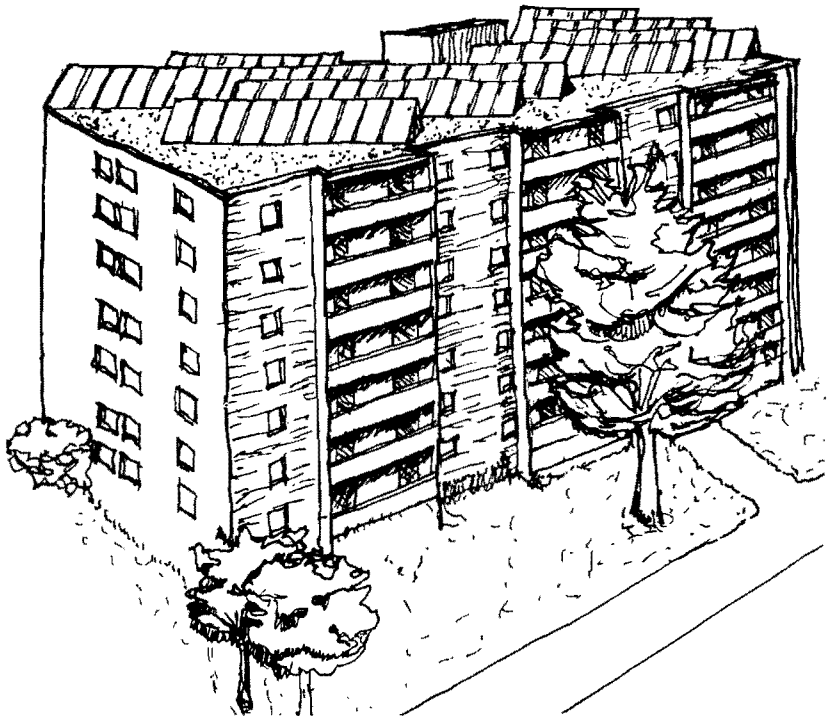
SOLAR ENERGY SYSTEM: ACTIVE

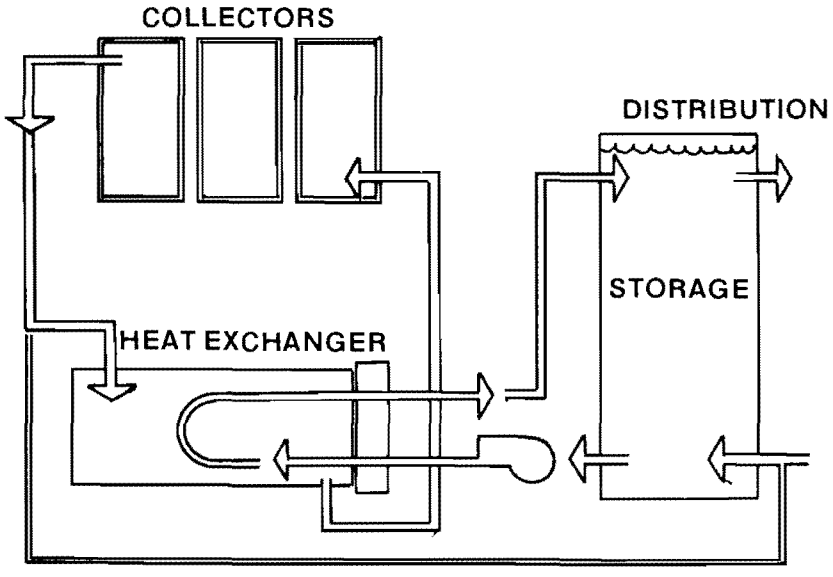
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 53%

COLLECTOR: 105 "Daystar 20" collectors are arrayed on the roof facing directly south at a tilt of 42°. The panels have a corrugated heat trap under which is located a copper absorber plate, backed by foam insulation. A 60/40 glycerol-water solution carries solar heat through a double shell and tube heat exchanger transferring heat to water.

STORAGE: A 6,000 gallon capacity steel tank stores solar heated water.

AUXILIARY ENERGY SYSTEM: Three 400 gallon capacity electric hot water heaters provide auxiliary and back up heating.





PROJECT INFORMATION:

BUILDER/APPLICANT: Hancock House Realty Trust
DESIGNER: Steven S. Strong
SOLAR SUB: Samuel Junta
LOCATION: Qunicy, MA
LATITUDE: 42°N
HOUSING TYPE: MF Mid, 92 Units
AREA: 667 sq. ft./unit
CLIMATIC DATA:
HEATING DD: 5,634
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 529 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 59%

BUILDING DESCRIPTION/ENERGY CONCERNS

The Hancock House is an eight-story 92-unit apartment building housing primarily senior citizens. The building is five years old and was previously being provided with hot water by a Megatherm electric boiler, which will now be supplemented by solar panels.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 55%

COLLECTOR: 1,976 sq. ft. of Daystar liquid flat-plate collectors on tubular steel trusses are mounted facing directly south at a 42° tilt. Solarguard "G" Glycerol solution transports collected heat through a shell and tube heat exchanger to water storage.

STORAGE: 1,000 gallons of solar heated water are stored in an insulated tank adjacent to the conventional DHW tank.

DISTRIBUTION: Preheated water is drawn from the top of the solar storage tank and taken to the existing DHW boiler for auxiliary heating and distribution.

AUXILIARY: An existing Megatherm electric boiler provides auxiliary and back-up energy for domestic hot water supply.

MASSACHUSETTS
5634 DD
MF MID RETRO
ACTIVE DHW
151

WEST VIRGINIA

5675 DD

MF MID RETRO

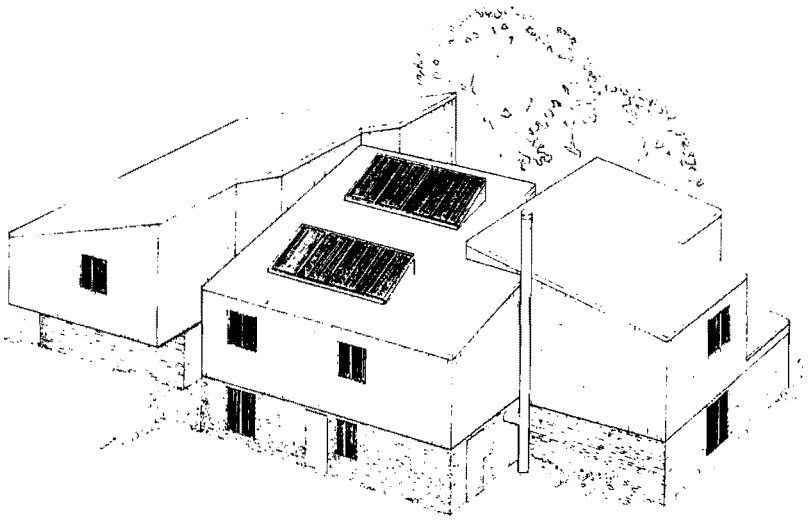
ACTIVE DHW

152

PROJECT INFORMATION:
BUILDER/APPLICANT: City of Clarksburg
DESIGNERS: Intertechnology Solar Corp.
SOLAR SUB: Intertechnology Solar Corp.
LOCATION: Clarksburg, WV
HOUSING TYPE: MF Mid, 21 Units
CLIMATIC DATA:
HEATING DD: 5,675
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 348 BTU/sq. ft.

LATITUDE: 39°0'N
AREA:

DESIGN TEMP:
INDOOR:
% SUN/YR: 48%



BUILDING DESCRIPTION/ENERGY CONCERNS

An existing low-income apartment complex is adding a solar system for domestic hot water heating. At first, only 7 buildings in the complex will receive solar systems, but the savings gained from these buildings will eventually pay for systems in all 34 buildings.

SOLAR ENERGY SYSTEM: ACTIVE

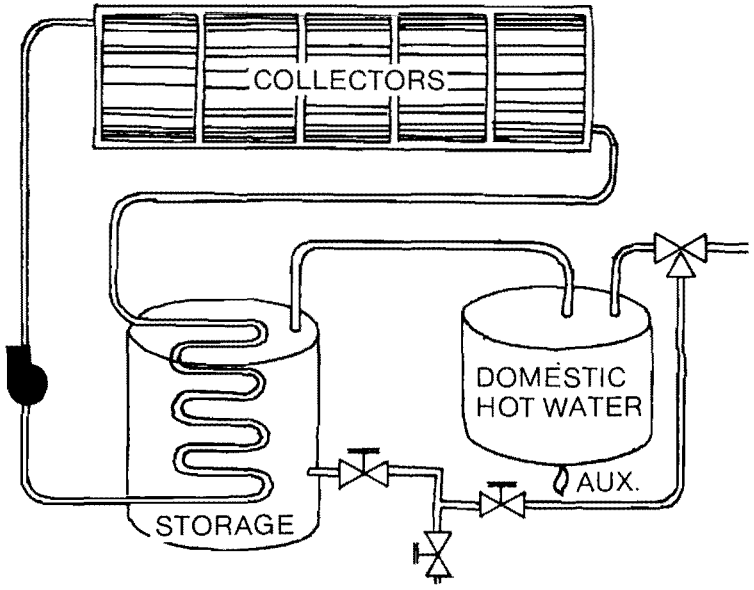
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 60%

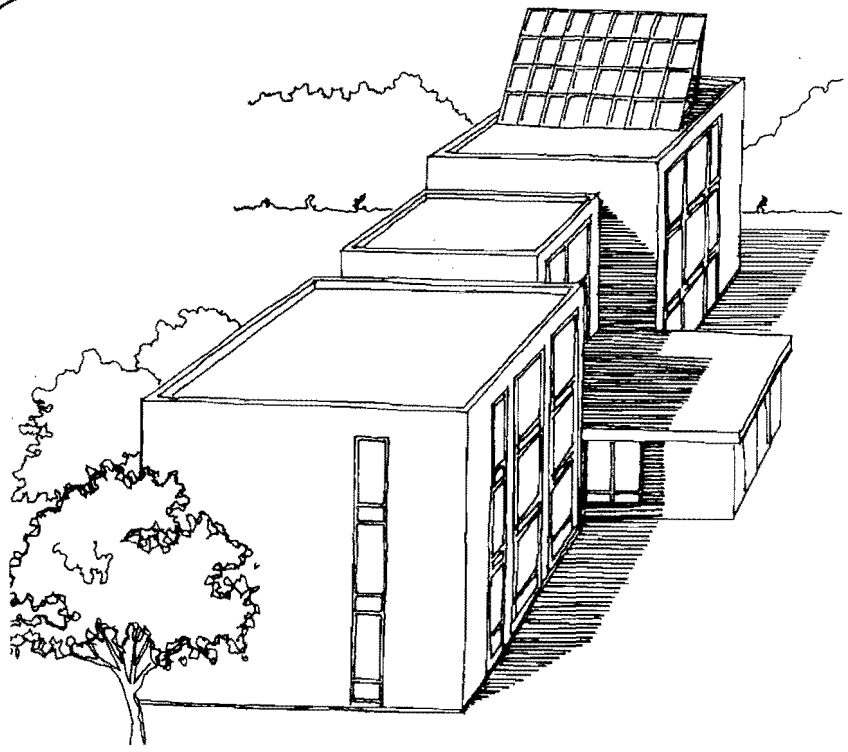
COLLECTOR: Each of the 7 buildings has 138 sq. ft. of flat-plate collectors rack-mounted on the existing south-facing roof at a tilt of 40°. Water is circulated through the collectors to a heat exchange coil in the solar storage tank. The collectors drain down to prevent freezing.

STORAGE: Each building has a 120 gallon solar storage tank located next to the existing DHW heater. Incoming water is pumped into the solar tank where it is preheated.

DISTRIBUTION: The hot water is drawn from solar storage and distributed by the existing DHW system.

AUXILIARY ENERGY SYSTEM: The existing gas-fired DHW system is the auxiliary energy source.





PROJECT INFORMATION:

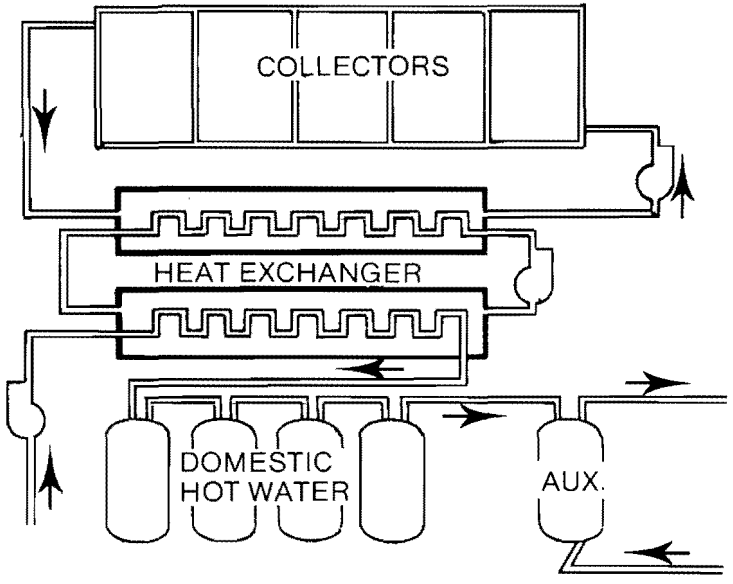
BUILDER/APPLICANT: Worcester Polytechnical Institute
DESIGNER: William A. Wright
SOLAR SUB: William F. Lynch
LOCATION: Worcester, MA
HOUSING TYPE: MF Mid, 36 Units
CLIMATIC DATA:
HEATING DD: 6,969
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 518 BTU/sq. ft.

LATITUDE: 42°N
AREA: 180 sq. ft./unit

DESIGN TEMP:
INDOOR:
% SUN/YR: 59%

BUILDING DESCRIPTION/ENERGY CONCERNS

Built in 1970, this mid-rise building is being retrofitted with a solar domestic hot water system. The building is a three-story dormitory containing 36 living units of approximately 180 sq. ft. each.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 68%

COLLECTOR: 588 sq. ft. of collector surface consists of one huge panel fabricated from a grid of 28 Daystar solar panels. The collector array is supported by a space truss on the roof and faces 8° west of south at a 45° tilt. A solution of 60% glycerol and 40% water collects heat in the solar panels and transfers heat to storage water in a series of shell and tube heat exchangers.

STORAGE: Eight 120 gallon stone-lined steel tanks are insulated with 2" batt for solar heated water storage.

DISTRIBUTION: City water is thus preheated in the second shell and tube heat exchanger for storage and conventional distribution by the adjacent existing water heater.

AUXILIARY ENERGY SYSTEM: The existing 284 gallon 120 KW electric hot water heater is in series with the solar storage tanks for auxiliary heating.

MASSACHUSETTS 6969 DD MF MID RETRO ACTIVE DHW

153

IDAHO

7033 DD

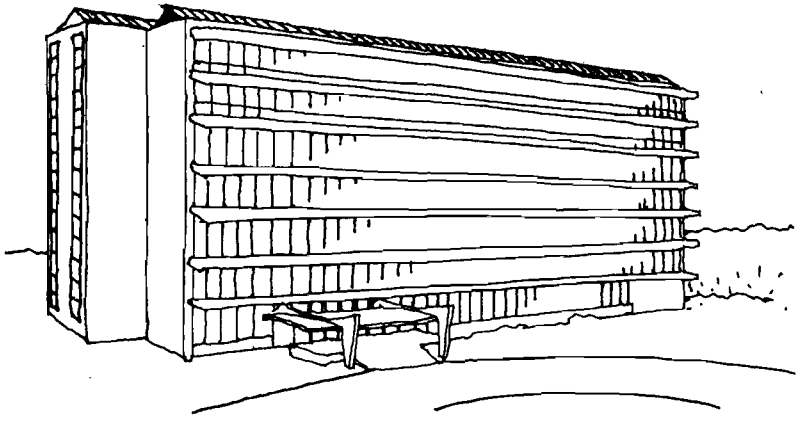
MF MID RETRO

ACTIVE DHW

154

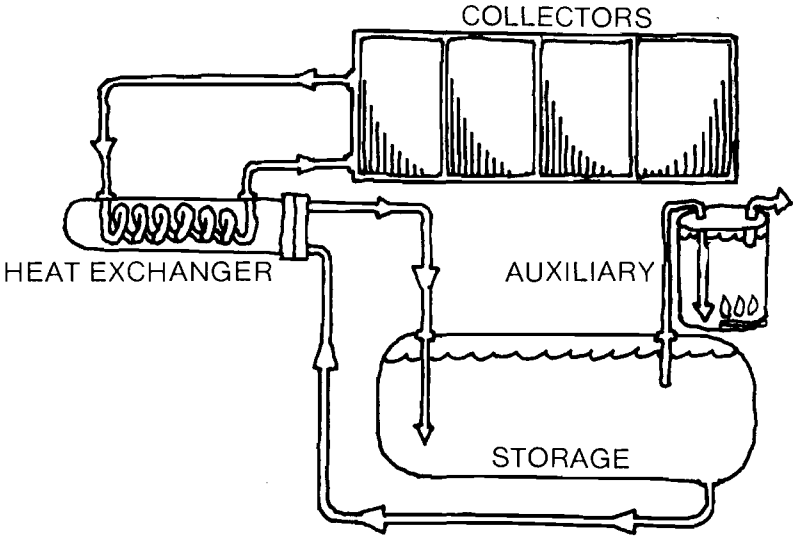
PROJECT INFORMATION:

BUILDER/APPLICANT: Idaho State University
DESIGNERS: P.W. Jensen & C. Sudweeks
SOLAR SUB: ISU Maintenance Dept.
LOCATION: Pocatello, ID — **LATITUDE:** 44°N
HOUSING TYPE: MF Mid, 160 Units — **AREA:**
CLIMATIC DATA:
HEATING DD: 7,033 — DESIGN TEMP:
DESIGN TEMP: WINTER: −10° F — INDOOR:
HORIZ. INSOL. JAN. DAY: 519 BTU/sq. ft. — % SUN/YR: 64%



BUILDING DESCRIPTION/ENERGY CONCERNS

This project involves the retrofit of an existing 5 story women's dormitory on the campus of Idaho State University. The solar system is to provide domestic hot water for 160 double rooms and a cafeteria.



SOLAR ENERGY SYSTEM: ACTIVE

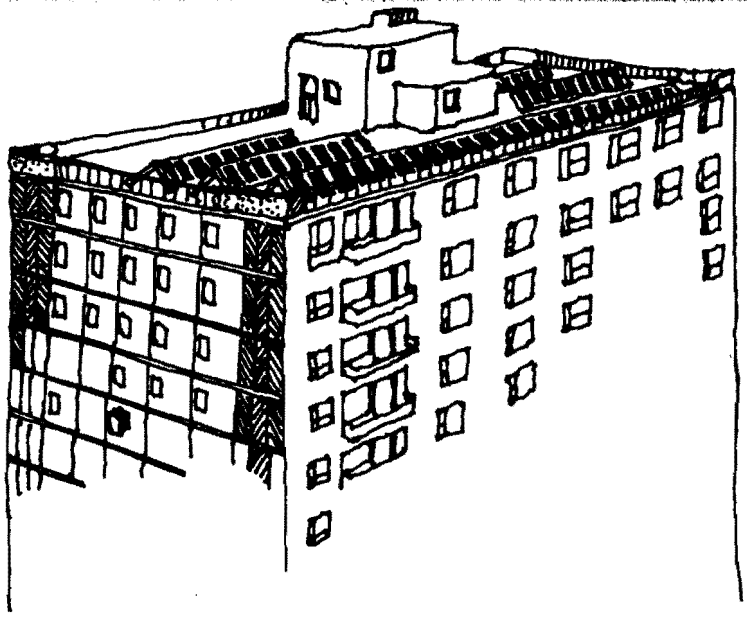
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 56%

COLLECTOR: 3,586 sq. ft. of Sunworks liquid collectors are rack mounted on the roof at a 48° angle. They face due south. The flat plate collectors use an anti-freeze and water solution to carry solar heat to a central heat exchanger. Storage water also circulates through the heat exchanger to transfer collected heat to solar storage.

STORAGE: A 12,000 gallon water tank buried in front of the building provides hot water storage for the DHW system.

DISTRIBUTION: Hot water is distributed through the existing DHW system.

AUXILIARY ENERGY SYSTEM: A gas-fired boiler provides back-up and auxiliary energy, with an assist from a central steam plant on campus.

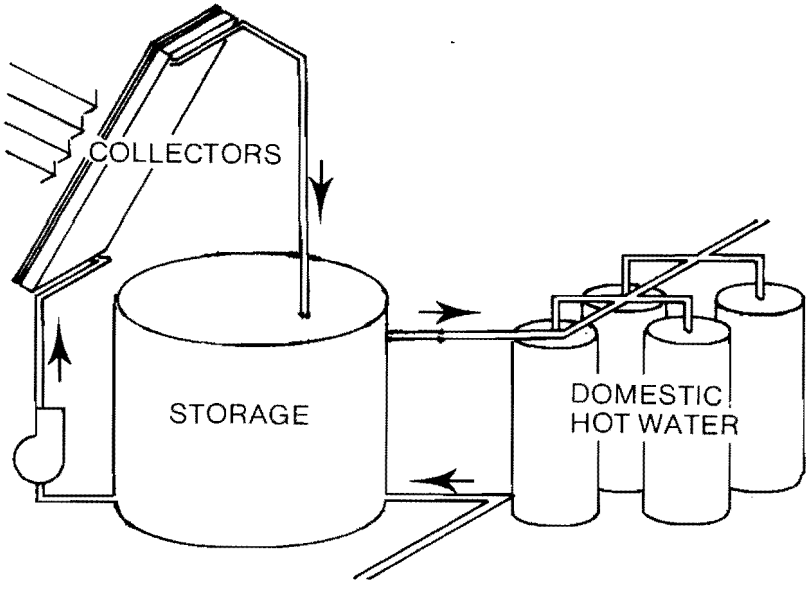


PROJECT INFORMATION:
BUILDER/APPLICANT: Lefrak Organization
DESIGNER: Morton Batlan
SOLAR SUB: Northeastern Solar Energy
LOCATION: New York, NY
HOUSING TYPE: MF High, 96 Units
CLIMATIC DATA:
HEATING DD: 5,219
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.

LATITUDE: 40°47'N
AREA:
DESIGN TEMP:
INDOOR:
% SUN/YR:

BUILDING DESCRIPTION/ENERGY CONCERNS

This high-rise apartment building, which is located on the east side of Manhattan, contains 230 efficiency and one bedroom apartments. The 96 apartments, located on the upper floors, will now be serviced by a solar DHW system.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 62%

COLLECTOR: 1,932 sq. ft. of Sunworks liquid flat plate collectors are rack-mounted on the roof. City water, supplied to the main storage tank, is pumped from storage to the collectors. Once heated, the water is returned to the storage tank. In winter, the system will drain down to prevent freezing.

STORAGE: One 2,000 gallon water tank provides for solar storage. The tank, which is insulated with 1" of fiberglass, contains an air cushion which allows for expansion of the stored water.

DISTRIBUTION: Preheated water from the main storage tank is pumped to the apartments' individual DHW heaters.

AUXILIARY ENERGY SYSTEM: Auxiliary hot water is provided by the separate DHW tanks which are oil-fired.

NEW YORK

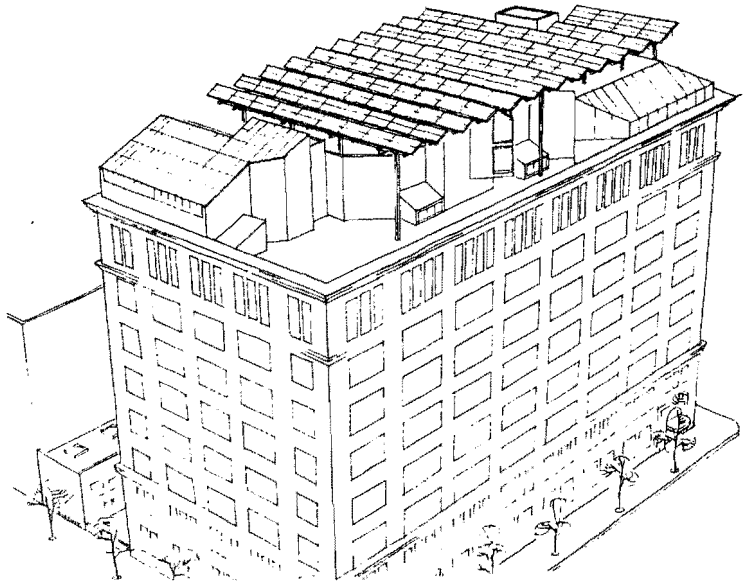
4848 DD

MF HIGH RETRO

ACTIVE DHW

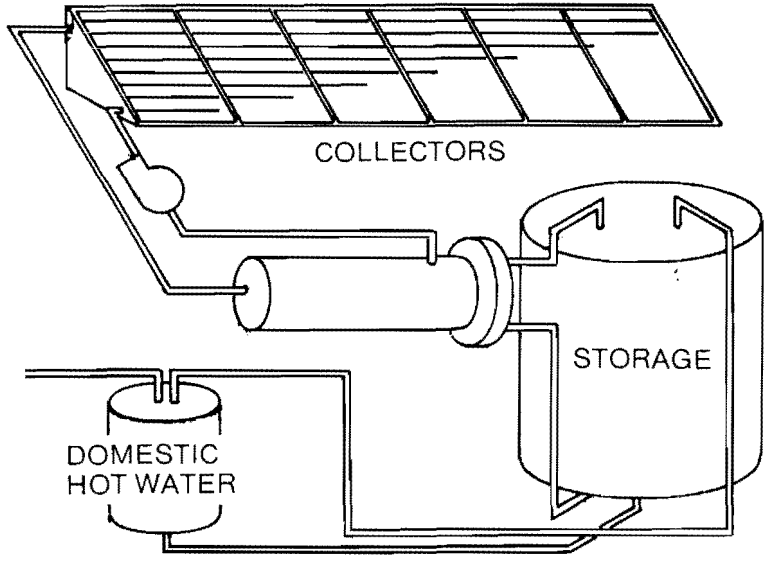
156

PROJECT INFORMATION:
BUILDER/APPLICANT: Mountbatten Equities
DESIGNER: Stephen B. Jacobs
SOLAR SUB: Stanley Corwin
LOCATION: New York, NY
LATITUDE: 40°46'N
HOUSING TYPE: MF High, 188 Units
AREA:
CLIMATIC DATA:
HEATING DD: 4,848
DESIGN TEMP: WINTER:
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.
DESIGN TEMP: INDOOR:
% SUN/YR: 45%



BUILDING DESCRIPTION/ENERGY CONCERNS

An old commercial printing building in the Greenwich Village section of New York City has been recycled and redesigned to contain 188 apartments with a solar assisted domestic hot water supply. The concept of recycling the old building is itself energy conserving, and the increased insulation and added insulating glass windows will further decrease energy consumption. The building contains one and two bedroom apartments, with plans for a restaurant and health club on the roof.



SOLAR ENERGY SYSTEM: ACTIVE

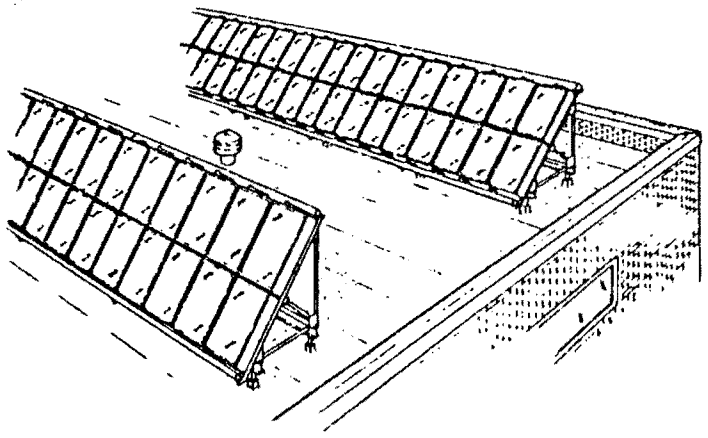
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 51%

COLLECTOR: The Grumman Energy Systems collectors are rack-mounted above the skylights on the roof of the building. They cover an area of 4,859 sq. ft. and use a silicone fluid to transfer heat from the flat plate collectors to water storage through an intermediate heat exchanger.

STORAGE: Solar storage is located in a 9,000 gallon water tank located in the solar equipment room on the roof.

DISTRIBUTION: The preheated water is pumped from storage to the existing DHW boiler in the basement. There it enters the conventional DHW distribution system.

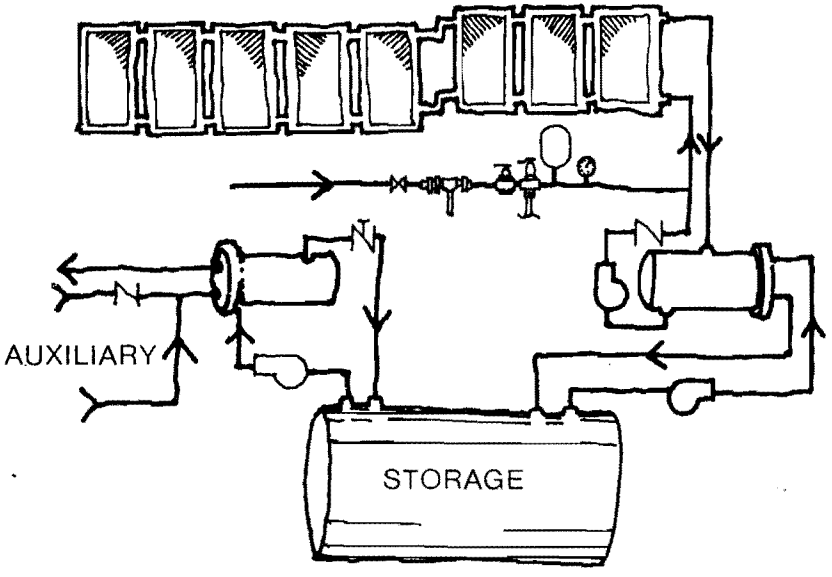
AUXILIARY ENERGY SYSTEM: An existing oil-burning boiler provides the auxiliary energy source for the DHW system.



PROJECT INFORMATION:
BUILDER/APPLICANT: West End Avenue Inc.
DESIGNERS: Stephen Weinstein
SOLAR SUB:
LOCATION: New York City, N.Y. **LATITUDE:** 40°0'
HOUSING TYPE: MF High, 68 Units **AREA:** 3,000 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,219 DESIGN TEMP:
DESIGN TEMP: WINTER: INDOOR:
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft. % SUN/YR: 59%

BUILDING DESCRIPTION/ENERGY CONCERNS

In this project, an existing high-rise apartment building, is being fitted with a solar energy system for domestic hot water. There are 3 and 4 bedroom models, with a total of 68 units in the building.



SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 60%

COLLECTOR: 2,457 sq. ft. of Daystar liquid flat plate collectors are rack-mounted onto the roof. The collectors face directly south at a tilt of 40°. A solution of 60% glycerol and 40% water is heated in the collectors before circulating through a double shell and tube heat exchanger in storage.

STORAGE: A 5,000 gallon steel tank stores water at an operating range between 85° F and 190° F. The tank is insulated with 2½" of batt insulation.

DISTRIBUTION: The heated storage water is pumped through a second shell and tube heat exchanger, to transfer heat to water in the existing domestic hot water tanks.

AUXILIARY ENERGY SYSTEM: The existing DHW tanks provide for both auxiliary heating and for distribution.

NEW YORK
5219 DD
MF HIGH RETRO
ACTIVE DHW
157

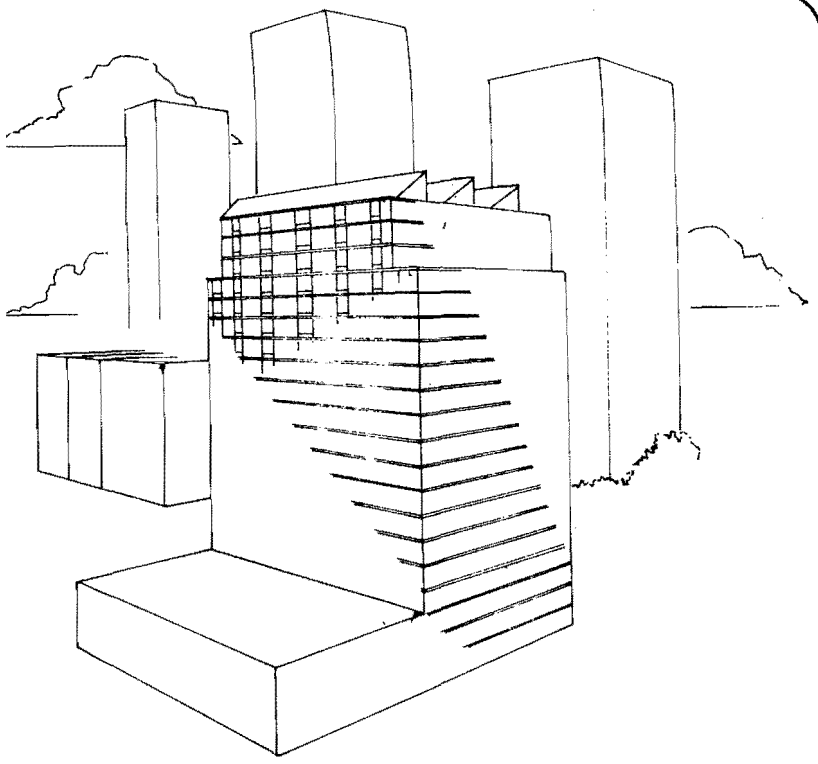
NEW YORK - MF HIGH RETRO - 5219 DD - ACTIVE DHW

158

PROJECT INFORMATION:
BUILDER/APPLICANT: Lefrak Organization
DESIGNER: Morton Batlan
SOLAR SUB: Northeastern Solar Energy
LOCATION: Forest Hills, NY
HOUSING TYPE: MF High, 207 Units
CLIMATIC DATA:
HEATING DD: 5,219
DESIGN TEMP: WINTER: 11° F
HORIZ. INSOL. JAN. DAY: 481 BTU/sq. ft.

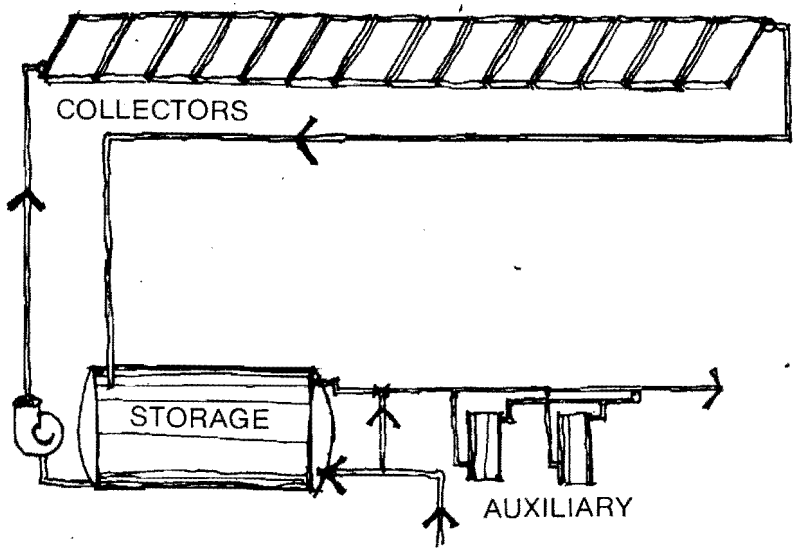
LATITUDE: 40°47'N
AREA: 1,000 sq. ft./unit

DESIGN TEMP:
INDOOR:
% SUN/YR: 59%



BUILDING DESCRIPTION/ENERGY CONCERNS

Rack mounted solar panels, to provide domestic hot water preheat, have been added to this already existing building. The multi-family high-rise apartment building consists of 207 units of one and two bedroom apartments, on 20 floors. The one bedroom apartments are approximately 740 sq. ft. in size and the two bedroom units are approximately 1,030 sq. ft.



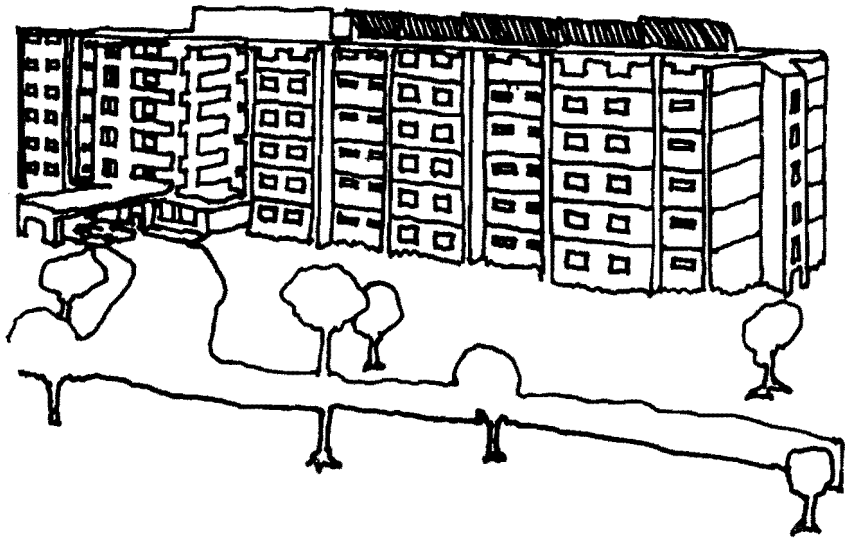
SOLAR ENERGY SYSTEM: ACTIVE

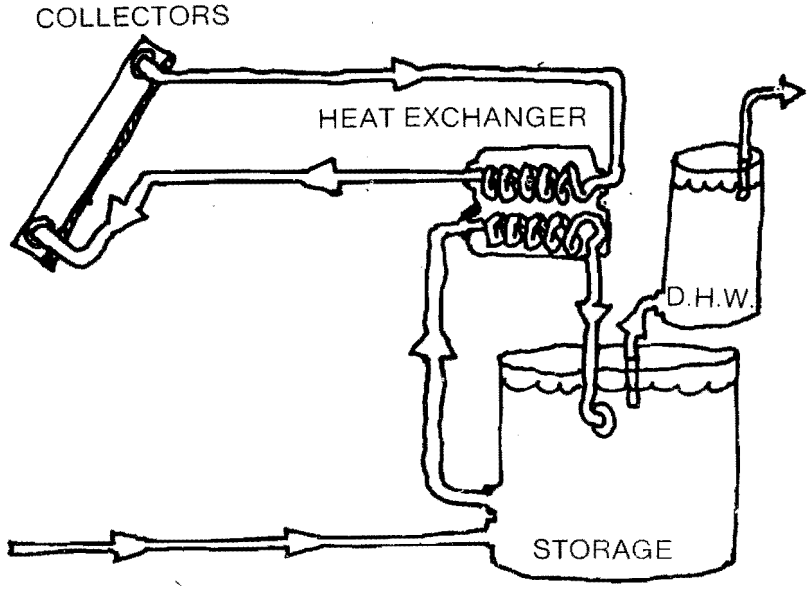
SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 36%

COLLECTOR: 2,839 sq. ft. of Sunworks flat-plate collectors are rack-mounted onto the roof, facing directly south at a tilt of 45°. Drawn from storage, water is circulated through the collectors for solar heating.

STORAGE: A 3,000 gallon steel tank with plascite lining is located in the basement for solar storage. The tank is insulated with batt insulation.

DISTRIBUTION: Solar heated water is drawn directly from solar storage for hot water distribution to the units.





BUILDER/APPLICANT: United Methodist Homes For Aging
DESIGNERS: W. Fleischer & S. Schaeffer
SOLAR SUB: G. R. Sponaugle & Sons Inc.
LOCATION: Mechanicsburg, PA — **LATITUDE:** 40°0'N
HOUSING TYPE: MF High, 150 Units — **AREA:** 612 sq. ft.
CLIMATIC DATA:
HEATING DD: 5,987 — DESIGN TEMP:
DESIGN TEMP: WINTER: — INDOOR:
HORIZ. INSOL. JAN. DAY: 390 BTU/sq. ft. — % SUN/YR: 57%

BUILDING DESCRIPTION/ENERGY CONCERNS

This new 6 story United Methodist Home for the Aging contains 150 one-bedroom apartments. It uses solar energy to help provide domestic hot water for the occupants. The upper floors contain identical apartments along a double loaded corridor; the lower floors contain community and service facilities. A double door entry vestibule, which serves as an air lock, helps to minimize heat loss.

SOLAR ENERGY SYSTEM: ACTIVE

SYSTEM TYPE: Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 57%

COLLECTOR: In this project Lennox flat plate collectors, using an antifreeze transfer media, are rack-mounted onto the roof at a 50° tilt. One hundred panels have been used to give 1,540 sq. ft. of collector surface area. Antifreeze, from the collectors, circulates through a central heat exchanger where energy is transferred to water for storage.

STORAGE: A tank, containing 8,388 gallons of water, provides for solar storage.

DISTRIBUTION: Heated water from solar storage is pumped through one of two conventional DHW tanks and then onto the apartments.

AUXILIARY ENERGY SYSTEM: Electricity provides auxiliary heat to the conventional DHW tanks.

ARIZONA

4456 DD

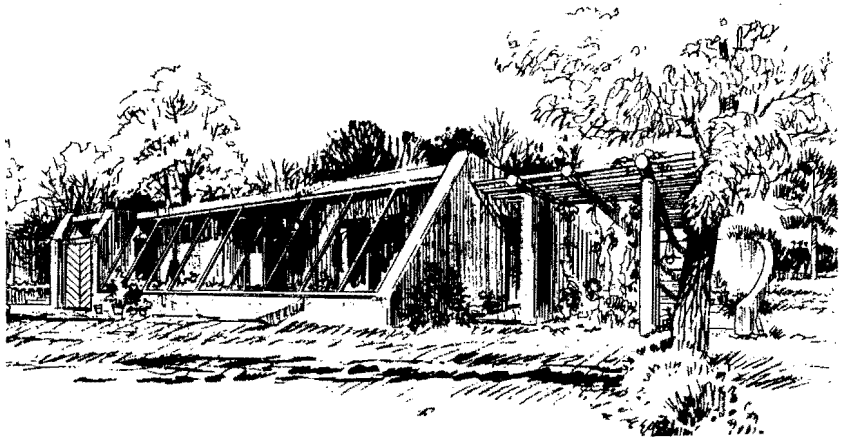
1 SFD NEW

PASSIVE HEATING

160

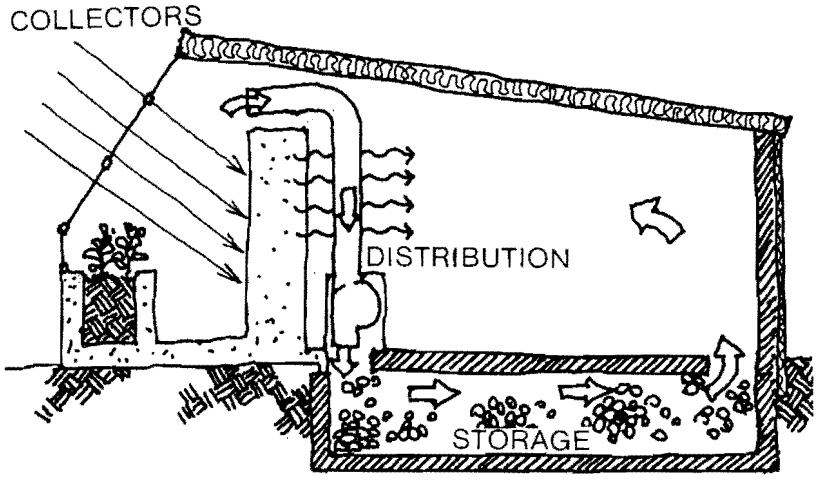
PROJECT INFORMATION:

BUILDER/APPLICANT: Hullco Construction Co.
DESIGNER: Michael Frerking
SOLAR SUB: Michael Frerking
LOCATION: Prescott, AZ
LATITUDE: 34°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,056 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,456
DESIGN TEMP:
DESIGN TEMP: WINTER: 37° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 1,110 BTU/sq. ft.
% SUN/YR: 80%



BUILDING DESCRIPTION/ENERGY CONCERNS

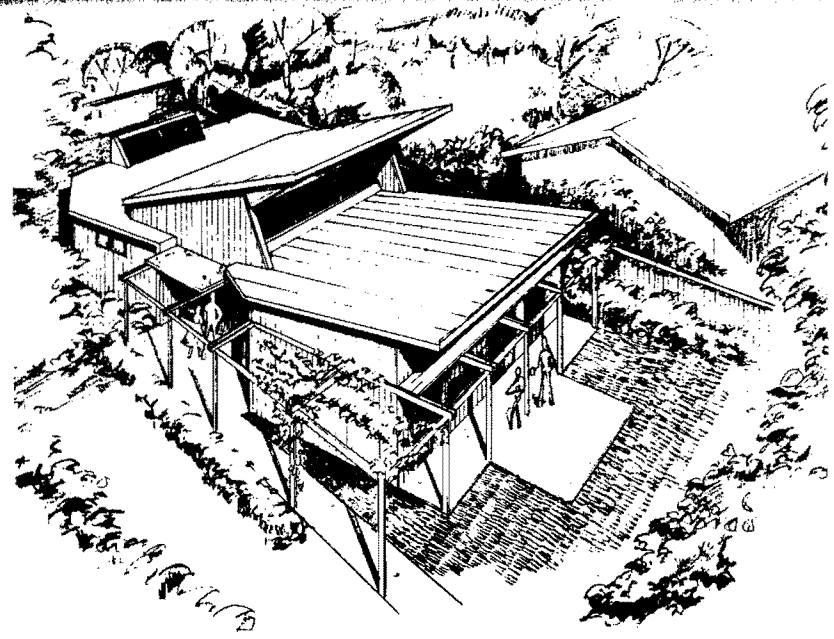
This single family home, consisting of 1,056 sq. ft. of floor space including 2 bedrooms, uses a passive solar heating system. The structural envelope opens to the south where a greenhouse traps solar heat. Heat losses from the house are reduced by using heavy insulation in the ceiling and reducing glass areas on north, east, and west facades. In addition, earth is piled against the north wall to provide natural insulation. In summer, the greenhouse is vented to create convective currents which pull warm air from the living space.

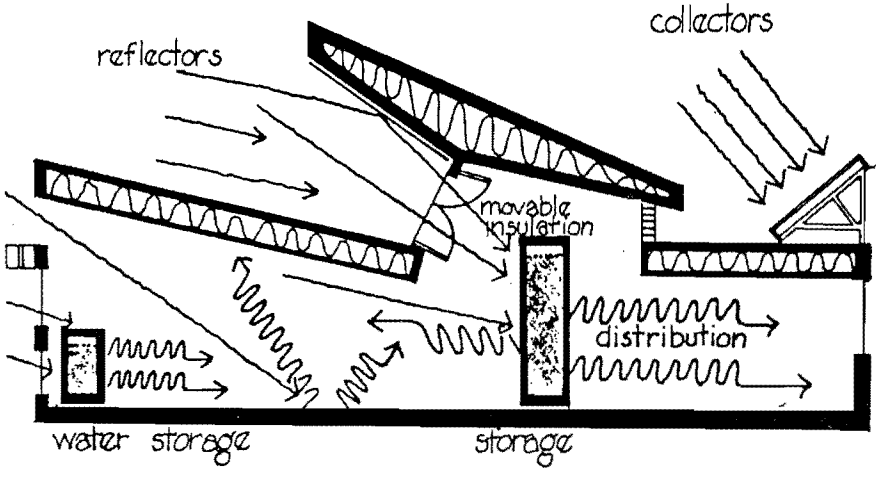


SOLAR ENERGY SYSTEM: PASSIVE

SYSTEM TYPE: Heating
PREDICTED SOLAR CONTRIBUTION: 80%

PASSIVE SYSTEM: Sunlight enters the double glass wall of the greenhouse and heats it. Hot air at the top of the greenhouse is carried by ducts to a symmetrical pair of 20 inch deep rock storage bins. Heated air from the middle of each storage bin enters the living space through floor registers on the periphery of the rock bins. The 14" massive adobe walls at the back of the greenhouse also store solar heat and distribute it by radiation during the night. The earth in the greenhouse serves as an additional heat sink. A ¼ h.p. fan drives air through ceiling ducts where a 6 K.W. strip heater provides auxiliary heating. Also, auxiliary heat from a wood burning stove is distributed through ductwork in the ceiling and can be recycled through rock storage.





DESIGNER: Jonathan Hammond
SOLAR SUB: Living Systems & Natural Heating
LOCATION: Davis, CA
LATITUDE: 38°38'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,671 sq. ft.
CLIMATIC DATA:
HEATING DD: 2,819
DESIGN TEMP:
DESIGN TEMP: WINTER: 30° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 917 BTU/sq. ft.
% SUN/YR: 76%

BUILDING DESCRIPTION/ENERGY CONCERNS

This house, called the "Suncatcher," is in Davis, California. It has 3 bedrooms and a floor area of 1,671 sq. ft. The section and plan of the house allows for maximum ventilation and air movement. Overhangs shade the wall surfaces from the summer sun and trellises shade the patios. The "Suncatcher" roof design is also a direct response to the passive use of solar energy. The building envelope is well insulated to ensure energy conservation, with R-19 insulation in the walls and R-30 insulation in the roof. All glass surfaces are double glazed and are large on the south, but reduced on the other walls. Movable insulated shutters and curtains cover these surfaces at night to reduce unwanted heat loss.

SOLAR ENERGY SYSTEM: PASSIVE

SYSTEM TYPE: Passive Heating, Cooling & Active Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 88%

PASSIVE SYSTEM: For passive solar heating, the large south-facing window wall and clerestory skylight permit direct winter sun to enter the house. Many of the sun's rays strike large concrete storage tubes which stand in the living space. The 3' high tubes are filled with water and are located in front of the south-facing windows, and 11' high tubes are located under the skylight within reach of the winter sun. When the sun strikes the black painted surfaces of these tubes, the storage water is heated for immediate and later radiant distribution. Solar heat is also stored in the concrete slab floor near the southern windows. At night, the stored heat continues to be distributed by radiation and convective air currents (moving across the surface of the storage tubes). Overheating is prevented by use of insulating shutters.

Auxiliary heat is provided by a gas-fired furnace. Passive cooling is achieved by cross-ventilating the house at night. As the cool night air passes across the water tubes, its temperature drops. In the morning, the house is closed up, and the cool water in the tubes continues to temper the living space temperature.

DOMESTIC HOT WATER: On the roof, active flat plate collectors with an area of 46 sq. ft. collect solar energy for DHW preheat. Incoming cold water is circulated directly through the sunburst collectors, to a 52 gallon storage tank. On demand, this preheated water is pumped to a 20 gallon DHW heater, raised to operating temperature, and pumped to the house.

BUILDER/APPLICANT: Colorado Sunworks Partnership
DESIGNER: Paul Shipee
SOLAR SUB: Wright Development Co.
LOCATION: Longmont, CO
LATITUDE: 40°N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,792 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,360
DESIGN TEMP:
DESIGN TEMP: WINTER: −5° F
INDOOR: 70° F
HORIZ. INSOL. JAN. DAY: 743 BTU/sq. ft.
% SUN/YR: 64%

BUILDING DESCRIPTION/ENERGY CONCERNS

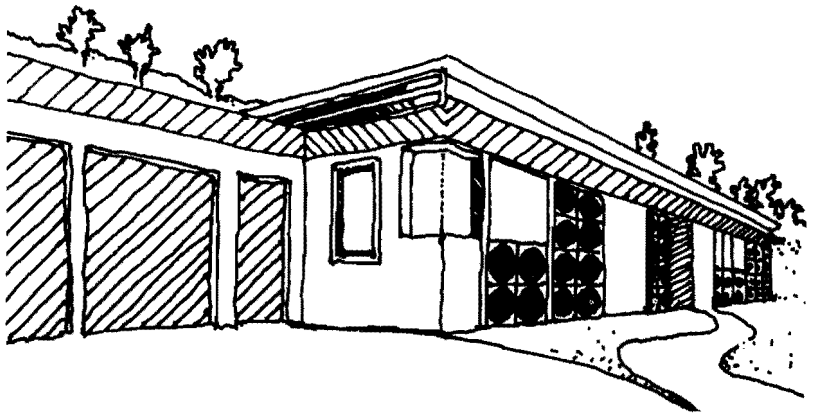
This 3 bedroom home, name the Sunearth House by its designer, has approximately 1,792 sq. ft. of living space. In addition to an increased insulation and the use of berms on the north, east, and west sides, the roof is earth covered, significantly decreasing heat loss. The passive heating system, which was designed in part by Zomeworks of Albuquerque, New Mexico, consists of a drumwall collector/storage unit used in conjunction with a beadwall. This heating system is incorporated in the south wall of the building. Additional energy conserving features include the use of an entry vestibule to serve as an air lock and the placement of a garage to the northwest to serve as a windbreaker.

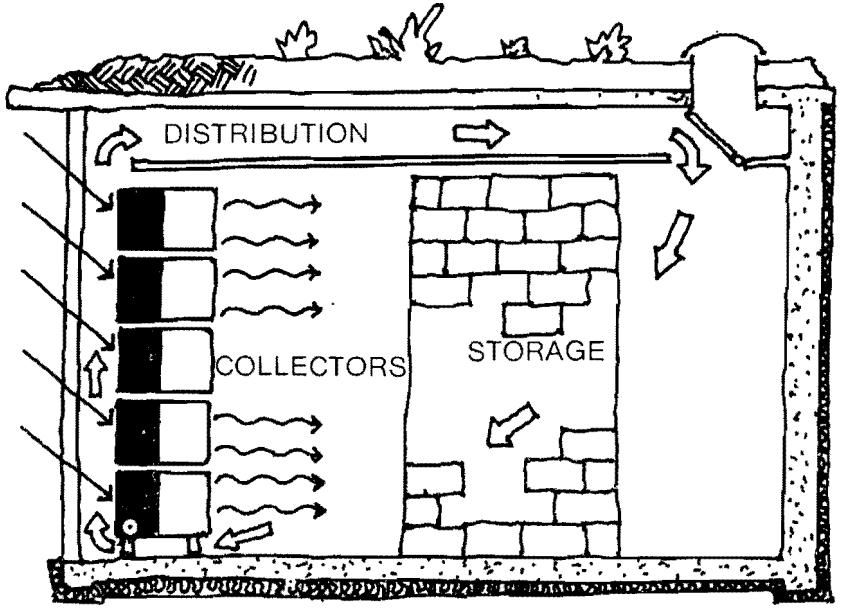
SOLAR ENERGY SYSTEM: PASSIVE

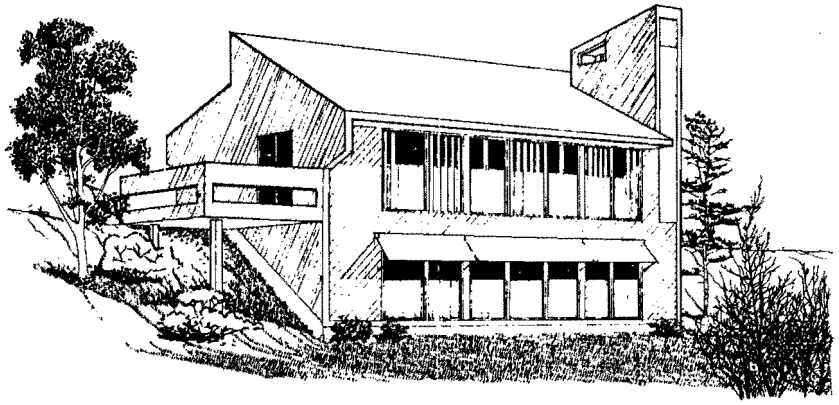
SYSTEM TYPE: Heating, Cooling & Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 65%

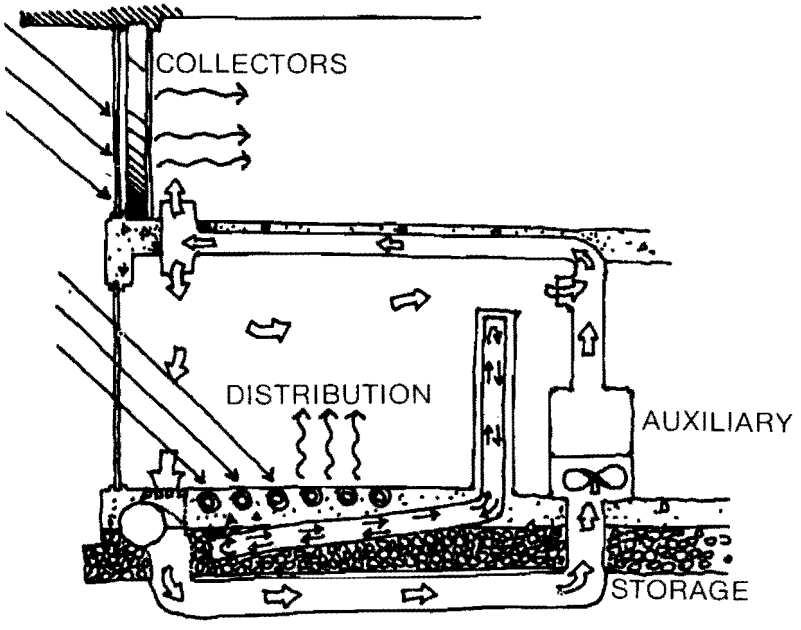
PASSIVE SYSTEM: Black, water-filled drums line the building's south facing glass wall. The water closest to the glass absorbs the heat and then moves to the cooler side of the drum where it transmits heat to the building interior. Thus the drum serves as collector, storage unit and distribution method. Moveable insulation in the form of a beadwall serves to prevent overheating as does an open air exhaust plenum at the top of the drumwall. The beadwall is constructed of two panes of glass spaced several inches apart. Beads of rigid insulation can be blown into the space or sucked out thereby giving the system the desired heat resistance. A central fireplace, along with propane fired hydronic baseboard units, provide auxiliary heating. During the summer cooling is aided by allowing cool night air to flow across the barrels, vented to the outdoors lowering the temperature of the water. When the building is closed up during the day, the cool water absorbs heat, tempering the living space.

DOMESTIC HOT WATER: Two standard 40 gallon tanks, which have been stripped of their insulation and then painted black, are used to preheat and store DHW. These tanks are positioned next to the south wall and insulated from the interior living space. DHW is preheated by direct solar gain through the glass wall; radiation is enhanced through the use of mirrors.









BUILDER/APPLICANT: Werner, Nowysz & Pattschill
DESIGNER: James Shoenfelder
SOLAR SUB: Lowell Leichty
LOCATION: Iowa City, IA — **LATITUDE:** 41°32'N
HOUSING TYPE: SFD, 1 Unit — **AREA:** 2,128 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,711 — DESIGN TEMP:
DESIGN TEMP: WINTER: −15° F — INDOOR: 68° F
HORIZ. INSOL. JAN. DAY: 644 BTU/sq. ft. — % SUN/YR: 59%

BUILDING DESCRIPTION/ENERGY CONCERNS

This project is a 3 bedroom house of 2,128 sq. ft. and uses a passive system to provide heating, cooling and domestic hot water for the space. The system is designed to maximize the use of solar and natural energies while keeping user participation low. The house is partially buried, using the earth as insulation. The walls and ceiling are heavily insulated and an air lock entry reduces infiltration. Natural ventilation is induced by operable clerestory windows and a solar ventilator on the chimney face which starts the circulation of cool basement air.

SOLAR ENERGY SYSTEM: PASSIVE

SYSTEM TYPE: Heating, Cooling and Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 89%

PASSIVE SYSTEM: A combination of passive techniques is used to heat and cool this house. On the upper floor, clear plexiglass tubes are placed in front of the windows and filled with both water and a dark liquid which is heavier than water. When the sun strikes these tubes the heavier liquid heats up quickly, and rises up to balance the absorbing properties of the tube. The stored heat is transferred to the space by radiation and convection. Insulating curtains can be closed outside the tubes at night to prevent heat loss, and curtains can be closed inside to prevent space overheating. In a second solar system, the sun strikes water-filled pipes imbedded in the massive (4" of concrete and 8" of gravel) floors of the southern rooms. As this water heats up, it flows naturally to the cooler end of the pipes and up the central cavity wall for radiant heat distribution. Air from the cooler (not sunlit) rooms flows into the southern rooms to be heated and recirculated. To assist the hot air heating system, return air is preheated in the ducts also located in the floor in front of the south-facing windows. For summer cooling, alternative water-filled pipes are buried in the floor slab of the northern rooms. These thermosiphoning pipes travel 40 feet beyond the north wall of the house, carrying off heat and dissipating it to the cooler earth. A retractable awning prevents overheating of the southern floors.

DOMESTIC HOT WATER: Incoming cold water passes through small pipes in the southern edge of the floor storage slab, preheating the water before it reaches a conventional DHW tank.

PASSIVE HEATING, COOLING & DHW 1 SFD NEW 6711 DD IOWA

163

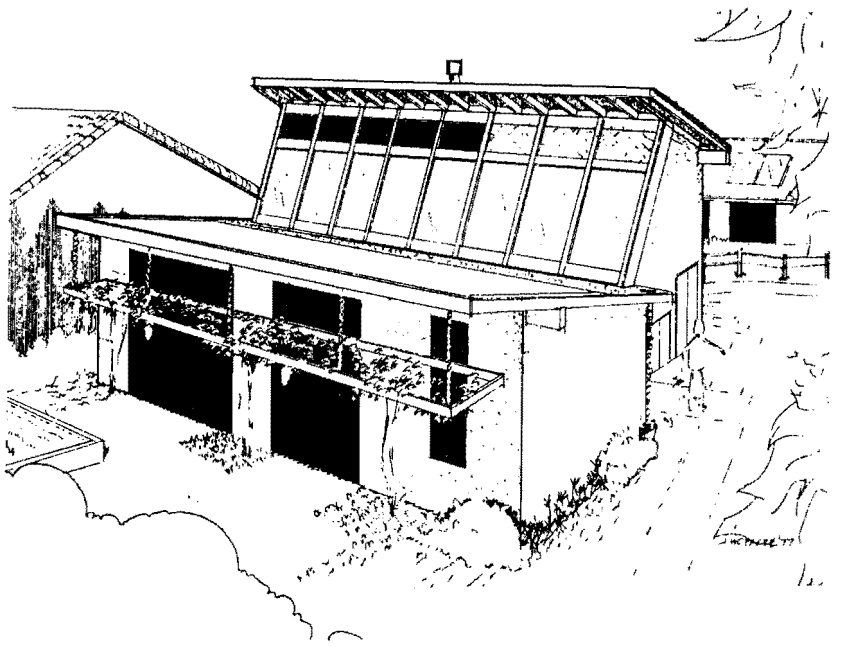
PROJECT INFORMATION:
BUILDER/APPLICANT: John Delapp Design & Construction
DESIGNER: J. Hofacre
SOLAR SUB: Natural Heating Systems
LOCATION: Davis, CA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 2,819
DESIGN TEMP: WINTER: 30° F
HORIZ. INSOL. JAN. DAY: 917 BTU/sq. ft.

LATITUDE: 39°N
AREA: 1,377 sq. ft.

DESIGN TEMP:
INDOOR: 70° F
% SUN/YR: 75%

BUILDING DESCRIPTION/ENERGY CONCERNS

Basic energy efficient design is evident in this 3 bedroom home of 1,377 sq. ft. The compact, rectangular design minimizes wall surface area. In addition, the design maximizes south facing glass for winter heating and reduces the area of east and west facing windows. The living spaces occupy the southern portion of the house, thereby taking advantage of the solar gain. In order to further reduce the heat load, insulation has been carefully considered. The design and placement of operable windows and doors allows natural ventilation to cool the house.

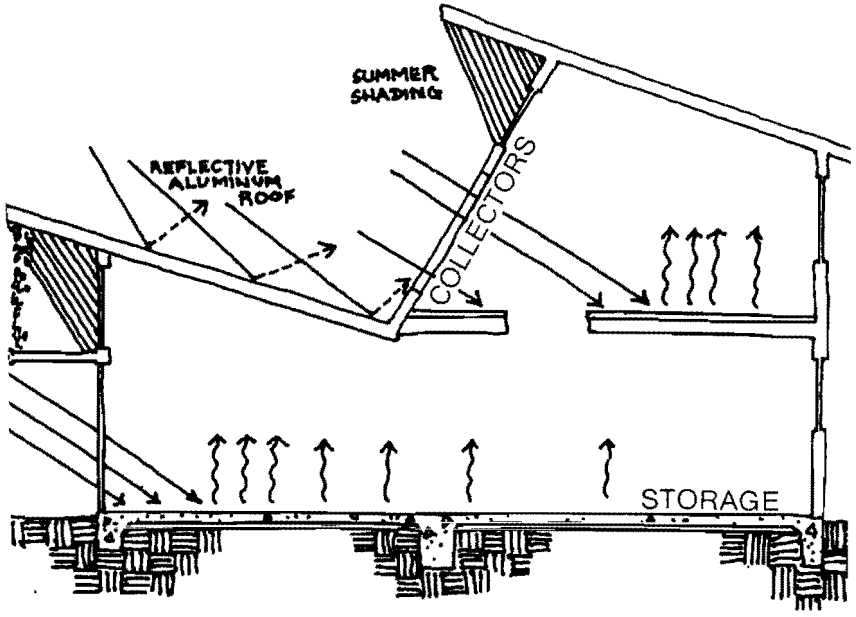


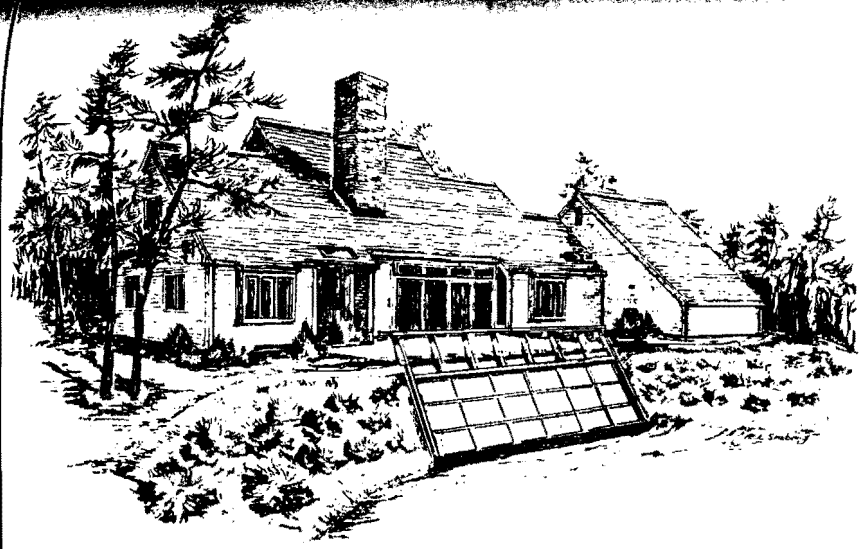
SOLAR ENERGY SYSTEM: HYBRID

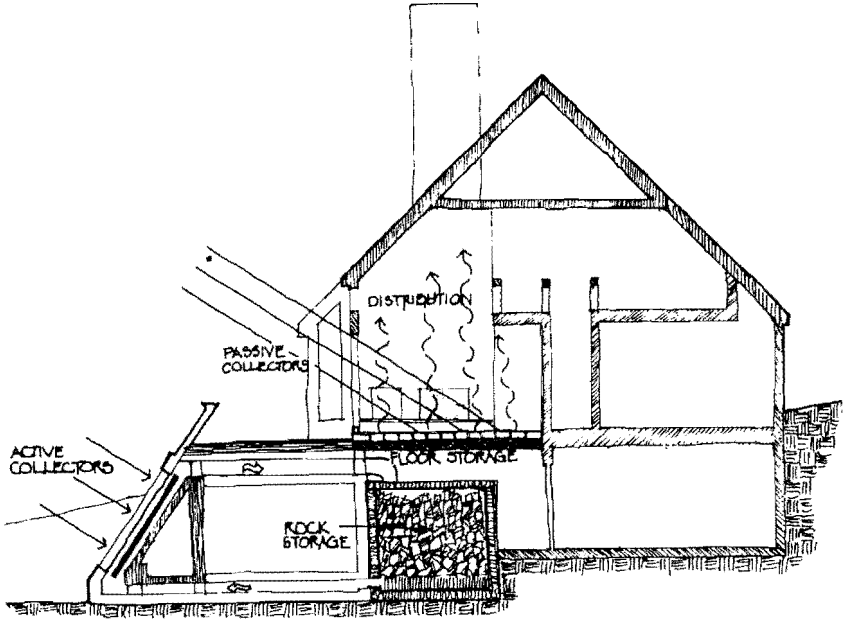
SYSTEM TYPE: Hybrid Heating, Active DHW
PREDICTED SOLAR CONTRIBUTION: 80%

PASSIVE SYSTEM: Direct solar gain through south facing windows heats the living areas on the first floor and bedrooms on the second floor. Massive concrete floors provide solar energy storage and a mechanism for distribution. Overheating of the space is prevented by insulated curtains, roof overhangs and deciduous vines which hang in front of the windows. South facing windows provide 291 sq. ft. of effective collector area.

ACTIVE SYSTEM: Sunburst copper absorber panels form the basis for the site built flat plate collectors used in this project. These panels are covered with an outside sheet of tempered glass and an inside sheet of acrylic film. Water circulates through the 181 sq. ft. of collectors which cover the southern portion of the roof. The roof below the collector is covered with aluminum which serves to reflect sunlight in to the collector surface. Warmed water is stored in a 271 gallon tank which is insulated with 2" of foam. This water is pumped through pipes which are contained in the concrete floors. In this manner, heat is radiated to the interior spaces. A gas fired furnace provides auxiliary heat. Potable water is pumped through a coil in the main storage tank. This serves to preheat water for domestic use.







DESIGNER: Richard L. Seaburg
SOLAR SUB: Alvin Hollis Co.
LOCATION: Cotuit, MA
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 5,630
DESIGN TEMP: WINTER: 0° F
HORIZ. INSOL. JAN. DAY: 529 BTU/sq. ft.

LATITUDE: 42°
AREA: 2,702 sq. ft.

DESIGN TEMP:
INSIDE:
% SUN/YR: 56%

BUILDING DESCRIPTION/ENERGY CONCERNS

This single-family detached home has 2,702 sq. ft. of floor space and two bedrooms. The house has been elongated on the east-west axis, to give maximum southern exposure. The site has been landscaped so that the collectors and the south face of the house receive maximum exposure, while the east, west and north faces are protected by trees from sun and wind.

SOLAR ENERGY SYSTEM: HYBRID

SYSTEM TYPE: Hybrid Heating & Active Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 67%

PASSIVE SYSTEM: Through 260 sq. ft. of south-facing glass, solar radiation enters directly into a "solar room," for passive solar heating. Brick flooring acts as the thermal mass to store and radiate solar heat. As the warm room air rises, both the loft and the sunroom are kept comfortable by direct solar gain.

ACTIVE SYSTEM: 556 sq. ft. of Solaron air collectors are rack-mounted at an angle of 53° facing south on an embankment behind the patio. Solar heated air rises from the collectors and passes beneath the patio before being fan drawn to 312 cu. ft. of rock storage. Rock storage is located in the basement in a concrete bin with 1½" of rigid insulation. A central air handling unit blows air across the rock storage for forced air distribution. An oil-fired heating system provides auxiliary and back-up energy.

DOMESTIC HOT WATER: Cold water passes through a fin-coil heat exchanger, in the collector to storage air duct, on its way to a conventional 80 gallon DHW heater.

MODES OF OPERATION: Collector to storage, collector to house, storage to house, storage to auxiliary to house, DHW preheat.

HYBRID HEATING & ACTIVE DHW 1 SFD NEW 5630 DD MASS.

165

PROJECT INFORMATION:
BUILDER/APPLICANT: Sun House Design & Environmental
DESIGNERS: R. Bruinsslot & P. Timerman
SOLAR SUB: David Koenigshofer
LOCATION: Bodega Bay, CA
LATITUDE: 38°15'N
HOUSING TYPE: SFD, 1 Unit
AREA: 1,484 sq. ft.
CLIMATIC DATA:
HEATING DD: 6,672
DESIGN TEMP:
DESIGN TEMP: WINTER: 68° F
INDOOR: 72° F
HORIZ. INSOL. JAN. DAY: 917 BTU/sq. ft.
% SUN/YR: 63%

BUILDING DESCRIPTION/ENERGY CONCERNS

This single family detached home contains 2 bedrooms and 1,484 sq. ft. of space. The building is zoned so that the living spaces take advantage of expansive south facing window. These windows are protected against summer overheating by deep overhangs. All sleeping areas on the north side are windowless and have only minimal amounts of glass in the east and west walls. Natural light is provided primarily by clerestory windows which are oriented to the south. The building is well protected against heat loss by an air lock at the entry, well insulated walls and triple pane glass for all windows.

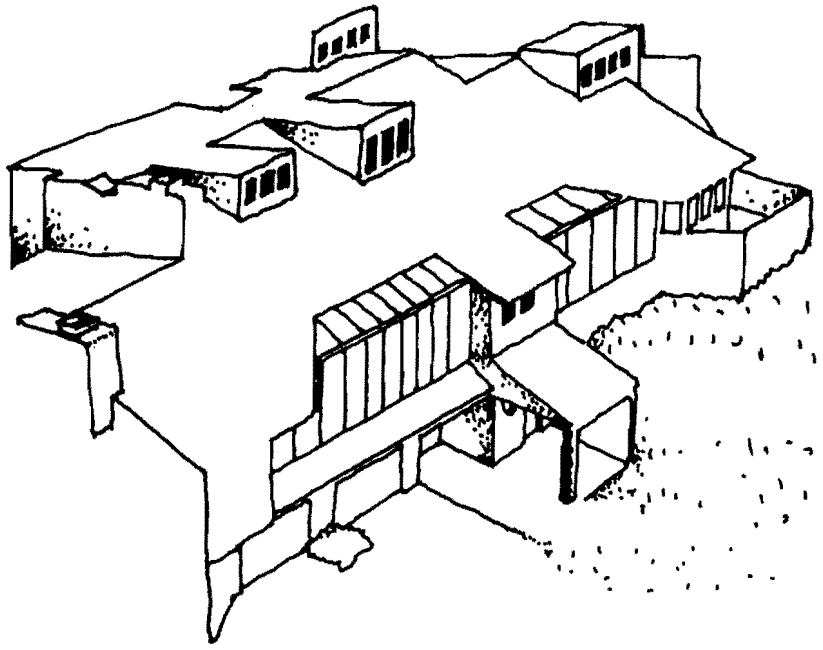
SOLAR ENERGY SYSTEM: HYBRID

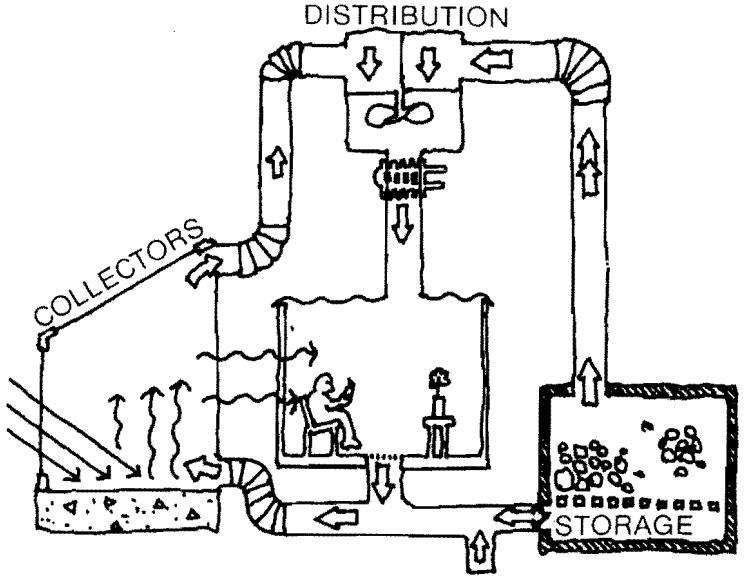
SYSTEM TYPE: Hybrid Heating, Active Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 79%

PASSIVE HEATING: A green house structure, which serves as a warm air collector, extends along the south side of the house. Warm air can circulate directly into the living spaces by opening doors to the greenhouse. The massive greenhouse floor serves to store part of the solar heat. In addition, south facing windows allow for direct solar gain. Together the greenhouse and the south facing windows provide an effective collector area of 428 sq. ft.

ACTIVE HEATING COMPONENTS: Warm air from the greenhouse can also be circulated throughout the house or blown into the rock storage bin until heat is needed. In the summer overheating of the living space is prevented by drawing hot air from the greenhouse, circulating it to the rock storage bin and then venting it to the outside. The storage bin is protected against heat transmission by 1½" of foam and 5½" of fiberous insulation. The capacity of this bin is 450 cu. ft. An electric resistance coil in the supply duct serves as an auxiliary energy system. It may be used to either heat the house directly or to heat the storage bin.

DOMESTIC HOT WATER: Sunburst absorption plates have been used to construct 96 sq. ft. of collector surface. Liquid is circulated through this system and then through a heat exchange coil contained in one of the two DHW tanks. This serves to preheat water for domestic use.





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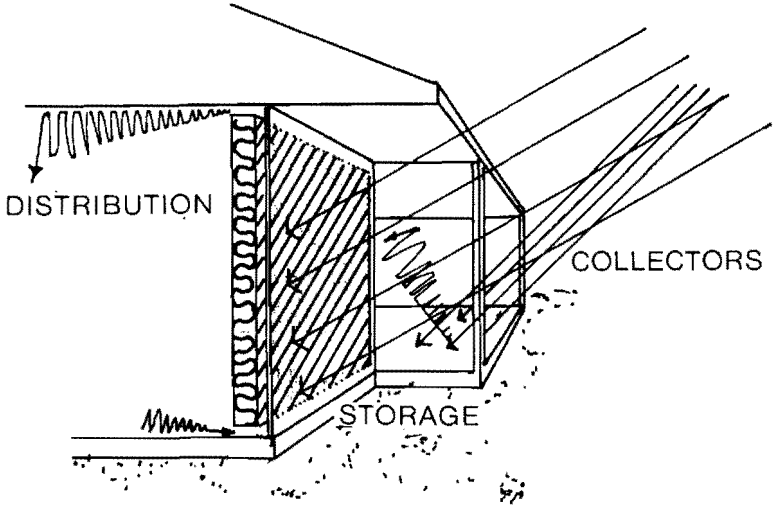

PROJECT INFORMATION:

BUILDER/APPLICANT: Stylecraft Homes Inc.
DESIGNER: Dan Scully
SOLAR SUB: Charles Joslin
LOCATION: Keene, NH
HOUSING TYPE: SFD, 1 Unit
CLIMATIC DATA:
HEATING DD: 7,694
DESIGN TEMP: WINTER: −10° F
HORIZ. INSOL. JAN. DAY: 433 BTU/sq. ft.

LATITUDE: 43°N
AREA: 1,728 sq. ft.

DESIGN TEMP:
INDOOR: 72° F
% SUN/YR: 49%

BUILDING DESCRIPTION/ENERGY CONCERNS

Located in Keane, New Hampshire, this 3-bedroom home utilizes a number of methods to take maximum advantage of the sun. Site built flat-plate collectors are used in conjunction with several passive components (a greenhouse and a south-facing thermosiphoning wall) in order to provide space heating. Energy conserving features utilized in this design include generous wall and roof insulation, the creation of a temperature buffer (entry vestibule), triple-glazed windows and window awnings over southern exposures.

SOLAR ENERGY SYSTEM: HYBRID

SYSTEM TYPE: Hybrid Heating, Active DHW
PREDICTED SOLAR CONTRIBUTION: 62%

PASSIVE SYSTEM: A greenhouse has been built on the southwest to take advantage of direct solar gain. A concrete and slate floor serves as heat storage. Warm air flows directly to the house, controlled by insulated sliding glass doors. A south-facing thermosiphoning wall also collects solar heat and provides passive heating to the house by natural convection.

ACTIVE SYSTEM: Over 370 sq. ft. of site-built flat-plate collectors have been used to support the central heating system. Air circulates through the collector, then into a rock storage bin or directly into the house. When air from the storage is not warm enough, it is circulated via the conventional oil-fired furnace before distribution.

DOMESTIC HOT WATER: 37 sq. ft. of Sunworks flat-plate collectors solar heat an antifreeze (propylene glycol) solution. This liquid circulates through a copper coil in the DHW tank in order to preheat the domestic hot water supply.

HYBRID HEATING, ACTIVE DHW 1 SFD NEW 7694 DD NEW HAMPSHIRE

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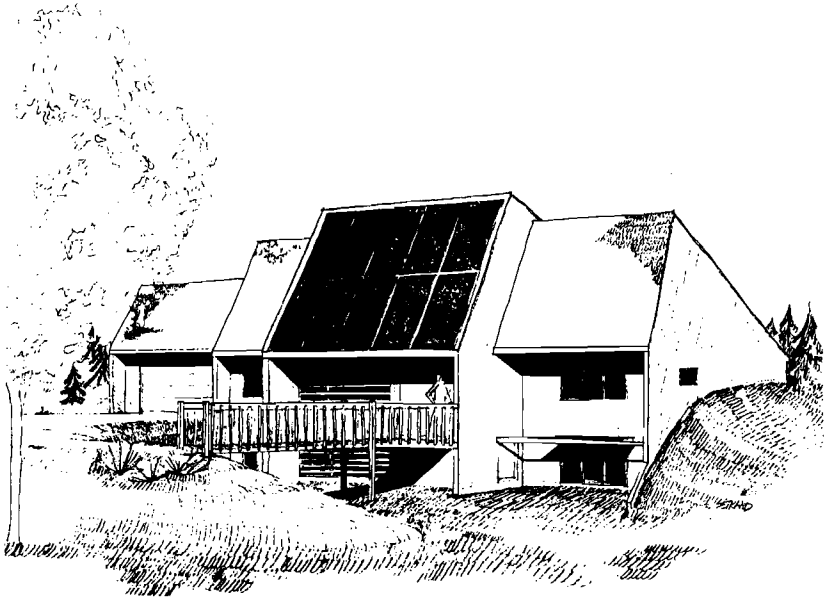
PROJECT INFORMATION:

BUILDER/APPLICANT: Gridley Construction Inc.
DESIGNER: John Oehlke & Stacy Strand
SOLAR SUB: Ilse Engineering
LOCATION: Maple Grove, MN
LATITUDE: 45°N
HOUSING TYPE: SFD, 1 Unit
AREA: 2,300 sq. ft.
CLIMATIC DATA:
HEATING DD: 8,382
DESIGN TEMP:
DESIGN TEMP: WINTER: −10° F
INDOOR: 65° F
HORIZ. INSOL. JAN. DAY: 622 BTU/sq. ft.
% SUN/YR: 56%



BUILDING DESCRIPTION/ENERGY CONCERNS

This house integrates active and passive solar systems to create a highly energy efficient building. The 2,300 sq. ft. 3 bedroom house is bermed on the north to reduce heat transfer, and evergreen trees are planted to deflect the winds. The living spaces in the building are oriented south, with large triple glazed windows which are shaded in the summer. Service spaces are located on the north wall, providing a thermal and wind buffer. The air lock entry prevents heat loss, and the house is very well insulated with 18" of glass fiber insulation in the ceiling and 6" in the walls. The open plan allows cross-ventilation in the summer, reducing the demand on the cooling system.

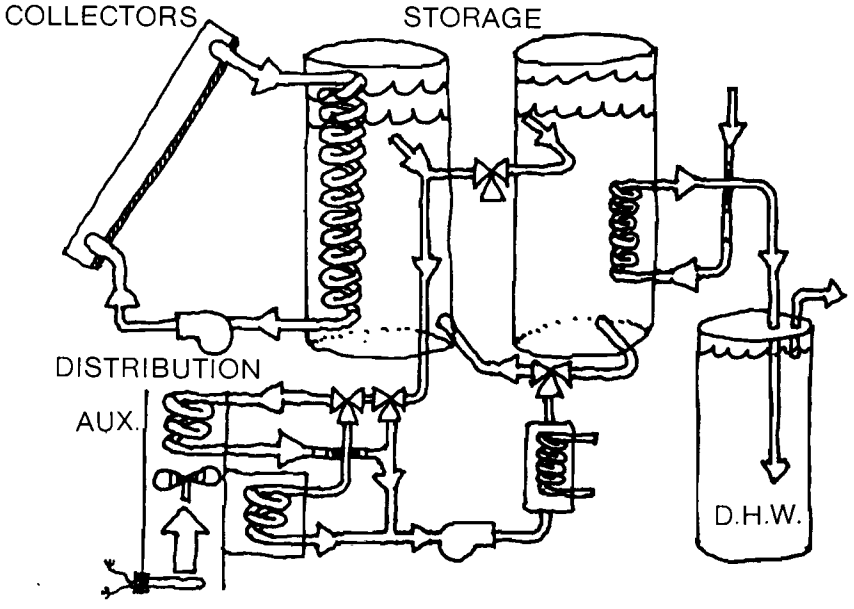
SOLAR ENERGY SYSTEM: HYBRID

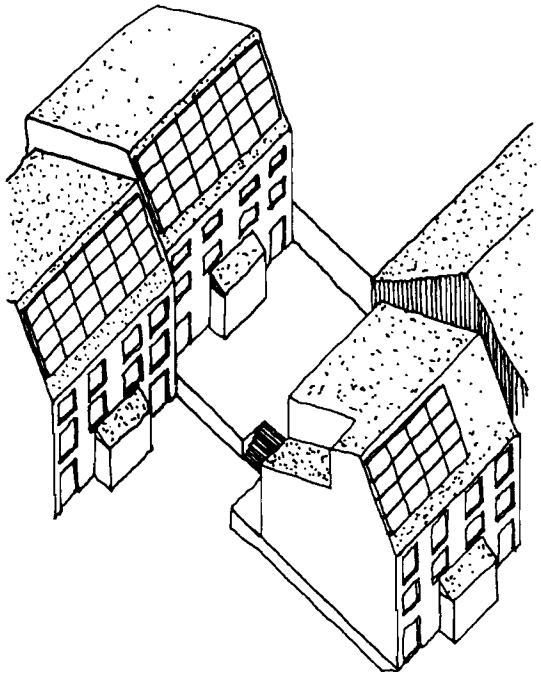
SYSTEM TYPE: Hybrid Heating & Active Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 59%

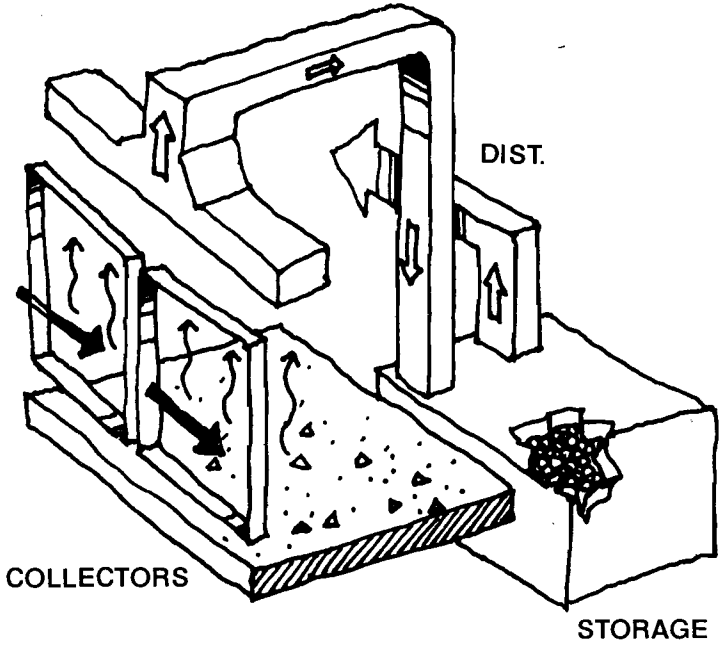
PASSIVE SYSTEM: The passive solar system for this house uses a greenhouse room and direct gain through a south facing window wall to collect the winter sun for space heat. The concrete floor and the earth in the greenhouse provide the thermal mass which stores this heat. At night, insulated louvers are closed to prevent heat loss through the large window, while the floor mass radiates its stored heat to the house. The louvers also provide shading from direct sun in the summer.

ACTIVE SYSTEM: 300 sq. ft. of liquid flat plate collectors by Ilse Engineering are roof-mounted and tilted at a 60° angle. Collected solar heat is transferred to water and stored in two 1,500 gallon water tanks located on the first floor of the house. The heated water is then pumped through a water-to-air heat exchanger, and air heat is blown into the house through conventional duct work. Auxiliary heat is provided by a heat pump which can also be driven by residual heat from storage. A more typical electric resistance coil in the duct can also provide space heat. An in-line immersion heating element allows for off peak hour heating of the storage water.

DOMESTIC HOT WATER: Incoming cold water passes through a coil immersed in one of the storage tanks, supplying preheated water to the conventional DHW system.







PROJECT INFORMATION:
BUILDER/APPLICANT: Strawbridge Square Assoc.
DESIGNER: Austin R. Costa, AIA
SOLAR SUB:
LOCATION: Fairfax Co., VA
LATITUDE: 38°30'N
HOUSING TYPE: SFA, 12 Units
AREA: 1,300 sq. ft.
CLIMATIC DATA:
HEATING DD: 4,224
DESIGN TEMP: WINTER: 10° F
HORIZ. INSOL. JAN. DAY: 584 BTU/sq. ft.
DESIGN TEMP: INDOOR: 72° F
% SUN/YR: 58%

BUILDING DESCRIPTION/ENERGY CONCERNS

In these 12 new single-family townhouses there are large glass surfaces on the south face to optimize solar gain. Four of the units with good southern exposure use 2" concrete topping over the wood frame floors as thermal masses to collect and store the solar heat for passive solar heating.

SOLAR ENERGY SYSTEM: HYBRID

SYSTEM TYPE: Hybrid Heating & Active Domestic Hot Water
PREDICTED SOLAR CONTRIBUTION: 48%

PASSIVE SYSTEM: Direct heat from south facing windows is stored in concrete flooring and distributed by radiation and natural convection. Collected heat can also be taken to the remote rock storage by fans.
ACTIVE SYSTEM: 1,248 sq. ft. of Solaron flat plate air collectors have been mounted on the south facing roofs of each unit at a 53° tilt. Air is drawn through the collectors and blown to the living space or into rock storage. 936 cu. ft. of rock storage per house is located in a concrete bin with rigid insulation. A central air handling unit blows air across the rock storage for forced air distribution. Electric baseboard units provide backup and auxiliary heating. To preheat domestic hot water, city supply is circulated through a heat exchange coil placed in the hottest part of the collector return air ducts. Preheated water goes from the coils to a conventional 60 gallon water heater.
MODES OF OPERATION: Collector to storage, collector to house, storage to house, storage to auxiliary to house, auxiliary to house, DHW preheat.

HYBRID HEATING & ACTIVE DHW 12 SFA NEW 4224 DD VIRGINIA

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appendix

definition of terms

PROJECT INFORMATION

SFD Single family detached.

SFA Single family attached; duplex or townhouse units, each with private entrances.

MFLow Multi-family low-rise; garden apartment buildings with common entrance.

MFMid Multi-family mid-rise; apartment buildings of 4-6 stories with elevator service.

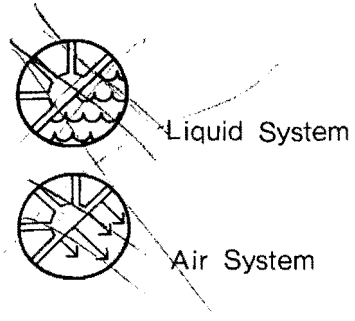
MFHigh Multi-family high-rise; apartment buildings of 7 or more stories and above with elevator service.

Heating Degree Days (DD) are the number of degrees that the average daily temperature is below 65°. Normally heating is not required in a building when outdoor daily temperature is 65°. Heating degree days are determined by subtracting the average daily temperature below 65°, from the base of 65°. A day with an average temperature of 50° has 15 degree days (65 − 50 = 15), while one with an average temperature of 65° or above has none. A map of heating degree days throughout the United States follows.

Design Temperature: Winter: represents the mean minimum outdoor temperature during the coldest three months of the year. It defines the average minimum temperature which a heating system must offset.

Design Temperature: Indoor: is the indoor temperature which is defined as comfortable for occupancy in indoor winter attire. The output of the heating system of a building will be set to achieve this indoor temperature in conditioning space for occupancy.

Horizontal Insolation: In general, solar radiation is measured on a horizontal surface and is the sum of both direct and diffuse sky radiation. January Day Horizontal Insolation is a measure of the mean monthly average of radiation incident to a horizontal surface for a specific region. It can be given in BTU/day or Langley/day where 1 BTU = 3.7 Langleys. A map of mean daily radiation in the months of January and June is included for comparison.



BUILDING DESCRIPTION/ENERGY CONCERNS

Energy conserving buildings do not rely solely on the conversion of solar radiation into thermal energy for the provision of occupant comfort. Energy conservation in building design also implies the reduction of the heating and cooling demand of a house—through better thermal design principles. The two, functioning together, fulfill the ideals expressed in the words "integrated solar architecture." By reducing the demand, one can increase the efficiency of the alternative (solar) supply and approach self-sufficiency in present day heating and cooling of buildings. In the building description of the preceding projects, design features which influence energy-use efficiency are credited. These include building orientation, location and massing, the use of berming, vegetation, improved building envelope design (through improved section design, insulation) careful window and door placement, and the use of additives such as awnings, movable insulation, curtains, vents.

SOLAR ENERGY SYSTEMS

1. **Active Solar Systems** can be characterized as one in which an energy resource, in addition to solar, is used for the transfer of thermal energy. This additional energy, generated on or off the site, is required for pumps, blowers, or other heat transfer medium moving devices necessary for system operation. Generally, the collection, storage, and distribution of thermal energy is achieved by moving a transfer medium throughout the system with the assistance of pumping power.

Collector: The collector subsystem is the assembly used for absorbing solar radiation, converting it into useful thermal energy, and transferring the thermal energy to a heat transfer fluid. Collectors vary in configuration to include flat plate, concentrating, and tracking collectors. They can be mounted directly to a finished roof, integrated with the roof structure, or mounted to racks on the roof or at a location separate from the building.

Heat Transfer Media: The heat transfer media is a fluid used in the transport of thermal energy. In some systems the transport media is air, while in others, a liquid such as water or a water/antifreeze solution is used.

Closed or Open Loop Circuits: In an open loop, one medium serves as the collector and storage, or storage and distribution heat transfer medium. In a closed loop, a primary transport medium transfers heat through a heat exchanger to a second medium which retains or carries the collected heat. Systems using anti-freeze usually use a closed loop to isolate the collector solution from solar storage, which may need to remain potable.

Storage: The component of the solar energy system which stores the collected solar heat. It may be a rock bed, a water tank, a solid mass wall . . .

Auxiliary Energy Systems: These systems consist of equipment using conventional energy sources both to supplement the output provided by the solar energy system as required by the design conditions, and to provide full energy back-up requirements when the solar heating or DHW systems are inoperable.

Modes of Operation: Each active solar heating system has the potential to transfer heat in several circuits:

*__Collector to House__—solar heat is transported directly from the collector to the building, bypassing storage.

*__Collector to Storage__—heat is transported from the collector to a storage unit for immediate or later distribution.

*__Storage to House__—a mode in which stored heat can be transported to the point of distribution in response to house demand.

*__Auxiliary to House__—when the solar system is inadequate or nonfunctioning, separate energy systems will provide enough back-up energy to handle the total load.

*__Storage to Auxiliary to House__—an energy boost could also be provided by allowing stored heat, whether inadequate or not, to pass through the auxiliary energy system before distribution.

*__Auxiliary toStorage to House__—if solar storage serves also as the distribution media, the auxiliary energy system will heat solar storage whenever collected energy is inadequate to meet distribution temperature requirements. This also allows for loading and storing of electric energy in the cheaper off-peak hours, for later use.

*A secondary transport media may be introduced at any time through a heat exchanger or an air handling unit.

3. **Passive Solar Systems** can be characterized as those in which solar energy alone is used for the transfer of thermal energy. This system requires no pumps, blowers, or other heat transfer medium moving devices which use energy other than solar. The major component in a passive solar system generally utilizes a mass with high thermal capacitance, where heat is collected, stored, and distributed to the building without additional pumping power. Collection, storage and distribution are achieved by natural heat transfer phenomena employing convection, radiation and conduction in conjunction with the use of thermal capacitance as a heat flow control mechanism.

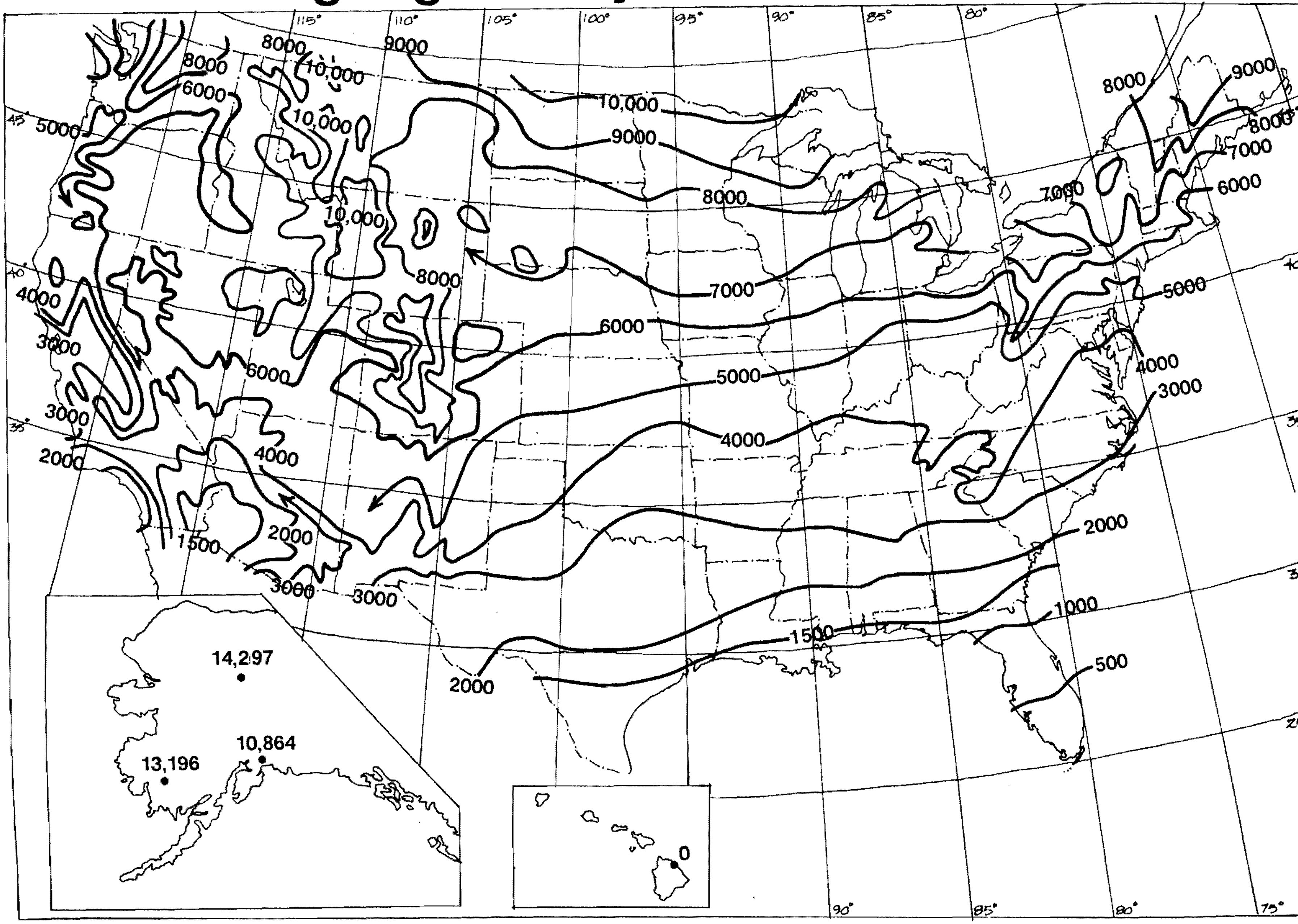
2. **Hybrid Solar Systems** refer to all projects where both passive and active solar systems combine to provide solar space heating. A strictly passive solar heating system in addition to a separate active domestic hot water system is still categorized as a passive system example.

5. **Domestic Hot Water Systems** (DHW) Although simply designated as one mode in the active system modes of operation, DHW preheat is accomplished by several methods.
1) city water can travel through a coil in storage or in the collector-storage loop to preheat water before placement in a preheat and/or conventional hot water tank. 2) city water can also fill a preheat tank located in solar storage to maintain preheated water for demand or for transfer to a conventional tank. 3) heated storage media can travel through a loop in the DHW tank to preheat water.

For active domestic hot water systems only, two other methods are often seen 1) city water is transported directly through the collector to a conventional hot water tank or to the house fixtures, and 2) city water goes to the solar storage tank, displacing preheated water provided by a second solar loop.

4. **Thermosyphoning:** In a passive domestic hot water system, city or cold water supply is pressure fed to a storage tank located above the solar collectors. Exposure of the collectors to solar radiation causes the cold water to circulate by convection from bottom to top of the collectors, and once heated back to the storage tank. The heated water is then stored until demand is initiated and then gravity fed to the dwelling.

annual heating degrees days (base 65° f)

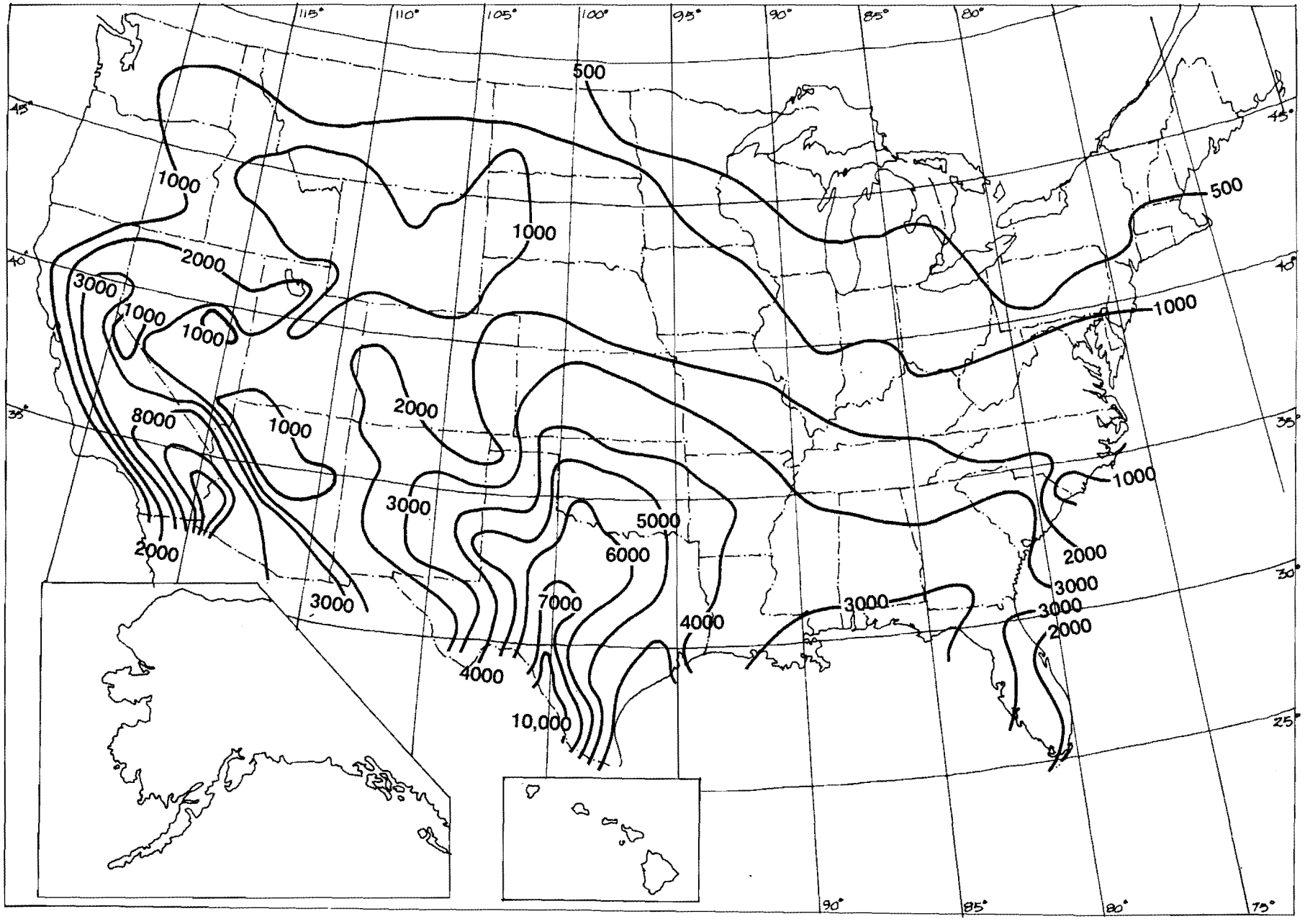


SOLAR ENERGY SYSTEMS

1\. **Active Solar Systems** can be characterized as one in which an energy

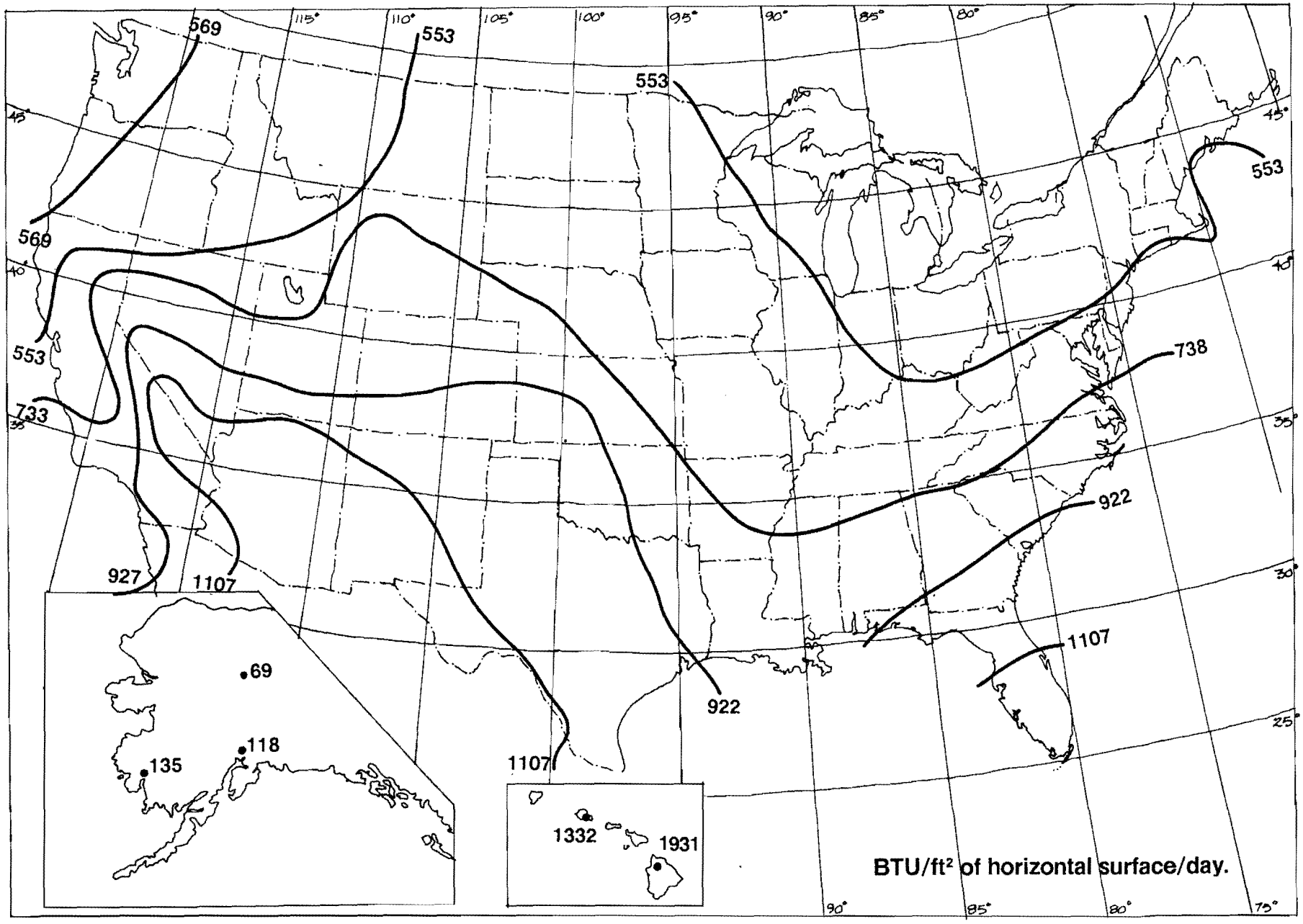
*__Storage to Auxiliary to House__—an energy boost could also be provided by allowing stored heat, whether inadequate or not, to pass through the auxiliary energy system before distribution.

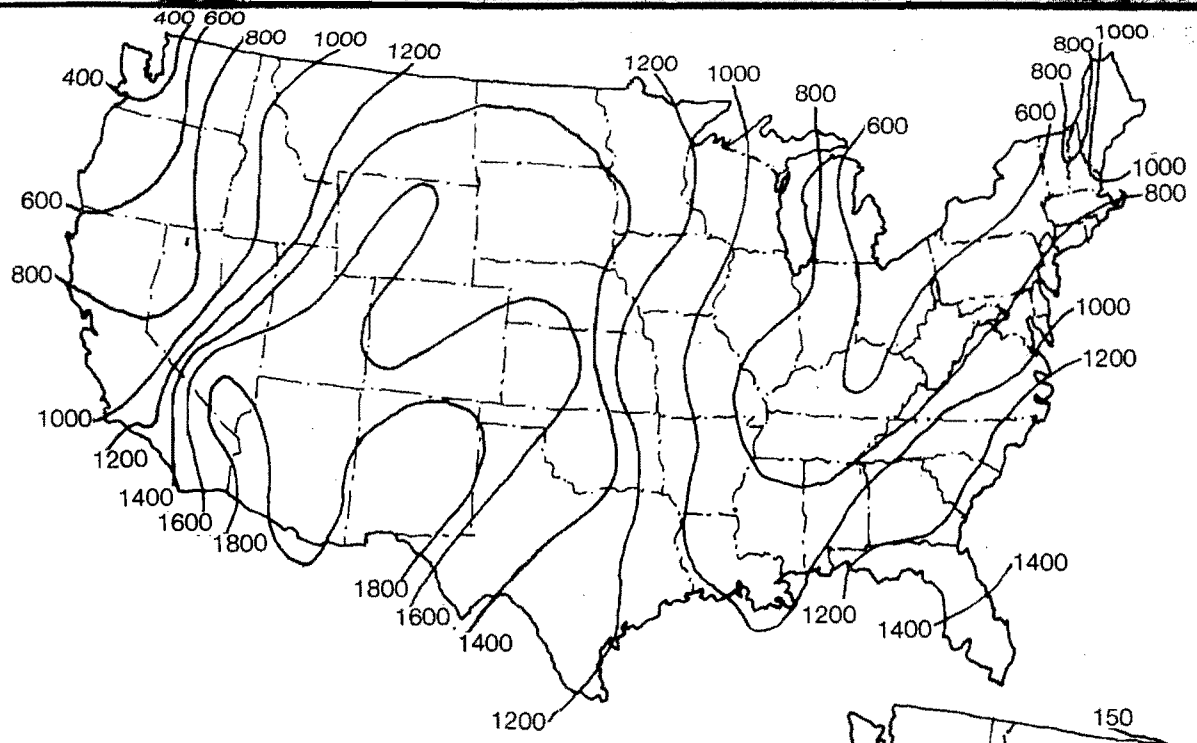
annual cooling degree hours (base 85° f)



annual cooling degree hours (base 85°F)

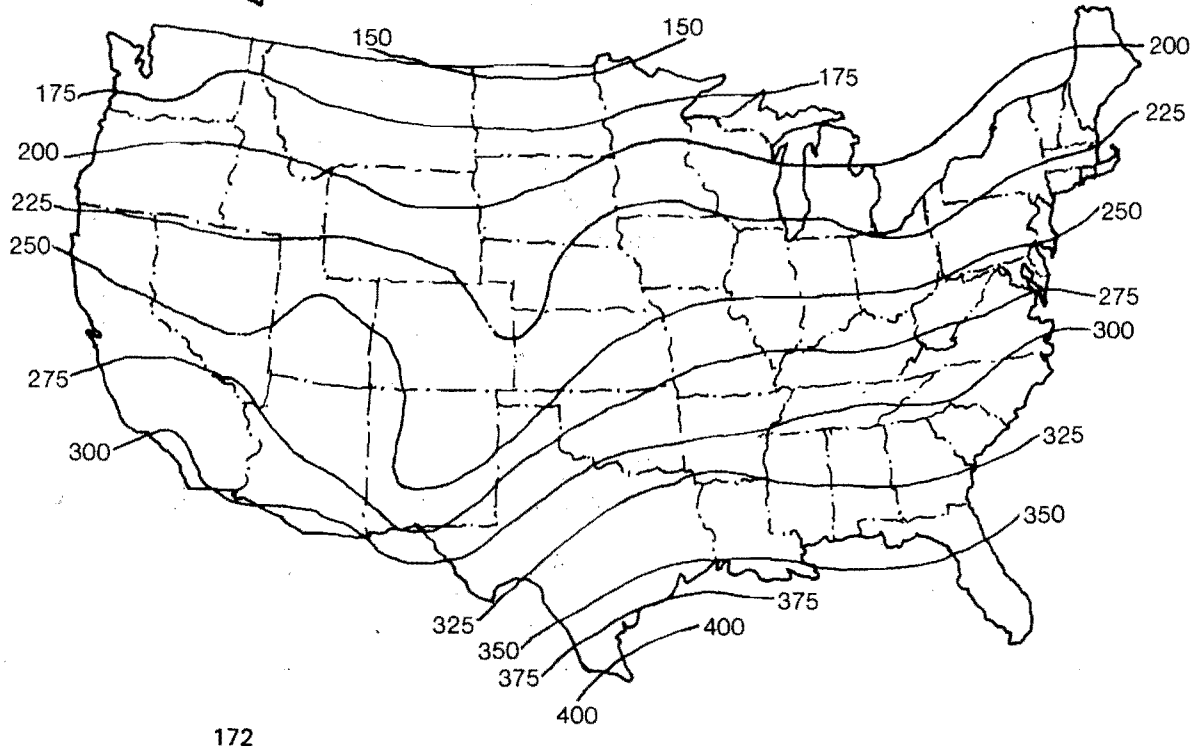
daily mean radiation, january (including both direct and diffuse radiation)





JANUARY
DIRECT RADIATION
on tilted surface
Latitude + 20°
(BTU/ft²/day)

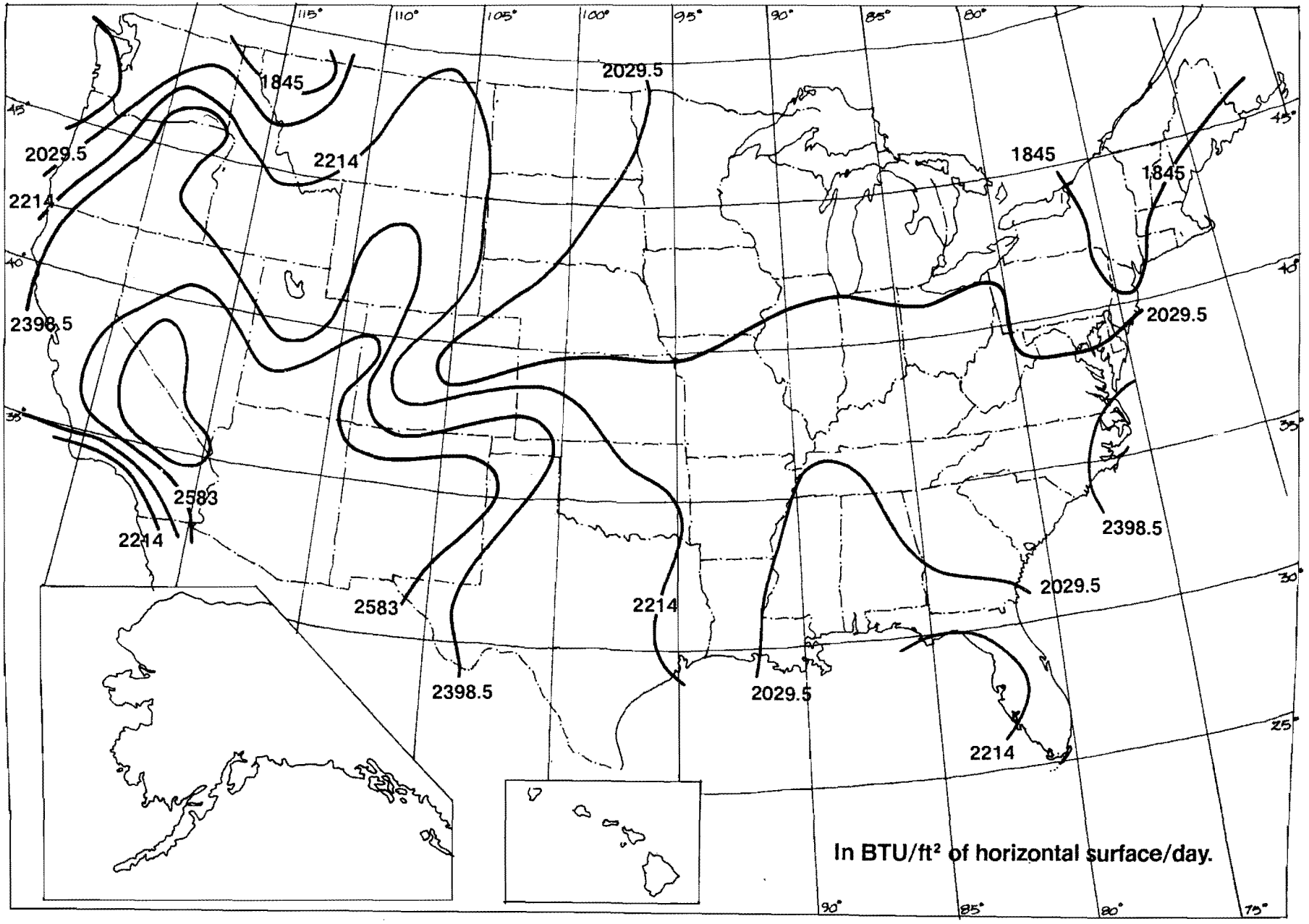
JANUARY
DIFFUSE RADIATION
on horizontal surface
(BTU/ft²/day)

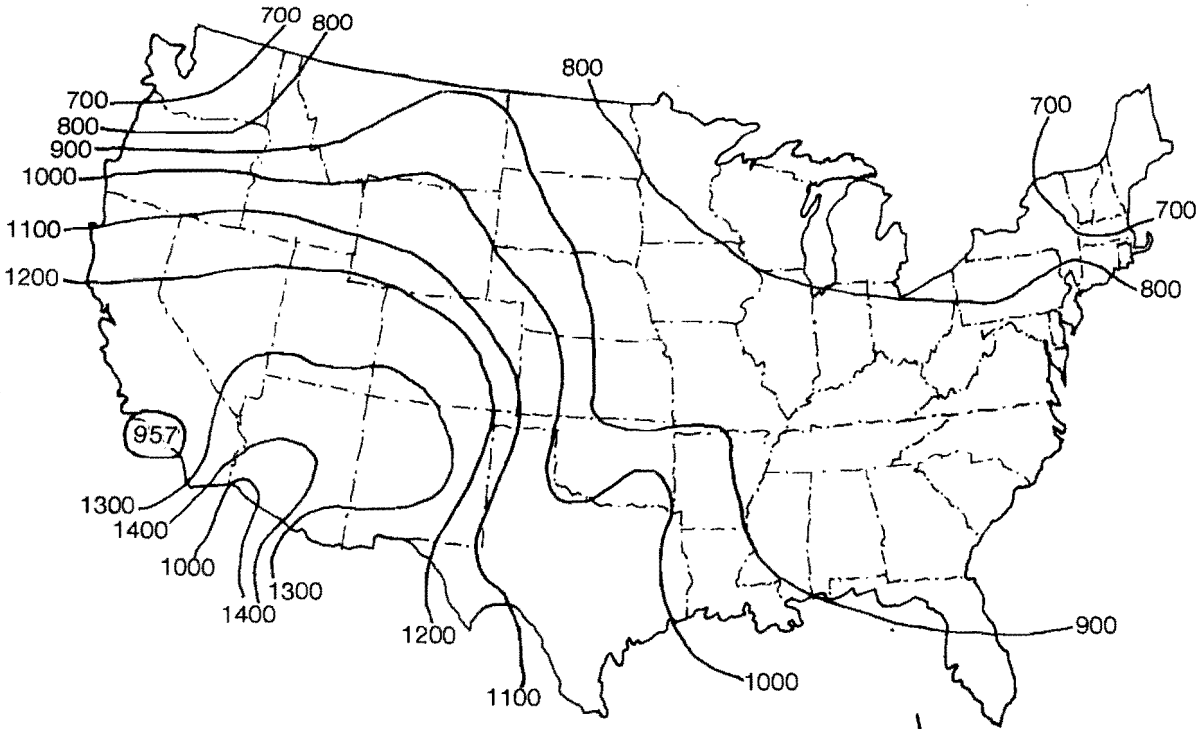


MEAN DAILY RADIATION (BTU/FT²/DAY) FOR A SURFACE TILTED LATITUDE +20° = DIRECT RADIATION$_{TILT}$ + DIFFUSE RADIATION$_{HORIZ. \cong TILT}$

The mean radiation or insolation values given on the previous page for a horizontal surface, do not indicate the actual radiation obtainable on a tilted collector surface. During the month of January, the low sun angle defines a collector tilt of latitude +20° for optimal gain of direct radiation. To determine the *increased* radiation gain over the horizontal measurement, add the direct radiation received by a surface tilted to latitude +20° (at your location) to diffuse radiation on a horizontal surface (which approximates that at a tilt). Collector surfaces tilted to an angle less than latitude +15° or 20° will receive less direct radiation during the winter heating months, approaching the previous values of mean radiation on a horizontal surface.

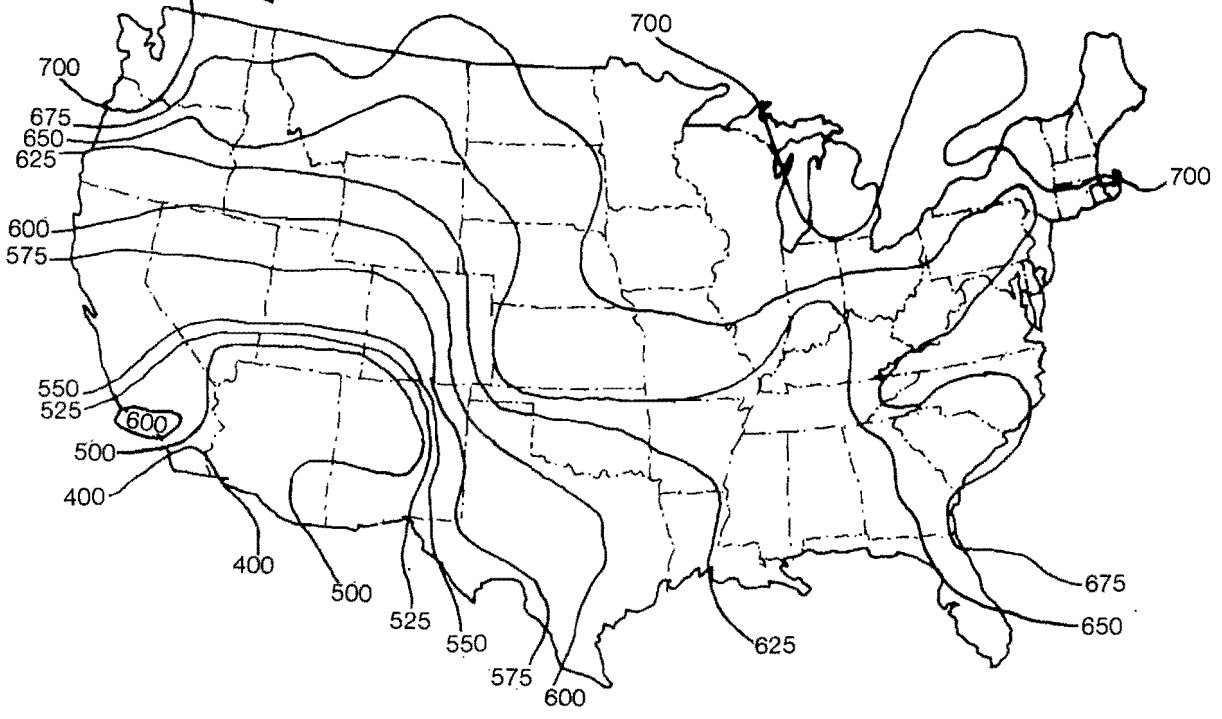
daily mean radiation, June (including both direct and diffuse radiation)





DIRECT RADIATION
JUNE DAY
on surface tilted to
Latitude + 20°
(BTU/ft²/day)

DIFFUSE RADIATION
JUNE DAY
on horizontal surface
(BTU/ft²/day)



MEAN DAILY RADIATION (BTU/FT²/DAY) FOR A SURFACE TILTED LATITUDE +20° = DIRECT RADIATION$_{TILT}$ + DIFFUSE RADIATION$_{HORIZ. \cong TILT}$

In the event that the solar collectors have been tilted to an angle optimal for winter radiation collection (latitude +20°), the amount of radiation actually received on the collector in summer may be *less* than the insolation values just given for a horizontal surface. To determine the actual radiation obtained on the tilted collector surface, add the direct radiation received at the latitude +20° tilt, to the diffuse radiation received. Collector surfaces tilted to an angle less than latitude +15 or 20° (or adjustable) will receive a greater amount of direct radiation during the summer cooling months, approaching the previous values of daily mean radiation on a horizontal surface.

*U.S. GOVERNMENT PRINTING OFFICE : 1977 0-732-426/250

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