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IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY

**program
to develop and test
solar heating
and cooling systems**

task I

Instrumented Facilities Survey
**for solar assisted
low energy dwellings**

WASTED

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february 1982

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INTERNATIONAL ENERGY AGENCY

In order to strengthen cooperation in the vital area of energy policy, an Agreement on an International Energy Program was formulated among a number of industrialized countries in November 1974. The International Energy Agency (IEA) was established as an autonomous body within the Organization for Economic Cooperation and Development (OECD) to administer that agreement. Nineteen countries are currently members of the IEA, with the Commission of the European Communities participating under a special arrangement.

As one element of the International Energy Program, the participants undertake cooperative activities in energy research, development, and demonstration. A number of new and improved energy technologies which have the potential of making significant contributions to our energy needs were identified for collaborative efforts. The IEA Committee on Energy Research and Development (CRD), assisted by a small Secretariat, coordinates the energy research, development, and demonstration program.

Solar heating and cooling program

Solar Heating and Cooling was one of the technologies selected by the IEA for a collaborative effort. The objective was to undertake cooperative research, development, demonstrations and exchanges of information in order to advance the activities of all Participants in the field of solar heating and cooling systems. Several sub-projects or »tasks« were developed in key areas of solar heating and cooling. A formal Implementing Agreement for this Program, covering the contributions, obligations and rights of the Participants, as well as the scope of each task, was prepared and signed by 15 countries and the Commission of the European Communities. The overall program is managed by an Executive Committee, while the management of the sub-projects is the responsibility of Operating Agents who act on behalf of the other Participants.

The tasks of the IEA Solar Heating and Cooling Program and their respective Operating Agents are:

- I Investigation of the Performance of Solar Heating and Cooling Systems — Technical University of Denmark
- II Coordination of R & D on Solar Heating and Cooling Components — Agency of Industrial Science and Technology, Japan
- III Performance Testing of Solar Collectors — Kernforschungsanlage Julich, Federal Republic of Germany
- IV Development of an Insolation Handbook and Instrumentation Package — United States Department of Energy
- V Use of Existing Meteorological Information for Solar Energy Application — Swedish Meteorological and Hydrological Institute
- VI Performance of Solar Heating, Cooling and Hot Water Systems using Evacuated Collectors — United States Department of Energy
- VII Central Solar Heating Plants with Seasonal Storage — Swedish Council for Building Research

Collaboration in additional areas is likely to be considered as projects are completed or fruitful topics for cooperation identified.

Task I — Investigation of the performance of solar heating and cooling systems

In order to effectively assess the performance of solar heating and cooling systems and improve the cost-effectiveness of these systems, the participants in Task I have undertaken to establish common procedures for predicting, measuring, and reporting the thermal performance of systems and methods for designing economical, optimized systems. The results will be an increased understanding of system design and performance as well as reports and/or recommended formats on each of the task activities.

The subtasks of this project are:

- A Assessment of modeling and simulation for predicting the performance of solar heating and cooling systems
- B Development of recommended procedures for measuring system thermal performance
- C Development of a format for reporting the performance of solar heating and cooling systems
- D Development of a procedure for designing economical optimized systems
- E Validation of simulation programs by comparison with measured data
- F Solar-assisted low-energy dwellings

The participants in this task are: Belgium, Denmark, Germany, Italy, Japan, the Netherlands, New Zealand, Spain, Sweden, Switzerland, United Kingdom, United States, and the Commission of the European Communities.

INTERNATIONAL ENERGY AGENCY

DOE/NBM--2015158

DE82 015158

Instrumented Facilities Survey

for solar
assisted
low energy
dwellings

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Burt Hill Kosar Rittelmann Associates.

Butler, Pennsylvania

February 1982

BURT HILL
KOSAR
RITTELMANN
ASSOCIATES

ARCHITECTS

FORWARD

This publication of thirty-eight dwelling projects is the result of a survey conducted to identify projects and their associated instrumentation available in participating countries as a source of performance data. The survey was coordinated and compiled by the United States Department of Energy under the direction of the Operating Agent, Denmark. It represents one of the assigned items of work under Task I, Subtask (F) Solar-Assisted Low-Energy Dwellings (SALED).

The purpose of the survey is to permit the participating countries to identify selected instrumented solar assisted low energy dwellings as a starting point for obtaining performance data necessary to test and validate their performance simulations models. The specific applicability and appropriateness of the data from these projects for testing and validating simulation models cannot be assured. Additionally, many other instrumented projects exist and may be suitable to validation of simulation models. This survey of instrumented facilities is only a starting point to locate appropriate and usable performance data.

The survey form was designed to be in conformance with performance reporting procedures established by the CEC Performance Monitoring Group and the author is indebted to this group for their earlier work. Also, the author wishes to acknowledge the work of Task I, Subtask (C) Reporting Formats who have developed a standard reporting procedures and formats for thermal performance of solar heating and cooling systems in buildings. This format carefully describes the form the data should take to be useful to modelers for analysis and validation.

A handwritten signature in black ink, reading "P. Richard Rittelmann". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

P. Richard Rittelmann
Representative for the
U.S. Department of Energy

The following document is a compilation of surveys outlining the instrumentation of thirty-eight active or passive solar projects in nine countries. For organization's sake, they have been arranged alphabetically by country. They have also been arranged alphabetically by project title within each country.

The first section is composed of the surveys themselves. The second section is a rearrangement of data compiled from the surveys. The rearrangement compares answers from similar survey questions for each of the thirty-eight projects. Since the survey was divided into distinct parts, such as climate, building and solar system description and meteorological, solar system and building system instrumentation capabilities, the data comparison in Section II is grouped in these subsets:

- . Building Description
- . Solar System Description
- . Instrumentation Description
- . Meteorological Instrumentation
- . Solar System Instrumentation
- . Building Instrumentation

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SECTION I

DENMARK



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

1

PROJECT TITLE

Hjortekaer, House C

Address

Proevekaeret

2800 Lyngby

Denmark

MAIN PARTICIPANTS

	1	2	3
Name	M. Byberg	Hom Huse Ltd.	Vibe-Hansen &
Address	Thermal Insulation Lab. Technical University of Denmark. DK-2800 Lyngby Denmark	Oremosegaard 9870 Sindal (08) 935700	Lomborg Ltd. Østeraa 19 9000 Aalborg (08) 126077
Phone	2 883511		
Responsibility	Coordination	Construction	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>55 N</u> Longitude <u>-13 E</u> Altitude <u>~ sea level</u> DD <u>2829</u> Base Temp. <u>17</u>			
	Sunshine Hours July <u>226</u> January <u>70</u> Annual <u>1580</u>			
	Source of data <u>Danish "Test Reference Year"</u>			
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>			
BUILDING	Floor area	<u>135 m²</u>	No. Occupants	<u>4 (simulated)</u>
	Design Temperature	internal w <u>21</u> s <u>26</u> °C	external w <u>-12</u> s <u>-</u> °C	
	Mass	type <u>concrete</u>	location	<u>floor</u>
	South Glazing	type <u>3 layers thermo-panes + 1 outside layer</u>	on all non-moveable windows	
		area(south glass) <u>13.3 m²</u>	% of total glass	<u>55%</u>
		night insulation <u>-</u>	shaded	<u>S:100% W:0%</u>
	Heated Volume	<u>268.3 m³</u>	Ventilation Rate	<u>206 m³/h</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>(Floor)-heating and DHW</u>			
	Collector	type <u>Tube and fin flat plate</u>	area(net)	<u>20 m²</u>
		orientation <u>due South</u>	tilt	<u>45°</u>
	Storage	type <u>Water tank</u>	capacity	<u>1.8 m³</u>
	Auxiliary System	type <u>Electricity</u>	fuel type	<u> </u> fuel cost <u>10 ¢/kWh</u>
+ heat pump: exhaust air - DHW (after heat-exchanger)				

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980	1981	1982
Construction completion		X				
Monitoring period			sim.hab.	non-occupied		
Final reports					X	X

Report availability

Title

Six low-energy houses at Hjortekaer, May 1979

(available from)

Thermal Insulation Laboratory

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 27,000-36,000 \$

Description of data recording method 10 min data first stored on cassettes for each 3 days period then transferred to hard discs (1 month each)

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	10 sec.	
	Outdoor Temperature	10 sec.	
	Incident radiation on horizontal surface	10 sec.	
	Diffuse radiation	10 sec.	
	Incident radiation in plane of collector	10 sec.	
	Relative Humidity	10 sec.	
	Wind Speed	10 sec.	
	Wind direction	10 sec.	
SOLAR SYSTEM	Radiation on vertical south, east and west	10 sec.	
	Collectors		Temperatures are measured with a resolution of .3 °C and an accuracy of .5 °C
	Flow rate entering collectors	10 min.	
	Temperature entering & leaving collectors	10 min.	
	Storage		Flowrates:
	Flow rate inputs to storage	10 min.	Resolution 12-25% (10 min)
	Temperature entering & leaving storage	10 min.	Accuracy 1-2% (day)
	Temperature readings in storage(1 or more)	10 min.	
	Auxiliary energy supplied to storage	-	
	Space heat, Space cooling, Hot water Subsystems		
BUILDING SYSTEM	Flow rates entering subsystems	10 min.	
	Temperature entering & leaving subsystems	10 min.	Resolution and accuracy: 6-12% (10 min)
	Auxiliary energy supplied to subsystems	10 min.	1-2% (day)
	(all rooms separately)		
	Average DB inside temperature	10 min.	
	Infiltration load (ventilation)	10 - 20 min.	5%
	Auxiliary energy	10 min.	
	Operating energy	10 min.	
	Total building energy load	10 min.	
	Internal energy gains (simulated)	10 min.	
	Solar gains	10 min.	
	Solar as a % of total load		
	Thermal capacity of building		



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

4

PROJECT TITLE

Address

Hjortekaer, House FProvekaeret2800 LyngbyDenmark

MAIN PARTICIPANTS

	1	2	3
Name	M. Byberg	Højgaard & Schultz	Cowiconsult Ltd.
Address	Thermal insulation Lab, Technical University of Denmark DK-2800 Lyngby Denmark	Jægersborg Allé 4 2920 Charlottenlund	Teknikerbyen 45 2830 Virum
Phone	2 883511	(01) 631212	(02) 857311
Responsibility	Coordination	Construction	Consulting engineers

PROJECT DESCRIPTION

CLIMATE	Latitude <u>55 N</u> Longitude <u>13 E</u> Altitude <u>sea level</u> DD <u>2889</u> Base Temp. <u>17</u>	
	Sunshine Hours July <u>226</u> January <u>70</u> Annual <u>1580</u>	
	Source of data <u>Danish "Test Reference Year"</u>	
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>	
BUILDING	Floor area <u>88 x 2 m² + basement</u> No. Occupants <u>4 (simulated)</u>	
	Design Temperature internal w <u>21</u> s <u>26</u> °C	
	external w <u>-12</u> s <u>-</u> °C	
	Mass type <u>Concrete</u> location <u>walls, floors, ceiling</u>	
	South Glazing type <u>3 layers thermo panes</u>	
	area(south glass) <u>25.4 m²</u> % of total glass <u>93%</u>	
	night insulation <u>aut. shutters</u> shaded <u>S: 90%, W: 0%</u>	
SOLAR SYSTEM	Heated Volume <u>350 m³/h</u> Ventilation Rate <u>200 m³/h</u> a.c.h.	
	exhaust air heat recovery	
	System energy use(eg. heating) <u>Floor-heating and DHW</u>	
Collector	type <u>Aluminium tube and fin, 1 g</u> area(net) <u>19 m²</u>	
	orientation <u>due south</u> tilt <u>45°</u>	
	Storage type <u>water tank</u> capacity <u>1.5 m³</u>	
	Auxiliary System type <u>gas-boiler</u> fuel type <u>gas</u> fuel cost <u> </u>	

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980	1981	1982
Construction completion			X			
Monitoring period			sim.hab.	occupied		
Final reports					X	X

Report availability

Title
(available from)

Simulated occupation in 6 Low-energy
Dwellings in Hjørtelkaer ?
Thermal Insulation Laboratory

INSTRUMENTATION

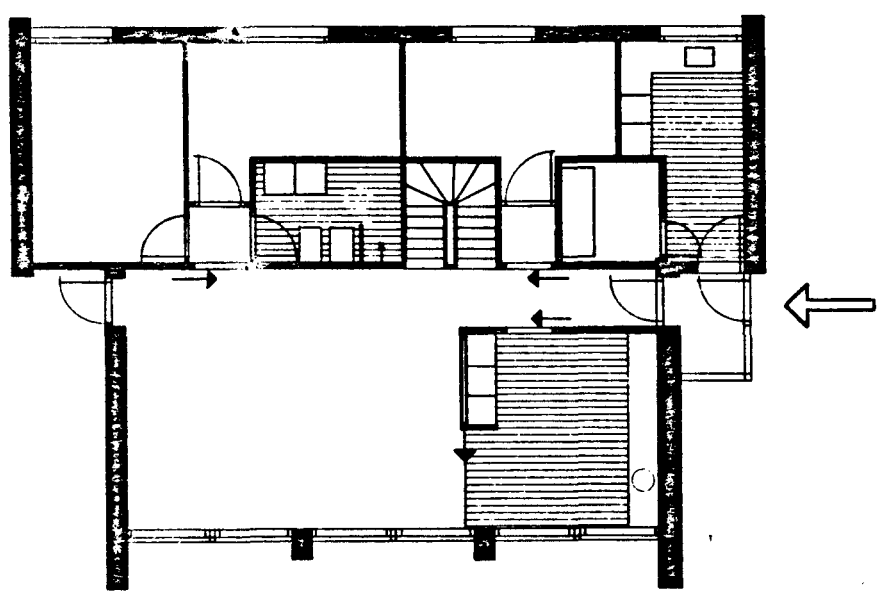
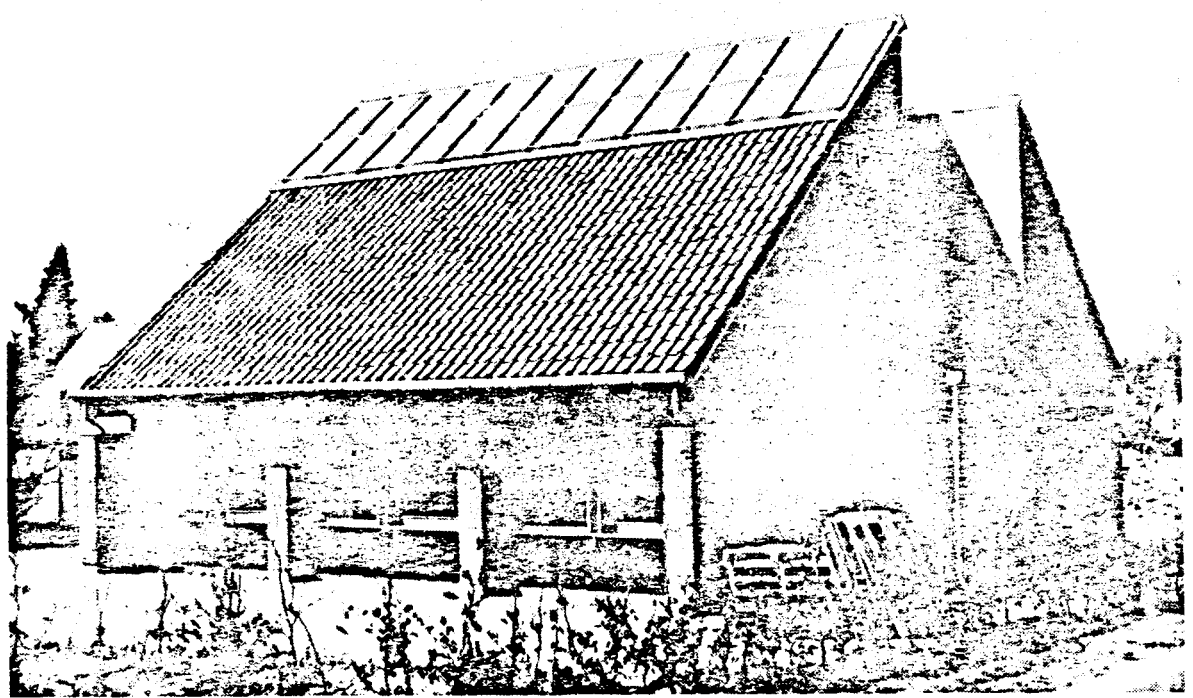
(existing or anticipated)

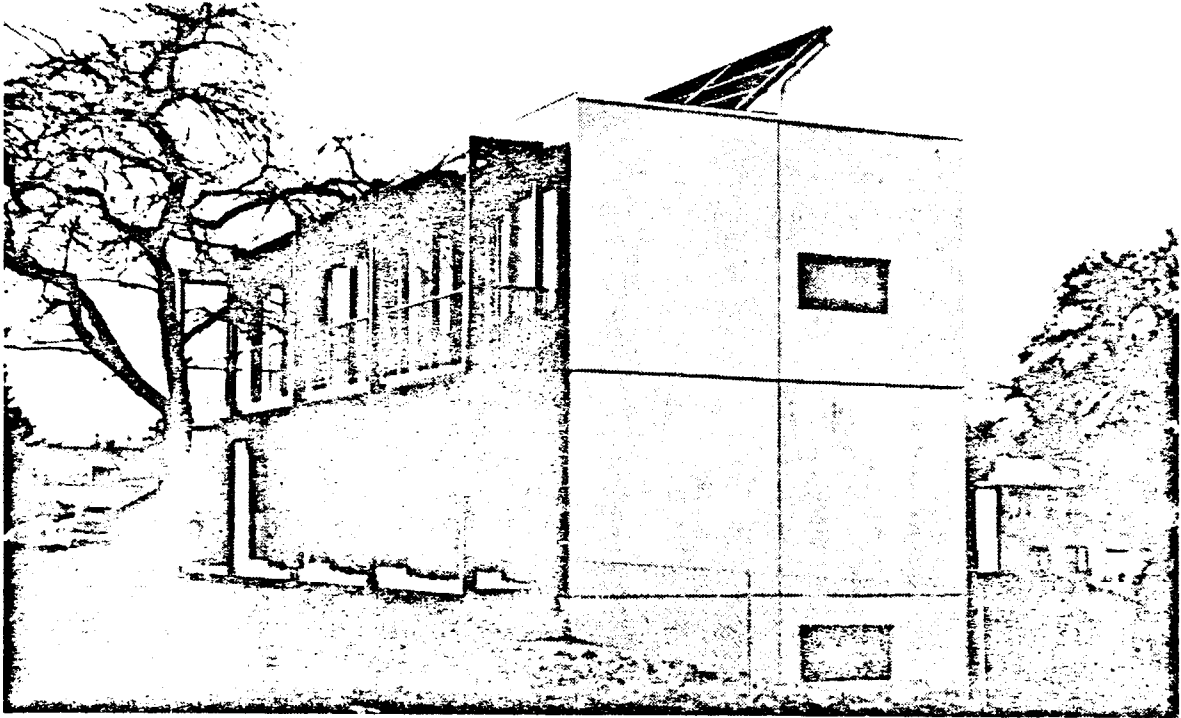
Approximate cost of instrumentation package 27,000-36,000 \$Description of data recording method 10 min. data first stored on cassettes
for each 3 days period then transferred to hard discs (1 month each)

DATA RECORDED

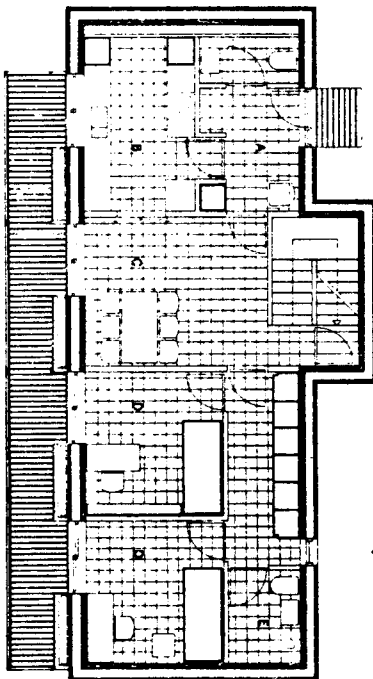
METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	<u>10 sec.</u>	<u> </u>
	Outdoor Temperature	<u>10 sec.</u>	<u> </u>
	Incident radiation on horizontal surface	<u>10 sec.</u>	<u> </u>
	Diffuse <u> </u>	<u>10 sec.</u>	<u> </u>
	Incident radiation in plane of collector	<u>10 sec.</u>	<u> </u>
	Relative Humidity	<u>10 sec.</u>	<u> </u>
	Wind Speed	<u>10 sec.</u>	<u> </u>
	Wind direction	<u>10 sec.</u>	<u> </u>
SOLAR SYSTEM	Radiation on vertical south, east and west	<u>10 sec.</u>	<u> </u>
	Collectors		Temperatures are measured with a resolution of 3° C and an accuracy of 5° C
	Flow rate entering collectors	<u>10 min.</u>	<u> </u>
	Temperature entering & leaving collectors	<u>10 min.</u>	<u> </u>
	Storage		Flowrates: <u> </u>
	Flow rate inputs to storage	<u>10 min.</u>	Resolution 12-25% (10 min)
	Temperature entering & leaving storage	<u>10 min.</u>	Accuracy 1-2% (day)
	Temperature readings in storage (1 or more)	<u>10 min.</u>	<u> </u>
	Auxiliary energy supplied to storage	<u> </u>	<u> </u>
BUILDING SYSTEM	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	<u>10 min.</u>	<u> </u>
	Temperature entering & leaving subsystems	<u>10 min.</u>	Resolution and
	Auxiliary energy supplied to subsystems	<u>10 min.</u>	accuracy: 6-12 (10 min)
			1-2% (day)
BUILDING SYSTEM	(all rooms separately)		
	Average DB inside temperature	<u>10 min.</u>	<u> </u>
	Infiltration load (ventilation)	<u>10 - 20 min.</u>	<u>5%</u>
	Auxiliary energy	<u>10 min.</u>	<u> </u>
	Operating energy	<u>10 min.</u>	<u> </u>
	Total building energy load	<u>10 min.</u>	<u> </u>
	Internal energy gains (simulated)	<u>10 min.</u>	<u> </u>
	Solar gains	<u>10 min.</u>	<u> </u>
	Solar as a % of total load	<u> </u>	<u> </u>
BUILDING SYSTEM	Thermal capacity of building	<u> </u>	<u> </u>

ILLUSTRATION

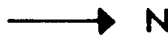
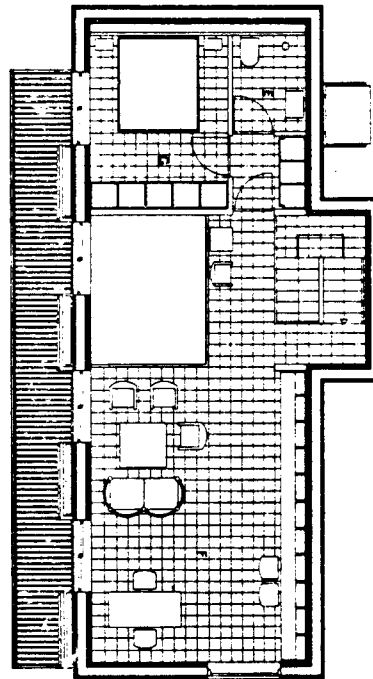




Ground floor



First floor



ITALY



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

The Barra-Costantini Solar Passive System

Address

Salisano (Rieti) - Italy

MAIN PARTICIPANTS

	1	2	3
Name	Prof. Orazio A. Barra	Dr. Tommaso Costantini	
Address	Dipartimento di Fisica - Universiya di Calabria - 87030 - Cosenza (Italy)	Casa Solare - Salisano (Rieti) - Italy	
Phone	0984 - 839389		
Responsibility	Chief of the project	Executive Chief	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>42° 15' N</u> Longitude <u>12° 45'</u> Altitude <u>300 M</u> DD <u>1800</u> Base Temp. <u>0°C</u>
	Sunshine Hours July <u>337</u> January <u>127</u> Annual <u>2518</u>
	Source of data _____
	Urban _____ Suburban _____ Rural <u>X</u>
BUILDING	Floor area <u>130 M²</u> No. Occupants <u>2</u>
	Design Temperature internal w _____ s _____ ° External = 19°C, External hourly simulated by computer using the available meteorol. data
	external w _____ s _____ °
	Mass type <u>concrete ceilings & lecablock walls</u> location _____
	South Glazing type <u>double glass</u>
	area(south glass) <u>15 M²</u> % of total glass <u>60%</u>
	night insulation <u>yes</u> shaded _____
	Heated Volume <u>380 M³</u> Ventilation Rate <u>1</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Barra-Costantini System (solar chimneys on the south wall & storage in ceiling slabs)</u>
	Collector type <u>solar chimneys on the south wall</u> area(net) <u>30M²</u> tilt <u>vertical</u>
	orientation <u>south</u>
	Storage type <u>in the ceilings having hot air channels inside</u> capacity <u>900 KJoule/oc per m² of coll. +1700 " " "</u>
	Auxiliary System type <u>wood chimney</u> fuel type <u>wood</u> the house structure fuel cost _____

PROJECT SCHEDULE

DATE MILESTONES	1979	1980	1981	1982		
Construction completion	X					
Monitoring period		X	X	X		
Final reports	X	X	X	X		

Report availability

Title
(available from)

- 1) A theoretical study..., Solar Energy 23, 211 (1979)
 2) The Barra-Costantini..., Proc. Cong. Buil. Eu. Meudj., Povod de Verrim (Portugal), edited by Pergamon Press (1980)
 3) A well natural connection..., Energy and Buildings, in press

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

6000 U.S.\$

Description of data recording method

Data logger and chart recorders, or manual

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days		
	Outdoor Temperature	hourly	+ 1°C
	Incident radiation on horizontal surface		
	Incident radiation in plane of collector	hourly	+ 50 W/M ²
	Relative Humidity	Furnished by the national	
	Wind Speed	existing meteorological stations	
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	hourly	+ 5 CM/sec
	Temperature entering & leaving collectors	hourly	+ 1°C
	Storage		
	Flow rate inputs to storage	hourly	+ 5 CM/sec
	Temperature entering & leaving storage	hourly	+ 1°C
	Temperature readings in storage(1 or more)	hourly (24 sensors)	+ 1°C
	Auxiliary energy supplied to storage		
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	hourly	+ 5 CM/sec
BUILDING SYSTEM	Temperature entering & leaving subsystems	hourly	+ 1°C
	Auxiliary energy supplied to subsystems		
	Average DB inside temperature	hourly	+ 1°C
	Infiltration load		
	Auxiliary energy	daily	Kg of fuel
	Operating energy		
	Total building energy load	monthly	
	Internal energy gains	monthly	
	Solar gains	monthly	
	Solar as a % of total load	monthly	
	Thermal capacity of building	evaluated	



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

"HABITAT"

Address

JRC

21020 ISPRA (VA)

ITALY

MAIN PARTICIPANTS

	1	2	3
Name	Commission of the		
Address	European Communities JRC I-21020 ISPRA (VA)		
Phone	0332/780 131		
Responsibility	E. ARANOVITCH		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>45° 48'</u> Longitude <u>8° 37'</u> Altitude <u>230m</u> DD <u>2600</u> Base Temp. <u>20°C</u>
	Sunshine Hours July _____ January _____ Annual _____
	Source of data <u>meteorological observatory</u>
	Urban _____ Suburban <u>X</u> Rural _____
BUILDING	Floor area <u>160 m²</u> No. Occupants <u>3</u>
	Design Temperature internal w <u>20</u> s _____ °C
	external w <u>-12</u> s _____ °C
	Mass type <u>masonry; concrete</u> location <u>walls; floor</u>
	South Glazing type <u>double glazing</u>
	area(south glass) <u>8,4 m²</u> % of total glass <u>≈ 40 %</u>
night insulation <u>---</u> shaded <u>during summer</u>	
Heated Volume <u>320m³</u> Ventilation Rate <u>variable</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>house heating</u>
	Collector type <u>different types</u> area(net) <u>41 m²</u>
	orientation <u>south</u> tilt <u>60°</u>
	Storage type <u>a) water tank; b) bassin water</u> capacity <u>a) 2m² b) 50m³</u>
Auxiliary System type <u>heatpump water to water</u> fuel type <u>electricity</u> fuel cost <u>---</u>	

PROJECT SCHEDULE

11

DATE						
MILESTONES						
Construction completion	in operation since 1977					
Monitoring period						
Final reports						

Report availability Title see annex
(available from)

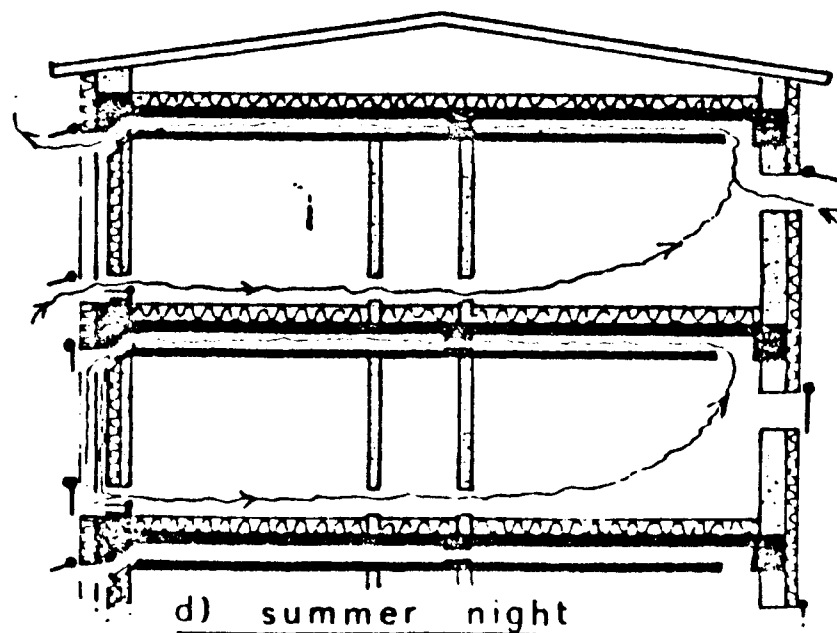
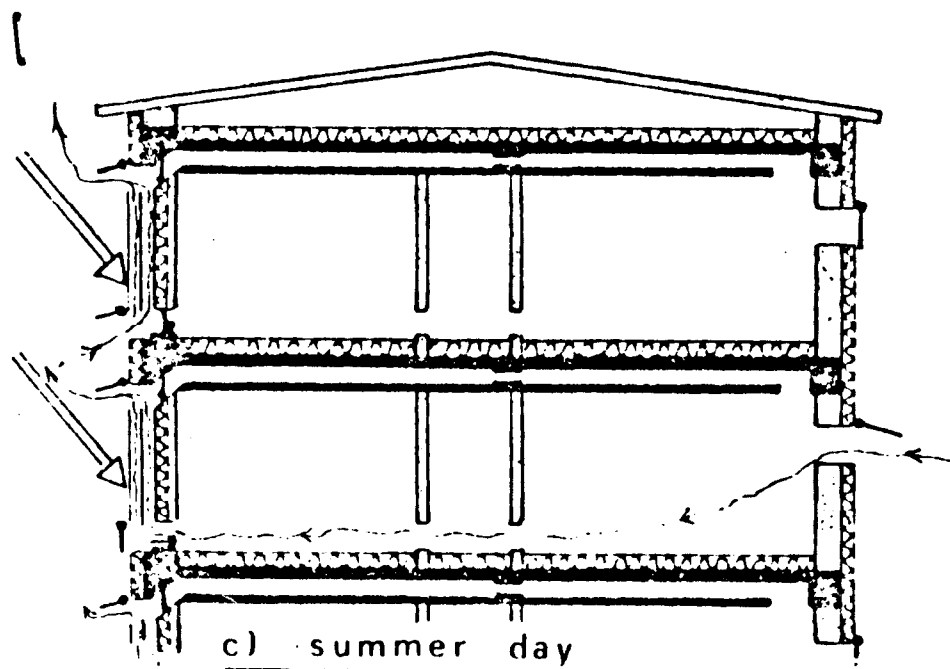
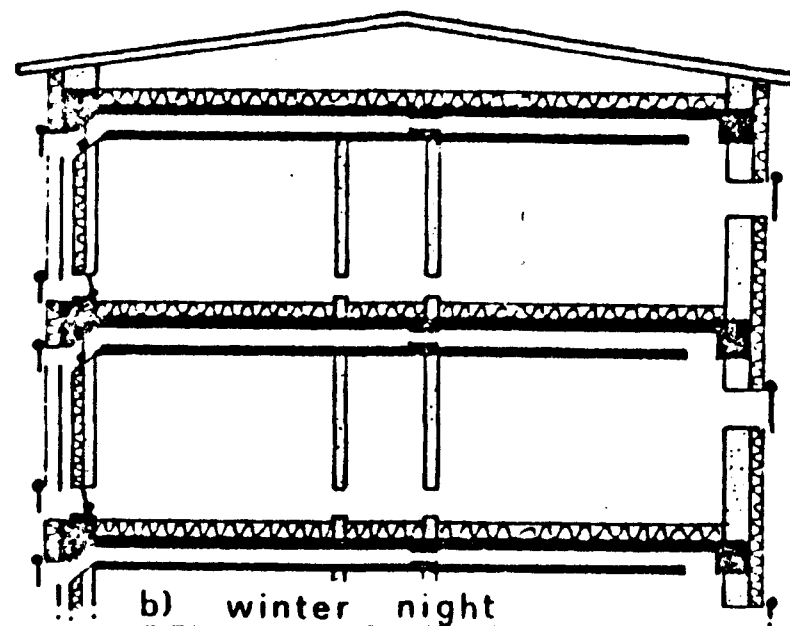
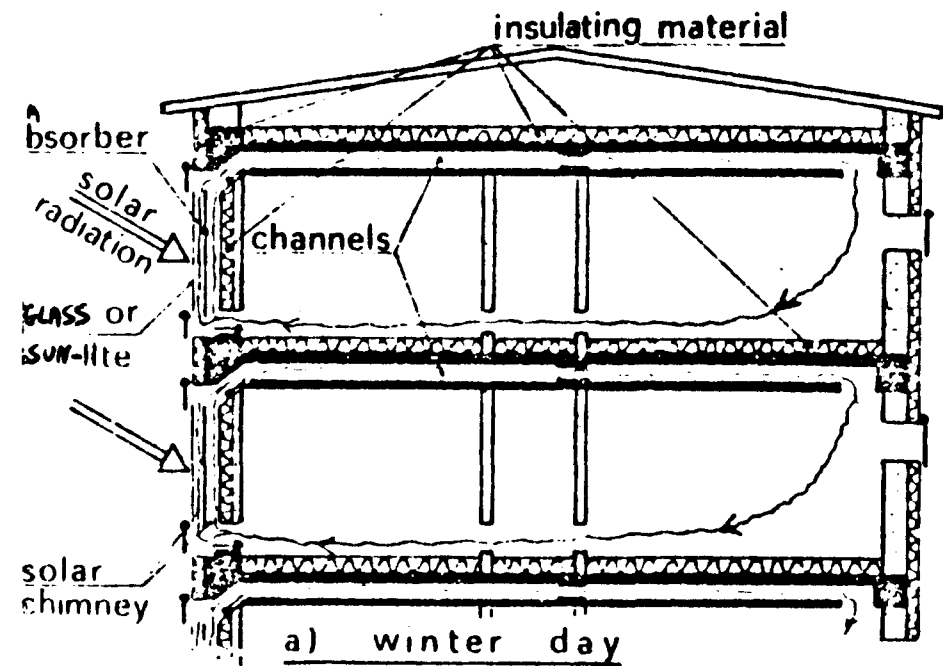
INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package 40 000 US \$
Description of data recording method computer based data acquisition system;
Hewlett-Packard 3052 A

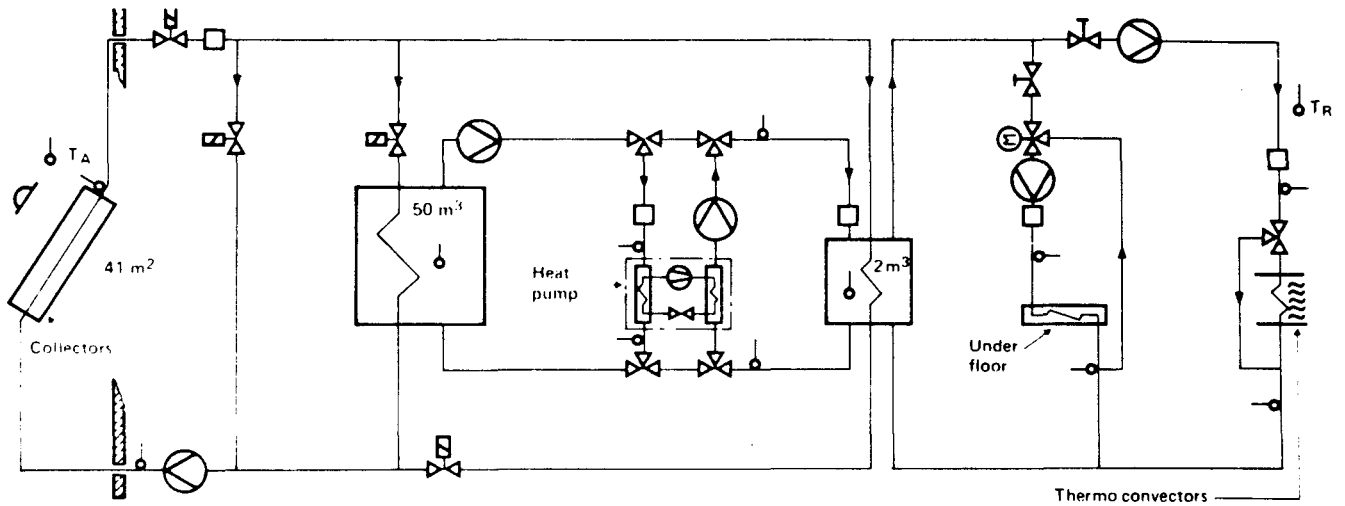
DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	every min.	$\pm 0,1^{\circ}\text{C}$
	Outdoor Temperature	"	$\pm 0,1^{\circ}\text{C}$
	Incident radiation on horizontal surface	"	$\pm 10 \text{ W/m}^2$
	Incident radiation in plane of collector	"	$\pm 10 \text{ W/m}^2$
	Relative Humidity	"	$\pm 5 \%$
SOLAR SYSTEM	Wind Speed	cont.	$\pm 10\%$
	Collectors		
	Flow rate entering collectors	every min.	$\pm 15 \text{ l/h}$
	Temperature entering & leaving collectors	"	$\pm 0,1^{\circ}\text{C}$
	Storage		
	Flow rate inputs to storage	"	$\pm 10 \text{ l/h}$
	Temperature entering & leaving storage	"	$\pm 0,1^{\circ}\text{C}$
	Temperature readings in storage(1 or more)	"	$\pm 0,1^{\circ}\text{C}$
	Auxiliary energy supplied to storage	"	$\pm 1\%$
	Space heat,Space cooling,Hot water Subsystems	"	$\pm 1\%$
BUILDING SYSTEM	Flow rates entering subsystems	"	$\pm 0,1\%$
	Temperature entering & leaving subsystems	"	$\pm 1\%$
	Auxiliary energy supplied to subsystems	"	
	Average DB inside temperature	every min.	$\pm 0,1\%$
	Infiltration load	---	---
	Auxiliary energy	every min	$\pm 1\%$
	Operating energy	"	$\pm 1\%$
	Total building energy load	"	$\pm 2\%$
	Internal energy gains	daily	$\pm 1\%$
	Solar gains	evaluated	
	Solar as a % of total load	idem	
	Thermal capacity of building	---	---

ILLUSTRATION



ILLUSTRATION



Hybrid Solar Heating System of the JRC Solar Laboratory

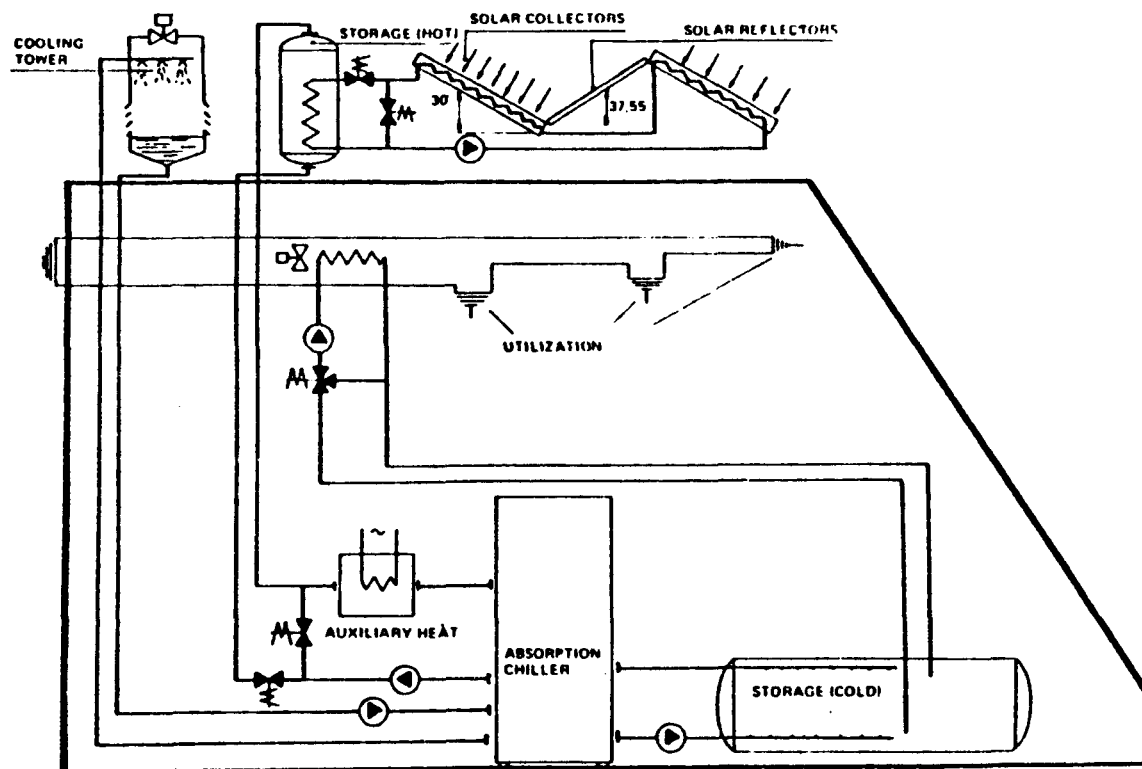


Fig.3 Schematic view of the solar cooling system of the JCR Solar laboratory.

JAPAN



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

13

PROJECT TITLE

Aratani house [Architectural use of Solar

Address

Radiation in Winter and Natural Cooling in Summer]

Teine-honcho 462, Nishi-ku Sapporo

Japan

MAIN PARTICIPANTS

	1	2	3
Name	Noboru Aratani		
Address	Teine-honcho 462 Nishi-ku Sapporo		
Phone	011-683-7630		
Responsibility	Designer, Researcher Resident		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>43°N</u> Longitude <u>141°E</u> Altitude <u>15^m</u> DD <u>3970</u> Base Temp. <u>18°C</u>
	Sunshine Hours July <u>194</u> January <u>101</u> Annual <u>1954</u>
	Source of data <u>Scientific chronology edited by Tokyo Astronomical Observatory</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>320 m²</u> No. Occupants <u>8 (two families)</u>
	Design Temperature internal w <u>18</u> s <u>28</u> °C
	external w <u>-12</u> s <u>32</u> °C
	Mass type <u>cement concrete blocks</u> location <u>construction wall</u>
	South Glazing type <u>triple triple glass + long wave reflective film</u>
	area(south glass) <u>54 m²</u> % of total glass <u>77%</u>
	night insulation <u>38mm insulation board (unfinished)</u> shaded <u>horizontal louver (south)</u>
Heated Volume <u>912 m³</u> Ventilation Rate <u>0.33</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating (through the windows) - Hot water (by the collectors)</u>
	Collector type <u>triple glass window</u> plate collector area(net) <u>54 m²</u> Heating <u>54 m²</u> Hot Water <u>4.5 m²</u>
	orientation <u>south</u> south tilt <u>90°</u> 67°
	Storage type <u>construction wall</u> water tank capacity <u>46000^{keal}/k</u> 230 ^ℓ x2
	Auxiliary System type <u>water heating system</u> waste heat boiler fuel type <u>oil</u> fuel cost <u>80 yen/ℓ</u> waste <u>free</u>

PROJECT SCHEDULE

14

DATE	Oct. 30, 1979	Jan., 1980				
MILESTONES						
Construction completion	o					
Monitoring period		o		continued		
Final reports						unfinished

Report availability

Title
(available from)

Thermal on Ventilative Test Results of the Highly
Insulated House. T. Sasaki, N. Aratani, 1980.
Architectural Institute of Japan

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package

Description of data recording method

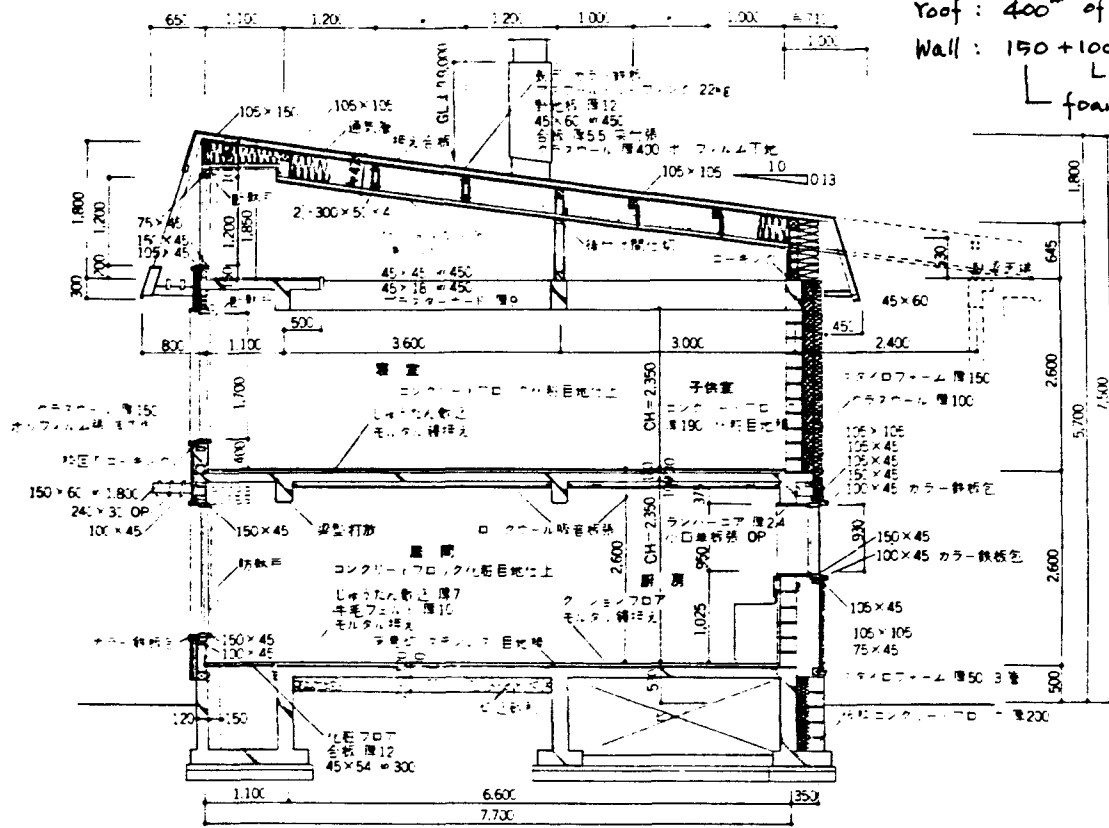
Thermo couple + multi point recorder

Eply radiometer + Integrator + recorder

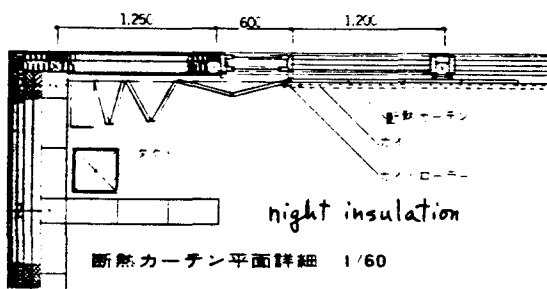
DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	continued	good
	Outdoor Temperature	continued	good
	Incident radiation on horizontal surface	---	---
	Incident radiation in plane of collector	continued	good
	Relative Humidity	---	---
	Wind Speed	---	---
SOLAR SYSTEM			
	Collectors		
	Flow rate entering collectors	---	
	Temperature entering & leaving collectors	---	
	Storage		
	Flow rate inputs to storage	---	
	Temperature entering & leaving storage	---	
	Temperature readings in storage(1 or more)	6 points - continued	
	Auxiliary energy supplied to storage	---	
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	---	
	Temperature entering & leaving subsystems	---	
	Auxiliary energy supplied to subsystems	once a day	
BUILDING SYSTEM			
	Average DB inside temperature	continued	good
	Infiltration load	3 times/season	
	Auxiliary energy	once a day	
	Operating energy	---	
	Total building energy load	once a month	
	Internal energy gains 80% of total		
	Solar gains load for heating		
	Solar as a % of total load		
	Thermal capacity of building	estimated	

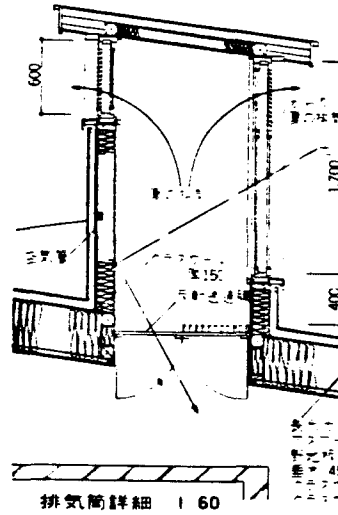
Roof : 400^{mm} of grass wool 15
 Wall : 150 + 100
 L grass wool
 foam polystyrene



矩計詳細 1/100

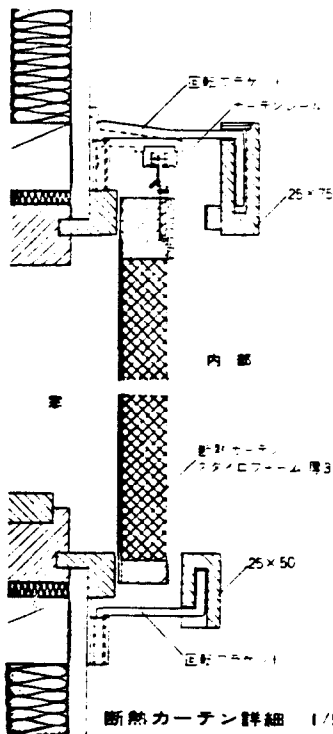


断熱カーテン平面詳細 1/60



排気筒平面詳細 1/60

natural ventilation tower
 for night ventilation



断熱カーテン詳細 1/1

Photos: T. Waki



太陽熱の建築的な利用

荒谷邸／荒谷豊（北海道大学）

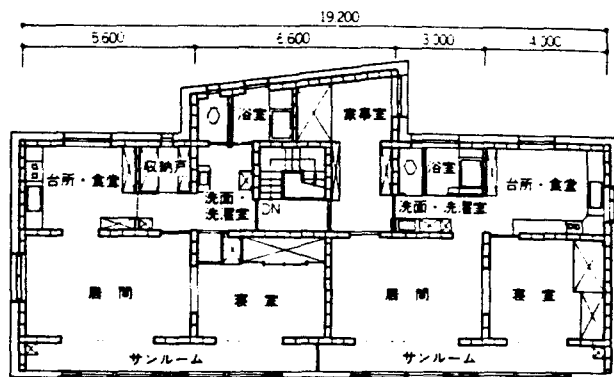
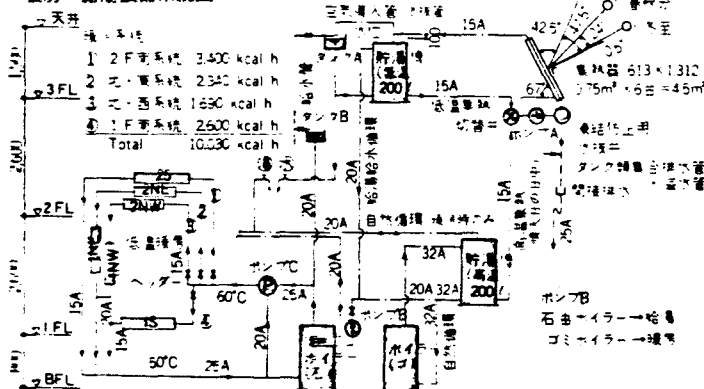


所在地／札幌市・手稲
敷地面積／946m²
建築面積／161.7m²
延床面積／323.4m²
1階：161.7m²
2階：161.7m²

施工／常盤工業

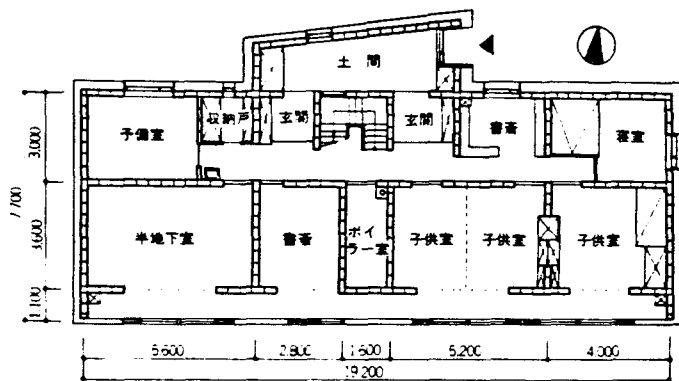
暖房機器／スウェーデン製低温水ボイラー＋PS・HRヒーター（放熱器）。給湯熱源として薪ボイラーおよび太陽熱コレクター

暖房・給湯設備系統図



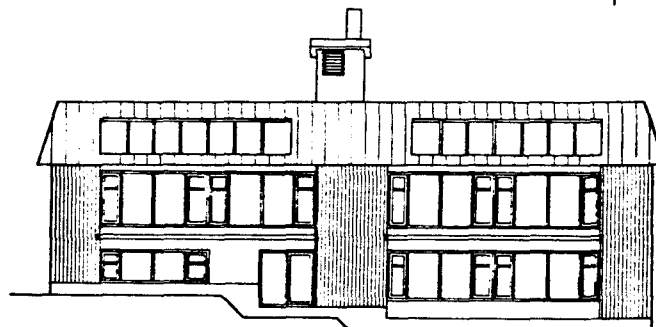
2階平面

2nd floor



1階平面 1/250

1st floor



南側立面 1/250

South elev.

作者は、北海道の寒地住宅の研究の中で、主として環境工学的な立場からの理論を支える中心的な存在として役割を果たしている。日本の建築、特に住宅建築の分野において、研究者や各種の分野の専門家にとって互いに協力し合いながら、実験的な住宅を造り上げるという機会はきわめて少ない。この住宅は、氏の研究の実験室であり、また自らが住み手となってその成果の確認と次への問題を発見する場となっている。その意味からも未完成品と自認されるが、盛り込まれた主張は明快であり、強い説得力をもつものである。この住宅にしつらえられた装置は、家の大きさからみれば非常に小さい給湯補助熱源としての太陽熱コレクターと、スウェー

デン製の熱効率95%という高性能ボイラーと約50°Cくらいで放熱するパネルラジエーターを除くと、まさに建築的な手法に彩られている。ブロック造の開口部の不自由さから逃れるための木造のカーテンウォール、そこに南面一杯にとられた木製枠による三重ガラス窓、その窓から入る太陽熱を吸・放熱するためのブロック壁とRCスラブ、内部の熱を逃がさないための徹底した高断熱化された壁と屋根と断熱カーテン、さらに南面にできる縁側スペースを含めたオープンなプランニングを床下にまで広げ、基礎断熱された床下の地盤蓄熱の利用等によって、この広い住宅が、北海道の普通の暖房面積 30~40m²の住宅の約半

分の灯油消費で隔々まで終日暖房されるということは、特に北海道の人びとにとって驚異であろう。注目すべきは、17~18°Cという普通よりは5°Cくらい低めの設定温度でまったく寒さを感じない内部空間は、現在は竣工直後のためか多少湿度が高いが、外断熱と熱容量の大きい部位構成と低温水による終日暖房の成果といえる。安上がりで工夫に富む開口部まわりや断熱のディテールは、熱・空気の理論を熟知した者のみが行ないうる確かさと、大量生産部品に対するアンチテーゼが感じられる。普及という点からは、まだ解決しなければならない点もあるが、最初に述べたとおり、これは氏の研究、実験の場なのである。

THE NETHERLANDS



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

BOUWCENTRUM SOLAR HOUSE Type II
Zundert (The Netherlands)

MAIN PARTICIPANTS

	1	2	3
Name	Bouwcentrum	Technisch Physische	
Address	Binnenmilieutechniek Weena 700 P.O.Box 299 3000 AG ROTTERDAM	Dienst TNO-TH Stieltjesweg 1 P.O.Box 1 2628 CK DELFT	
Phone			
Responsibility	Bouwcentrum		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>51°5'</u> Longitude <u>5°7'</u> Altitude <u>+5</u> DD <u>3644</u> Base Temp. <u>18°C</u>
	Sunshine Hours July <u>225</u> January <u>73</u> Annual <u>1400</u>
	Source of data <u>Kon. Ned. Meteorologisch Instituut De Bilt</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>230 m²</u> No. Occupants <u>4</u>
	Design Temperature internal w <u>20</u> s <u> </u> °C
	external w <u>-10</u> s <u> </u> °C
	Mass type <u>concrete, bricks</u> location <u>Zundert</u>
	South Glazing type <u>insul. double glazing (U-value 1.7 W/m².K)</u>
	area(south glass) <u>21,6 m²</u> % of total glass <u>45%</u>
	night insulation <u>--</u> shaded <u>--</u>
Heated Volume <u>660 m³</u> Ventilation Rate <u>0,5</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>air collector with integrated heat storage</u>
	Collector type <u>see above</u> area(net) <u>30 m²</u>
	orientation <u>south</u> tilt <u>55°</u>
	Storage type <u>concrete slab 120 mm thick</u> capacity <u>5,8 MJ</u>
	Auxiliary System type <u>air heater</u> fuel type <u>gas</u> fuel cost <u> </u>

PROJECT SCHEDULE

DATE						
MAILESTONES						
Construction completion						
Monitoring period		March '80 -- Oct.'81				
Final reports				Dec. '81		

Report availability

Title

(available from)

December 1981

INSTRUMENTATION

(existing or anticipated)

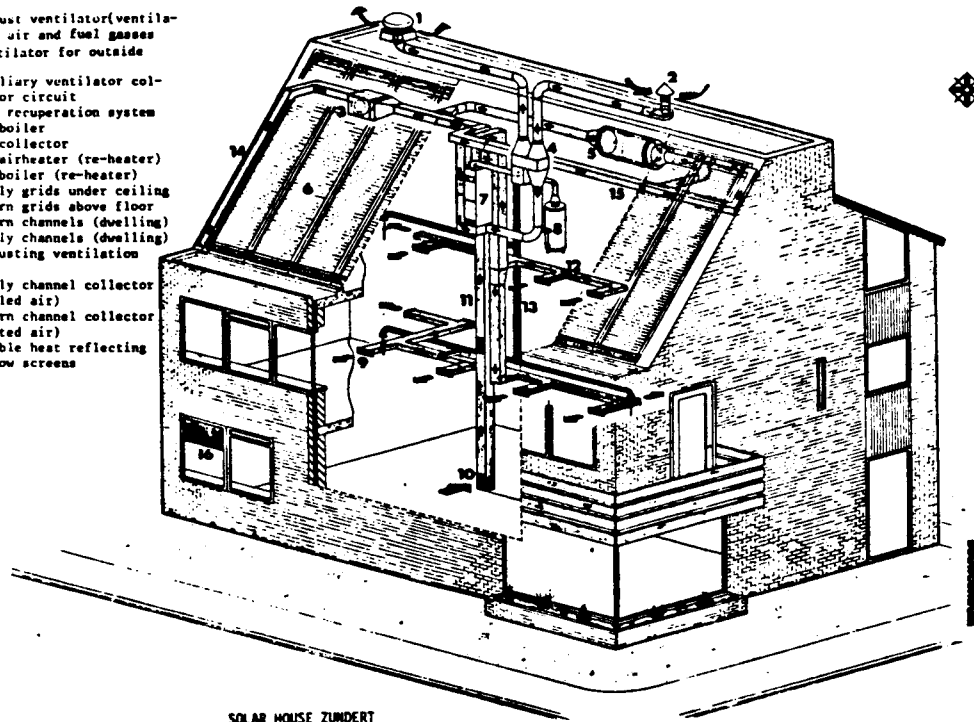
Approximate cost of instrumentation package Df1.50.000,--
 Description of data recording method Microprocessor controlled data-logger
data storage on cartridge

DATA RECORDED

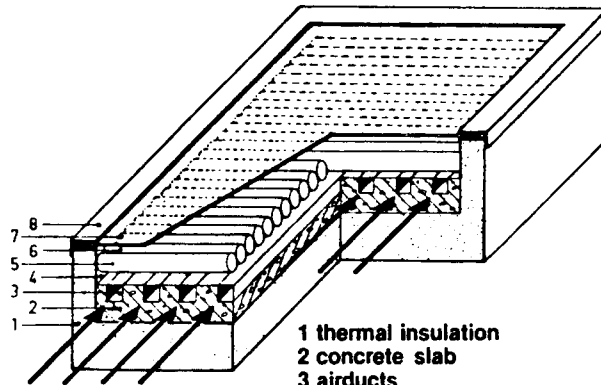
		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	--	
	Outdoor Temperature	7 sec.	1%
	Incident radiation on horizontal surface	--	
	Incident radiation in plane of collector	7 sec.	2%
	Relative Humidity	--	
	Wind Speed	--	
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	7 sec.	5%
	Temperature entering & leaving collectors	7 sec.	1%
	Storage		
	Flow rate inputs to storage	--	
	Temperature entering & leaving storage		
	Temperature readings in storage(1 or more)	20 min.	1%
	Auxiliary energy supplied to storage	--	
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	7 sec.	5%
BUILDING SYSTEM	Temperature entering & leaving subsystems	7 sec.	1%
	Auxiliary energy supplied to subsystems	7 sec.	2%
	Average DB inside temperature	7 sec.	1%
	Infiltration load	--	
	Auxiliary energy	duty time	2%
	Operating energy	duty time	2%
	Total building energy load	7 sec. SH*)	2%
	Internal energy gains	--	
	Solar gains	--	
	Solar as a % of total load	7 sec. SH*)	2%
	Thermal capacity of building		

ILLUSTRATION

1. exhaust ventilator (ventilation air and fuel gasses)
2. ventilator for outside air
3. auxiliary ventilator collector circuit
4. heat recuperation system
5. air boiler
6. air collector
7. gas airheater (re-heater)
8. gas boiler (re-heater)
9. supply grids under ceiling
10. return grids above floor
11. return channels (dwelling)
12. supply channels (dwelling)
13. exhausting ventilation air
14. supply channel collector (cooled air)
15. return channel collector (heated air)
16. movable heat reflecting window screens

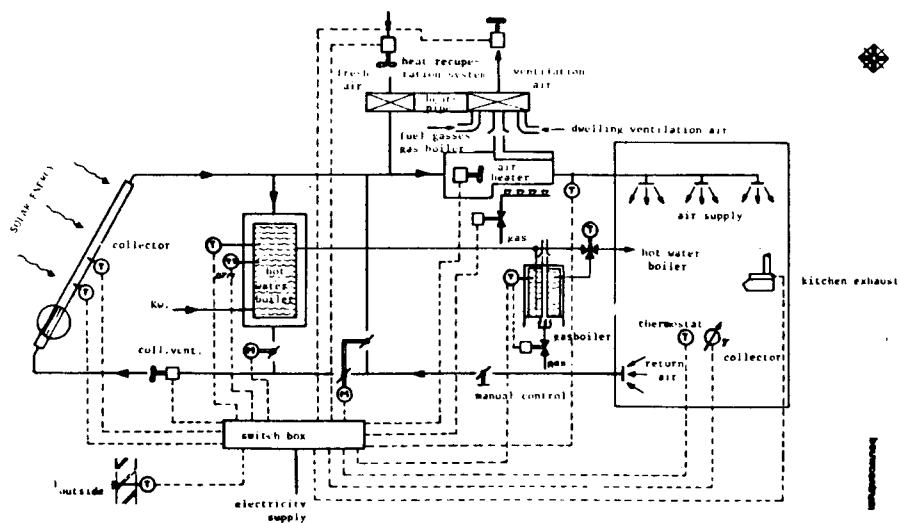


SOLAR HOUSE ZUNDERT



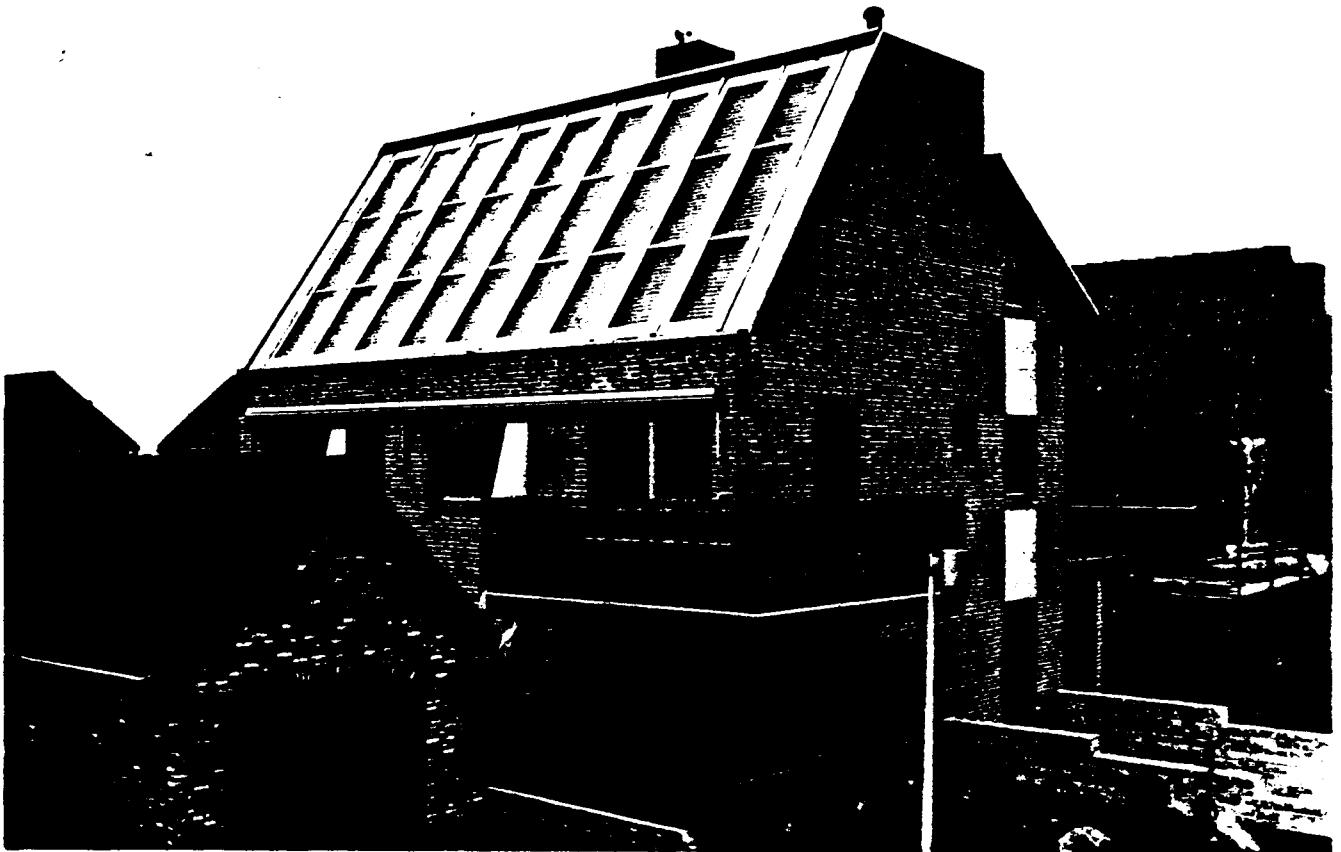
- 1 thermal insulation
- 2 concrete slab
- 3 airducts
- 4 cavity
- 5 glass vacuum tubes with spectrally selective coating
- 6 cavity
- 7 single glazing
- 8 frame

AIR COLLECTOR WITH INTEGRATED HEAT-STORAGE



CONTROL SYSTEM OF THE SOLAR HEATING INSTALLATION IN ZUNDERT

ILLUSTRATION



SWEDEN



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Low Energy House in Bollebygd

Address

Bollebygd

Göteborg

Sweden

MAIN PARTICIPANTS

	1	2	3
Name	Prof. Hans Nordenström	Egil Ofverholm	T. Esbensen
Address	Matti Mikkonen, architect Chalmers University of Technology Goteborg, Sweden	Swedish Council for Building Research Stockholm, Sweden	E.K. Energirådgivning (Energy consultancy) Copenhagen
Phone	031/810 100	08 - 54 06 40	02 - 87 72 76
Responsibility	Project coordinator Architect and owner	Financial support	Evaluation and reporting

This format was filled in by Poul E. Kristensen
Technical Univ. of Denmark and (3)

PROJECT DESCRIPTION

CLIMATE	Latitude <u>58°</u> Longitude <u>12° E</u> Altitude <u>~ 0 m</u> DD <u>3120</u> Base Temp. <u>17</u>
	Sunshine Hours July <u>270</u> January <u>52</u> Annual <u>1894</u>
	Source of data <u>Roger Taesler: "Klimatdata för Sverige", 1972 (Torslanda Airport, Göteborg 1952-68)</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>140 m²</u> No. Occupants <u>4</u>
	Design Temperature internal w <u>20</u> s <u> </u> °
	external w <u>-15</u> s <u> </u> °
	Mass type <u> </u> location <u> </u>
	South Glazing type <u>4 pane glazing</u>
	area(south glass) <u>18 m²</u> % of total glass <u>75%</u>
	night insulation <u>none</u> shaded <u>yes</u>
Heated Volume <u> </u> Ventilation Rate <u>.4</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u> </u>
	Collector type <u>single glazed, non insulated</u> area(net) <u>22 m²</u> } <u>28 m²</u>
	orientation <u>south</u> tilt <u>70°</u>
	Storage type <u>steel tanks, 2.8 + 0.2 m³</u> capacity <u>12.6 MJ/K (3 m³ water)</u>
	Auxiliary System type <u>wood-burner furnace and direct electricity</u> fuel type <u>wood</u> fuel cost <u> </u> ?
	+ electr. approx. <u>.23</u>

PROJECT SCHEDULE

DATE						
DATE						
Construction completion	May 78					
Monitoring period		Jan. 79	April 81			
Final reports				Oct. 81		

Report availability

 Title
 (available from)

"A Low Energy House in Sweden ..."

by T.V. Esbensen

Proceedings from 2. Int. Sonnenforum, Hamburg 1978

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 60,000 Dcrs.Description of data recording method manual reading weekly (energy)+ chart recorder (temperatures)

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	-	
	Outdoor Temperature	Ch	
	Incident radiation on horizontal surface	-	
	Incident radiation in plane of collector	-	
	Relative Humidity	Ch	
	Wind Speed	-	
	Ch = chart recording w = weekly reading of meter		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	-	
	Temperature entering & leaving collectors	-	
	Storage		
	Flow rate inputs to storage		
	Temperature entering & leaving storage	w	± 5-10%
	Temperature readings in storage(1 or more)	-	
	Auxiliary energy supplied to storage	-	
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems		
BUILDING SYSTEM	Temperature entering & leaving subsystems	w	± 2%
	Auxiliary energy supplied to subsystems	w	
	Average DB inside temperature	Ch	
	Infiltration load	-	
	Auxiliary energy	w	
	Operating energy	w	
	Total building energy load	-	
	Internal energy gains	-	
	Solar gains	-	
	Solar as a % of total load	-	
	Thermal capacity of building	-	



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

SUN SEC: Serieanpasset Solhus

Address

Rågvägen 10
Fjärås (36 km south of Göteborg)
Sweden

MAIN PARTICIPANTS

	1	2	3
Name	G. Nordseidt	Egil Ofverholm	T. Esbensen
Address	Research Fellow Chalmers University of Technology Göteborg, Sweden	Swedish Council for Building Research Stockholm, Sweden	E.K. Energirådgivning (Energy consultancy) Copenhagen
Phone	031/810 100	08-54 06 40	02-87 72 76
Responsibility	Owner Project coordinator	Financial support	Evaluation and reporting

PROJECT DESCRIPTION

This format was filled in by Poul E. Kristensen
Technical Univ. of Denmark and (3)

CLIMATE	Latitude <u>57° 24' N</u> Longitude <u>12° 10' E</u> Altitude <u>~ 0</u> DD <u>3120</u> Base Temp. <u>17</u>
	Sunshine Hours July <u>270</u> January <u>52</u> Annual <u>1894</u>
	Source of data <u>Roger Taesler: Klimatdat för Sverige (Torslanda airport, Göteborg 1952-68)</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>~ 160 m² *</u> No. Occupants <u>3</u>
	Design Temperature internal w <u>20 °C</u> s <u> </u> °
	external w <u>-15 °C</u> s <u> </u> °
	Mass type <u> </u> location <u> </u>
	South Glazing type <u>triple glazing</u>
	area(south glass) <u>15 m²</u> % of total glass <u>90</u>
	night insulation <u>no</u> shaded <u>yes</u>
Heated Volume <u>~ 380 m³</u> Ventilation Rate <u> </u> a.c.h.	
*) heated area, within ext. walls	
SOLAR SYSTEM	System energy use(eg. heating) <u>10.800 kWh</u>
	Collector type <u>AGA DFP air collector</u> area(net) <u>32.4 m²</u>
	orientation <u>177° from N</u> tilt <u>70°</u>
	Storage type <u>two steel tanks</u> capacity <u>12.6 MJ/K (3 m³ water)</u>
Auxiliary System type <u>heat pump and</u> fuel type <u>el</u> fuel cost <u>23 Skr/kWh</u>	
	<u>direct electricity</u>

PROJECT SCHEDULE

26

DATE						
MILESTONES						
Construction completion	Sept. 79					
Monitoring period		April 80	Oct. 81			
Final reports				March 82		

Report availability

Title
(available from)

SUN SEC: Serieanpasset Solhus

G. Nordfeldt et al.

Byggeforskningsrådet, Stockholm

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package

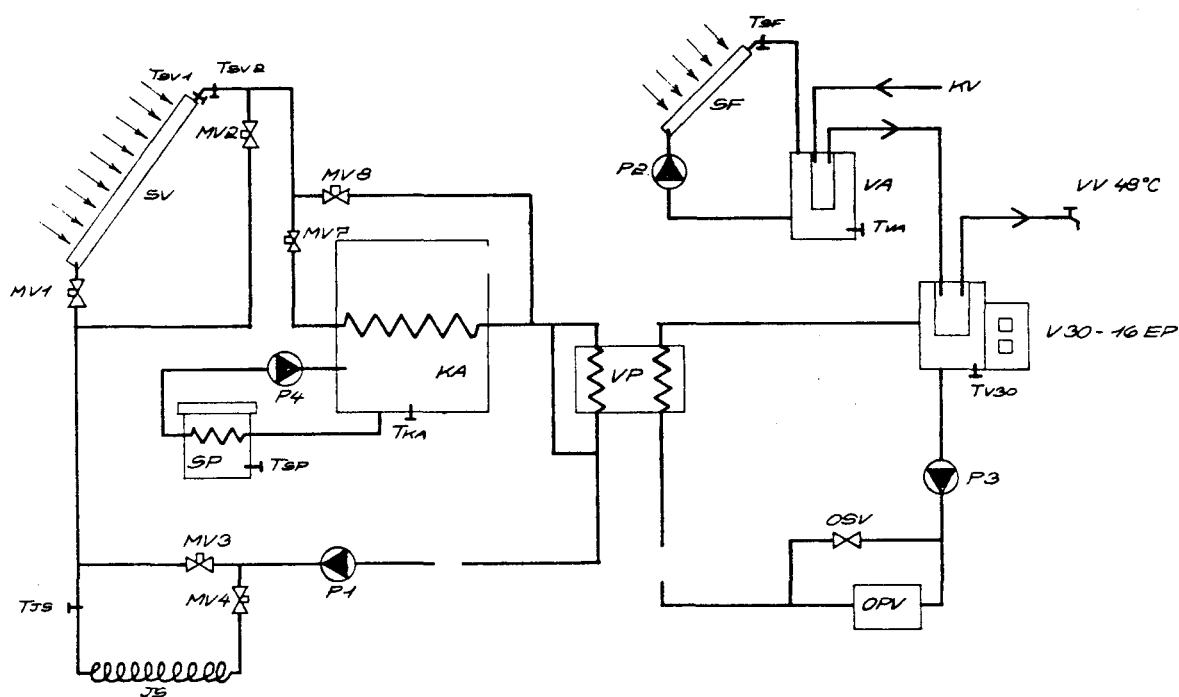
Description of data recording method

mag. tape cassettes

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	-	-
	Outdoor Temperature	1 hour	$\pm .5^{\circ}\text{C}$
	Incident radiation on horizontal surface	10 min.	$\pm 5\%$
	Incident radiation in plane of collector	- " -	- " -
	Relative Humidity	-	-
	Wind Speed	10 min.	$\pm .6 \text{ m/s}$
SOLAR SYSTEM	Collectors	I = integrated value	
	Flow rate entering collectors	1 hour I	$\pm 5\%$
	Temperature entering & leaving collectors	-	-
	Storage		
	Flow rate inputs to storage	1 hour I	$\pm 5\%$
	Temperature entering & leaving storage	1 hour	$\pm .5^{\circ}\text{C}$
	Temperature readings in storage(1 or more)	-	-
	Auxiliary energy supplied to storage	-	-
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	1 hour I	$\pm 5\%$
BUILDING SYSTEM	Temperature entering & leaving subsystems	1 hour I	
	Auxiliary energy supplied to subsystems		
		I = integrated value	
	Average DB inside temperature	1 hour	$\pm .5^{\circ}\text{C}$
	Infiltration load	-	-
	Auxiliary energy	-	-
	Operating energy	1 hour	-
	Total building energy load	(1 hour)	-
	Internal energy gains	1 hour	
	Solar gains	1 hour I	$\pm 5\%$
	Solar as a % of total load	-	-
	Thermal capacity of building	-	-

ILLUSTRATION

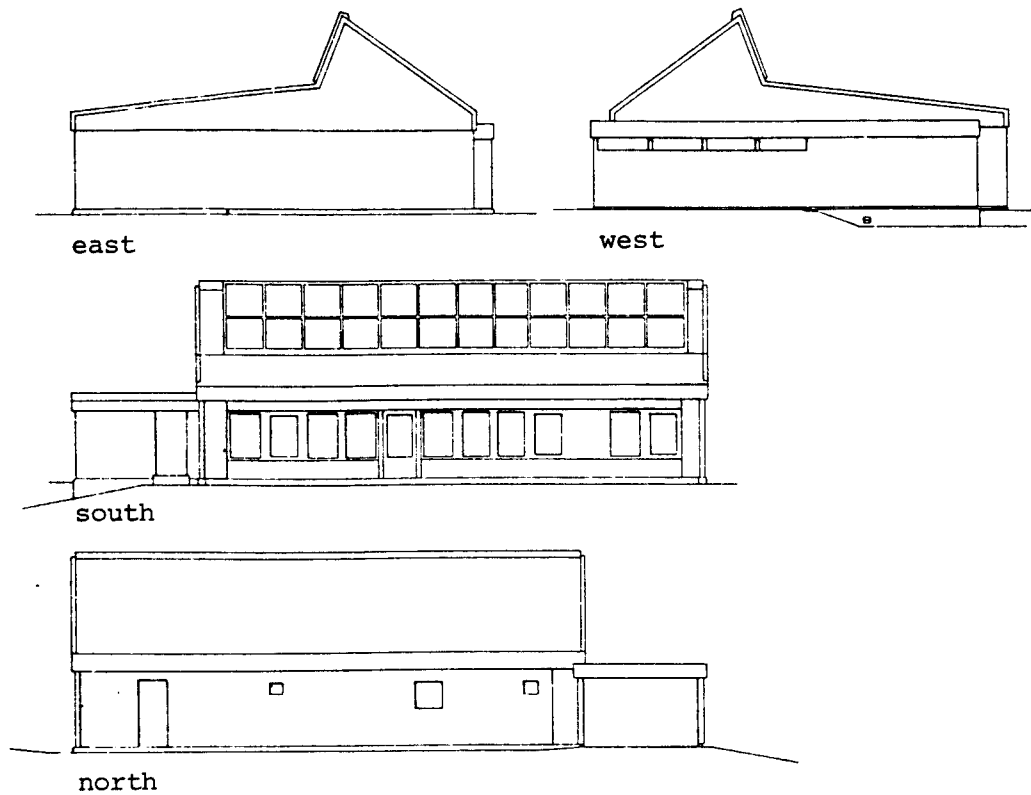


System Diagram

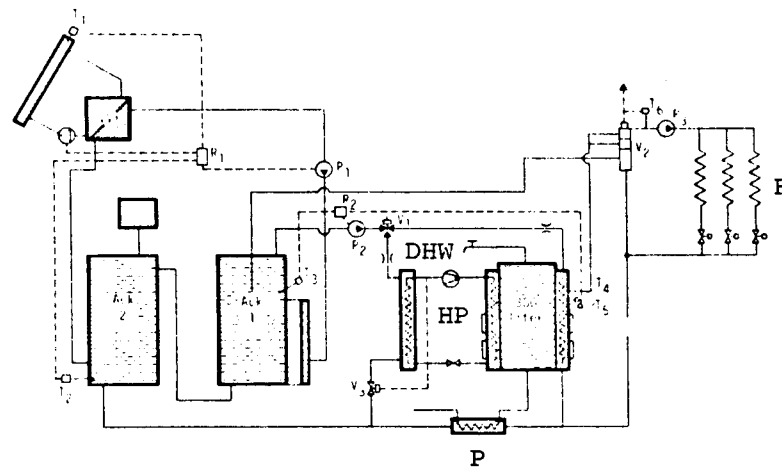
SV : low temperature collector
(22 m²)
KA : accumulator (3 m³)
JS : ground coils
KV : domestic cold water

SF : high temperature collector (6 m²)
VA : accumulator (0.2 m³)
VP : heat pump
SP : waste water recovery
VV : domestic hot water
OPV : space heating system

ILLUSTRATION



The SUN SEC house
Front elevations



System Diagram

VVX: air/water heat exchanger
 Ack: heat storage tank
 DHW: domestic hot water
 HP: heat pump
 P: domestic hot water preheater
 F: floor heating

SWITZERLAND



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

PASSIVE SOLAR HOUSE

Address

" BEGNINS "

(Direct gains)

BEGNINS (Switzerland)

MAIN PARTICIPANTS

	1	2	3
Name	STUBY F. & G.	PERRIN G.-R.	FAIST A.
Address	Les Fontanettes 1268 BEGNINS	Solar Group EPF-L Department of Physics P.O.Box 1024 CH - 1001 Lausanne (021) 47.34.31	Solar Group EPF-L Department of Physics P.O.Box 1024 CH - 1001 Lausanne (021) 47.34.31
Phone	(022) 66.26.18	(021) 47.34.31	(021) 47.34.31
Responsibility	Architect / Owner	Responsible researcher	Professor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>46.5°</u> Longitude <u>6.5°</u> Altitude <u>615 m</u> DD <u>3240°K</u> Base Temp. <u>20/12</u>
	Sunshine Hours July <u>272</u> January <u>70</u> Annual <u>1950</u>
	Source of data <u>Institut Suisse de Météorologie (Average data)</u>
	Urban ☐ Suburban ☐ Rural ☒
BUILDING	Floor area <u>210 m²</u> No. Occupants <u>2 - 3</u>
	Design Temperature internal w <u>18</u> s <u>24</u> °C
	external w <u>-10</u> s <u>30</u> °C
	Mass type <u>Concrete</u> location <u>Floor + Chimney</u>
	South Glazing type <u>Double-pane (thermopane)</u>
	area(south glass) <u>28 m²</u> % of total glass <u>40 %</u>
SOLAR SYSTEM	night insulation U value night <u>1.6 W/m²K</u> shaded <u>0.3 - 0.5</u> a.c.h.
	Heated Volume <u>742.5 m³</u> Ventilation Rate <u>0.3 - 0.5</u> a.c.h.
	System energy use(eg. heating) <u>Space heating (Passive direct gain)</u>
	Collector type <u>windows double pane with night insulation</u> area(net) <u>28.0 m²</u>
orientation <u>(South-East) 165°</u> tilt <u>90 °C</u>	
Storage type <u>Concrete (floor+Chimney)</u> capacity <u>10 m³ (concrete)</u>	
Auxiliary System type <u>Electric resistance</u> fuel type <u>Electricity</u> fuel cost <u>Sfr. 0.1/kWh</u>	

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980
Construction completion				
Monitoring period				
Final reports				

Report availability

Title

(available from)

Passive Solar House "Begnins" Task I(IEA) (english)

Passive Solar House "Begnins" Task I(IEA) (french)

Solar Group EPF-L, Dept. of Physics, G.-R.PERRIN

P.O.Box 1024 / CH-1001 Lausanne

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package US\$ 20'000.-Description of data recording method 64 channels analogic (with integrator) 8 pulse counter, A-D connector & scanner magnetic cartridge recorder

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	<u>0.5 hour</u>	<u>1.0 °C</u>
	Outdoor Temperature	<u>0.5 hour</u>	<u>0.5 °C</u>
	Incident radiation on horizontal surface	<u>0.5 hour *</u>	<u>5 % (Kipp-Zonen)</u>
	Incident radiation in plane of collector	<u>0.5 hour *</u>	<u>5 % (Kipp-Zonen)</u>
	Relative Humidity	<u>0.5 hour</u>	<u>3 %</u>
	Wind Speed	<u>0.5 hour *</u>	<u>2 % (max.)</u>
* mesure every 30 seconds, integration every 0.5 hour.			
SOLAR SYSTEM	Collectors	NO ACTIVE SYSTEM	
	Flow rate entering collectors	<u> </u>	<u> </u>
	Temperature entering & leaving collectors	<u> </u>	<u> </u>
	Storage		
	Flow rate inputs to storage	<u> </u>	<u> </u>
	Temperature entering & leaving storage	<u> </u>	<u> </u>
	Temperature readings in storage(1 or more)	<u> </u>	<u> </u>
	Auxiliary energy supplied to storage	<u> </u>	<u> </u>
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	<u> </u>	<u> </u>
	Temperature entering & leaving subsystems	<u> </u>	<u> </u>
	Auxiliary energy supplied to subsystems	<u> </u>	<u> </u>
BUILDING SYSTEM	Average DB inside temperature	<u>0.5 h.</u>	<u>0.5 °C</u>
	Infiltration load	<u>0.5 h. **</u>	<u> </u>
	Auxiliary energy	<u>0.5 h. *</u>	<u>3 %</u>
	Operating energy	<u>0.5 h. *</u>	<u>3 %</u>
	Total building energy load	<u>0.5 h. *</u>	<u> </u>
	Internal energy gains	<u>0.5 h. *</u>	<u> </u>
	Solar gains	<u>0.5 h. *</u>	<u> </u>
	Solar as a % of total load	<u>0.5 h. *</u>	<u> </u>
	Thermal capacity of building	<u>0.5 h.</u>	<u> </u>
** Aperture time of doors and windows are integrated.			



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

PASSIVE & ACTIVE Solar House

Address

"Les Geneveys / Coffranes"

(Greenhouse + air & water collectors)

Switzerland

MAIN PARTICIPANTS

	1	2	3
Name	A.GILLABERT	PERRIN G.R.	FAIST A.
Address	rte des Carabiniers 2206 Les Geneveys/Coffrane Switzerland	Solar group EPF-L Dept. Physics P.O.Box 1024 CH - 1001 Lausanne	Solar Group EPF-L Dept. Physics P.O.Box 1024 CH - 1001 Lausanne
Phone		(021) 47'34'31	(021) 47'34'31
Responsibility	Owners	Responsible researcher	Professor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>47.0°</u> Longitude <u>6.9°</u> Altitude <u>820 m</u> DD <u>4234° C</u> Base Temp. <u>20/12</u>
	Sunshine Hours July <u>237.3</u> January <u>50.1</u> Annual <u>1450</u>
	Source of data <u>Inst. Suisse de Météorologie (average data)</u>
	Urban <u> </u> Suburban <u> </u> Rural <u>X</u>
BUILDING	Floor area <u>136.8 m²</u> No. Occupants <u>3 - 4</u>
	Design Temperature internal w <u>18</u> s <u>24</u> °C
	external w <u>-10</u> s <u>30</u> °C
	Mass type <u>concrete</u> location <u>Floor + walls(ext. insul.)</u>
	South Glazing type <u>double pane (thermopane)</u>
	area(south glass) <u>21.3 m²</u> % of total glass <u>67 %</u>
	night insulation U value night <u>1.6(W/m²k)</u> shaded <u> </u>
Heated Volume <u>319 m³</u> Ventilation Rate <u>0.3 - 0.5</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Space heating + DHW (passive + active system)</u>
	Collector type <u>Falt palte</u> (double glazed (water) area(net) <u>14 m² / 23 m²</u> orientation <u>225°</u> <u>135°</u> single glazed (air) tilt <u>90° / 80°</u>
	Storage type <u>water (vertical tank)</u> capacity <u>3.7 m³</u>
	Auxiliary System type <u>wood-burner</u> fuel type <u>wood</u> fuel cost <u>0.05 sfr/kWh</u>

PROJECT SCHEDULE

DATE		1978	1979	1980	1981	
MILESTONES						
Construction completion						
Monitoring period						
Final reports					0	

Report availability

Title

(available from)

Solar group EPF-L dept. Physics, G.-R. Perrin
P.O.Box 1024 / CH-1001 Lausanne - Sitzerland

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 20'000.- US\$

Description of data recording method 64 channels analogic (with integrator) 12 pulse-counters - A-D converter & Scanner magnetic cartridge recorder

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	0.5 hour	1.0 °C
	Outdoor Temperature	0.5 hour	0.5 °C
	Incident radiation on horizontal surface	0.5 hour *	5% (kipp-Zonen)
	Incident radiation in plane of collector	0.5 hour *	5% (kipp-Zonen)
	Relative Humidity	0.5	3%
	Wind Speed	0.5 hour *	2% (max.)
	* mesure every 30 seconds, integration every 0.5 hour		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	0.5 hour ***	3%
	Temperature entering & leaving collectors	0.5 hour ***	0.2 °C
	Storage		
	Flow rate inputs to storage	0.5 hour ***	3%
	Temperature entering & leaving storage	0.5 hour	0.2 °C
	Temperature readings in storage (1 or more)	0.5 hour	0.2 °C
	Auxiliary energy supplied to storage	0.5 hour	
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	0.5 hour ***	3%
BUILDING SYSTEM	Temperature entering & leaving subsystems	0.5 hour	0.2 °C
	Auxiliary energy supplied to subsystems		
	*** Energy is counted doing the product $\dot{m} \cdot C_p \cdot \Delta T$ every pulse of the flowmeter		
	Average DB inside temperature	0.5 hour	0.5 °C
	Infiltration load	0.5 hour **	
	Auxiliary energy	0.5 hour *	3%
	Operating energy	0.5 hour *	3%
	Total building energy load	0.5 hour *	
	Internal energy gains	0.5 hour *	
	Solar gains	0.5 hour *	
	Solar as a % of total load	0.5 hour	
	Thermal capacity of building		
	** Aperture time of doors and windows are integrated		



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE Performance of real active heating systems

Address _____

MAIN PARTICIPANTS

	1	2	3
Name	A.DELFOSSE	JP.THERRE	
Address	Institut de thermique appliquée Ecole Polytechnique Fédérale-Halle de Méca- nique 1015-Lausanne (021)473525	Institut de thermique appliquée Ecole Polytechnique Fédérale-Halle de Méca- nique 1015-Lausanne (021)473525	
Phone	(021)473525	(021)473525	
Responsibility	Research scientist	Research scientist	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>46° 50'</u> Longitude <u>~ 6°</u> Altitude <u>495m</u> DD <u>3820</u> Base Temp. <u>18° C</u>
	Sunshine Hours July _____ January _____ Annual <u>1810</u>
	Source of data <u>Centre Meteorologique de Payerne</u>
	Urban _____ Suburban <u>*</u> Rural _____
BUILDING	Floor area <u>211 m²</u> No. Occupants <u>4-5</u>
	Design Temperature internal w <u>22</u> s <u>18</u> ° C
	external w <u>-20</u> s <u>30</u> ° C
	Mass type <u>Villa pertaining to family</u> location <u>Payerne (Suisse)</u>
	South Glazing type <u>double glass</u>
	area(south glass) <u>/</u> % of total glass <u>/</u>
	night insulation <u>/</u> shaded <u>/</u>
Heated Volume <u>613m³</u> Ventilation Rate _____ a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating+D.H.W</u>
	Collector type <u>Built-in, flat</u> area(net) <u>20 m²</u>
	orientation <u>South-West 219°</u> tilt <u>43°</u>
	Storage type <u>Water + Beton</u> capacity <u>14800Litres</u>
	Auxiliary System type <u>Boiler + Wood chimney (35kW)</u> fuel type <u>Domestic fuel</u> fuel cost <u>0.6SF/L</u>

PROJECT SCHEDULE

DATE	1976	Jan 1980	1980	1981	1 trim1982	
MILESTONES						
Construction completion	House	Instrumentation				
Monitoring period			*	*		
Final reports					*	

Report availability

Title

(available from)

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package

Description of data recording method 30 seconds interval measurements
recording of integrated values at 15 minutes intervals on cassette-tape

DATA RECORDED

METEOROLOGICAL	Degree Days	Frequency of data recording <u>15 minutes</u>	Accuracy of instrument <u>0.2 °C.time</u>
	Outdoor Temperature	"	<u>0.2 °C</u>
	Incident radiation on horizontal surface	"	<u>4 %</u>
	Incident radiation in plane of collector	"	<u>4 %</u>
	Relative Humidity	"	
	Wind Speed	"	<u>2 % f.s.</u>
SOLAR SYSTEM	Collectors	"	<u>1 %</u>
	Flow rate entering collectors		<u>0.1 °C</u>
	Temperature entering & leaving collectors	"	
	Storage		<u>1 %</u>
	Flow rate inputs to storage	"	<u>0.1 °C</u>
	Temperature entering & leaving storage	"	<u>0.1 °C</u>
	Temperature readings in storage(1 or more)	"	
	Auxiliary energy supplied to storage	"	<u>est. 5 %</u>
	Space heat,Space cooling,Hot water Subsystems	"	<u>1 %</u>
	Flow rates entering subsystems	"	<u>0.1 °C</u>
	Temperature entering & leaving subsystems	"	<u>est. 5 %</u>
	Auxiliary energy supplied to subsystems		
BUILDING SYSTEM	Average DB inside temperature	"	<u>0.2 °C</u>
	Infiltration load	<u>not meas.</u>	
	Auxiliary energy	<u>15 minutes</u>	
	Operating energy	"	
	Total building energy load	"	
	Internal energy gains	<u>not meas.</u>	
	Solar gains	<u>15 minutes</u>	
	Solar as a % of total load	"	
	Thermal capacity of building	<u>not meas.</u>	



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Trombe Wall instrumentation

Address

Chemin des Côtes

- 1020 Renens - Switzerland

Mr. Martin WENGER

MAIN PARTICIPANTS

	1	2	3
Name	WENGER M.	MOREL N.	PERRIN G.-R.
Address	Chemin des Côtes 1020 Renens Switzerland	Solar Groupe EPFL Dpt. of Physics PO Box 1024 1001 Lausanne - Switz. (021) 47'34'27	Solar Group EPFL Dept. of Physics P.O.Box 1024 1001 Lausanne - Switz. (021) 47'34'31
Phone			
Responsibility	Owner	Responsible researcher	Responsible researcher

PROJECT DESCRIPTION

CLIMATE	Latitude <u>46.5°N</u> Longitude _____ Altitude <u>450 m</u> DD <u>3250</u> Base Temp. <u>20° C</u>
	Sunshine Hours July <u>272</u> January <u>69</u> Annual <u>1953</u>
	Source of data <u>Solar Group EPFL</u>
	Urban _____ Suburban <u>X</u> Rural _____
BUILDING	Floor area <u>220 m²</u> No. Occupants <u>3 - 4</u>
	Design Temperature internal w <u>18</u> s <u>24</u> °C
	external w <u>-10</u> s <u>+30</u> °C
	Mass type <u>Concrete</u> location <u>Floors + Walls</u>
	South Glazing type <u>Double pane (thermopane)</u>
	area(south glass) <u>8 m² (16m² green-house)</u> % of total glass <u>30% (56% ind.grch.)</u>
	night insulation <u>--</u> shaded _____
Heated Volume <u>≈ 700 m³</u> Ventilation Rate <u>0.3 - 0.5</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Space heating</u>
	Collector type <u>TROME - WALL + GREENHOUSE</u> area(net) <u>14 m²</u>
	orientation <u>SOUTH (210°)</u> tilt <u>90° (vertical)</u>
	Storage type <u>Concrete</u> capacity <u>1764 Wh/°K</u>
Auxiliary System type <u>gaz heater</u> fuel type <u>gaz</u> fuel cost <u>Sfr. 0.05/kWh</u>	

PROJECT SCHEDULE

DATE MILESTONES	1980	1981	1982			
Construction completion						
Monitoring period						
Final reports						

Report availability

Title

(available from)

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package Sfr. 60'000.-Description of data recording method Hewlett-Packard data acquisition system(HP 9835A + scanner + digital voltmeter + pulse counter), recording on HP-cassettes

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	-	-
	Outdoor Temperature	<u>30 min.</u>	<u>± 0.2 °K</u>
	Incident radiation on horizontal surface	-	-
	Incident radiation in plane of collector	<u>30 sec/30min.</u>	<u>± 50 W/m²</u>
	Relative Humidity	-	-
	Wind Speed	<u>30 min.</u>	<u>± 1 m/s</u>
when 2 numbers are specified, the first one is 1 measurement rate, and the second one the integrated measurement recording rate.			
SOLAR SYSTEM	(Collectors)		
	Flow rate entering collectors	<u>30 sec/30 min.</u>	<u>± 0.1 m/s</u>
	Temperature entering & leaving collectors	<u>30 min.</u>	<u>± 0.2 °K</u>
	Storage		
	Flow rate inputs to storage	_____	_____
	Temperature entering & leaving storage	_____	_____
	Temperature readings in storage(1 or more)	_____	_____
	Auxiliary energy supplied to storage	_____	_____
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	_____	_____
BUILDING SYSTEM	Temperature entering & leaving subsystems	_____	_____
	Auxiliary energy supplied to subsystems	_____	_____
	Average DB inside temperature	<u>30 sec/30 min.</u>	<u>± 0.2 °K</u>
	Infiltration load	_____	_____
	Auxiliary energy	_____	_____
	Operating energy	_____	_____
	Total building energy load	_____	_____
	Internal energy gains	_____	_____
BUILDING SYSTEM	Solar gains	_____	_____
	Solar as a % of total load	_____	_____
	Thermal capacity of building	_____	_____
		_____	_____



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

SONNENENERGIEHAUS ZUG

Address

Stiftung Sonnenenergiehaus Zug

c/o Dr. A. Stebler Schönbühl 6

CH-6300 ZUG

MAIN PARTICIPANTS

	1	2	3
Name	Dr. A. Stebler	E. Ruosch	
Address	Schönbühl 6 CH-6300 ZUG	c/o Landis & Gyr Zug AG CH-6301 ZUG	
Phone	042 24 20 40	042 24 31 44	
Responsibility	General Project	Instrumentation	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>47.2 N</u> Longitude <u>8.5 E</u> Altitude <u>448 m</u> DD <u>4115</u> Base Temp. <u>5 °C</u>
	Sunshine Hours July <u>6.5</u> January <u>0.8</u> Annual <u>3.9</u> mean outside Temp. during heating period
	Source of data <u>S.M.A. Zürich Krähbühlstrasse 58</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>440 m²</u> No. Occupants <u>19</u>
	Design Temperature internal w <u>22</u> s <u>—</u> °C
	external w <u>-10</u> s <u>—</u> °C
	Mass type <u>Brick</u> location <u>plain</u>
	South Glazing type <u>double glazing</u>
	area(south glass) <u>24 m²</u> % of total glass <u>41.5</u>
	night insulation <u>shutters</u> shaded <u>0-100 %</u>
Heated Volume <u>1100 m³</u> Ventilation Rate <u>0.4</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating and warm water</u>
	Collector type <u>low temperature (Energy-roof)</u> area(net) <u>113 m²</u>
	orientation <u>40 m² NN / 73 m² SE</u> tilt <u>27 °</u>
	Storage type <u>Hot water</u> capacity <u>1.2 m³</u>
Auxiliary System type <u>el. heat pump bivalent with oil burner</u> fuel type <u>Electric.</u> fuel cost <u>Fr.0,14/kWh</u>	
	<u>Oil</u> <u>Fr.0.5/1</u>

PROJECT SCHEDULE

DATE						
MILESTONES	Oct. 78	March 80	Dec. 82			
Construction completion	Insulation	Energy Roof	System-Optimization			
Monitoring period	since Oct. 78	since March 80	till Dec. 82			
Final reports	Nov. 79	Dec. 81	July 83			

Report availability

Title

(available from)

Projekt Sonnenenergiehaus Zug

Bericht No 1 und No 2

Stiftung Sonnenenergiehaus Zug

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

40 000.- Fr.

Description of data recording method

Recorder (12-Points) + Counters

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	—	—
	Outdoor Temperature	cont.	3 %
	Incident radiation on horizontal surface	—	—
	Incident radiation in plane of collector	—	—
	Relative Humidity	—	—
	Wind Speed	—	—
SOLAR SYSTEM	Collectors	—	—
	Flow rate entering collectors	cont.	3 %
	Temperature entering & leaving collectors	cont.	3 %
	Storage	—	—
	Flow rate inputs to storage	cont.	3 %
	Temperature entering & leaving storage	cont.	3 %
	Temperature readings in storage(1 or more)	cont.	3 %
	Auxiliary energy supplied to storage	cont.	3 %
	Space heat, Space cooling, Hot water Subsystems	—	—
	Flow rates entering subsystems	cont.	3 %
BUILDING SYSTEM	Temperature entering & leaving subsystems	cont.	1 %
	Auxiliary energy supplied to subsystems	cont.	1 %
	Average DB inside temperature	cont.	5 %
	Infiltration load	sporadically	20 %
	Auxiliary energy	cont.	1 %
	Operating energy	cont.	1 %
	Total building energy load	cont.	3 %
	Internal energy gains	—	—
	Solar gains	} mean coefficient of performance ~2	—
	Solar as a % of total load		10 %
	Thermal capacity of building	—	—

ILLUSTRATION

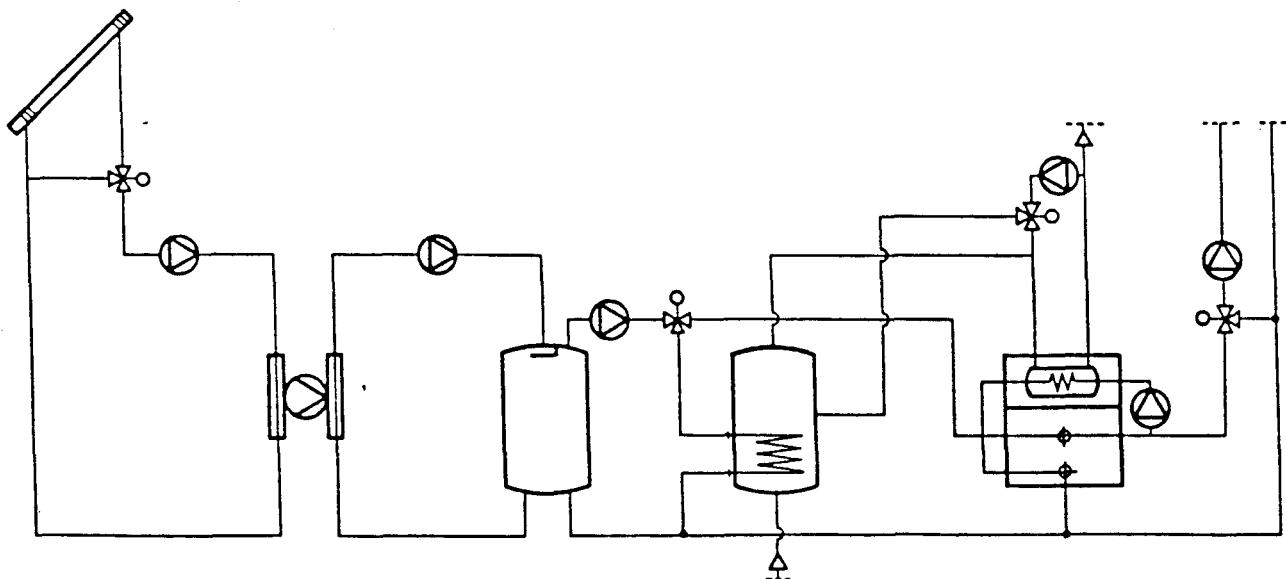
See enclosures

- . Photo showing energy-roof and general situation (identical not renewed neighbouring buildings)
- . "hydraulic" system
- . report 13.9.78 - 30.6.79



PROJEKT SONNENERGIEHAUS ZUG

HYDRAULISCHES PRINZIPSCHEMA



NT-KOLLEKTOREN
(113.0m²)

WÄRMEPUMPE
(10PS 2STUFIG)

ARBEITSSPEICHER
600LT

BOILER 400LT NEU

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UND WW ZIRKULATIONSPUMPE

UNITED KINGDOM



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

43

PROJECT TITLE

Linford

Address

Milton Keynes

Bucks

England

MAIN PARTICIPANTS

	1	2	3
Name	Alan Morton	Bob Everett	John Dogart
Address	Energy Research Group Open University Milton Keynes	Energy Research Group Open University Milton Keynes	Milton Keynes Development Corporation Cofferidge Close Stony Stratford Milton Keynes 0908 565454
Phone	0908 653335	0908 653335	0908 565454
Responsibility	Project Officer	Research Fellow	Project Supervisor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>52°3'N</u> Longitude <u>0°45'W</u> Altitude <u>100m</u> DD <u>2000</u> Base Temp. <u>15.5°C</u>	
	Sunshine Hours July <u>5.98</u> January <u>1.58</u> Annual <u>4.07</u>	
	Source of data <u>London data, building research establishment</u>	
	Urban <u> </u> Suburban <u>x</u> Rural <u> </u>	
BUILDING	Floor area <u>120m²</u>	No. Occupants <u>4 - 5</u>
	Design Temperature internal w <u>18</u> s <u> </u> °C	external w <u>5</u> s <u> </u> °C
	Mass type <u>concrete block</u>	location <u>inner skin</u>
	South Glazing type <u>double</u>	
	area(south glass) <u>18.4m²</u>	% of total glass <u>40%</u>
	night insulation <u>---</u>	shaded <u>no</u>
	Heated Volume <u>300m³</u>	Ventilation Rate <u>1</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u> </u>	
	Collector type <u> </u> area(net) <u> </u>	orientation <u> </u> tilt <u> </u>
	Storage type <u> </u> capacity <u> </u>	
	Auxiliary System type <u>radiators</u> fuel type <u>gas</u> fuel cost <u>1p/KWHR</u> useful	

PROJECT SCHEDULE

44

DATE	80	81	82	83		
MILESTONES						
Construction completion						
Monitoring period						
Final reports						

Report availability

Title

(ERG031) Passive Solar in Milton Keynes.

(available from)

R. Everett - E.R.G. Open University

Milton Keynes, Price 5

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 6000/house (8 houses)

Description of data recording method Microdata MI600L Data Logger
Magnetic Cartridges

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	hourly	
	Outdoor Temperature	hourly	$\pm 1^{\circ}\text{C}$
	Incident radiation on horizontal surface	hourly	5%
	Incident radiation in plane of collector	hourly	5%
	Relative Humidity	hourly	5%
	Wind Speed	hourly	5%
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors		
	Temperature entering & leaving collectors		
	Storage		
	Flow rate inputs to storage		
	Temperature entering & leaving storage		
	Temperature readings in storage(1 or more)		
	Auxiliary energy supplied to storage		
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems		
BUILDING SYSTEM	Temperature entering & leaving subsystems		
	Auxiliary energy supplied to subsystems		
	Average DB inside temperature	hourly	$\pm 1^{\circ}\text{C}$
	Infiltration load	hourly ? perhaps	
	Auxiliary energy	hourly	
	Operating energy	hourly	
	Total building energy load	hourly	
	Internal energy gains	hourly	
	Solar gains	hourly	
	Solar as a % of total load	hourly	
	Thermal capacity of building	?	



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

46

PROJECT TITLE

Field Trial of Space and Water Heating Installations
Utilizing Solar Energy at:

Address

Solar Court, Great Linford

Milton Keynes, Buckinghamshire

(Group 2 houses - Nos. 1, 2, 3 and Control Group

(Non Solar) houses - Nos. 4, 5 and 6)

MAIN PARTICIPANTS

	1	2	3
Name	John Laing Research and Development, Ltd.	John Laing Construction, Ltd.	Solar Energy Development Bay 8
Address	Manor Way Borehamwood Herts WD6 1LN	Page Street Mill Hill London NW7 2ER	16 South Wharf Road London W2 1PF
Phone	01 953 6144	01 959 3636	01 402 3203
Responsibility	Project Managers System Installation Monitoring Installation, and Monitoring	Site Construction	Architects

PROJECT DESCRIPTION

CLIMATE	Latitude <u>52°</u> Longitude <u>0</u> Altitude <u>approx. 75m a.s.l.</u> DD _____ Base Temp. _____
	Sunshine Hours July _____ January _____ Annual _____
	Source of data _____
	Urban _____ Suburban _____ Rural <u>x</u>
BUILDING	Floor area <u>104m²</u> No. Occupants <u>varies over 3 houses (up to 5)</u>
	Design Temperature internal w <u>18-20</u> s <u>N/A</u> ° C
	external w <u>-1</u> s <u>N/A</u> ° C
	Mass type <u>brick/block</u> location <u>Milton Keynes, Bucks. UK</u>
	South Glazing type <u>double</u>
	area(south glass) <u>approx. 18m²</u> % of total glass <u>approx. 80%</u>
	night insulation <u>owners provision</u> shaded <u>600mm overhang</u>
SOLAR SYSTEM	Heated Volume <u>488m³ approx.</u> Ventilation Rate <u>designed 1</u> a.c.h.
	System energy use(eg. heating) <u>heating + hot water</u>
	Collector type <u>copper flat plate</u> area(net) <u>18.5m²</u>
	orientation <u>Due South</u> tilt <u>45°</u>
Storage type <u>Water</u> capacity <u>0.8m³ and 6m³</u>	
Auxiliary System type <u>2 stage boiler</u> fuel type <u>gas</u> fuel cost _____	

PROJECT SCHEDULE

47

DATE	1980	1981	1982			
MILESTONES						
Construction completion						
Monitoring period		EXTENSION APPLIED FOR				
Final reports						

Report availability

Title
(available from)

Solar Court, Milton Keynes, Space Heating and Water
Heating Field Trials - Energy Technology Support Unit,
Aere Harwell, and John Laing Research and Development
Limited

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 45,000

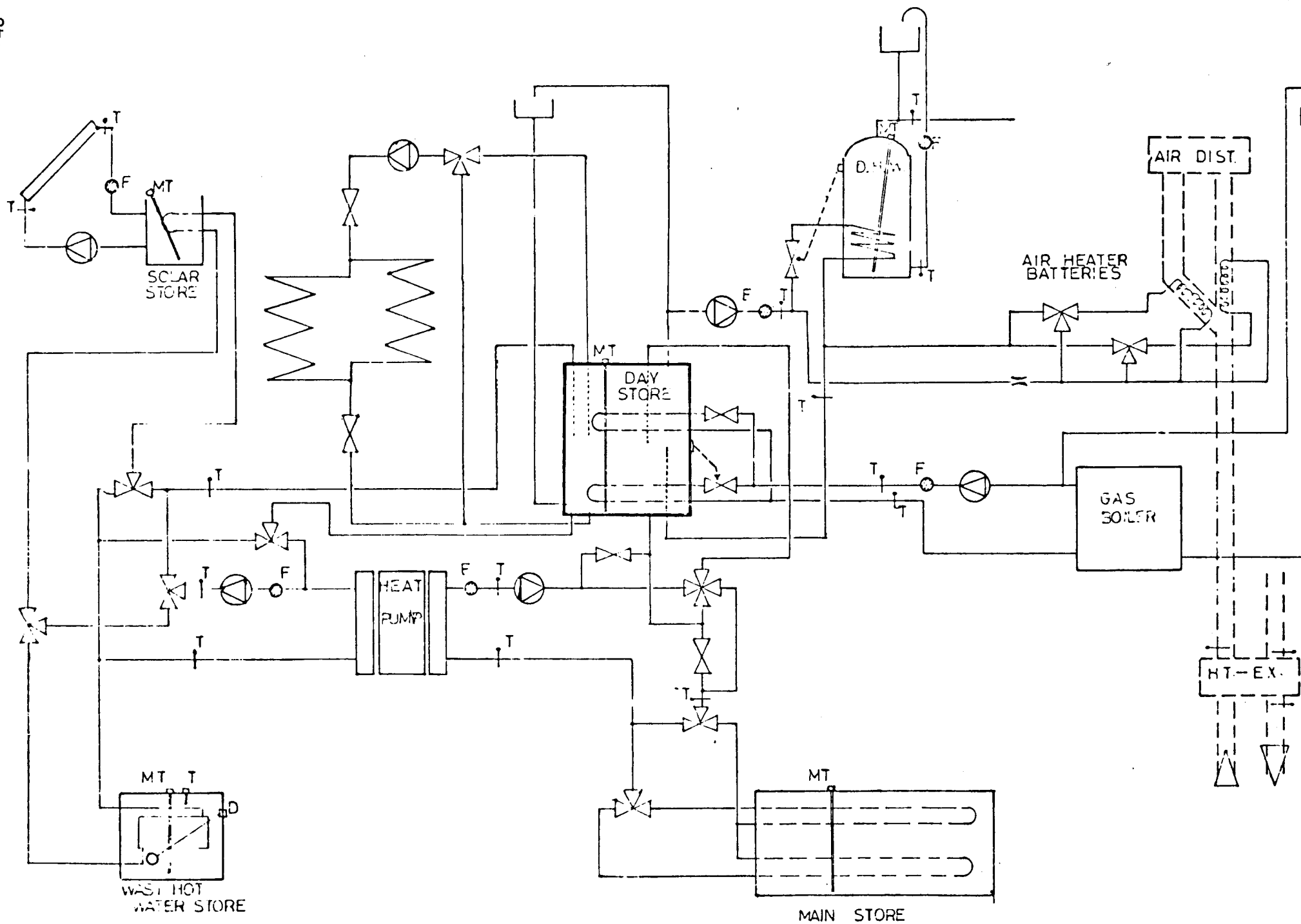
Description of data recording method Magnetic tape via micro controlled logger. All
houses ducted to central monitor station. Readings time based, continuous, on syst
request

DATA RECORDED

METEOROLOGICAL	Degree Days	Frequency of data recording <u>Daily</u>	Accuracy of instrument <u>0.1°</u>
	Outdoor Temperature	<u>Hourly</u>	<u>0.1°</u>
	Incident radiation on horizontal surface	<u>2 minute intervals</u>	<u>4% 'KIPP + ZONEN'</u>
	Incident radiation in plane of collector	<u>2 minute intervals</u>	<u>4%</u>
	Relative Humidity	<u>Hourly</u>	<u>0.1%</u>
	Wind Speed	<u>Hourly and Wind Run</u>	<u>0.5%</u>
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u>continuous</u> count	
	Temperature entering & leaving collectors	<u>continuous</u> count	
	Storage		
	Flow rate inputs to storage	<u>on demand</u>	
	Temperature entering & leaving storage	<u>on demand</u>	
	Temperature readings in storage (1 or more)	<u>on demand</u>	
	Auxiliary energy supplied to storage	<u>on demand</u>	
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	<u>as used</u>	
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>continuous</u> in operation	
	Auxiliary energy supplied to subsystems	<u>continuous</u> in operation	
	Average DB inside temperature	<u>Hourly</u>	
	Infiltration load		
	Auxiliary energy	<u>Daily</u>	
	Operating energy	<u>as used</u>	
	Total building energy load	<u>Daily</u>	
	Internal energy gains	<u>--</u>	
	Solar gains	<u>calculated</u>	
BUILDING SYSTEM	Solar as a % of total load	<u>calculated</u>	
	Thermal capacity of building	<u>--</u>	

ILLUSTRATION





SYSTEM SCHEMATIC MONITOR POINTS



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Field Trial of Space and Water Heating Installations
Utilizing Solar Energy at:

Address

Solar Court, Great Linford

Milton Keynes, Buckinghamshire

(Group 3 houses - Nos. 7, 8, 9)

MAIN PARTICIPANTS

	1	2	3
Name	The Calor Group, Ltd.	Solar Energy Developments	Fulmer Research Institute
Address	Calor House, Windsor Road Slough, Berks. U.K.	Bay 8, South Wharf Road London W2 1PF.	Stoke Poges, Slough, Berks. U.K.
Phone			
Responsibility	System Manufacturer Installation and Monitoring	Co-Designers Architects	Co-Designers, Supply and Installation of Controls, Monitoring Electronics

PROJECT DESCRIPTION

CLIMATE	Latitude <u>52°</u> Longitude <u>0</u> Altitude <u>Approx. 75m a.s.l.</u> DD _____ Base Temp. _____
	Sunshine Hours July _____ January _____ Annual _____
	Source of data _____
	Urban _____ Suburban _____ Rural <u>X</u>
BUILDING	Floor area <u>104m²</u> No. Occupants <u>Varies over 3 houses (up to 5)</u>
	Design Temperature internal w <u>18-20</u> s <u>N/A</u> °C
	external w <u>-1</u> s <u>N/A</u> °C
	Mass type <u>Brick/block</u> location <u>Milton Keynes, Bucks. UK</u>
	South Glazing type <u>double</u>
	area(south glass) <u>approx. 18m²</u> % of total glass <u>approx. 80%</u>
	night insulation <u>owners provision</u> shaded <u>600mm overhang</u>
Heated Volume <u>488m³</u> Ventilation Rate <u>designed 1</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>heating + hot water</u>
	Collector type <u>copper flat plate</u> area(net) <u>40m²</u>
	orientation <u>Due South</u> tilt <u>45°</u>
	Storage type <u>water</u> capacity <u>2.0m³</u>
	Auxiliary System type <u>Gen Boiler</u> fuel type <u>--</u> fuel cost _____

PROJECT SCHEDULE

50

DATE	1980	1981	1982			
CONSTRUCTION						
COMPLETION						
MONITORING						
PERIOD						
FINAL						
REPORTS						

Report availability

Title
(available from)

Solar Court, Milton Keynes, Space Heating and Water
Heating Field Trials - Energy Technology Support Unit,
Aere Harwell, and The Calor Group Limited

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package 25,000
Description of data recording method Digital Magnetic Cassette

DATA RECORDED

METEOROLOGICAL	Degree Days	Frequency of data recording $1H^{-1}$	Accuracy of instrument 0.15%
	Outdoor Temperature	$1H^{-1}$	0.15%
	Incident radiation on horizontal surface	$1H^{-1}$ (integrated)	1%
	Incident radiation in plane of collector	$1H^{-1}$ (integrated)	1%
	Relative Humidity		
	Wind Speed		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	heat meter,	<1%
	Temperature entering & leaving collectors	integrated $1H^{-1}$	<1%
	Storage		
	Flow rate inputs to storage	--	--
	Temperature entering & leaving storage	--	--
	Temperature readings in storage(1 or more)	$1H^{-1}$	0.2%
	Auxiliary energy supplied to storage	$1H^{-1}$	1%
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	heat meter	1%
BUILDING SYSTEM	Temperature entering & leaving subsystems	integrated $1H^{-1}$	
	Auxiliary energy supplied to subsystems	$1H^{-1}$	1%
	Average DB inside temperature	--	--
	Infiltration load	--	--
	Auxiliary energy	$1H^{-1}$	1%
	Operating energy	$1H^{-1}$	1%
	Total building energy load	$1D^{-1}$	1%
	Internal energy gains	$1H^{-1}$	1%
	Solar gains	$1H^{-1}$	1%
	Solar as a % of total load	$1D^{-1}$	2%
	Thermal capacity of building	$1D^{-1}$	2%



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Low Energy House Laboratory (Heat Pump House)

Address

Building Research Establishment

Garston

Watford UK

MAIN PARTICIPANTS

	1	2	3
Name	Dr. S. J. Wozniak		
Address	Building Research Establishment Garston, Watford UK		
Phone	09273-74040		
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>51°42'N</u> Longitude <u>00°23'W</u> Altitude <u>78 m</u> DD <u>2120</u> Base Temp. _____
	Sunshine Hours July <u>204</u> January <u>46</u> Annual <u>1517</u>
	Source of data <u>BRE Meteorological Station</u>
	Urban _____ Suburban <u>x</u> Rural _____
BUILDING	Floor area <u>100 m²</u> No. Occupants <u>Simulated occupancy</u>
	Design Temperature internal w <u>20</u> s _____ °C
	external w <u>-1</u> s _____ °C
	Mass type <u>Brick/insulated cavity/light-weight concrete</u> location _____
	South Glazing type <u>single pane</u>
	area(south glass) <u>5.47m²</u> % of total glass <u>54%</u>
	night insulation _____ shaded _____
Heated Volume <u>235m³</u> Ventilation Rate <u>1.0 (nominal)</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Preheat to heat pumps</u>
	Collector type <u>Unglazed black painted</u> area(net) <u>63m²</u>
	orientation <u>south</u> tilt <u>54½°</u>
	Storage type <u>NIL</u> capacity _____
	Auxiliary System type <u>Gas</u> fuel type _____ fuel cost _____

PROJECT SCHEDULE

52

DATE						
MILESTONES						
Construction completion						
Monitoring period						
Final reports						

Report availability

Title
(available from)

Low Energy House Laboratories

(BRE News 46)

BRE, Garston, Watford

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package £ 25,000 for 4 houses + cost of sensors

Description of data recording method PDP II Computer data logger

DATA RECORDED

Not yet finished

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days		
	Outdoor Temperature		
	Incident radiation on horizontal surface		
	Incident radiation in plane of collector		
	Relative Humidity		
	Wind Speed		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors		
	Temperature entering & leaving collectors		
	Storage		
	Flow rate inputs to storage		
	Temperature entering & leaving storage		
	Temperature readings in storage(1 or more)		
	Auxiliary energy supplied to storage		
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems		
BUILDING SYSTEM	Temperature entering & leaving subsystems		
	Auxiliary energy supplied to subsystems		
	Average DB inside temperature		
	Infiltration load		
	Auxiliary energy		
	Operating energy		
	Total building energy load		
	Internal energy gains		
	Solar gains		
	Solar as a % of total load		
	Thermal capacity of building		

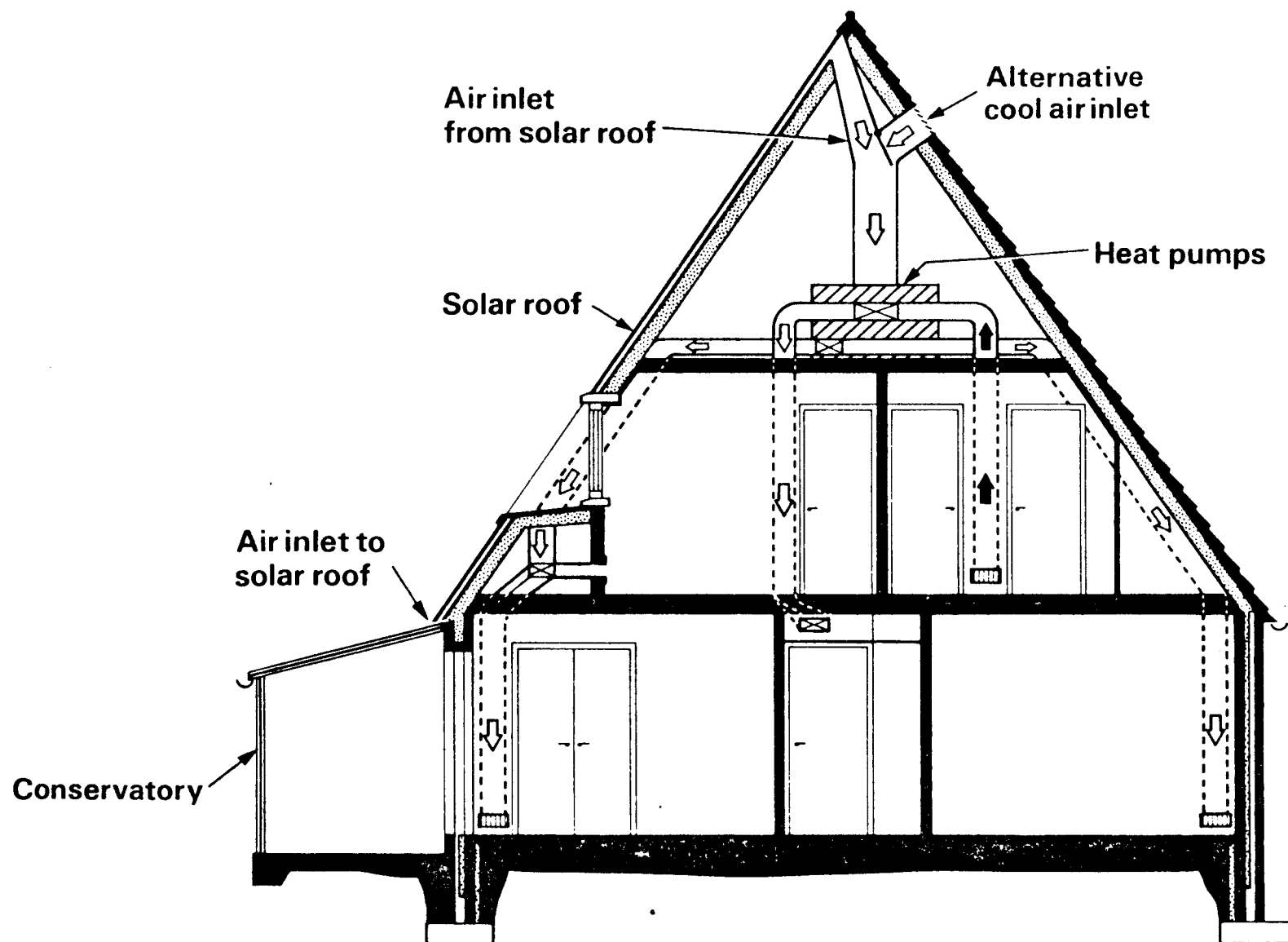


Figure 13 Heat pump house. Section showing layout of house, heat pumps and warm air ducting

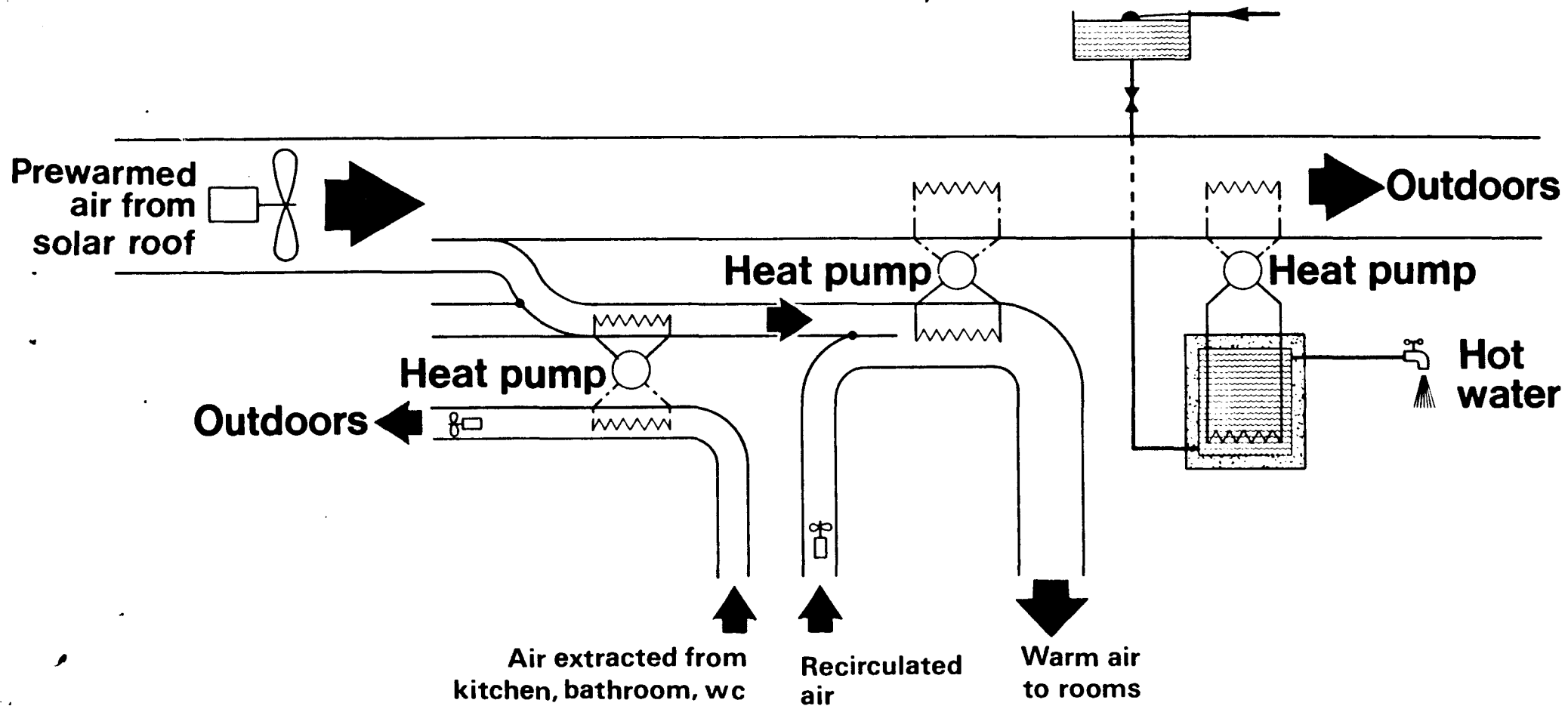


Figure 15 Heat pump house. Systems diagram for winter operation



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Low Energy House Laboratory (Solar House)

Address

Building Research Establishment

Garston,

Watford. UK.

MAIN PARTICIPANTS

	1	2	3
Name	Dr. S. J. Wozniak		
Address	Building Research Establishment Garston, Watford UK		
Phone	09273-74040		
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>51°42'N</u> Longitude <u>00°23'W</u> Altitude <u>78 m</u> DD <u>2120</u> Base Temp. _____
	Sunshine Hours July <u>204</u> January <u>46</u> Annual <u>1517</u>
	Source of data <u>BRE Meterological Station</u>
	Urban _____ Suburban <u>x</u> Rural _____
BUILDING	Floor area <u>88 m²</u> No. Occupants <u>Simulated occupancy</u>
	Design Temperature internal w <u>20</u> s _____ °C
	external w <u>-1</u> s _____ °C
	Mass type <u>lightweight (timber frame)</u> location _____
	South Glazing type <u>single pane</u>
	area(south glass) <u>3 . 72 m²</u> % of total glass <u>43%</u>
	night insulation <u>thin curtains</u> shaded _____
	Heated Volume <u>207 m³</u> Ventilation Rate <u>1.0 (nominal)</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>space and water heating</u>
	Collector type <u>selective surface single glazed</u> area(net) <u>18 m²</u>
	orientation <u>south</u> tilt <u>42°</u>
	Storage type <u>water</u> capacity <u>40 m³, 2.3 m³, 0.3 m³</u>
Auxiliary System type <u>heat pump assistance</u> fuel type <u>elec.</u> fuel cost _____	

PROJECT SCHEDULE

57

DATE						
Construction completion						
Monitoring period						
Final reports						

Report availability

Title

(available from)

Low Energy House Laboratories

(BRE News 46)

BRE, Garston, Watford

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

£ 25,000 for 4 houses, + cost of sensors

Description of data recording method

PDP II Computer data logger

DATA RECORDED

Not yet finished

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days		
	Outdoor Temperature		
	Incident radiation on horizontal surface		
	Incident radiation in plane of collector		
	Relative Humidity		
	Wind Speed		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors		
	Temperature entering & leaving collectors		
	Storage		
	Flow rate inputs to storage		
	Temperature entering & leaving storage		
	Temperature readings in storage(1 or more)		
	Auxiliary energy supplied to storage		
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems		
BUILDING SYSTEM	Temperature entering & leaving subsystems		
	Auxiliary energy supplied to subsystems		
	Average DB inside temperature		
	Infiltration load		
	Auxiliary energy		
	Operating energy		
	Total building energy load		
	Internal energy gains		
	Solar gains		
	Solar as a % of total load		
	Thermal capacity of building		

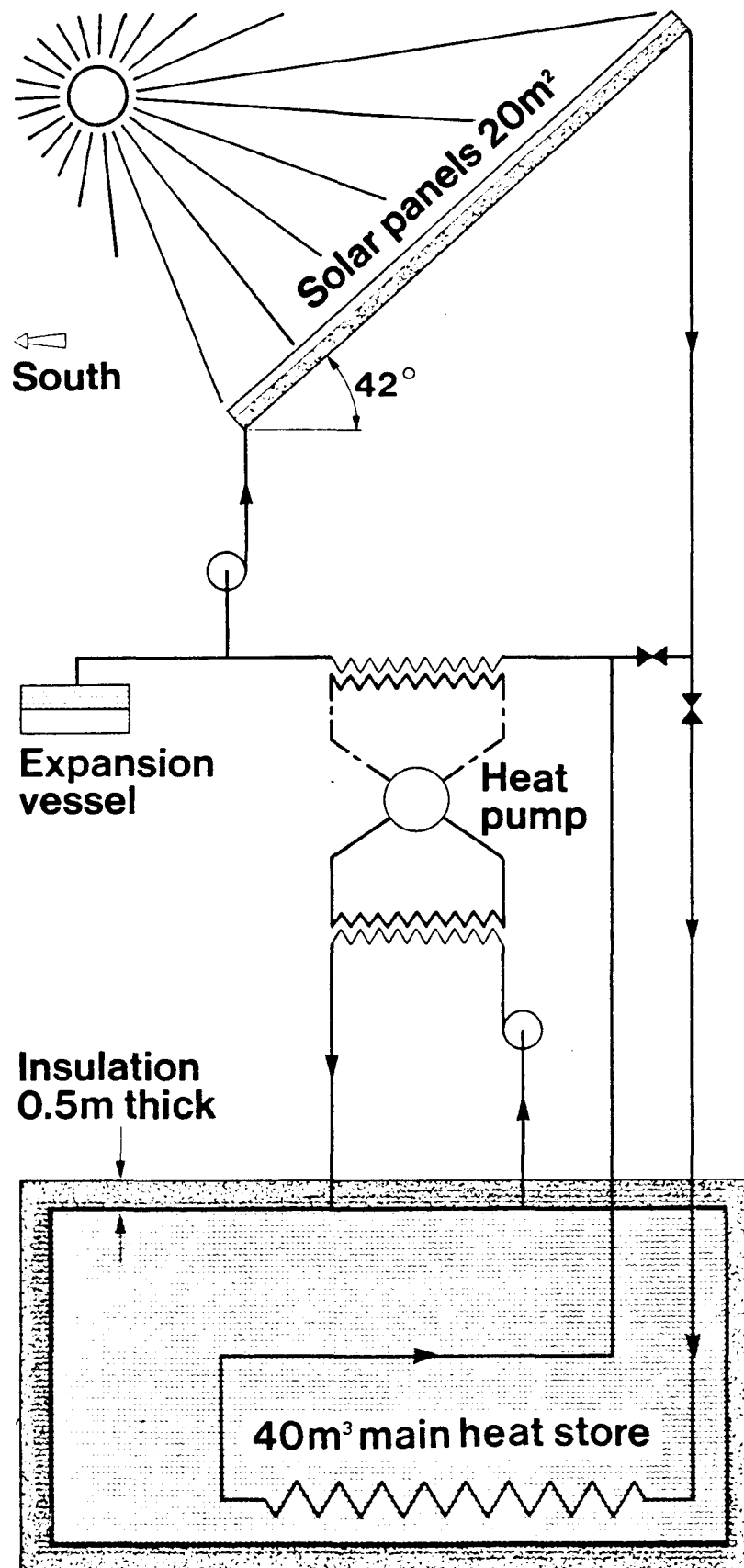


Figure 10 Solar house. Solar energy collection and storage

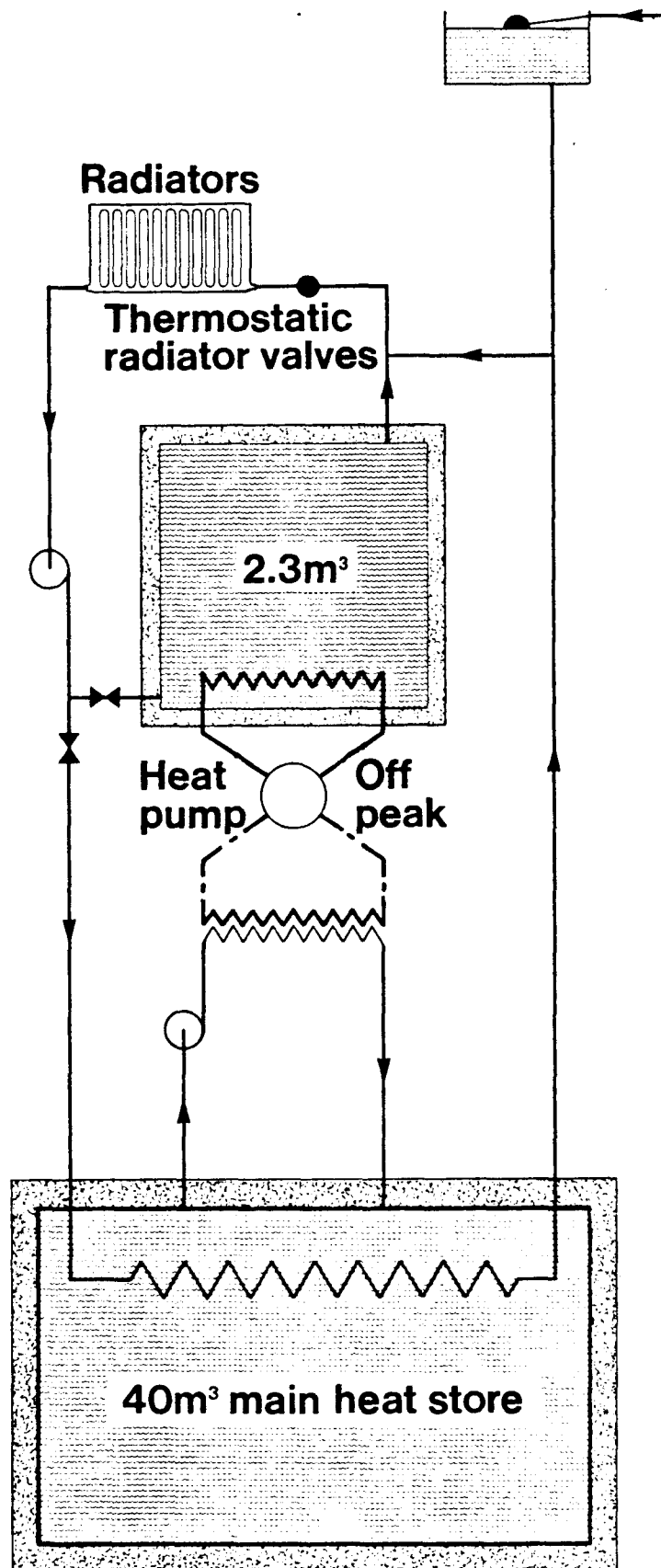
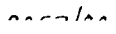


Figure 11 Solar house. Space heat system



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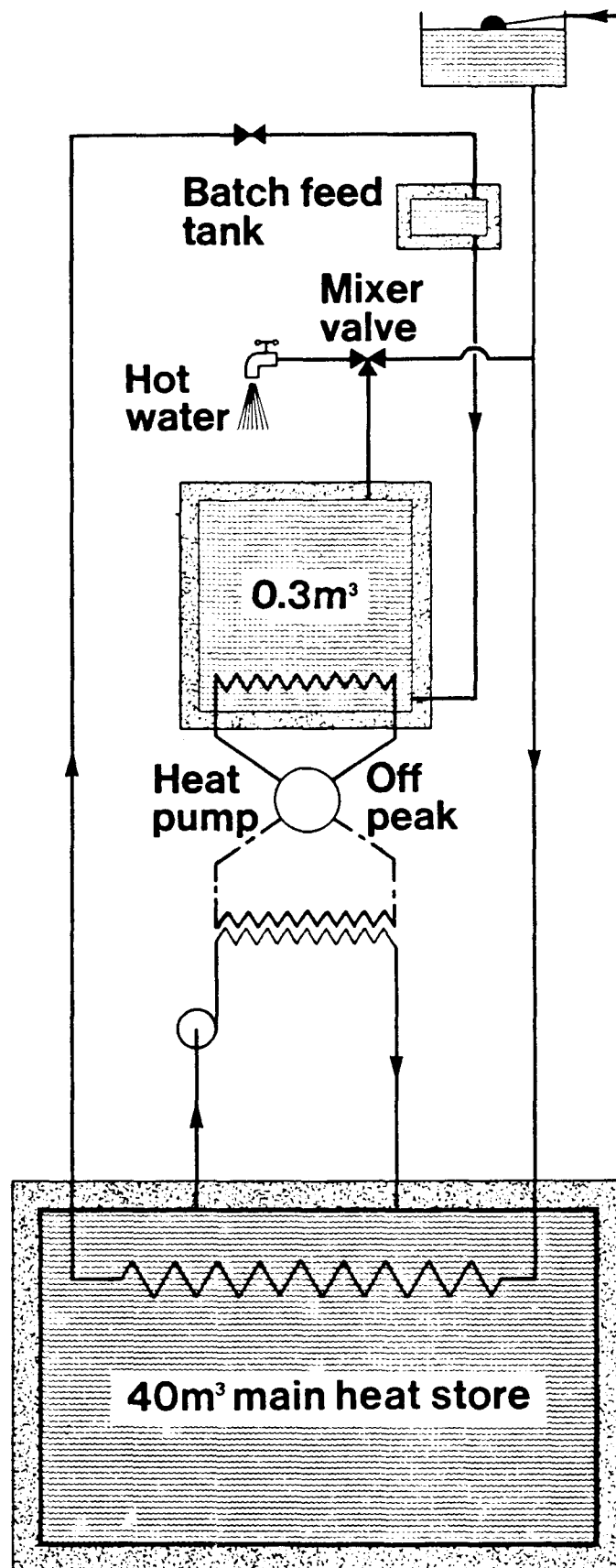


Figure 12 Solar house. Domestic hot water supply



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

61

PROJECT TITLE

Pennyland

Address

Milton KeynesBucksEngland

MAIN PARTICIPANTS

	1	2	3
Name	Tereny Chatfield	Bob Everett	John Daggart
Address	Energy Research Group Open University Milton Keynes	Energy Research Group Open University Milton Keynes	Milton Keynes Develop- ment Corp. Cofferidge Close Stony Stratford Milton Keynes
Phone	0908 653335	0908 653335	0908 565454
Responsibility	Project Officer	Research Fellow	Project Supervisor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>52°3'N</u> Longitude <u>0°45'W</u> Altitude <u>100m</u> DD <u>2000</u> Base Temp. <u>15.5°C</u>	
	Sunshine Hours July <u>5.98</u> January <u>1.58</u> Annual <u>4.07</u>	
	Source of data <u>London data, building research establishment</u>	
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>	
BUILDING	Floor area <u>100m² *</u> No. Occupants <u>3 - 4 *</u>	
	Design Temperature internal w <u>18</u> s <u> </u> °C	
	external w <u>5</u> s <u> </u> °C	
	Mass type <u>dense concrete</u> location <u>inner skin</u>	
	South Glazing type <u>single or double</u>	
	area(south glass) <u>9 - 13m²</u> % of total glass <u>30 - 40%</u>	
	night insulation <u>blinds or shutters</u> shaded <u>no</u>	
	Heated Volume <u>250m³ *</u> Ventilation Rate <u>1</u> a.c.h.	
* Main Design Variant		
SOLAR SYSTEM	System energy use(eg. heating) <u> </u>	
	Collector type <u> </u> area(net) <u> </u>	
	orientation <u> </u> tilt <u> </u>	
	Storage type <u> </u> capacity <u> </u>	
Auxiliary System type <u>Gas radiators or warm air</u> fuel type <u>gas</u> fuel cost <u>1p/KWHR</u> useful		

PROJECT SCHEDULE

62

DATE MILESTONES	1980	1981	1982	1983		
Construction completion						
Monitoring period						
Final reports						

Report availability

Title
(available from)

(ERG031) Passive Solar in Milton Keynes, R. Everett
Energy Research Group, Open University
Milton Keynes Price 5

INSTRUMENTATION

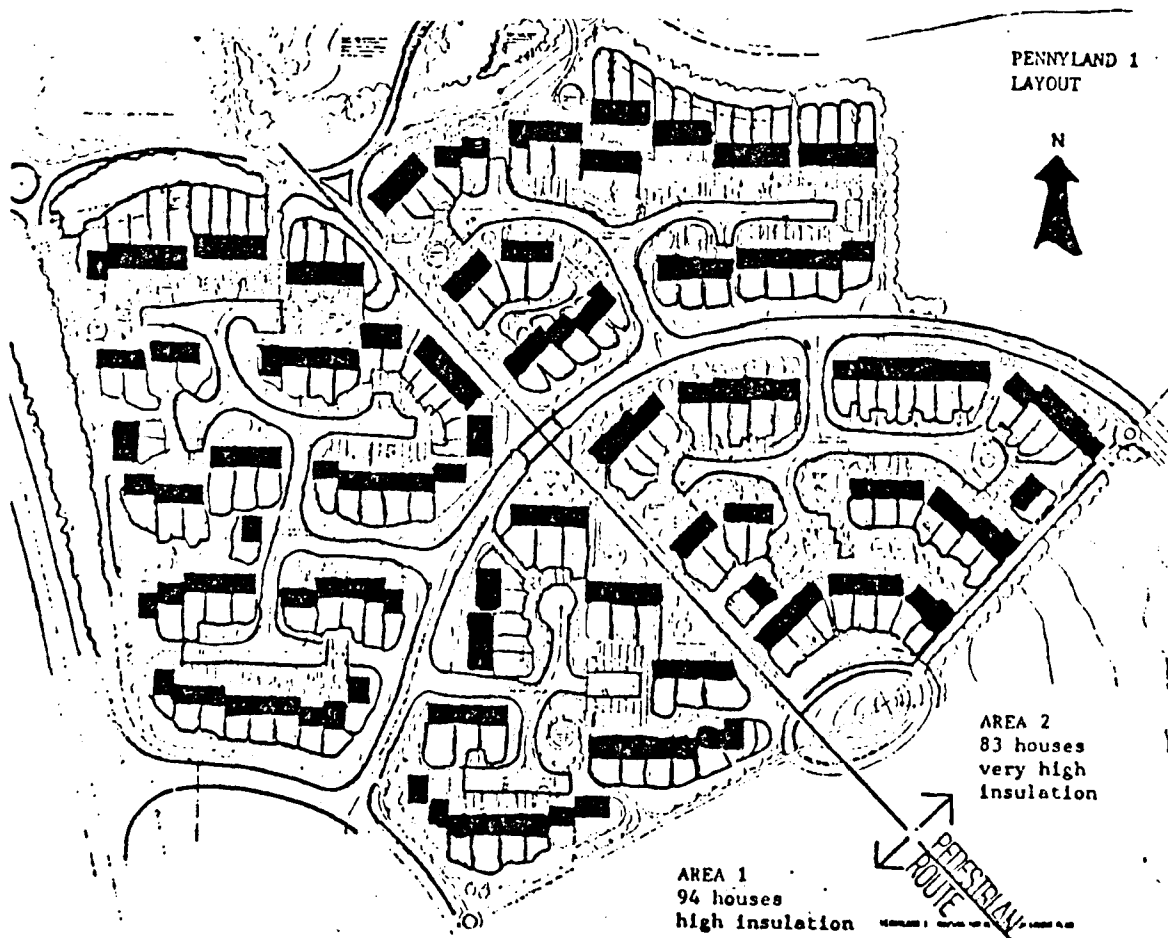
(existing or anticipated)

Approximate cost of instrumentation package 350/house
Description of data recording method integrating displays in house meter cupboard

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days		
	Outdoor Temperature	<u>hourly</u>	<u>±1°C</u>
	Incident radiation on horizontal surface	<u>hourly</u>	<u>5%</u>
	Incident radiation in plane of collector (vertical)	<u>hourly</u>	<u>5%</u>
	Relative Humidity	<u>hourly</u>	<u>5%</u>
	Wind Speed	<u>hourly</u>	<u>5%</u>
Recordings from Linford Project			
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u> </u>	<u> </u>
	Temperature entering & leaving collectors	<u> </u>	<u> </u>
	Storage		
	Flow rate inputs to storage	<u> </u>	<u> </u>
	Temperature entering & leaving storage	<u> </u>	<u> </u>
	Temperature readings in storage (1 or more)	<u> </u>	<u> </u>
	Auxiliary energy supplied to storage	<u> </u>	<u> </u>
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	<u> </u>	<u> </u>
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u> </u>	<u> </u>
	Auxiliary energy supplied to subsystems	<u> </u>	<u> </u>
	Average DB inside temperature	<u>weekly</u>	<u>±1°C</u>
	Infiltration load	<u>--</u>	<u> </u>
	Auxiliary energy	<u>weekly</u>	<u> </u>
	Operating energy	<u>--</u>	<u> </u>
	Total building energy load	<u>weekly</u>	<u> </u>
	Internal energy gains	<u> </u>	<u> </u>
	Solar gains	<u>hourly</u>	<u> </u>
	Solar as a % of total load	<u>weekly</u>	<u> </u>
	Thermal capacity of building	<u>--</u>	<u> </u>

ILLUSTRATION



UNITED STATES



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

A-Frame Industries

46-198 Lilipuna

Kaneohe, HI 96774

MAIN PARTICIPANTS

	1	2	3
Name	Berry Dean Root		
Address	46-198 Lilipuna Kaneohe, HI 96774		
Phone	808-247-1635		
Responsibility	Occupant		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>21.5n</u> Longitude <u>158°w</u> Altitude <u>500 ft</u> DD <u>--</u> Base Temp. <u>76°F</u>
	Sunshine Hours July <u> </u> January <u> </u> Annual <u> </u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u> </u> Suburban <u>☒</u> Rural <u> </u>
BUILDING	Floor area <u>unknown</u> No. Occupants <u>2</u>
	Design Temperature internal w <u>--</u> s <u>--</u> ° <u>--</u>
	external w <u>--</u> s <u>--</u> ° <u>--</u>
	Mass type <u>unknown</u> location <u>unknown</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Miromet - 4 panel flat plate</u> area(net) <u>68 ft²</u>
	orientation <u>10° E of south</u> tilt <u>21°</u>
	Storage type <u>Chromalox - domestic hot water</u> system capacity <u>120 gal</u>
Auxiliary System type <u>electrical - 240V</u> fuel type <u>--</u> fuel cost <u>--</u>	

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980		
Construction completion	8/77					
Monitoring period	No data	Feb-Dec	Jan-Nov	April-June		
Final reports	No data	Feb-Sept & Nov	Feb-May	April-June		

Report availability Title Monthly Performance Report (A-Frame Industries)
 (available from) Technical Information Center
P.O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package \$3510.00
 Description of data recording method Data collected on tape every 320 seconds, and
sent to the Central Data Processing System daily

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	<u>--</u>	<u>--</u>
	Outdoor Temperature	<u>320 sec</u>	<u>0.5°F</u>
	Incident radiation on horizontal surface	<u>--</u>	<u>--</u>
	Incident radiation in plane of collector	<u>320 sec</u>	<u>3%</u>
	Relative Humidity	<u>N/A</u>	<u>N/A</u>
	Wind Speed	<u>N/A</u>	<u>N/A</u>
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u>320 sec</u>	<u>3%</u>
	Temperature entering & leaving collectors	<u>320 sec</u>	<u>0.5°F</u>
	Storage		
	Flow rate inputs to storage	<u>320 sec</u>	<u>3%</u>
	Temperature entering & leaving storage	<u>320 sec</u>	<u>0.5°F</u>
	Temperature readings in storage(1 or more)	<u>320 sec</u>	<u>0.5°F</u>
	Auxiliary energy supplied to storage	<u>N/A</u>	<u>N/A</u>
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	<u>N/A</u>	<u>N/A</u>
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>N/A</u>	<u>N/A</u>
	Auxiliary energy supplied to subsystems	<u>N/A</u>	<u>N/A</u>
	Average DB inside temperature	<u>N/A</u>	<u>N/A</u>
	Infiltration load	<u>N/A</u>	<u>N/A</u>
	Auxiliary energy	<u>N/A</u>	<u>N/A</u>
	Operating energy	<u>N/A</u>	<u>N/A</u>
	Total building energy load	<u>N/A</u>	<u>N/A</u>
	Internal energy gains	<u>N/A</u>	<u>N/A</u>
	Solar gains	<u>N/A</u>	<u>N/A</u>
	Solar as a % of total load	<u>N/A</u>	<u>N/A</u>
	Thermal capacity of building	<u>N/A</u>	<u>N/A</u>



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Albuquerque Western II

Address

110 Texas St., N.E.

Albuquerque, NM 87110

MAIN PARTICIPANTS

	1	2	3
Name	Brad Shaw		
Address	110 Texas St., N.E. Albuquerque, NM 87110		
Phone	550-266-1976		
Responsibility	Manager		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>35°</u> Longitude <u>106°</u> Altitude <u>5339 ft</u> DD <u>4383</u> Base Temp. <u>65°F</u>
	Sunshine Hours July <u>11.2</u> January <u>5.1</u> Annual <u>8.0</u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u>X</u> Suburban <u> </u> Rural <u> </u>
BUILDING	Floor area <u>630 ft²/unit</u> No. Occupants <u>unknown</u>
	Design Temperature internal w <u>75</u> s <u>78</u> ° F
	external w <u>10</u> s <u>100</u> ° F
	Mass type <u>composit (brick/concrete)</u> location <u>Albuquerque, NM</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>15000 CFM</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Space heating</u>
	Collector type <u>Solcan, concentrating & tracking</u> area(net) <u>5732.6 ft²</u>
	orientation <u>south</u> tilt <u>35°</u>
	Storage type <u>concrete storage tank</u> capacity <u>57000 gal</u>
Auxiliary System type <u>gas-fired hot water boiler</u> fuel type <u>natural gas</u> cost <u>\$2.93/ft³</u>	

Report availability	Title	<u>Monthly Performance Report (Albuquerque Western II)</u>
	(available from)	<u>Technical Information Center</u>
		P.O. Box 62, Oak Ridge, TN 37830

Approximate cost of instrumentation package _____

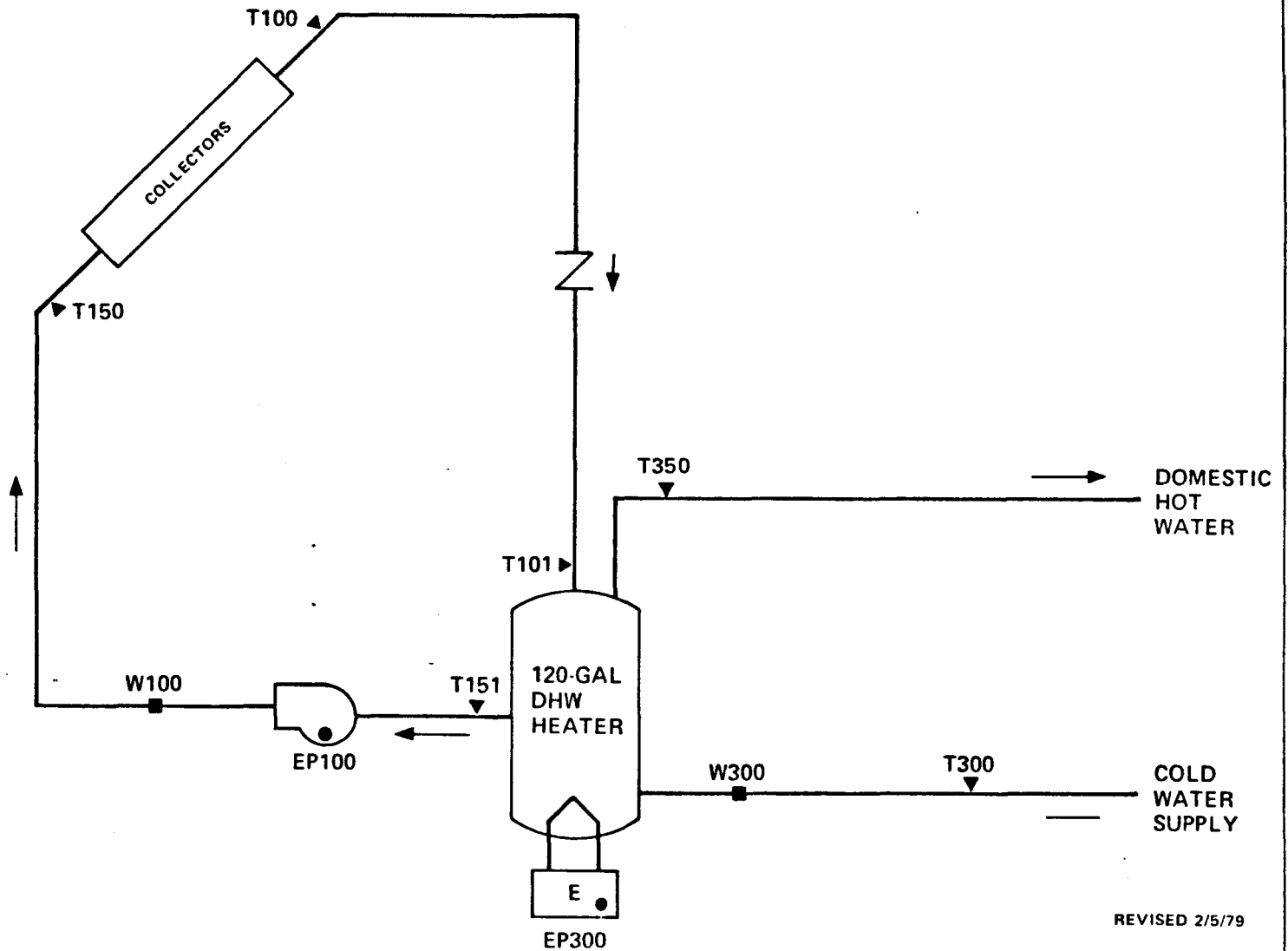
Description of data recording method Data collected on tape every 320 seconds and
sent to the Central Data Processing System daily

METEOROLOGICAL	Frequency of data recording	Accuracy of instrument
Degree Days	--	--
Outdoor Temperature	320 sec	$\pm 0.5^{\circ}\text{F}$
Incident radiation on horizontal surface	--	--
Incident radiation in plane of collector	320 sec	$\pm 2\%$
Relative Humidity	--	--
Wind Speed	--	--

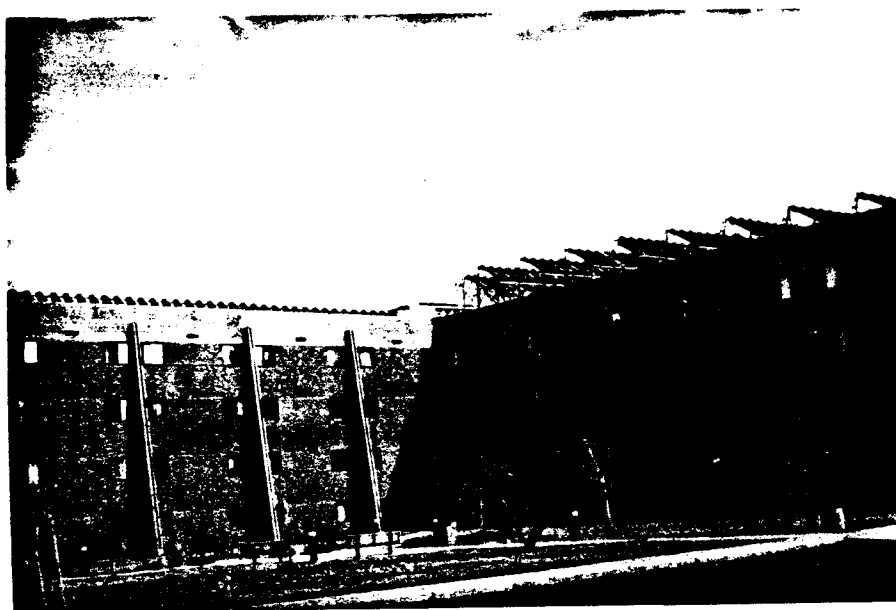
SOLAR SYSTEM	Frequency of data recording	Accuracy of instrument
Collectors		
Flow rate entering collectors	320 sec	$\pm 3\%$
Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
Storage		
Flow rate inputs to storage	320 sec	$\pm 3\%$
Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
Temperature readings in storage(1 or more)	320 sec	$\pm 0.5^{\circ}\text{F}$
Auxiliary energy supplied to storage	--	--
Space heat,Space cooling,Hot water Subsystems		
Flow rates entering subsystems	320 sec	$\pm 3\%$
Temperature entering & leaving subsystems	320 sec	$\pm 0.5^{\circ}\text{F}$
Auxiliary energy supplied to subsystems	320 sec	$\pm 1\%$

BUILDING SYSTEM	Frequency of data recording	Accuracy of instrument
Average DB inside temperature	--	--
Infiltration load	--	--
Auxiliary energy	--	--
Operating energy	--	--
Total building energy load	--	--
Internal energy gains	--	--
Solar gains	--	--
Solar as a % of total load	--	--
Thermal capacity of building	--	--

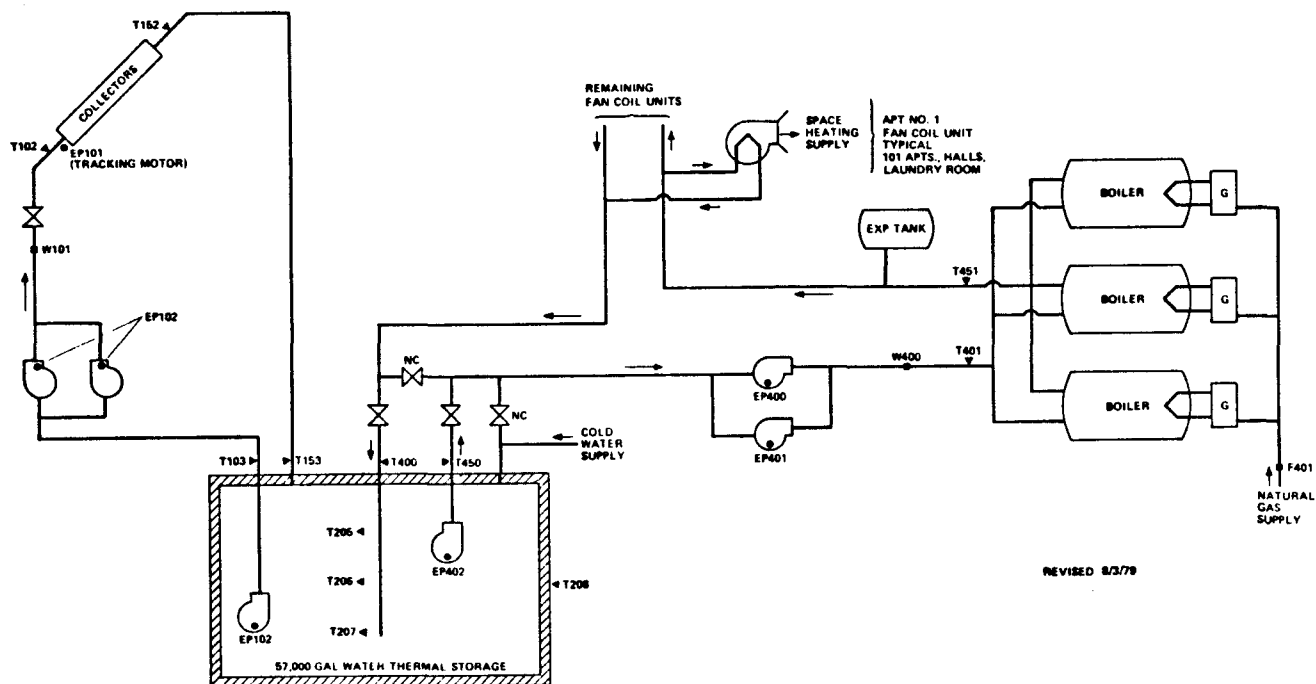
▲ T001 OUTDOOR TEMPERATURE



A-Frame Industries Solar Energy System Schematic



- 1883 HORIZONTAL PLANE DIFFUSED INSOLATION
- 1882 COLLECTOR PLANE TOTAL INSOLATION
- T801 OUTDOOR TEMPERATURE



Albuquerque Western II Solar Energy System Schematic



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Cathedral Square

3 Cathedral Square

Burlington, VT 05401

MAIN PARTICIPANTS

	1	2	3
Name	Steve Schuh	James Brown, PE	Robert Wheeler
Address	Boeing Aerospace Company P.O. Box 3999 MS-8612 Seattle, WA 98124	Jennison Engineering Inc. 182 Main Street Burlington, VT 05401	Yankee Solar Systems 121 Pearl Street Burlington, VT 05401
Phone	206-773-0640	802-863-4571	802-864-4522
Responsibility	File Representative	Solar System Designer	Solar Subcontractor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>44°N</u> Longitude <u>73°</u> Altitude <u>200 ft</u> DD <u>8269</u> Base Temp. <u>65°</u>
	Sunshine Hours July _____ January _____ Annual _____
	Source of data <u>NOAA climatological data</u>
	Urban <u>X</u> Suburban _____ Rural _____
BUILDING	Floor area <u>unknown</u> No. Occupants <u>114</u>
	Design Temperature internal w _____ s _____ ° _____
	external w _____ s _____ ° _____
	Mass type <u>unknown</u> location <u>Burlington, VT</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Daystar, flat plate</u> area(net) <u>1798 ft²</u>
	orientation <u>42°W of south</u> tilt <u>45°</u>
	Storage type <u>water</u> capacity <u>2699 gal</u>
Auxiliary System type <u>boiler</u> fuel type <u>gas</u> fuel cost <u>unknown</u>	

PROJECT SCHEDULE

DATE MILESTONES	1979	1980				
Construction completion	unknown					
Monitoring period	Jun-Dec	Jan-Aug				
Final reports	Jun-Oct	Jan-Aug				

Report availability

 Title
(available from)

Monthly Performance Report (Cathedral Square)
Technical Information Center
P.O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package _____

 Description of data recording method Data collected on tape every 320 seconds and
sent to the Central Data Processing System daily

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	--	--
	Outdoor Temperature	320 sec	$\pm 0.5^{\circ}\text{F}$ calibrated
	Incident radiation on horizontal surface	--	--
	Incident radiation in plane of collector	320 sec	$\pm 3\%$
	Relative Humidity	--	--
	Wind Speed	--	--
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
	Storage		
	Flow rate inputs to storage	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
	Temperature readings in storage(1 or more)	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to storage	--	--
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	320 sec	$\pm 3\%$ full scale
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to subsystems	--	--
	Average DB inside temperature	--	--
	Infiltration load	--	--
	Auxiliary energy	--	--
	Operating energy	320 sec	$\pm 1\%$
	Total building energy load	--	--
	Internal energy gains	--	--
	Solar gains	--	--
	Solar as a % of total load	--	--
	Thermal capacity of building	--	--



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Facilities Development

Address

5750 Friars Road

San Diego, CA 92108

MAIN PARTICIPANTS

	1	2	3
Name	Jeff Andrews		
Address	5750 Friars Road San Diego, CA 92108		
Phone	714-295-4483		
Responsibility	President of condominium		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>32°</u> Longitude <u>117°</u> Altitude <u>13 ft</u> DD <u>1507</u> Base Temp. <u>65° F</u>
	Sunshine Hours July <u>10.9</u> January <u>5.3</u> Annual <u>8.0</u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u> </u> Suburban <u>☒</u> Rural <u> </u>
BUILDING	Floor area <u>1100 sq ft/unit</u> No. Occupants <u>unknown</u>
	Design Temperature internal w <u> </u> s <u> </u> °
	external w <u>43</u> s <u> </u> ° F
	Mass type <u>unknown</u> location <u>San Diego, CA</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Revere, flat plate</u> area(net) <u>520 ft²</u>
	orientation <u>south</u> tilt <u>46°</u>
	Storage type <u>glass-lined, insulated & buried</u> capacity <u>1000 gal</u>
Auxiliary System type <u>electric heaters</u> fuel type <u>electric</u> fuel cost <u>5¢/kwh</u>	

PROJECT SCHEDULE

DATE MILESTONES	1978	1979	1980	Seasonal 1979		
Construction completion	unknown					
Monitoring period	Jan-Dec	Jan-Dec	Jan-Aug			
Final reports	Mar-Sept	Jan-Oct	Feb-Jun & Aug	Sesonal Oct		
1978-Mar 1979						
Report availability	Title	Monthly Performance Report (Facilities Development)				
	(available from)	Technical Information Center				
		P.O. Box 62, Oak Ridge, TN 87830				

INSTRUMENTATION (existing or anticipated)

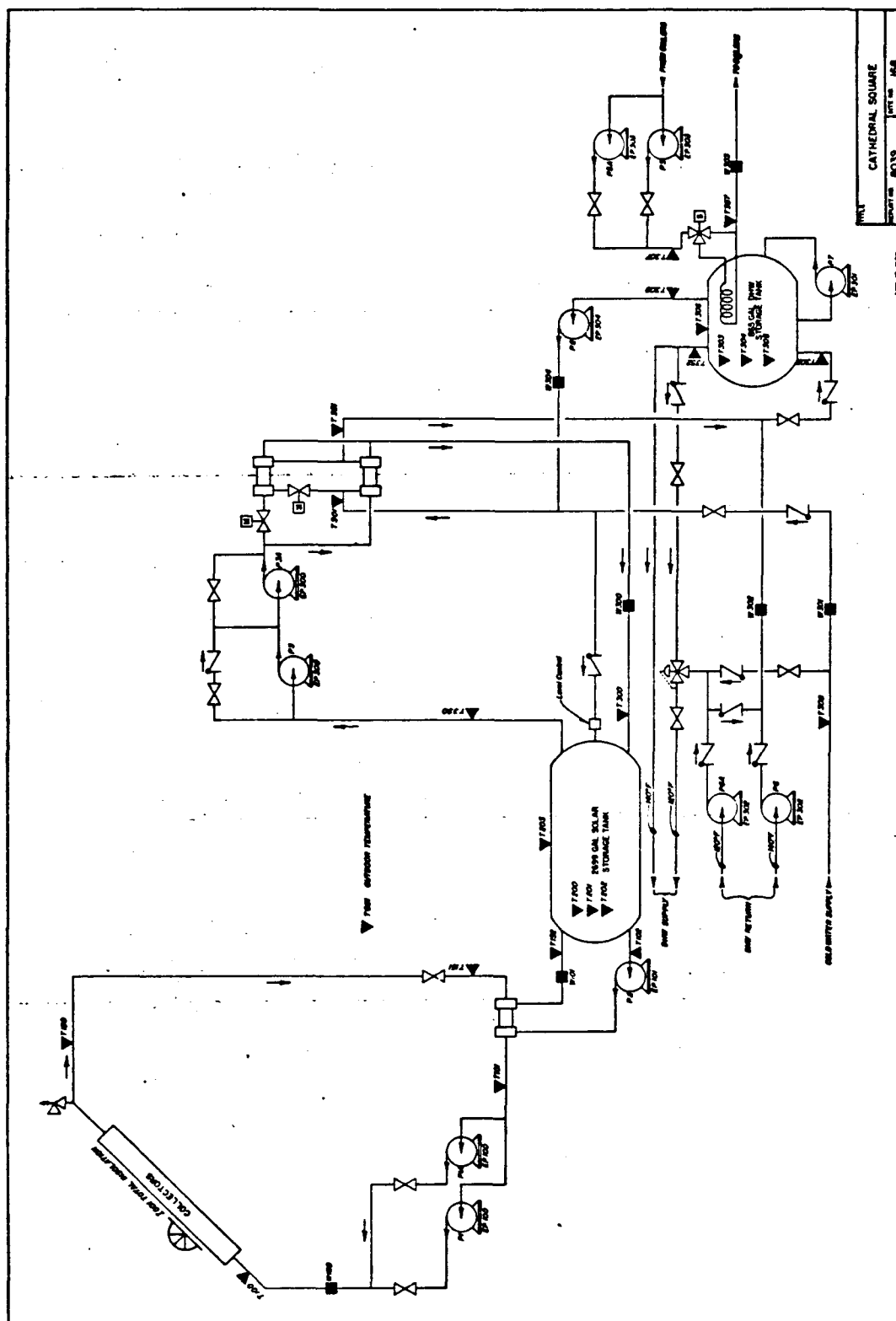
Approximate cost of instrumentation package _____

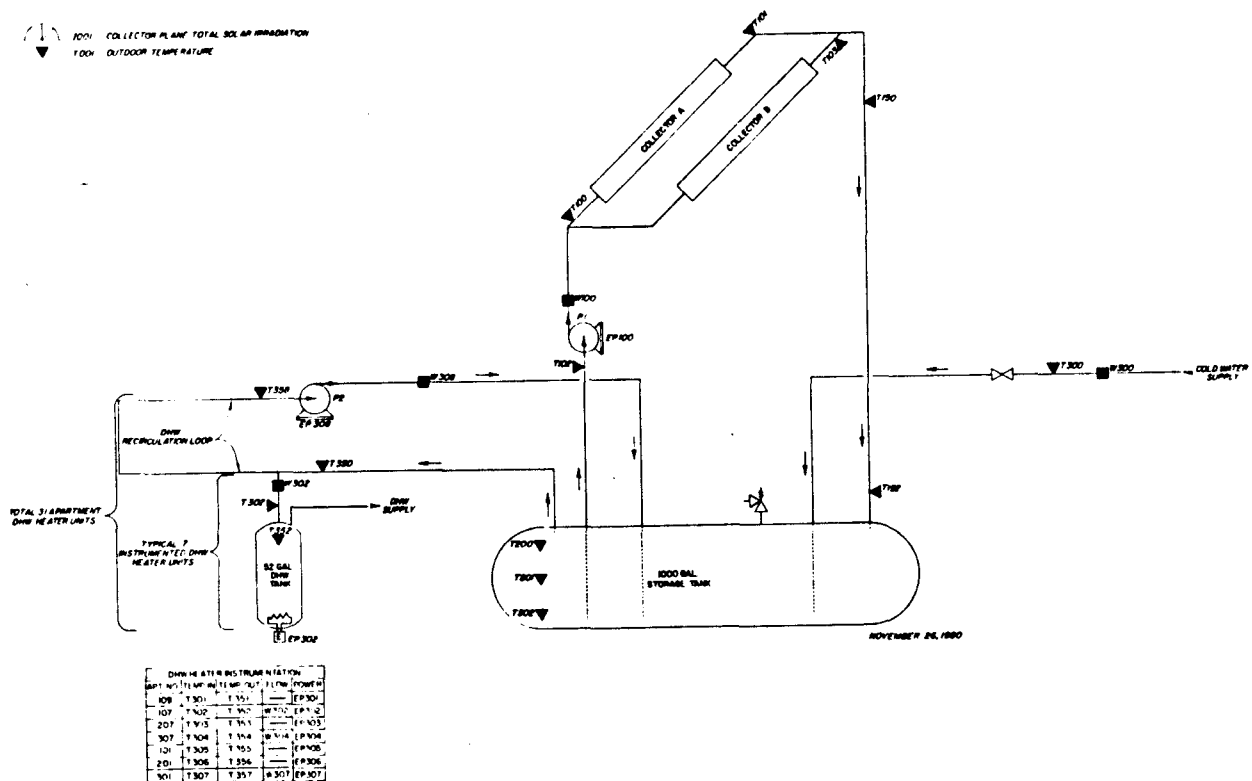
Description of data recording method Data collected on tape every 320 seconds and sent to the Central Data Processing System daily

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	--	--
	Outdoor Temperature	320 sec	$\pm 0.5^{\circ}\text{F}$
	Incident radiation on horizontal surface	--	--
	Incident radiation in plane of collector	320 sec	$\pm 2\%$
	Relative Humidity	--	--
	Wind Speed	--	--
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec	$\pm 3\%$
	Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
	Storage		
	Flow rate inputs to storage	320 sec	$\pm 3\%$
	Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
	Temperature readings in storage(1 or more)	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to storage	--	--
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	320 sec	$\pm 3\%$
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to subsystems	320 sec	$\pm 2\%$
	Average DB inside temperature	--	--
	Infiltration load	--	--
	Auxiliary energy	--	--
	Operating energy	--	--
	Total building energy load	--	--
	Internal energy gains	--	--
	Solar gains	--	--
BUILDING SYSTEM	Solar as a % of total load	--	--
	Thermal capacity of building	--	--

ILLUSTRATION





Facilities Development Solar Energy System Schematic



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Forest City Dillon

3001 Bladensburg Road, N. E.

Washington, D. C.

(Fort Lincoln Apartments)

MAIN PARTICIPANTS

	1	2	3
Name	Forest City Dillon, Inc.	Perry Noe	
Address	10800 Brookpark Road Cleveland, Ohio 44130	c/o Andrew Bryant & Associates	
Phone	Ken Yarus or Max Rabner (216) 267-1200	(216) 653-3149	
Responsibility	Builder	Designer	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>39°N</u> Longitude <u>77°</u> Altitude <u>200 ft.</u> DD <u>4,600</u> Base Temp. <u>15°F</u>
	Sunshine Hours July <u>72%</u> January <u>41%</u> Annual <u>58%</u>
	Source of data <u>HUD Documentation/U. S. Weather Data</u>
	Urban <u>X</u> Suburban <u> </u> Rural <u> </u>
BUILDING	Floor area <u>approx. 135,000 ft²</u> No. Occupants <u>approx. 188</u>
	Design Temperature internal w <u>68</u> s <u>78</u> °F
	external w <u>15</u> s <u>91</u> °F
	Mass type <u>unknown</u> location <u>none</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>none</u> shaded <u>none</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Lennox LSC181S</u> area(net) <u>2,217 ft²</u>
	orientation <u>South</u> tilt <u>40 degrees</u>
	Storage type <u>Liquid</u> capacity <u>3,200 gallons (water)</u>
	Auxiliary System type <u>Oil burner</u> fuel type <u>#2 oil</u> fuel cost <u>unknown</u>

PROJECT SCHEDULE

DATE MILESTONES						
Construction completion	unknown	unknown				
Monitoring period	1/79-12/79	1/80-12/80				
Final reports	None	3/81				

Report availability

Title

(available from)

Monthly Performance Reports, 12/79 to PresentU. S. Department of EnergyT. I. C., P. O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package \$30,000Description of data recording method 320 second intervals

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	-	-
	Outdoor Temperature	320 sec.	5%
	Incident radiation on horizontal surface	-	-
	Incident radiation in plane of collector	320 sec.	5%
	Relative Humidity	320 sec.	5%
	Wind Speed	320 sec.	5%
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec.	5%
	Temperature entering & leaving collectors	320 sec.	5%
	Storage		
	Flow rate inputs to storage	320 sec.	5%
	Temperature entering & leaving storage	320 sec.	5%
	Temperature readings in storage(1 or more)	320 sec.	5%
	Auxiliary energy supplied to storage	320 sec.	5%
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	320 sec.	5%
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec.	5%
	Auxiliary energy supplied to subsystems	320 sec.	5%
	Average DB inside temperature	-	-
	Infiltration load	-	-
	Auxiliary energy	-	-
	Operating energy	-	-
	Total building energy load	-	-
	Internal energy gains	-	-
	Solar gains	-	-
	Solar as a % of total load	-	-
	Thermal capacity of building	-	-



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Hei Wai WongBanyan Street Manor1132 Banyan StreetHonolulu, Hawaii 96814

MAIN PARTICIPANTS

	1	2	3
Name	Glenn A. Rome	Mike Bean	Eleanor Lisenbee
Address	Boeing Aerospace Company P.O. Box 3999 MS 8612 Seattle, WA 98124	Cody Company 1168 Waimann Honolulu, HI 96814	Resident Manager Banyan Street Manor 1132 Banyan St. Honolulu, HI 96814
Phone	206-773-0640	808-537-5285	808-841-7075
Responsibility	Field Representative	System Designer	Building Manager

PROJECT DESCRIPTION

CLIMATE	Latitude <u>22°N</u> Longitude <u>157°W</u> Altitude <u>60 ft</u> DD <u>---</u> Base Temp. <u>65°F</u>
	Sunshine Hours July <u>-----</u> January <u>-----</u> Annual <u>-----</u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u>X</u> Suburban <u>-----</u> Rural <u>-----</u>
BUILDING	Floor area <u>unknown</u> No. Occupants <u>19</u>
	Design Temperature internal w <u>---</u> s <u>---</u> ° <u>---</u>
	external w <u>---</u> s <u>---</u> ° <u>---</u>
	Mass type <u>unknown</u> location <u>Honolulu, HI</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Raypak, flat-plate</u> area(net) <u>807 ft²</u>
	orientation <u>south</u> tilt <u>24°</u>
	Storage type <u>water</u> capacity <u>1230 gal</u>
Auxiliary System type <u>gas heater/elec. hot water heater</u> fuel type <u>gas/elec</u> fuel cost <u>unknown</u>	

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980		
Construction completion	unkown					
Monitoring period	Oct-Dec	Jan-Dec	Jan-Dec	Jan-Aug		
Final reports	None	Apr-Sept	Feb-Sept, Nov & Dec	Apr-Aug		

Report availability

 Title
(available from)

Monthly Performance Report (Hei Wai Wong)

Technical Information Center

P.O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package _____

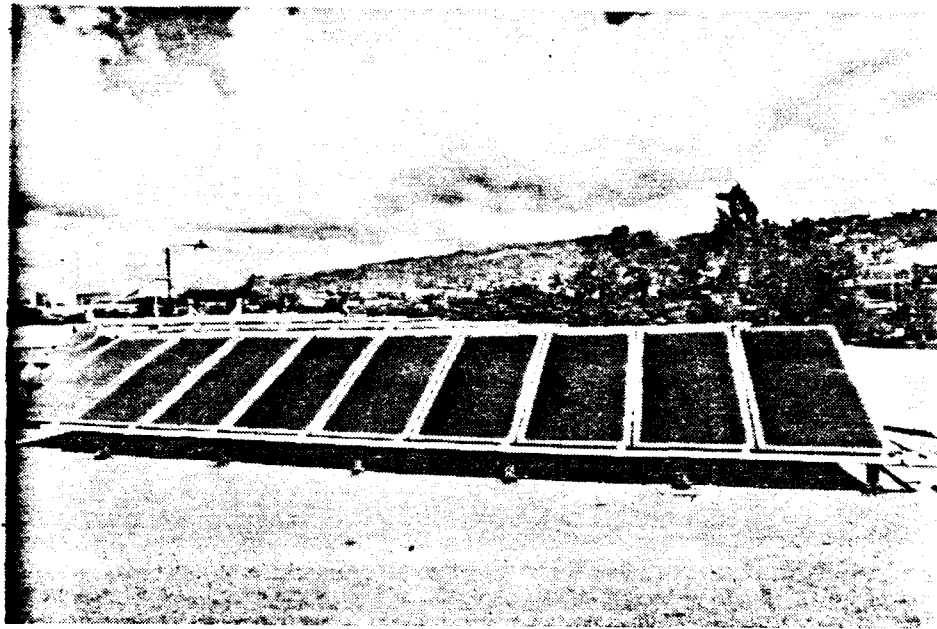
 Description of data recording method Data collected on tape every 320 seconds and sent to the Central Data Processing System daily

DATA RECORDED

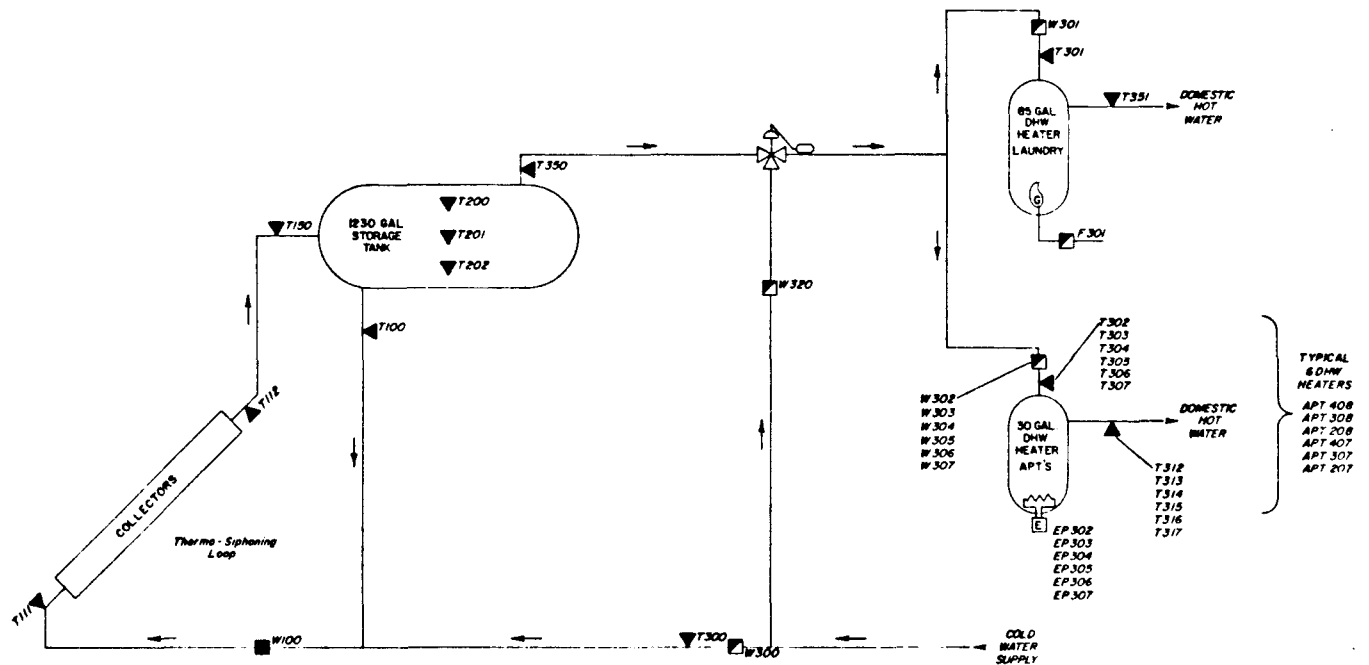
		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	--	--
	Outdoor Temperature	320 sec	-0.5 F calibrated
	Incident radiation on horizontal surface	--	--
	Incident radiation in plane of collector	320 sec	- 3%
	Relative Humidity	--	--
	Wind Speed	320 sec	- 2%
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec	+ 3% full scale
	Temperature entering & leaving collectors	320 sec	+ 0.5°F
	Storage		
	Flow rate inputs to storage	320 sec	± 3% full scale
	Temperature entering & leaving storage	320 sec	+ 0.5°F
	Temperature readings in storage(1 or more)	320 sec	- 0.5°F
	Auxiliary energy supplied to storage	--	--
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	320 sec	± 3% full scale
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec	± 0.5°F
	Auxiliary energy supplied to subsystems	320 sec	± 1%
	Average DB inside temperature	--	--
	Infiltration load	--	--
	Auxiliary energy	--	--
	Operating energy	--	--
	Total building energy load	--	--
	Internal energy gains	--	--
BUILDING SYSTEM	Solar gains	--	--
	Solar as a % of total load	--	--
	Thermal capacity of building	--	--

ILLUSTRATION

81

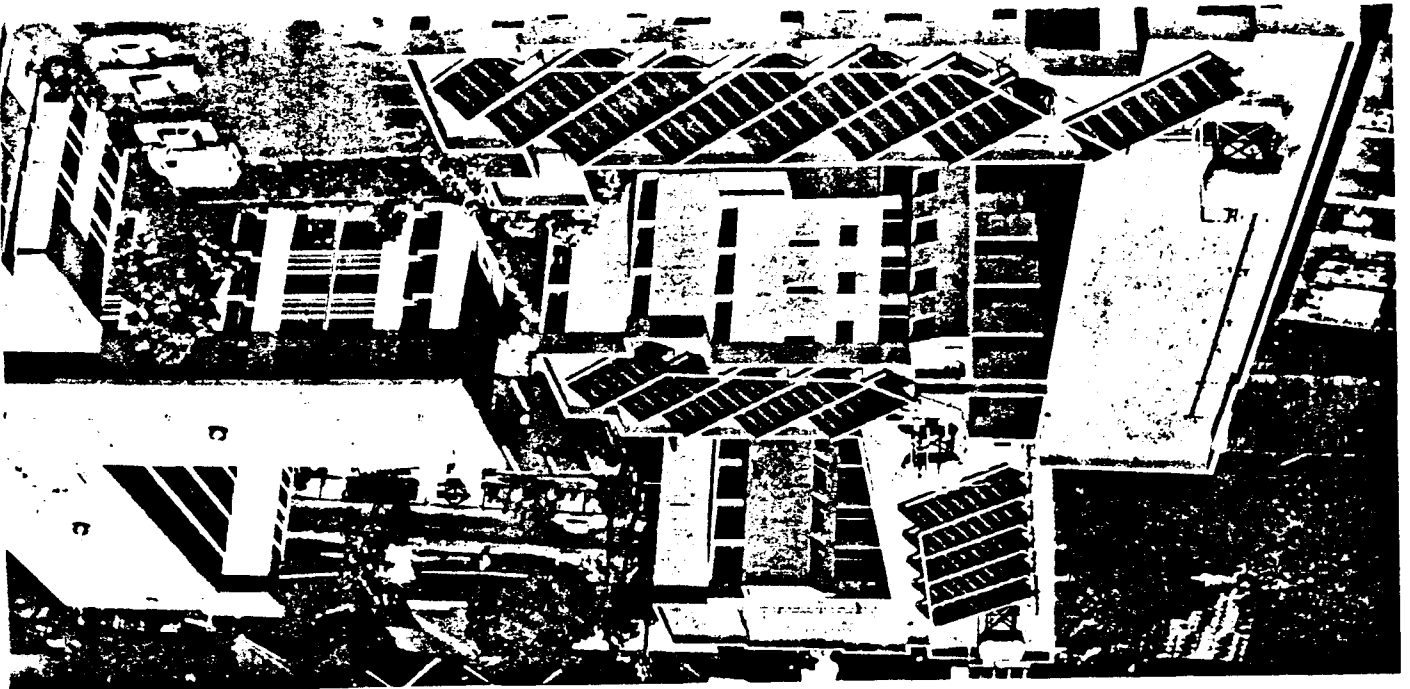


-  1001 COLLECTOR PLANE TOTAL SOLAR IRRADIATION
-  T001 OUTDOOR TEMPERATURE
-  D001 WIND DIRECTION
-  V001 WIND SPEED



AUGUST 27, 1980

Hei Wai Wong Solar Energy System Schematic





SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Matt Cannon

Address

1827 N. E. 16th Way

Gainesville, Florida 32601

MAIN PARTICIPANTS

	1	2	3
Name	Matt Cannon	Architectural Design	Solar Energy Products
Address	P. O. Box 1454 Gainesville, Florida 32601	Associates, Inc. 502 N. W. 16th Ave. Suite 7 Gainesville, Fl. 32601	1208 N. W. 8th Ave. Gainesville, Florida 32601
Phone	(904) 378-2511	(904) 377-7501	(904) 377-6527
Responsibility	Grantee	Building Designer	Solar System Designer

PROJECT DESCRIPTION

CLIMATE	Latitude <u>29°</u> Longitude <u>82°</u> Altitude <u>155 ft.</u> DD <u>1,599</u> Base Temp. <u>65°F</u>
	Sunshine Hours July _____ January _____ Annual _____
	Source of data <u>Solar Project Description by NBS and Boeing</u>
	Urban _____ Suburban <u>X</u> Rural _____
BUILDING	Floor area <u>2,426 ft²</u> No. Occupants <u>6-8</u>
	Design Temperature internal w <u>69</u> s <u>70</u> °F
	external w <u>57</u> s <u>83</u> °F
	Mass type <u>unknown</u> location <u>Gainesville, Florida</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>541 ft²</u> % of total glass <u>10% June</u>
	night insulation <u>Cellular rubber/Rubutex</u> shaded <u>0% December</u>
Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water and space heating</u>
	Collector type <u>liquid flat plate collectors</u> area(net) <u>527 ft²</u>
	orientation <u>South</u> tilt <u>34 degrees</u>
	Storage type <u>Liquid</u> capacity <u>1,000 gallons</u>
	Auxiliary System type <u>None</u> fuel type <u>Elec.</u> fuel cost <u>5¢/kwh</u>

PROJECT SCHEDULE

DATE						
MILESTONES						
Construction completion	9/77					
Monitoring period	5/78-present					
Final reports	June 1980					

Report availability Title Matt Cannon Solar Energy Perf. Eval. Reports 6/78-present
 (available from) U. S. Department of Energy
T. I. C., P. O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION (existing or anticipated)

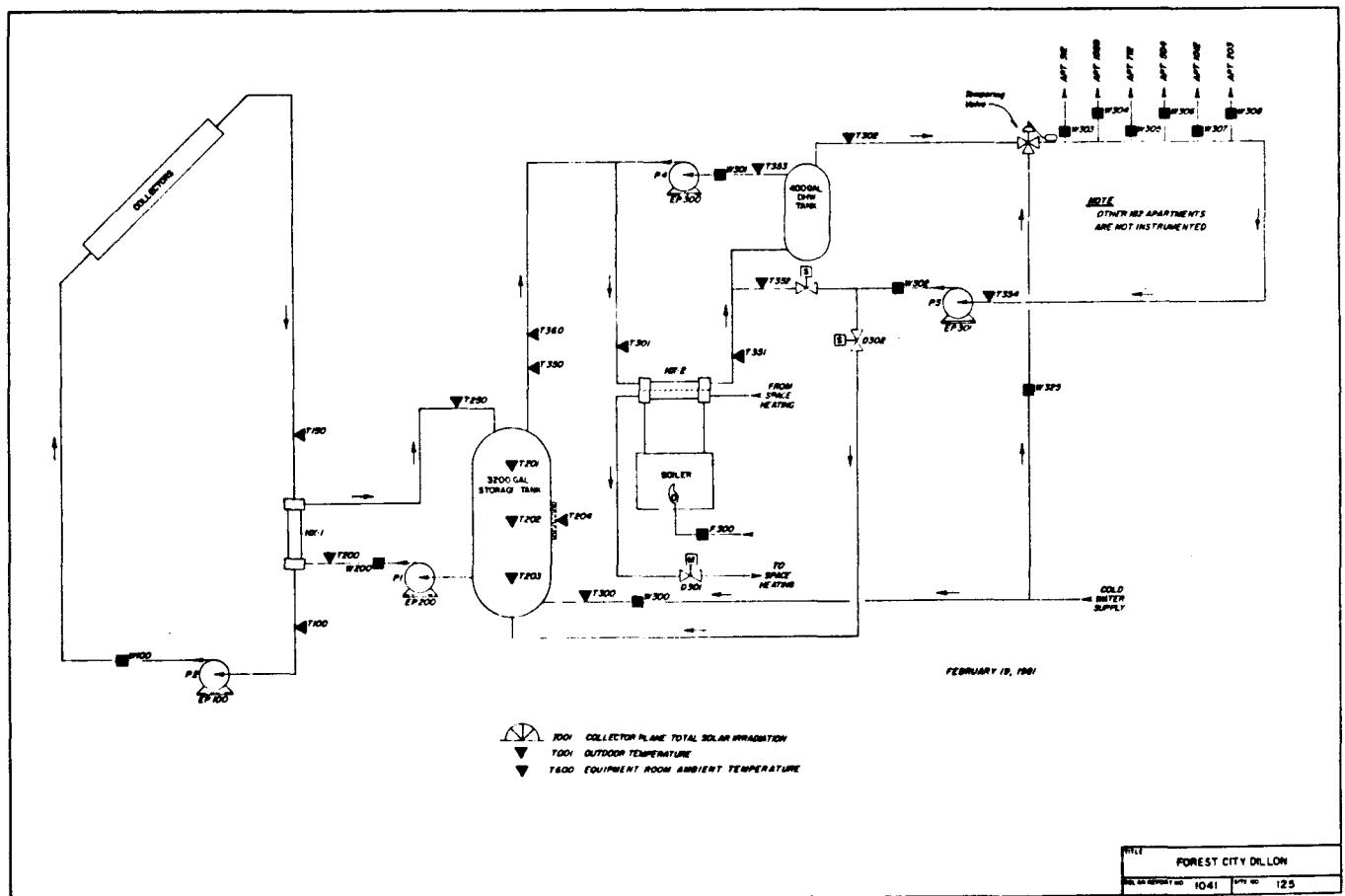
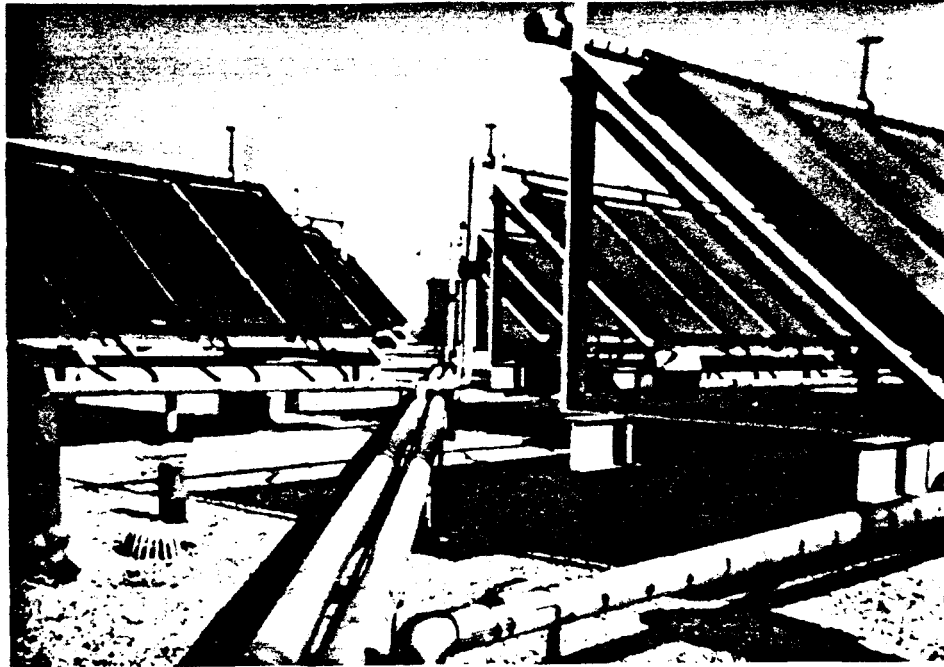
Approximate cost of instrumentation package unknown
 Description of data recording method Data is collected every 320 seconds on tape and is sent daily to the central processing unit.

DATA RECORDED

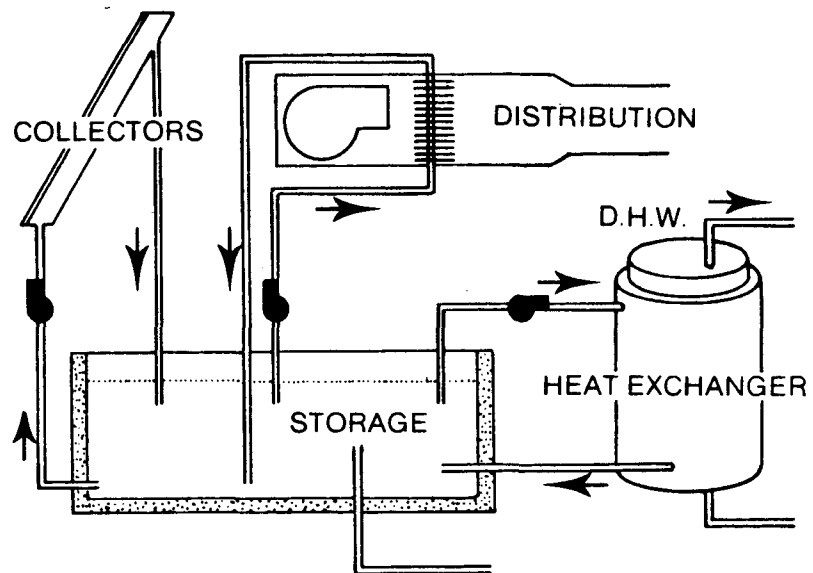
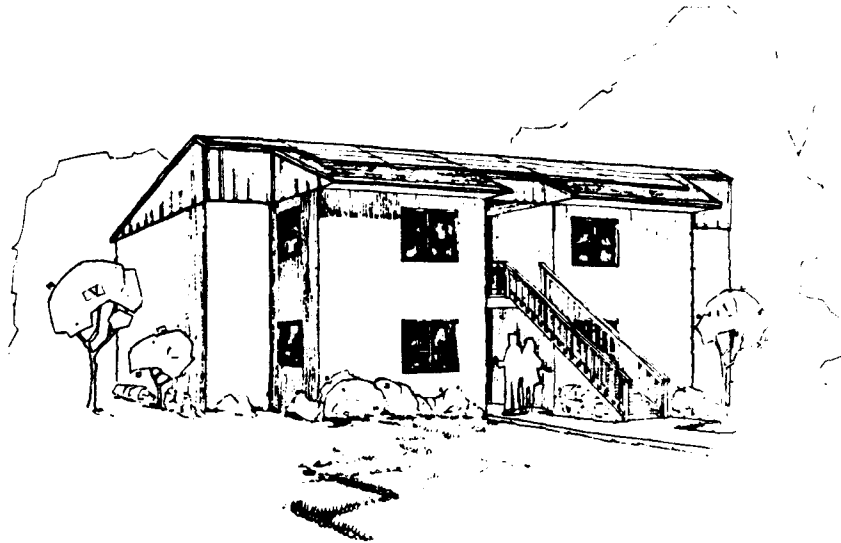
METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	-	-
	Outdoor Temperature	320 sec.	5%
	Incident radiation on horizontal surface	-	-
	Incident radiation in plane of collector	320 sec.	5%
	Relative Humidity	-	-
	Wind Speed	-	-
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec.	5%
	Temperature entering & leaving collectors	320 sec.	5%
	Storage		
	Flow rate inputs to storage	320 sec.	5%
	Temperature entering & leaving storage	320 sec.	5%
	Temperature readings in storage(1 or more)	320 sec.	5%
	Auxiliary energy supplied to storage	-	-
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	320 sec.	5%
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec.	5%
	Auxiliary energy supplied to subsystems	320 sec.	5%
	Average DB inside temperature	-	-
	Infiltration load	-	-
	Auxiliary energy	-	-
	Operating energy	-	-
	Total building energy load	-	-
	Internal energy gains	-	-
	Solar gains	-	-
	Solar as a % of total load	-	-
	Thermal capacity of building	-	-

ILLUSTRATION

78



ILLUSTRATION





SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

NBS Passive Solar Test Building

Address

National Bureau of Standards, Annex

Gaithersburg, Maryland USA

MAIN PARTICIPANTS

	1	2	3
Name	Thomas Richtmyer		
Address	Building 226, Room B104 National Bureau of Standards Washington, DC 20234		
Phone	301/921-3754		
Responsibility	Instrumentation Engineer		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>39.1°N</u> Longitude <u>77.2°W</u> Altitude <u>400 ft.</u> DD <u>500Z</u> Base Temp. <u>65°F</u>	
	Sunshine Hours July <u>53,300</u> January <u>18,900</u> Annual <u>444,000</u> BTU/hr. ft. ²	
	Source of data <u>TMY, Sterling, VA (Dulles Airport)</u>	
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>	
BUILDING	Floor area <u>1,460 sq. ft.</u> No. Occupants <u>0</u>	
	Design Temperature internal w <u>65</u> s <u>84</u> °F	
	external w <u>14</u> s <u>90</u> °F	
	Mass type <u>masonry</u> location <u> </u>	
	South Glazing type <u>double</u>	
	area(south glass) <u>322 sq. ft.</u> % of total glass <u>95%</u>	
	night insulation <u>R5, 50% of glass</u> shaded <u>yes</u>	
Heated Volume <u>12,700 cu. ft.</u> Ventilation Rate <u>estimated - 1</u> a.c.h.		
SOLAR SYSTEM	System energy use(eg. heating) <u>heating (passive only)</u>	
	Collector type <u>direct gain, vented trombe wall</u> area(net) <u>322 sq. ft.</u>	
	orientation <u>true south</u> tilt <u>90° (vertical)</u>	
	Storage type <u>storage wall, slab-on-grade floor</u> capacity <u>approx. 200,000 BTU @</u>	
	internal CMU wall	20° F swing
Auxiliary System type <u>Fan Coil: Elec. resist., central</u> fuel type <u>elec.</u> fuel cost <u>5¢/KW hr.</u>	chiller	

PROJECT SCHEDULE

DATE MILESTONES	11/15/80	11/80	10/82	6/81	6/82	
Construction completion	X					
Monitoring period						
Final reports				X	X	

Report availability

Title

(available from)

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

\$50,000

Description of data recording method

Minicomputer (HP2100), magnetic tape

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	---	---
	Outdoor Temperature	5 min	+ 1°F
	Incident radiation on horizontal surface		Class I WMO
	Incident radiation in plane of collector		"
	Relative Humidity		+ 40
	Wind Speed & Direction		+ 5% of reading
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	several times	?
	Temperature entering & leaving collectors	5 min	+ 10F
	Storage		
	Flow rate inputs to storage	---	---
	Temperature entering & leaving storage	---	---
	Temperature readings in storage(1 or more)	5 min	+ 1°F
	Auxiliary energy supplied to storage	---	---
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	cont.	?
BUILDING SYSTEM	Temperature entering & leaving subsystems	5 min	+ 1°F
	Auxiliary energy supplied to subsystems	5 min	+ 2% of reading
	Average DB inside temperature	5 min	+ 2°F
	Infiltration load	winter/summer	?
	Auxiliary energy	cont.	+ 2% of reading
	Operating energy	cont.	"
	Total building energy load	winter/summer	?
	Internal energy gains	5 min	+ 2% of reading
	Solar gains	5 min	?
	Solar as a % of total load	monthly	?
	Thermal capacity of building	monthly	?



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Saddle Hill Trust Lot 36

21 Saddle Hill Road

Medway, Massachusetts 20253

MAIN PARTICIPANTS

	1	2	3
Name	Don Huber	Warren Mackensen	Sanford Kaplan
Address	Boeing Aerospace Company P.O. Box 3999 MS-8612 Seattle, Wash. 98123	Sippican Solar Systems 14 Ichabod Lane Marion, Mass. 02738	10 Kearney Road Needham, Mass. 02194
Phone	206-773-0640	671-748-2810	617-443-3400
Responsibility	Instrumentation Engineer	Designer	Contractor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>43n</u> Longitude <u>71w</u> Altitude <u>200 ft</u> DD <u>5791</u> Base Temp. <u>65°F</u>
	Sunshine Hours July <u>--</u> January <u>--</u> Annual <u>--</u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u>--</u> Suburban <u>X</u> Rural <u>--</u>
BUILDING	Floor area <u>1944 ft²</u> No. Occupants <u>4</u>
	Design Temperature internal w <u>--</u> s <u>--</u> ° <u>--</u>
	external w <u>--</u> s <u>--</u> ° <u>--</u>
	Mass type <u>unknown</u> location <u>Medway, Mass</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating and domestic hot water</u>
	Collector type <u>Daystor #2001, flat plate liquid</u> area(net) <u>393 ft²</u>
	orientation <u>south</u> tilt <u>58°</u>
	Storage type <u>water</u> capacity <u>750 gallon</u>
Auxiliary System type <u>heating/oil furnace</u> fuel type <u>#2 oil</u> fuel cost <u>unknown</u>	

PROJECT SCHEDULE

DATE					
MILESTONES					
Construction completion	1977				
Monitoring period	3/79 to present				
Final reports	3/79 to present				

Report availability

Title

(available from)

Monthly Performance Report (Saddle Hill Trust (36))Technical Information CenterP.O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package _____

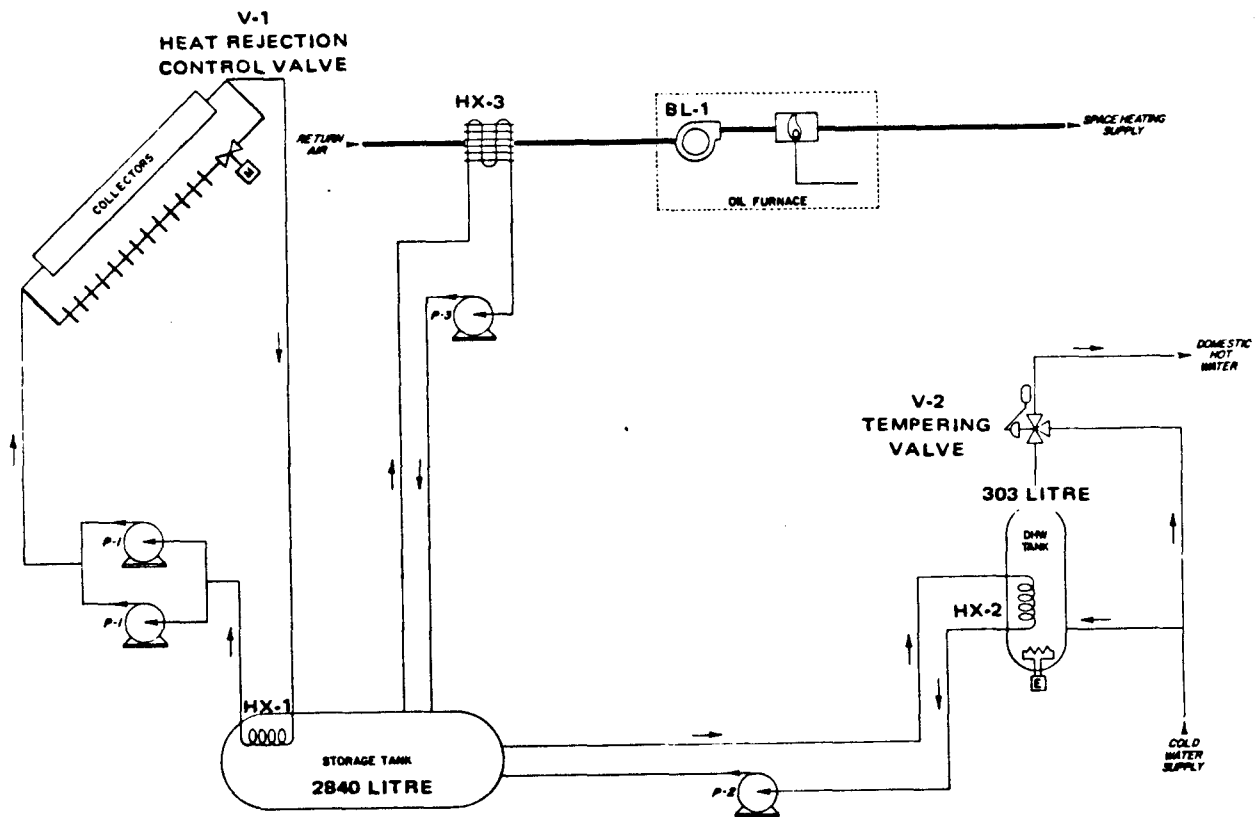
 Description of data recording method Data collected on tape every 320 seconds, and sent to the Central Data Processing System daily

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	--	--
	Outdoor Temperature	320 sec	$\pm 0.5^{\circ}\text{F}$ calibrated
	Incident radiation on horizontal surface	--	--
	Incident radiation in plane of collector	32 sec	$\pm 3\%$
	Relative Humidity	--	--
	Wind Speed	320 sec	$\pm 2\%$
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
	Storage		
	Flow rate inputs to storage	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
	Temperature readings in storage(1 or more)	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to storage	--	--
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	320 sec	$\pm 3\%$ full scale
BUILDING SYSTEM		320 sec	$\pm 0.5^{\circ}\text{F}$
	Average DB inside temperature	320 sec	$\pm 0.5^{\circ}\text{F}$
	Infiltration load	--	--
	Auxiliary energy	320 sec	$\pm 1\%$
	Operating energy	320 sec	$\pm 1\%$
	Total building energy load	--	--
	Internal energy gains	--	--
	Solar gains	--	--
	Solar as a % of total load	--	--
	Thermal capacity of building	--	--

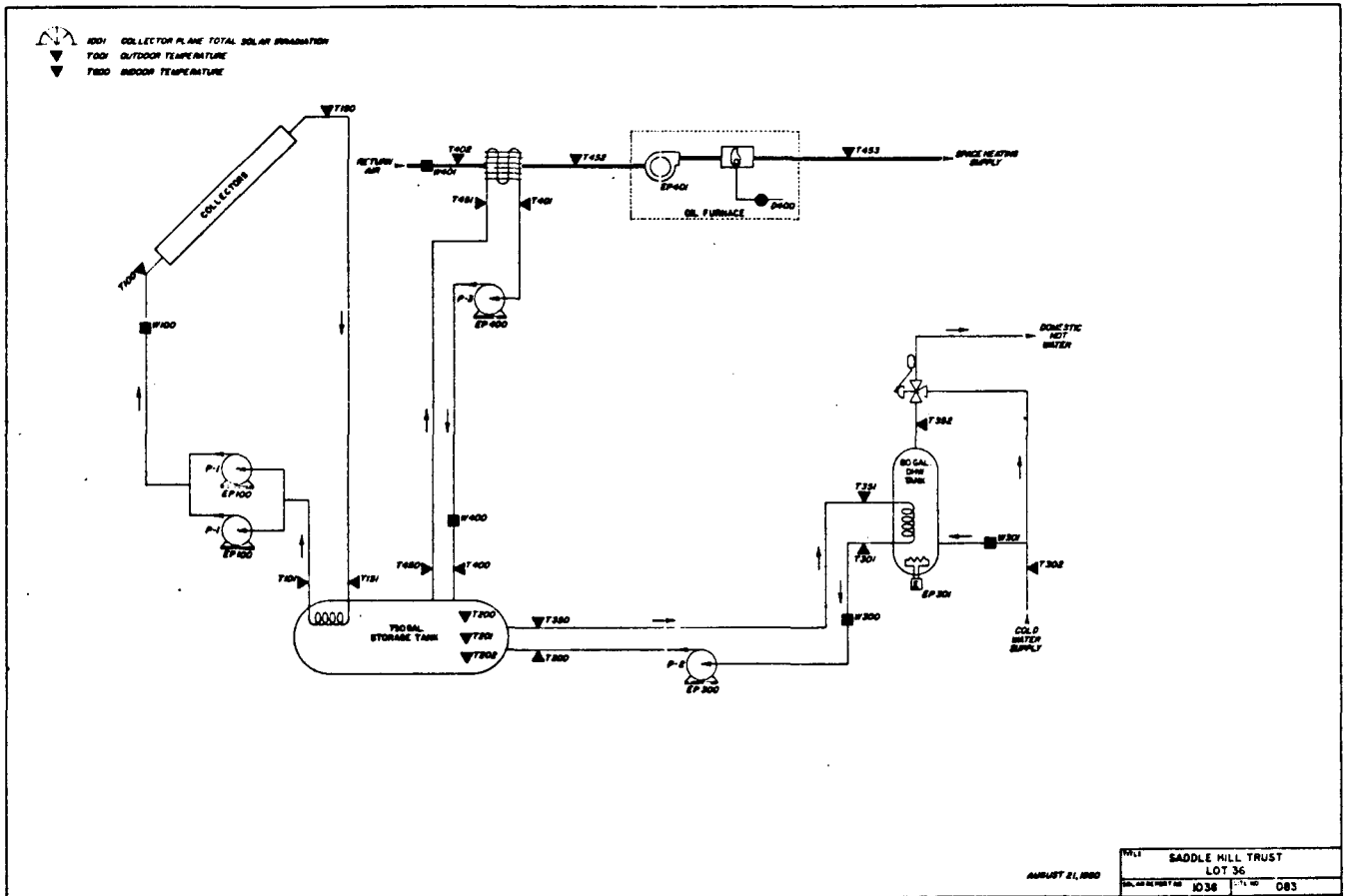
ILLUSTRATION

91



Saddle Hill Trust Lot 36 Solar Energy System Schematic

ILLUSTRATION





SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Saddle Hill Trust Lot 77

22 Green Walley Road

Medway, Massachusetts 20253

MAIN PARTICIPANTS

	1	2	3
Name	Don Huber	Warren Mackensen	Sanford Kaplan
Address	Boeing Aerospace Company P.O. Box 3999 MS-8612 Seattle, Wash. 98124	Sippican Solar Systems 14 Ichabod Lane Marion, Mass. 02738	10 Kearney Road Needham, Mass. 02194
Phone	206-773-0640	617-748-2810	617-443-3400
Responsibility	Instrumentation Engineer	Designer	Contractor

PROJECT DESCRIPTION

CLIMATE	Latitude <u>42n</u> Longitude <u>71w</u> Altitude <u>200 ft</u> DD <u>5791</u> Base Temp. <u>65°F</u>
	Sunshine Hours July _____ January _____ Annual _____
	Source of data <u>NOAA local climatological data</u>
	Urban _____ Suburban <u>X</u> Rural _____
BUILDING	Floor area <u>1696 ft²</u> No. Occupants <u>4</u>
	Design Temperature internal w <u>---</u> s <u>---</u> ° <u>---</u>
	external w <u>---</u> s <u>---</u> ° <u>---</u>
	Mass type <u>unknown</u> location <u>Medway, Mass.</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>unknown</u> % of total glass <u>unknown</u>
	night insulation <u>unknown</u> shaded <u>unknown</u>
	Heated Volume <u>unknown</u> Ventilation Rate <u>unknown</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Domestic hot water</u>
	Collector type <u>Solaron air, flat-plate</u> area(net) <u>78 (gross)</u>
	orientation <u>south</u> tilt <u>38°</u>
	Storage type <u>water pre-heat tank</u> capacity <u>120 gal</u>
Auxiliary System type <u>gas heater</u> fuel type <u>gas</u> fuel cost <u>unknown</u>	

PROJECT SCHEDULE

DATE MILESTONES						
Construction completion	1977					
Monitoring period	1/79 to present					
Final reports	1/79 to present (except 2/79)					

Report availability

 Title
(available from)

Monthly Performance Report (Saddle Hill Trust (77))
Technical Information Center
P.O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package _____

Description of data recording method

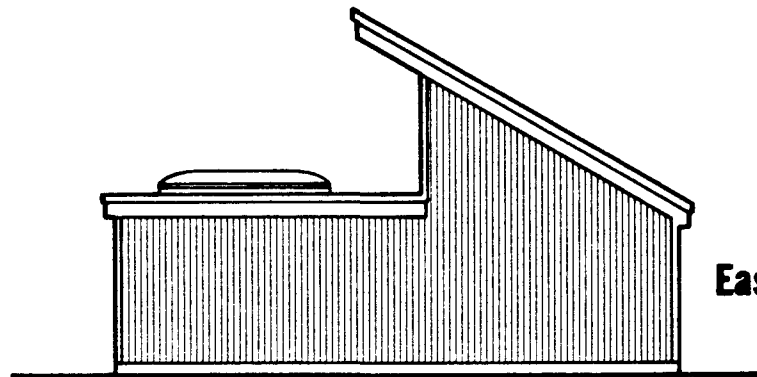
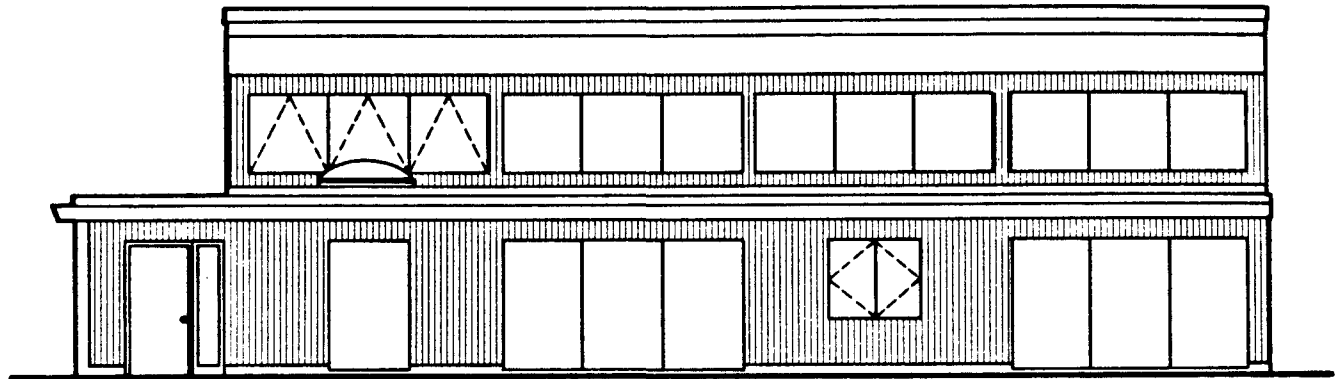
Data collected on tape every 320 seconds, and
sent to the Central Processing System daily

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	---	---
	Outdoor Temperature	320 sec	$\pm 0.5^{\circ}\text{F}$ calibrated
	Incident radiation on horizontal surface	---	---
	Incident radiation in plane of collector	320 sec	$\pm 3\%$
	Relative Humidity	---	---
SOLAR SYSTEM	Wind Speed	320 sec	$\pm 2\%$
	Collectors		
	Flow rate entering collectors	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
	Storage		
	Flow rate inputs to storage	320 sec	$\pm 3\%$ full scale
	Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
	Temperature readings in storage(1 or more)	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to storage	---	---
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	320 sec	$\pm 3\%$ full scale
BUILDING SYSTEM	Temperature entering & leaving subsystems	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy supplied to subsystems	320 sec	$\pm 1\%$
	Average DB inside temperature	320 sec	$\pm 0.5^{\circ}\text{F}$
	Infiltration load	320 sec	$\pm 0.5^{\circ}\text{F}$
	Auxiliary energy	320 sec	$\pm 0.5^{\circ}\text{F}$
	Operating energy	320 sec	$\pm 0.5^{\circ}\text{F}$
	Total building energy load	320 sec	$\pm 0.5^{\circ}\text{F}$
	Internal energy gains	320 sec	$\pm 0.5^{\circ}\text{F}$
	Solar gains	320 sec	$\pm 0.5^{\circ}\text{F}$
	Solar as a % of total load	320 sec	$\pm 0.5^{\circ}\text{F}$
	Thermal capacity of building	320 sec	$\pm 0.5^{\circ}\text{F}$

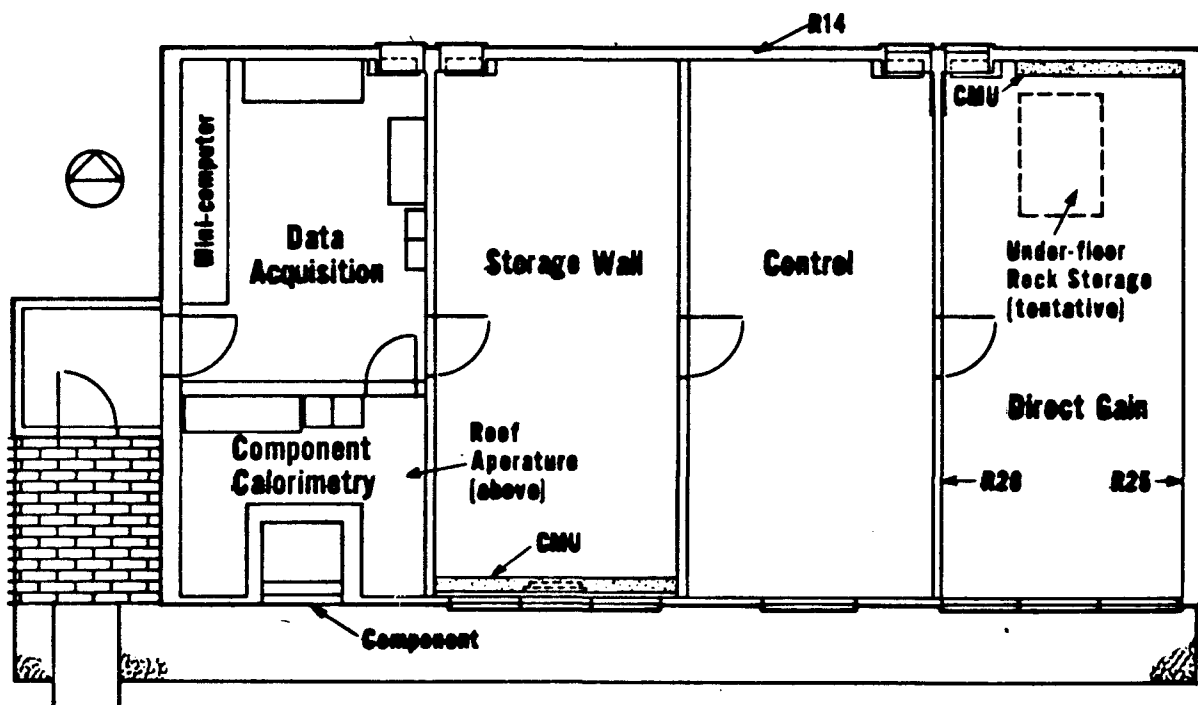
NBS PASSIVE TEST BUILDING

South Elevation

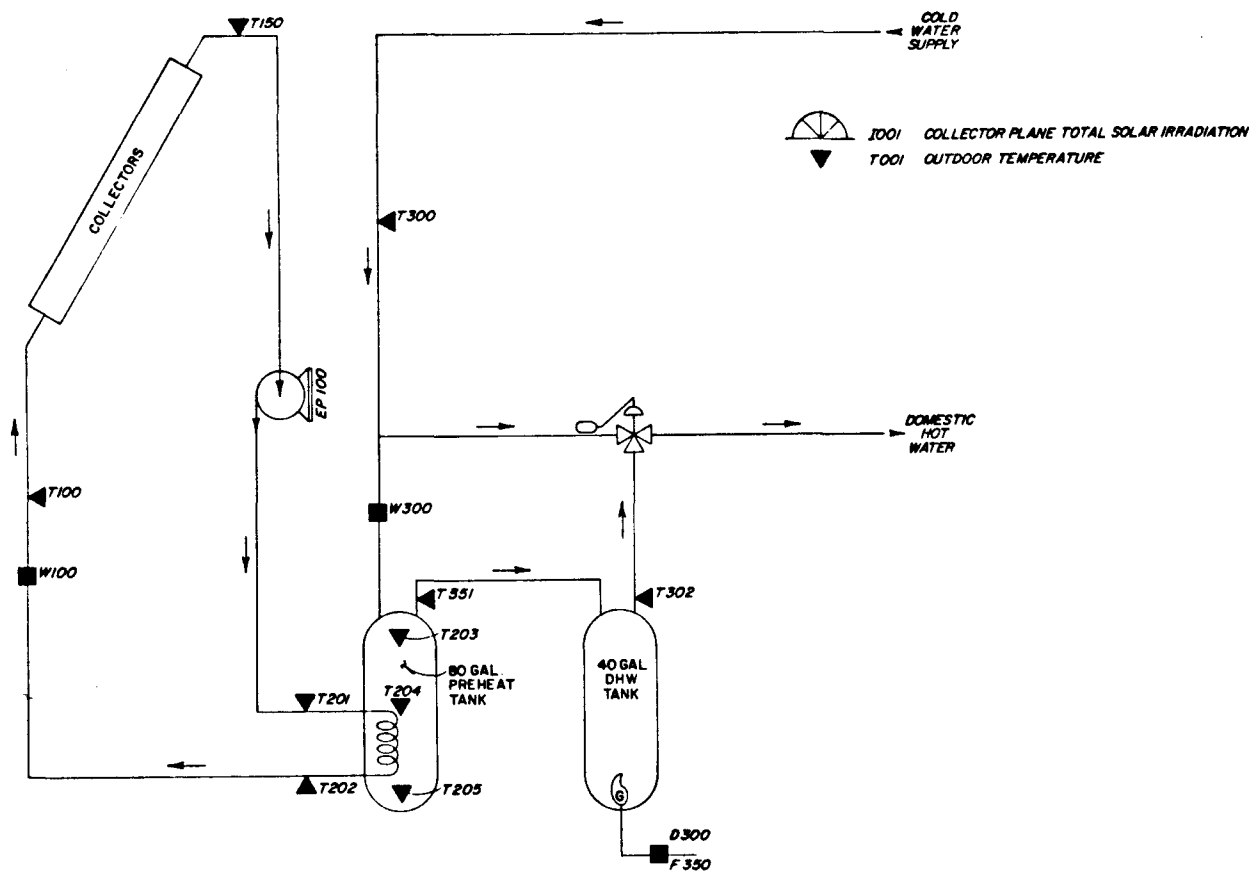


East Elevation

NBS PASSIVE TEST BUILDING



ILLUSTRATION



Saddle Hill Trust Lot 73 Solar Energy System Schematic



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Sir Galahad Company

Address

3929 Forest Glen Road

Virginia Beach, Virginia 23452

MAIN PARTICIPANTS

	1	2	3
Name	Solar One Ltd.		
Address	2644 Barrett Street Virginia Beach, Virginia 23452		
Phone	(804) 340-7262		
Responsibility	Designer, Solar Contractor		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>37°N</u> Longitude <u>76°W</u> Altitude <u>26 ft.</u> DD <u>3,488</u> Base Temp. <u>65°F</u>
	Sunshine Hours July <u>65%</u> January <u>57%</u> Annual <u>63%</u>
	Source of data <u>NOAA Local Climatological Data for Norfolk, Va.</u>
	Urban <u> </u> Suburban <u>X</u> Rural <u> </u>
BUILDING	Floor area <u>1,604 ft²</u> No. Occupants <u>1</u>
	Design Temperature internal w <u>68</u> s <u> </u> °F
	external w <u>23</u> s <u> </u> °F
	Mass type <u>unknown</u> location <u>Virginia</u>
	South Glazing type <u>unknown</u>
	area(south glass) <u>80 square feet</u> % of total glass <u>50%</u>
	night insulation <u>none</u> shaded <u>0%</u>
	Heated Volume <u>approx. 13,000 cubic feet</u> Ventilation Rate <u>1.3</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating and Domestic Hot Water</u>
	Collector type <u> </u> area(net) <u>640 ft² (absorber)</u>
	orientation <u>South</u> tilt <u>45 degrees</u>
	Storage type <u>Steel</u> capacity <u>1,500 gallons</u>
	Auxiliary System type <u>Heat pump, elec. DHW aux.</u> fuel type <u>elec.</u> fuel cost <u>6.5¢/kwh</u>

PROJECT SCHEDULE

DATE						
DATE						
Construction completion	11/77					
Monitoring period	2/78-present					
Final reports	Monthly Reports Dec. 1979-Sept. 1980					

Report availability

 Title
(available from)

Sir Galahad Solar Energy System Perf. Eval. 11/79-4/80
U. S. Department of Energy
T. I. C., P. O. Box 62, Oak Ridge, TN 37830

INSTRUMENTATION

(existing or anticipated)

 Approximate cost of instrumentation package \$18,000

 Description of data recording method Data collected on tape every 320 seconds,
sent to central computer every day.

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days	-	-
	Outdoor Temperature	320 sec.	.5°F
	Incident radiation on horizontal surface	-	-
	Incident radiation in plane of collector	320 sec.	.5°F
	Relative Humidity	-	-
	Wind Speed	-	-
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	320 sec.	.2 gpm
	Temperature entering & leaving collectors	320 sec.	.5°F
	Storage		
	Flow rate inputs to storage	320 sec.	.2 gpm
	Temperature entering & leaving storage	320 sec.	.5°F
	Temperature readings in storage(1 or more)	320 sec.	.5°F
	Auxiliary energy supplied to storage	320 sec.	.5°F
	Space heat, Space cooling, Hot water Subsystems		
BUILDING SYSTEM	Flow rates entering subsystems	320 sec.	.2 gpm
	Temperature entering & leaving subsystems	320 sec.	.5°F
	Auxiliary energy supplied to subsystems	320 sec.	.01 kw
	Average DB inside temperature	320 sec.	.5°F
	Infiltration load	-	-
	Auxiliary energy	320 sec.	.5°F
	Operating energy	320 sec.	.5°F
	Total building energy load	-	-
	Internal energy gains	-	-
BUILDING SYSTEM	Solar gains	-	-
	Solar as a % of total load	-	-
	Thermal capacity of building	-	-



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Solar House I

Address

Solar Energy Applications Lab.

Colorado State University

Ft. Collins, Colorado 80523

MAIN PARTICIPANTS

	1 Director	2 IEA Correspondent	3
Name	Dr. George O. G. Lof	Dr. William S. Duff	
Address	Solar Energy Applications Lab. Colorado State University Ft. Collins, Colorado 80523	Solar Energy Applications Lab. Colorado State University Ft. Collins, Colorado 80523	
Phone			
Responsibility			

PROJECT DESCRIPTION

Comparative performance of two types of evacuated tube collectors in a residential heating & cooling system.

CLIMATE	Latitude <u>40.6° N</u> Longitude <u>105.1° W</u> Altitude <u>1585° M</u> DD <u>3600° C</u> Base Temp. <u>18.3° C</u>
	Sunshine Hours July <u>321</u> January <u>207</u> Annual <u>3033</u>
	Source of data <u>On site data acquisition</u>
	Urban <u> </u> Suburban <u> </u> Rural <u> </u>
BUILDING	Floor area <u>128.5 M²</u> No. Occupants <u>used as offices</u>
	Design Temperature Internal w <u>22.2</u> s <u> </u> °C
	external w <u>-23</u> s <u> </u> °C
	Mass type <u>Low (wood frame)</u> location <u>Foothills of Eastern slopes of the Rockies.</u>
	South Glazing type <u>Vert. triple glazing</u>
	area(south glass) <u>10M²</u> % of total glass <u>35%</u>
	night insulation <u>none</u> shaded <u>45°</u>
Heated Volume <u> </u> Ventilation Rate <u> </u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Heating/Cooling DHW</u>
	Collector type <u>Flat plate - liquid</u> <u>Evac. tube (corning) (phillips) July 78</u> area(net) <u>71.3M²</u> <u>75.2M²</u>
	orientation <u>South</u> tilt <u>45°</u>
	Storage type <u>E.T. Water (galv. steel)</u> <u>F.P. Water (galv. steel)</u> capacity <u>4277 l</u> <u>4277 l</u>
	Auxiliary System type <u>Boiler 23.5kw output (rated)</u> fuel type <u>Gas</u> fuel cost <u> </u>

PROJECT SCHEDULE

DATE MILESTONES	1975	1976	1977	1978	1979	1980
Construction completion						
Monitoring period						
Final reports						

Report availability

 Title
(available from)

See "Project Description"

N.T.I.S. U.S. Dept. of Commerce

5285 Port Royal Road

Springfield, Virginia 22161

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

Description of data recording method

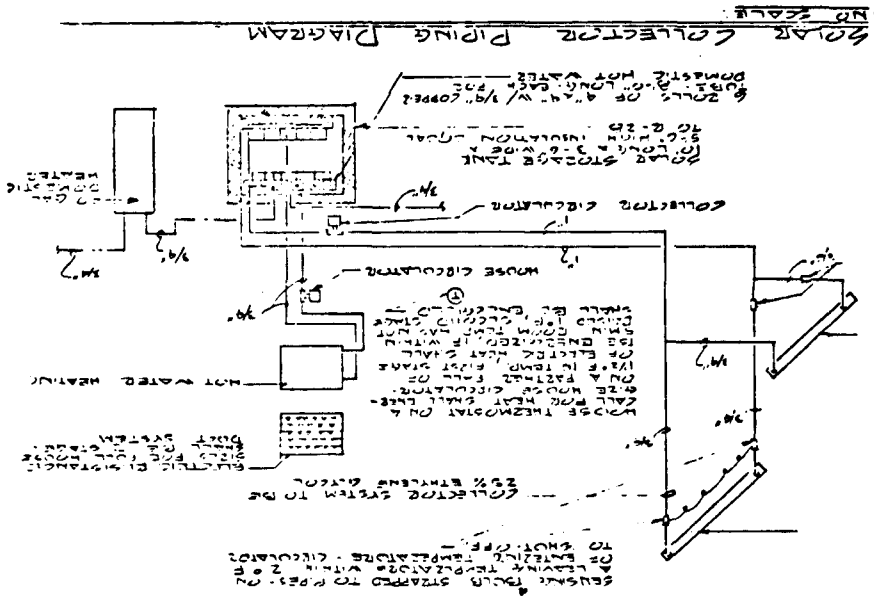
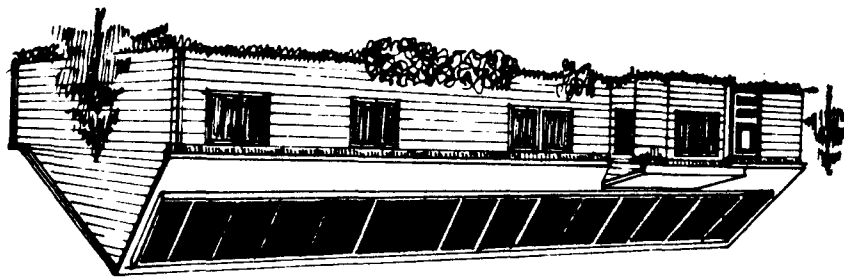
Analog and pulse accum. - Doric 220 Data Logger

Tape Recorder - Minicomputer for real time monitoring.

DATA RECORDED

METEOROLOGICAL		Frequency of data recording calculated	Accuracy of instrument
	Degree Days		-
	Outdoor Temperature	10 min.	.4°C
	Incident radiation on horizontal surface	read & reset @ 10 min.	1.5%R + .5%
	Incident radiation in plane of collector	read & reset @ 10 min.	1.5%R + .5%
	Relative Humidity	10 min.	.5%F
	Wind Speed	10 min.	.07 m/s
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	read & reset @ 10 min.	1.0%R + .02 n/m ²
	Temperature entering & leaving collectors	read & reset @ 10 min.	.4°C
	Storage		
	Flow rate inputs to storage	read & reset @ 10 min.	1.0%R + .02 n/m ²
	Temperature entering & leaving storage	read & reset @ 10 min.	.4°C
	Temperature readings in storage(1 or more)	10 min.	.4°C
	Auxiliary energy supplied to storage	read & reset @ 10 min.	.025%R + .025%F
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	read & reset @ 10 min.	1.0%R + .02 n/m ²
	Temperature entering & leaving subsystems	read & reset @ 10 min.	.4°C
	Auxiliary energy supplied to subsystems	read & reset @ 10 min.	.025%R + .025%F
BUILDING SYSTEM	Average DB inside temperature	10 min.	.4°C
	Infiltration load	calculated	-
	Auxiliary energy	read & reset @ 10 min.	.25%R + .25%F
	Operating energy	read & reset @ 10 min.	.25%R + .25%F
	Total building energy load	calculated	-
	Internal energy gains	calculated	-
	Solar gains	1 calculated	-
	Solar as a % of total load	calculated	-
	Thermal capacity of building	-	-

ILLUSTRATION



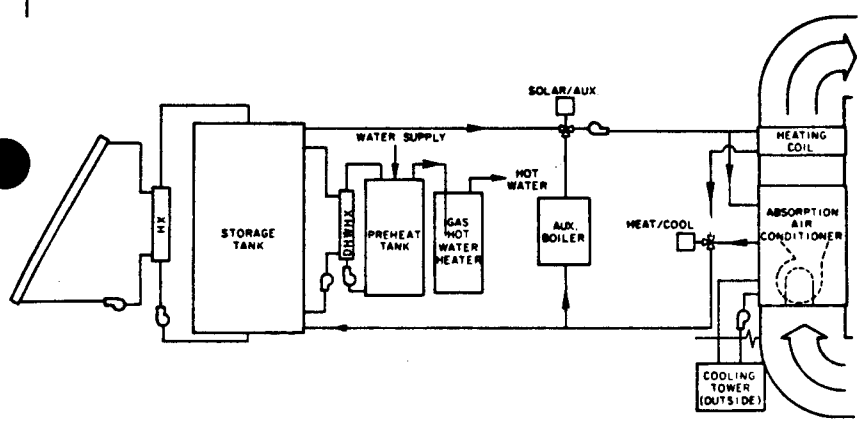


Figure 2-4. CSU Solar House I Equipment Diagram, July 1974 to May 1976

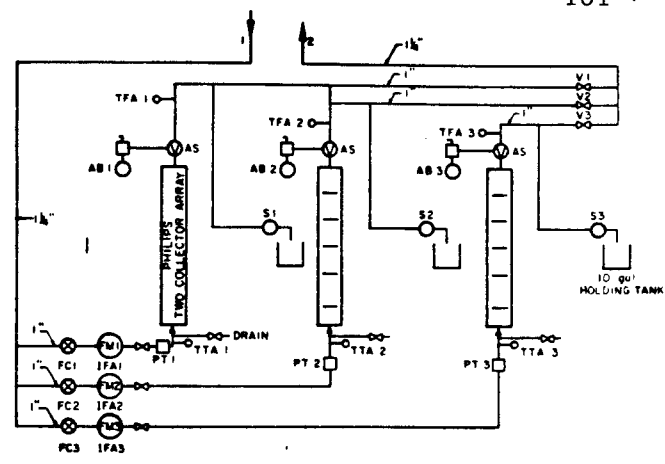


Figure 2-14. Phillips Collector Piping Detail, May 1978 to October 1978

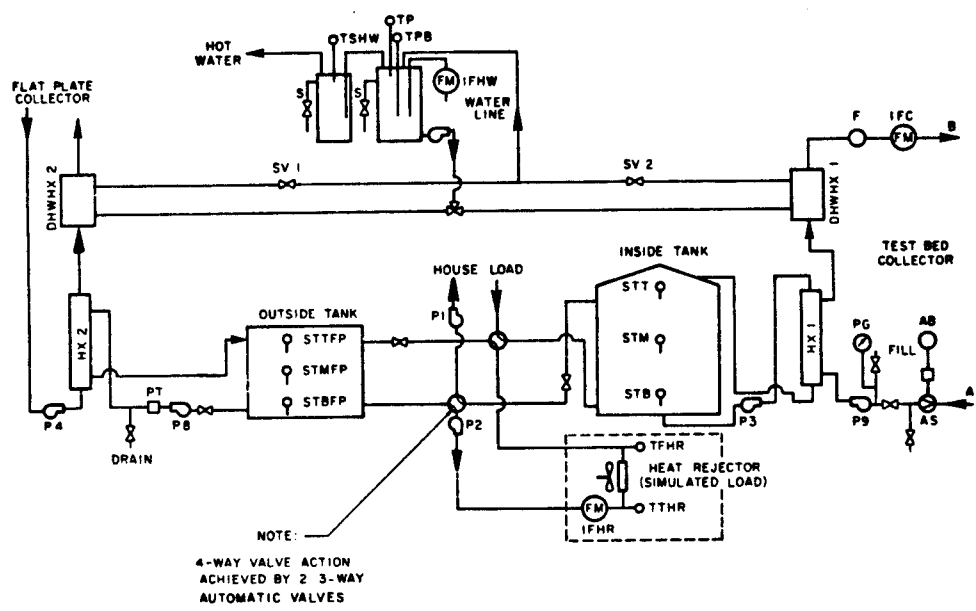


Figure 2-9. CSU Solar House I Solar Collection and Storage System, December 1976 to April 1978

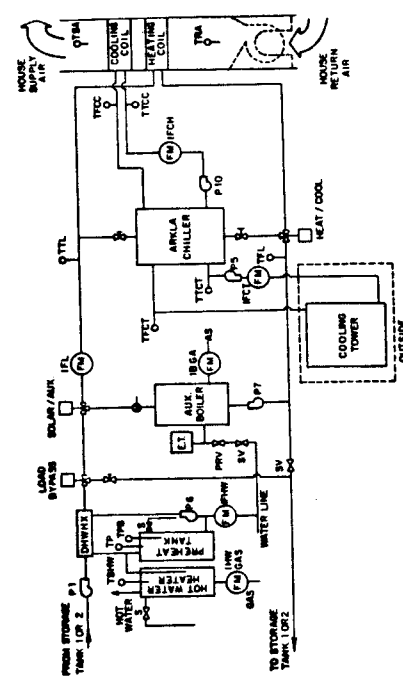


Figure 2-16. Solar House I Equipment and Piping Diagram, May 1978 to October 1978

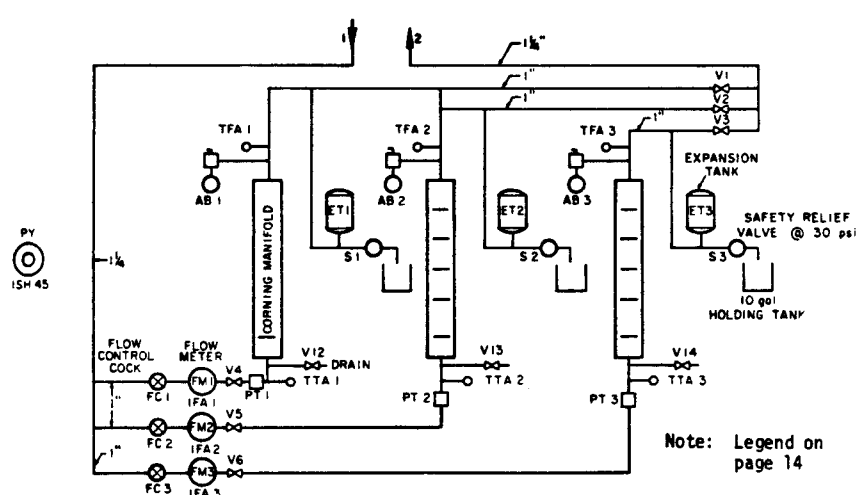


Figure 2-10. Corning Collector Piping Detail, December 1976 to June 1978

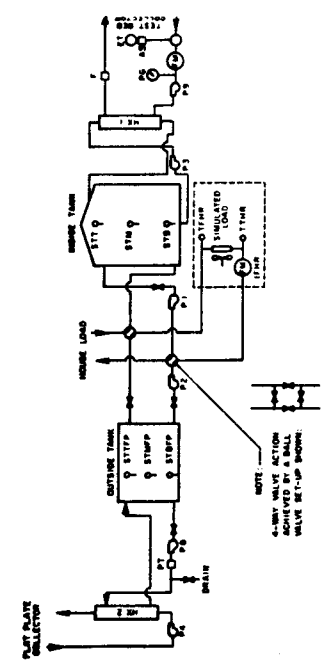


Figure 2-15. Storage and Fluid Distribution System, May 1978 to October 1978



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

102

PROJECT TITLE

Solar House II

Address

Solar Energy Applications Laboratory

Colorado State University

Fort Collins, CO 80523

MAIN PARTICIPANTS

	1 DIRECTOR	2 IEZ CORRESPONDENT	3
Name	Susumu Karaki	William S. Duff	
Address	(Above)	(Above)	
Phone			
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>40.6°N</u> Longitude <u>105.1°W</u> Altitude <u>1585 M</u> DD <u>3600°C</u> Base Temp. <u>18.3°C</u>		
	Sunshine Hours July _____ January <u>924 lang/day</u> Annual _____		
	Source of data <u>on site data acquisition</u>		
	Urban _____ Suburban <u>X</u> Rural _____		
BUILDING	Floor area <u>128.5 M²</u> No. Occupants <u>0 (Researchers)</u>		
	Design Temperature internal w _____ s _____ °		
	external w _____ s _____ °		
	Mass type <u>low (wood frame)</u> location _____		
	South Glazing type <u>vertical double glass</u>		
	area(south glass) <u>10 M²</u> % of total glass <u>35%</u>		
	night insulation <u>None</u> shaded <u>1.8 M overhang</u>		
Heated Volume _____ Ventilation Rate _____ a.c.h.			
SOLAR SYSTEM	System energy use(eg. heating) <u>space heating, DHW</u>		
	Collector type <u>Solaron Series 3000</u> area(net) <u>57.9 M²</u>		
	orientation <u>180°</u> tilt <u>45°</u>		
	Storage type <u>pebble bed (wood container)</u> capacity <u>10.3 M³</u>		
Auxiliary System type <u>heat pump (3 ton carrier)</u> fuel type <u>Elec.</u> fuel cost _____			
	<u>Air to Air</u>		

PROJECT SCHEDULE

DATE MILESTONES	1977	1978	1979	1980		
Construction completion						
Monitoring period						
Final reports				* Annual Report		

Report availability

Title
(available from)

Performance eval. S.O.A. Solar Air-Heating System with
Auxiliary Heat Pump Rpt. No. COO/30122-4

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package Unknown (very expensive)

Description of data recording method

Doric scientific mod. 200 Digitand - scanner,
multiflexer, analog to digital, convertor, printer - Kennedy tape deck and wang desk top

computer.

DATA RECORDED

		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days		
	Outdoor Temperature	300 sec	+ .4°C
	Incident radiation on horizontal surface	---	---
	Incident radiation in plane of collector	300 sec R-O-2800W/M ²	1.5% R + .5%
	Relative Humidity	300 sec	.5% F
	Wind Speed	300 sec	+ .07 M/S
	Wind Direction		+ 2°
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	300 sec R=1-20 M/S	+ 1.0% R + .02 N/M ²
	Temperature entering & leaving collectors	300 sec	+ .4°C
	Storage		
	Flow rate inputs to storage	300 sec	+ 1.0% R + .02 N/M ²
	Temperature entering & leaving storage	300 sec	+ .4°C
	Temperature readings in storage(1 or more)	300 sec	+ .4°C
	Auxiliary energy supplied to storage	---	---
	Space heat, Space cooling, Hot water Subsystems		
	Flow rates entering subsystems	300 sec	+ 1.0% R + .02 N/M ²
BUILDING SYSTEM	Temperature entering & leaving subsystems	300 sec	+ .4°C
	Auxiliary energy supplied to subsystems	300 sec	
	Average DB inside temperature	300 sec	+ .4°C
	Infiltration load	---	---
	Auxiliary energy	300 sec	+ .75% R + .25% F
	Operating energy	300 sec	+ .75% R + .25% F
	Total building energy load	---	---
	Internal energy gains	---	---
	Solar gains	calc.	calc.
	Solar as a % of total load	calc.	calc.
	Thermal capacity of building	---	---



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Stewart-Teele-Mitchell1 Northwood DriveBallston Spa, NY 12020

MAIN PARTICIPANTS

	1	2	3
Name	Max Gertsch	Brooks Teele	Carl Schmidtke
Address	Boeing Aerospace Company P.O. Box 3999 Seattle, WA 98124	Stewart-Teele-Mitchell Construction Company Plank Road, Box 374, Rt. 146 Clifton Park, NY 12065	1 Northwood Drive Ballston Spa, NY 12020
Phone	206-773-0640	518-371-2622	518-585-7413 home 518-885-6436 work
Responsibility	Field Representative	Site Contractor	Home Owner

PROJECT DESCRIPTION

CLIMATE	Latitude <u>45°</u> Longitude <u>74°</u> Altitude <u>278 ft.</u> DD <u>6785</u> Base Temp. <u>65°F</u>
	Sunshine Hours July <u>--</u> January <u>--</u> Annual <u>--</u>
	Source of data <u>NOAA local climatological data</u>
	Urban <u>--</u> Suburban <u>X</u> Rural <u>--</u>
BUILDING	Floor area <u>1900 ft²</u> No. Occupants <u>4</u>
	Design Temperature internal w <u>--</u> s <u>--</u> °
	external w <u>0</u> s <u>88</u> ° F
	Mass type <u>unknown</u> location <u>Ballston Spa, NY</u>
	South Glazing type <u>--</u>
	area(south glass) <u>--</u> % of total glass <u>unknown</u>
	night insulation <u>--</u> shaded <u>--</u>
Heated Volume <u>--</u> Ventilation Rate <u>--</u> a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>Space heating and domestic hot water</u>
	Collector type <u>Lennox flat plate</u> area(net) <u>432 ft²</u>
	orientation <u>south</u> tilt <u>45°</u>
	Storage type <u>liquid (water)</u> capacity <u>1000 gal.</u>
Auxiliary System type <u>gas boiler/electric hot water heater</u> fuel type <u>gas/elec.</u> fuel cost <u>unknown</u>	

Report availability	Title	Monthly Performance Report (Stewart-Teele-Mitchell)
	(available from)	Technical Information
		P.O. Box 62, Oak Ridge, TN 37830

Approximate cost of instrumentation package \$800

Description of data recording method Data collected on tape every 320 seconds, and sent to the central data processing system daily.

METEOROLOGICAL	Frequency of data recording	Accuracy of Instrument
Degree Days	--	--
Outdoor Temperature	320 sec.	$\pm 5^{\circ}\text{F}$
Incident radiation on horizontal surface	--	--
Incident radiation in plane of collector	320 sec	$\pm 5^{\circ}\text{F}$
Relative Humidity	--	--
Wind Speed	--	--

SOLAR SYSTEM	Frequency of data recording	Accuracy of Instrument
Collectors		
Flow rate entering collectors	320 sec	$\pm 3\%$ full scale
Temperature entering & leaving collectors	320 sec	$\pm 0.5^{\circ}\text{F}$
Storage		
Flow rate inputs to storage	320 sec	$\pm 3\%$
Temperature entering & leaving storage	320 sec	$\pm 0.5^{\circ}\text{F}$
Temperature readings in storage(1 or more)	3 at 320 sec	$\pm 0.5^{\circ}\text{F}$
Auxiliary energy supplied to storage	--	--
Space heat,Space cooling,Hot water Subsystems		
Flow rates entering subsystems	320 sec	$\pm 3\%$
Temperature entering & leaving subsystems	320 sec	$\pm 0.5^{\circ}\text{F}$
Auxiliary energy supplied to subsystems	320 sec	$\pm 1\%$

BUILDING SYSTEM	Frequency of data recording	Accuracy of Instrument
Average DB inside temperature	--	--
Infiltration load	--	--
Auxiliary energy	--	--
Operating energy	320 sec	$\pm 1\%$
Total building energy load	--	--
Internal energy gains	--	--
Solar gains	--	--
Solar as a % of total load	--	--
Thermal capacity of building	--	--

ILLUSTRATION

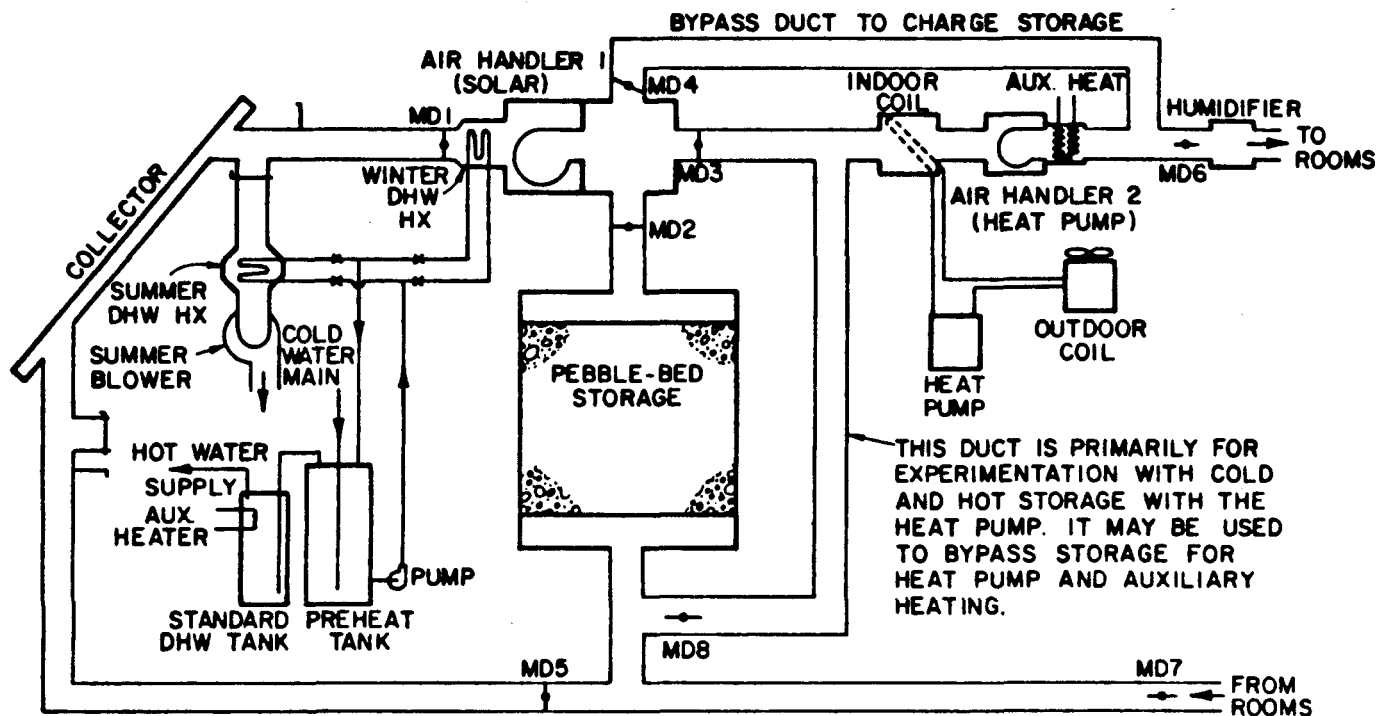
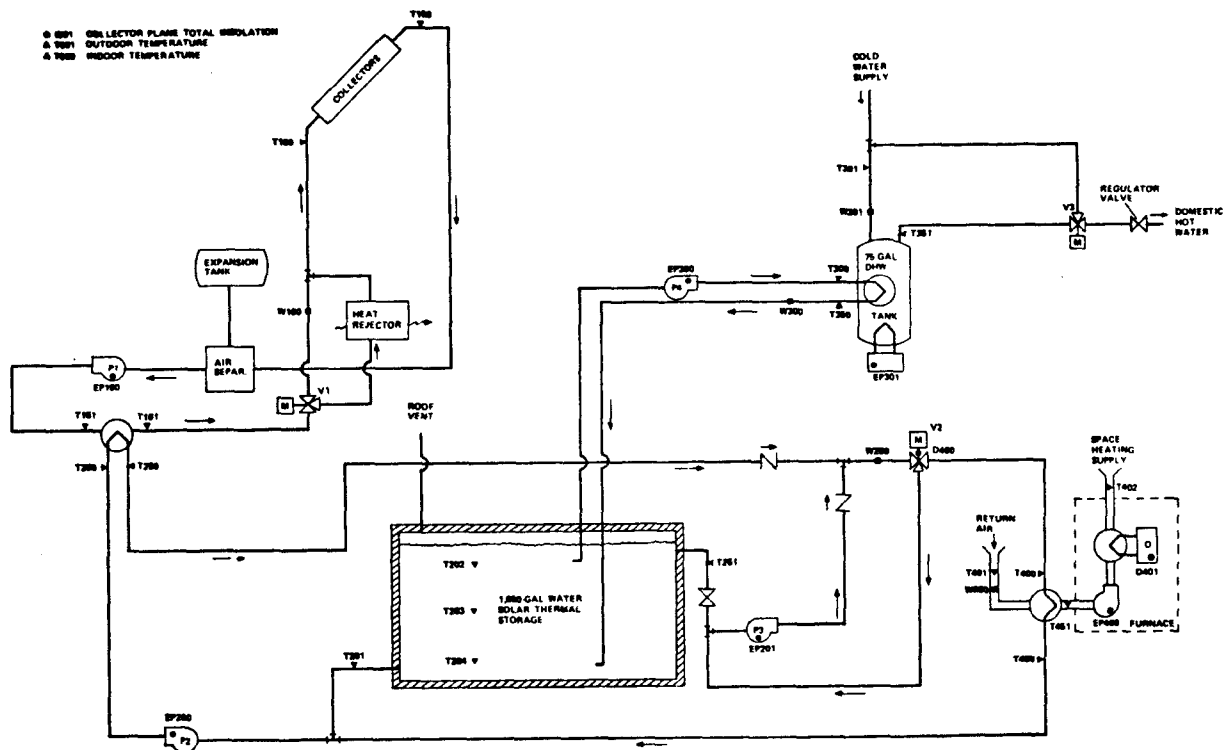


Figure 2-7. Schematic Diagram of Solar Heating and Heat Pump Auxiliary System in CSU Solar House II



REVISED 11/14/80

Stewart-Teele-Mitchell Solar Energy System Schematic

WEST GERMANY



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

"Energy Conservation and Utilisation of Solar Energy
in Buildings"

Address

Philips GmbH Forschungslaboratorium Aachen

Weisshausstrasse, D-5100 Aachen / West Germany

MAIN PARTICIPANTS

	1	2	3
Name	Dr. H. Hörster	Dr. G. Bergmann	
Address	Philips Forschungslaboratorium Weisshausstrasse D-5100 Aachen West Germany	Dr. R. Bruno Dr. W. Hermann Dr. R. Kersten K. Klinkenberg B. Steinmüller	
Phone	0241 - 62071		
Responsibility	Project leader		

PROJECT DESCRIPTION

CLIMATE	Latitude <u>50.76°</u> Longitude <u>6.09°</u> Altitude <u>195 m</u> DD <u>3445</u> Base Temp. <u>20°C</u>
	Sunshine Hours July <u>189</u> January <u>50</u> Annual <u>1510</u>
	Source of data <u>Meteorological Service Aachen</u>
	Urban <u>X</u> Suburban <u> </u> Rural <u> </u>
BUILDING	Floor area <u>116 m²</u> No. Occupants <u>4 (simulated)</u>
	Design Temperature internal w <u> </u> s <u>20 °C</u>
	external w <u> </u> s <u>- 12 °C</u>
	Mass type <u> </u> location <u>Aachen</u>
	South Glazing type <u>double glazed, gold layer</u> k = <u>1.9 W/m²K</u>
	area(south glass) <u>4.6 m²</u> % of total glass <u>40 %</u>
	night insulation <u>k = 1.3 W/m²K</u> shaded <u>sunset and sunrise</u>
Heated Volume <u>290 m³</u> Ventilation Rate winter <u>1</u> a.c.h. summer <u>2</u>	
SOLAR SYSTEM	System energy use(eg. heating) <u> </u>
	Collector type <u>evacuated tubular collector</u> area(net) <u>20.3 m²</u>
	orientation <u>south</u> tilt <u>48°</u>
	Storage type <u>long term storage unit</u> capacity <u>42 m³ water</u>
	type <u>heating and hot water storage unit</u> capacity <u>4 m³ water</u>
Auxiliary System type <u>heat pump</u> fuel type <u>electricity</u> fuel cost <u> </u>	

PROJECT SCHEDULE

DATE MILESTONES	1975	1976	1977	1978	1979	
Construction completion	X					
Monitoring period		X	X	X		
Final reports					X	

Report availability

 Title
(available from)

"Rationelle Energieverwendung und Nutzung der Sonnenenergie in Gebäuden" (ET 5052)
Bundesministerium für Forschung und Technologie, Bonn

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package

Description of data recording method

P 855 mini computer

DATA RECORDED

		Frequency of data recording		Accuracy of instrument
METEOROLOGICAL	Degree Days			
	Outdoor Temperature	<u>10 min</u>		<u>± 0.2 K</u>
	Incident radiation on horizontal surface	<u>1 min</u>		<u>± 2 %</u>
	Incident radiation in plane of collector	<u>1 min</u>		<u>± 2 %</u>
	Relative Humidity	<u>10 min</u>		<u>± 5 %</u>
	Wind Speed	<u>1 min</u>		
SOLAR SYSTEM			<u>total:</u>	
	Collectors			
	Flow rate entering collectors	<u>1 min</u>	<u>2.3 m³/h</u>	<u>± 3 %</u>
	Temperature entering & leaving collectors	<u>1 min</u>		<u>± 0.1 K</u>
	Storage			
	Flow rate inputs to storage	<u>1 min</u>		<u>± 2 %</u>
	Temperature entering & leaving storage	<u>1 min</u>		<u>± 0.1 K</u>
	Temperature readings in storage(1 or more)	<u>10 min</u>		<u>± 0.2 K</u>
	Auxiliary energy supplied to storage	<u>10 min</u>		<u>± 2 %</u>
	Space heat,Space cooling,Hot water Subsystems			
	Flow rates entering subsystems	<u>10 min</u>		<u>± 2 %</u>
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>10 min</u>		<u>± 0.1 K</u>
	Auxiliary energy supplied to subsystems	<u>10 min</u>		
	Average DB inside temperature	<u>10 min</u>	<u>19°C</u>	<u>± 0.2 K</u>
	Infiltration load	<u>uncontrolled</u>	<u>~0.2</u>	
	Auxiliary energy	<u>10 min</u>		<u>± 2 %</u>
	Operating energy	<u>10 min</u>		<u>± 2 %</u>
	Total building energy load	<u>10 min</u>	<u>4 kW (-12°C)</u>	
	Internal energy gains	<u>10 min</u>	<u>17 kWh/day</u>	
	Solar gains	<u>-</u>		
	Solar as a % of total load	<u>-</u>		
	Thermal capacity of building		<u>7 kWh/K</u>	



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

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PROJECT TITLE

Solar House Deizisau

Address

Inst. für Theorie der Elektrotechnik

Breitscheidstr. 3

7000 Stuttgart 1

MAIN PARTICIPANTS

	1	2	3
Name			
Address			
Phone			
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>48.7</u> Longitude <u>9.4</u> Altitude <u>274.5</u> DD _____ Base Temp. <u>-15°C</u>
	Sunshine Hours July _____ January _____ Annual <u>1600</u>
	Source of data <u>met. office</u>
	Urban <u>X</u> Suburban _____ Rural _____
BUILDING	Floor area <u>180 m²</u> No. Occupants <u>5</u>
	Design Temperature internal w <u>20</u> s <u>20</u> °C
	external w _____ s _____ °C
	Mass type <u>Gas-Stone</u> location <u>Deizisau</u>
	South Glazing type <u>double Glass</u> gesamt <u>30.7</u>
	area(south glass) <u>11.4</u> % of total glass <u>31 %</u>
	night insulation <u>shutter</u> shaded _____
	Heated Volume <u>ca. 400 m³</u> Ventilation Rate _____ a.c.h.
SOLAR SYSTEM	System: energy use(eg. heating) <u>hot water + heating</u>
	Collector type <u>double glass, part of the</u> area(net) <u>16 m² + 40 m²</u>
	orientation <u>30° west</u> roof tilt <u>28°</u>
	Storage type <u>water tank (under floor)</u> capacity <u>2 m³ + 70 m³</u>
Auxiliary System type <u>boiler</u> fuel type <u>electr</u> fuel cost _____	

PROJECT SCHEDULE

MILESTONES \ DATE	End of 1975	30.6.76	1.4.77	30.6.79	1980/1981	
Construction completion	16 m ² coll.		total 40m ² coll.			
Monitoring period		begin monitoring		end monitoring		
Final reports					*	

Report availability

Title
(available from)

Solar Energy System Design, Nov.30 th. 1978
 Proceedings of the Australien-German Workshop
 VDI-GET, P.O. Box 1139, 4000 Düsseldorf 1
 Fed.Rep. of Germany pp. 225-240

INSTRUMENTATION

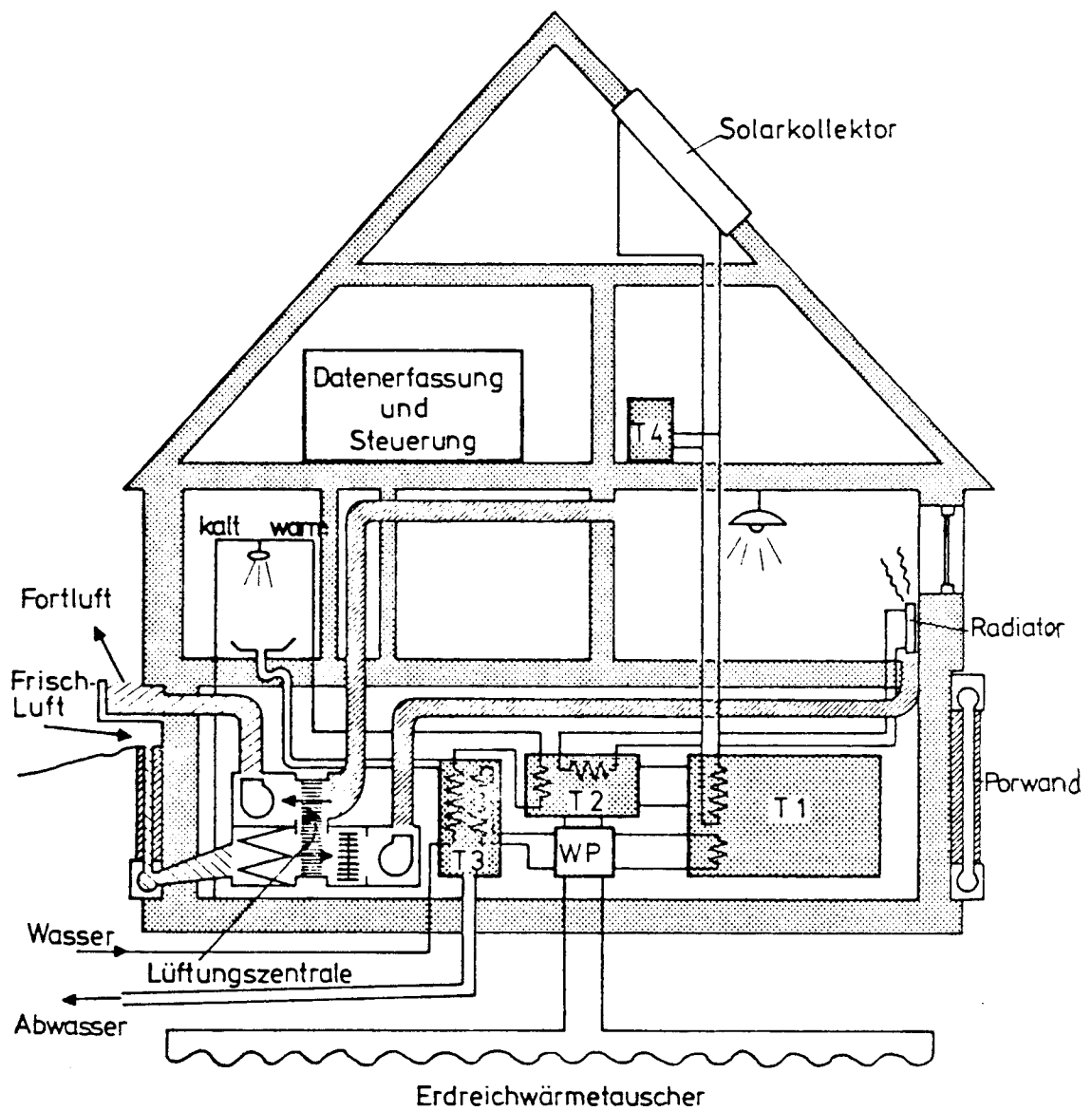
(existing or anticipated)

Approximate cost of instrumentation package 90 000.-
 Description of data recording method manuell listings plus stripcard
recording, readings of energy each 24 h.

DATA RECORDED

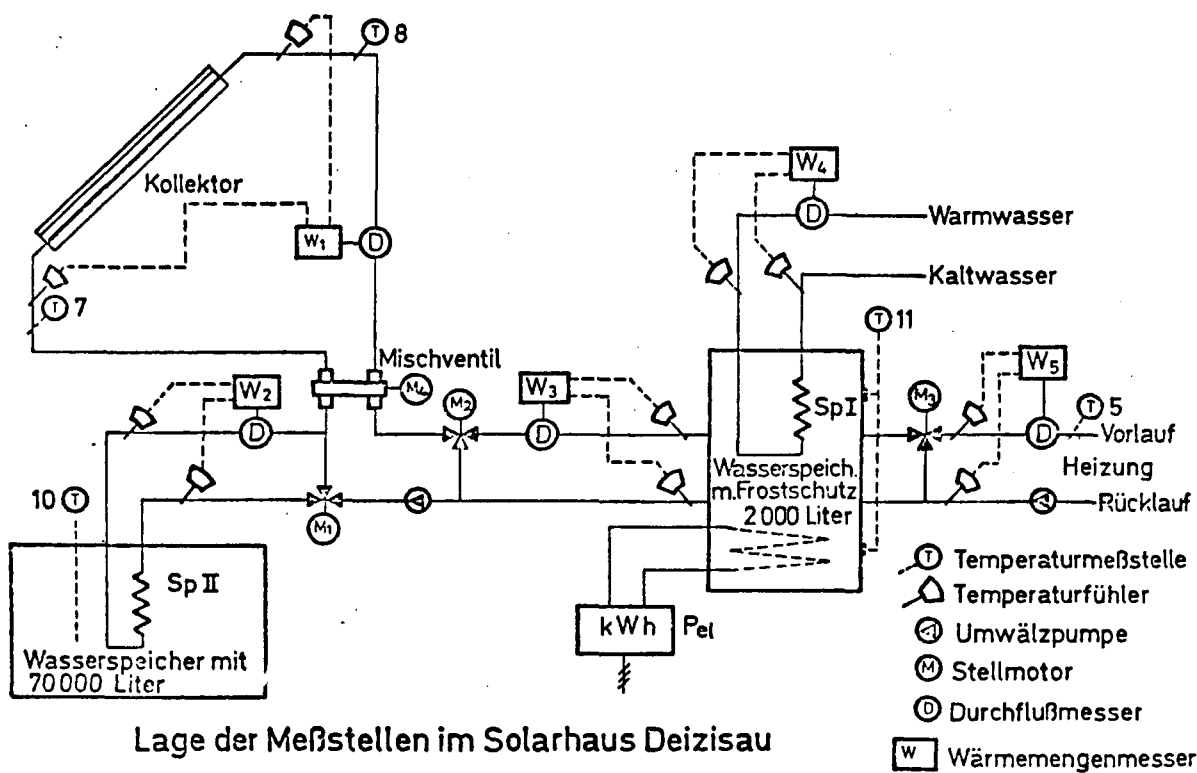
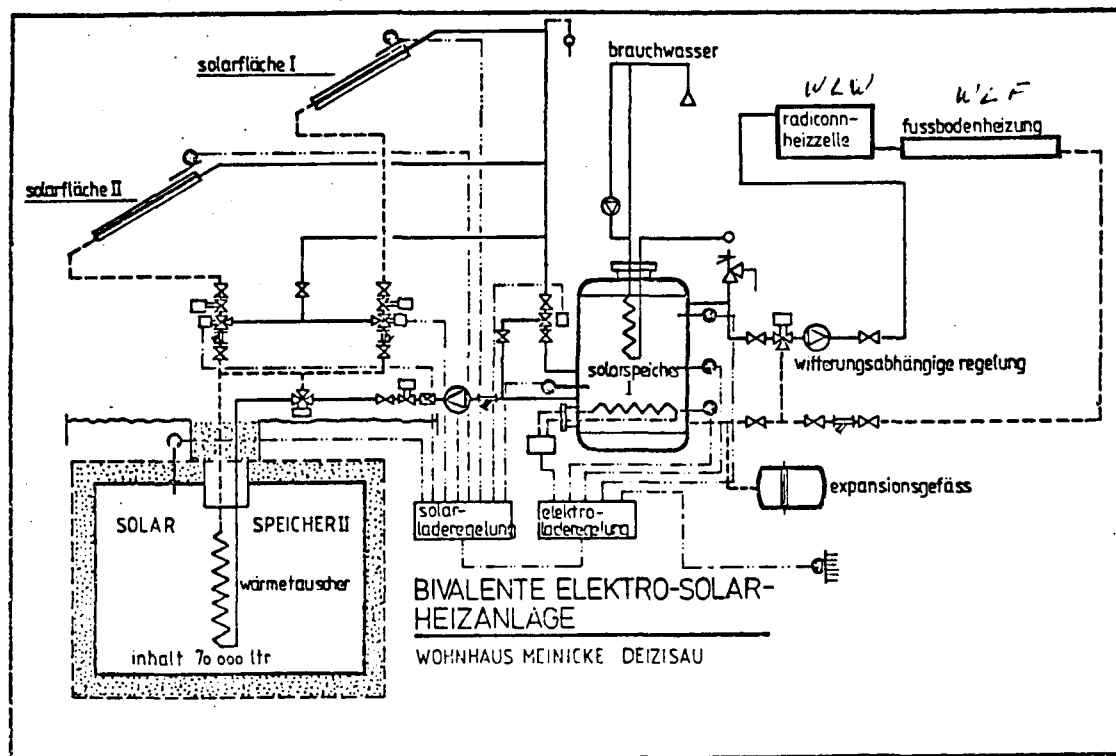
		Frequency of data recording	Accuracy of instrument
METEOROLOGICAL	Degree Days		
	Outdoor Temperature	<u>cont.</u>	<u>± 0.5°C.</u>
	Incident radiation on horizontal surface		
	Incident radiation in plane of collector	<u>cont.</u>	<u>± 5 %</u>
	Relative Humidity		
	Wind Speed		
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u>24 h</u>	<u>5 %</u>
	Temperature entering & leaving collectors	<u>cont.</u>	<u>± 1°C.</u>
	Storage		
	Flow rate inputs to storage	<u>24 h</u>	<u>5 %</u>
	Temperature entering & leaving storage	<u>cont.</u>	<u>± 1°C</u>
	Temperature readings in storage(1 or more)	<u>3</u>	
	Auxiliary energy supplied to storage	<u>24 h</u>	<u>± 0.5 %</u>
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	<u>24 h</u>	<u>5 %</u>
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>cont.</u>	
	Auxiliary energy supplied to subsystems		
	Average DB inside temperature	<u>cont.</u>	<u>0.2°C.</u>
	Infiltration load		
	Auxiliary energy		
	Operating energy	<u>24 h</u>	<u>0.5 %</u>
	Total building energy load		
	Internal energy gains		
BUILDING SYSTEM	Solar gains		
	Solar as a % of total load		
	Thermal capacity of building		

ILLUSTRATION



Schnitt durch das Experimentierhaus

ILLUSTRATION





SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

SOLAR HOUSE ESSEN

MAIN PARTICIPANTS

	1	2	3
Name	K. Speidel	J. Broschk	
Address	Abt. NTE Dornier System GmbH Postfach 1360 7990 Friedrichshafen	RWE Abt. Anwendungstechnik Postfach 27 4300 Essen 1	
Phone			
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>51° 25'</u> Longitude <u>6° 58'</u> Altitude <u>65,4</u> DD _____ Base Temp. _____
	Sunshine Hours July <u>152</u> January <u>49,3</u> Annual <u>1256</u> (1978)
	Source of data <u>Wetteramt ESSEN</u> in middle 1440 hours
	Urban <u>X</u> Suburban _____ Rural _____
BUILDING	Floor area <u>212 m²</u> No. Occupants _____
	Design Temperature internal w <u>22° C</u> s <u>25</u> °C
	external w <u>-2</u> s <u>29</u> °C
	Mass type <u>double glass see report</u> location _____
	South Glazing type _____
	area(south glass) _____ % of total glass _____
	night insulation _____ shaded _____
	Heated Volume _____ Ventilation Rate _____ a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>water heating, room heating</u>
	Collector type <u>DO-HP</u> area(net) <u>65 m²</u>
	orientation <u>south-south-west</u> tilt <u>48°</u>
	Storage type <u>2 for waterheating</u> capacity <u>600 l each</u>
	Auxiliary System type <u>5 for room heating</u> fuel type <u>electric</u> fuel cost _____

PROJECT SCHEDULE

DATE MILESTONES	1976	1977	1979			
Construction completion	X					
Monitoring period		X	X			
Final reports			X			

Report availability

Title
(available from)

SOLARHAUS ESSEN
enclosed with this paper

INSTRUMENTATION

(existing or anticipated)

Approximate cost of instrumentation package 200.000 DM
Description of data recording method see report

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	<u>1 per min</u>	<u>0,5 °C</u>
	Outdoor Temperature		
	Incident radiation on horizontal surface		
	incident radiation in plane of collector	<u>1 per min</u>	<u>1 %</u>
	Relative Humidity	<u>4 per hour</u>	<u>1 %</u>
	Wind Speed	<u>4 per hour</u>	<u>2 %</u>
SOLAR SYSTEM	Collectors	<u>4 per hour</u>	<u>2 %</u>
	Flow rate entering collectors	<u>1 per hour</u>	<u>0,3 °C</u>
	Temperature entering & leaving collectors		
	Storage	<u>4 per hour</u>	<u>1 %</u>
	Flow rate inputs to storage	<u>1 per min</u>	<u>0,3 °C</u>
	Temperature entering & leaving storage	<u>4 per hour</u>	<u>0,3 °C</u>
	Temperature readings in storage(1 or more)	<u>continuously</u>	
	Auxiliary energy supplied to storage		
	Space heat,Space cooling,Hot water Subsystems	<u>4 per hour</u>	<u>2 %</u>
	Flow rates entering subsystems	<u>1 per min</u>	<u>0,3 °C</u>
BUILDING SYSTEM	Average DB inside temperature	<u>-</u>	<u>-</u>
	Infiltration load	<u>continuously</u>	<u>-</u>
	Auxiliary energy	<u>1 per min</u>	<u>-</u>
	Operating energy	<u>1 per day</u>	<u>5 %</u>
	Total building energy load	<u>-</u>	<u>-</u>
	Internal energy gains	<u>1 per min</u>	<u>3 %</u>
	Solar gains	<u>1 per day</u>	<u>5 %</u>
	Solar as a % of total load	<u>-</u>	<u>-</u>
	Thermal capacity of building		



SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

Address

Entwicklung eines Meßsystems, Durchführung
und Auswertungen von Messungen an der Solar-
anlage Heggbach

MAIN PARTICIPANTS

	1	2	3
Name	Prof. Ernst Doering		
Address	Fachhochschule für Technik Esslingen D-7300 Esslingen Kanalstrasse 33		
Phone	0711/35112532		
Responsibility			

PROJECT DESCRIPTION

CLIMATE	Latitude <u>48°09'</u> Longitude <u>9°54'</u> Altitude <u>583 m</u> DD _____ Base Temp. _____
	Sunshine Hours _____ July _____ January _____ Annual _____
	Source of data _____
	Urban _____ Suburban _____ Rural ☒
BUILDING	Floor area <u>1650 m²</u> No. Occupants _____
	Design Temperature internal w <u>20°C</u> s <u>22°C</u> °
	external w _____ s _____ °
	Mass type _____ location <u>Biberach/Wttbg.</u>
	South Glazing type <u>k = 1,65 W/m²K</u>
	area(south glass) _____ % of total glass _____
	night insulation _____ shaded _____
Heated Volume <u>6 500 m³</u> Ventilation Rate _____ a.c.h.	
SOLAR SYSTEM	System energy use(eg. heating) <u>hot water and heating</u>
	Collector type <u>flat - roof - collector</u> area(net) <u>436 m²</u>
	orientation <u>south</u> tilt <u>10°</u>
	Storage type _____ capacity _____
Auxiliary System type <u>district heating</u> fuel type _____ fuel cost _____	

PROJECT SCHEDULE

DATE MILESTONES	1978	1980	1981-82	1983		
Construction completion	finished					
Monitoring period		preparation	measure			
Final reports				finished		

Report availability

Title

(available from)

INSTRUMENTATION

(existing or anticipated)

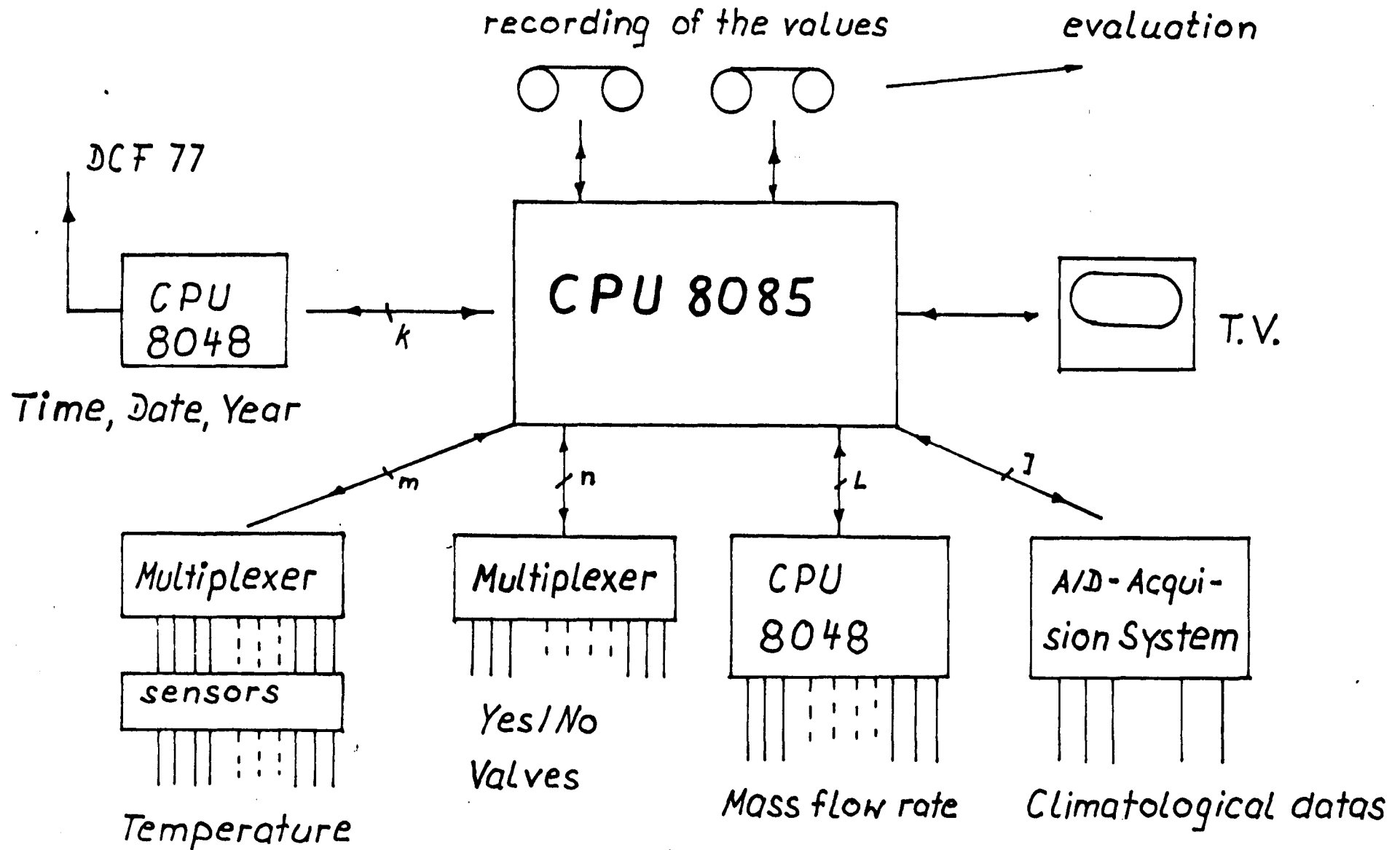
Approximate cost of instrumentation package 70 000.- DM

Description of data recording method

DATA RECORDED

METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	<u>5 min</u>	<u>0,2 K</u>
	Outdoor Temperature	<u>5 min</u>	<u>0,1 K</u>
	Incident radiation on horizontal surface	<u>5 min</u>	<u>1 %</u>
	Incident radiation in plane of collector	<u>1 min</u>	<u>1 %</u>
	Relative Humidity	<u>5 min</u>	<u>5 %</u>
	Wind Speed	<u>5 min</u>	<u>1 m/s</u>
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u>1 min</u>	<u>0,5 %</u>
	Temperature entering & leaving collectors	<u>1 min</u>	<u>0,1 K</u>
	Storage		
	Flow rate inputs to storage	<u>1 min</u>	<u>2 - 10 %</u>
	Temperature entering & leaving storage	<u>1 min</u>	<u>0,1 K</u>
	Temperature readings in storage(1 or more)	<u>1 min</u>	<u>0,1 K</u>
	Auxiliary energy supplied to storage	<u>1 min</u>	<u>2 %</u>
	Space heat,Space cooling,Hot water Subsystems		
	Flow rates entering subsystems	<u>1 min</u>	<u>2 %</u>
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>1 min</u>	<u>0,1 K</u>
	Auxiliary energy supplied to subsystems	<u>1 min</u>	
	Average DB inside temperature	<u>5 min</u>	<u>0,1 K</u>
	Infiltration load		
	Auxiliary energy		
	Operating energy		
	Total building energy load		
	Internal energy gains		
	Solar gains		
BUILDING SYSTEM	Solar as a % of total load		
	Thermal capacity of building		

Scheme of the Solar Data Acquisition System



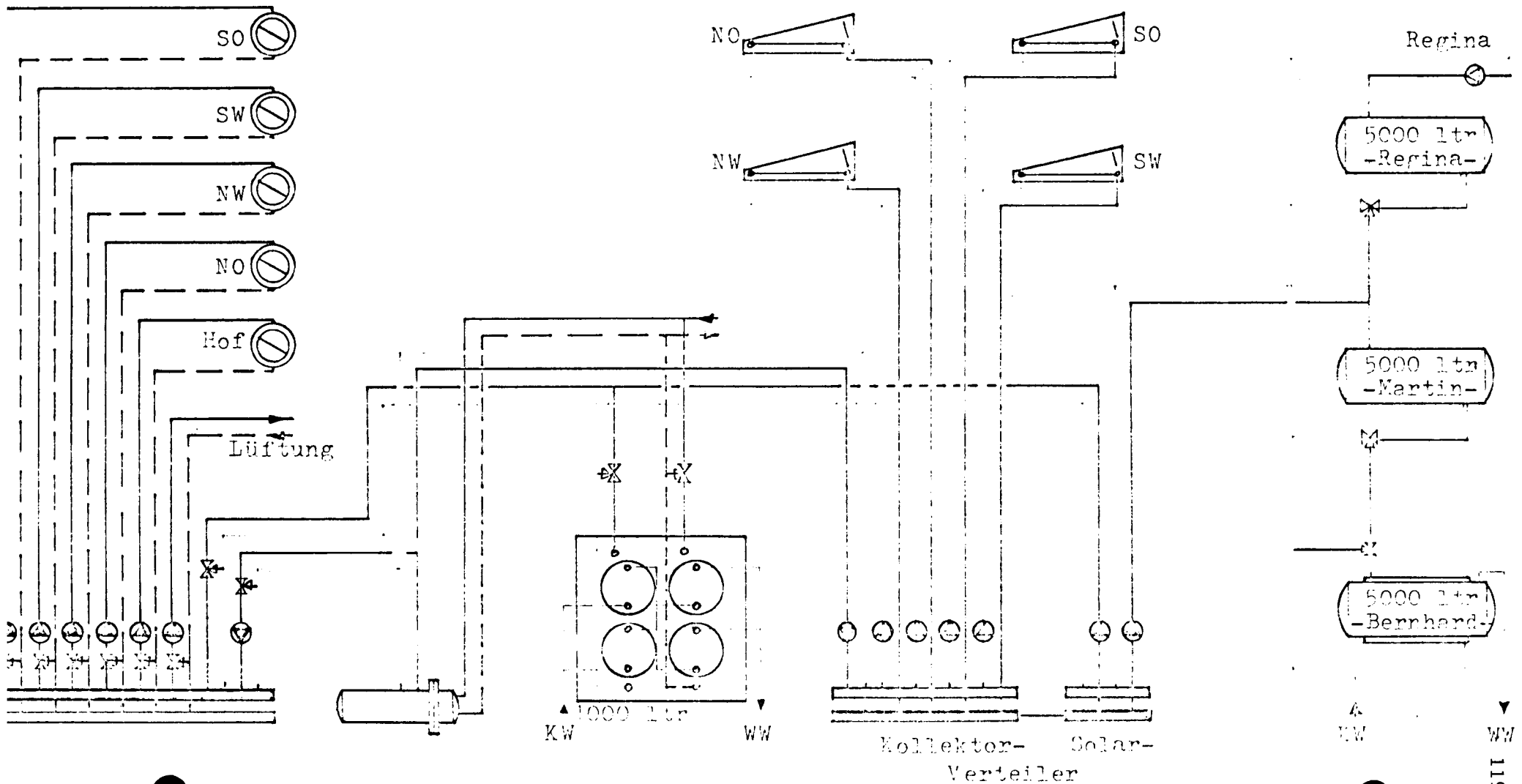
Solaranlage - Heggbacher Einrichtungen

FB - HEIZUNG

BOILER

SOLARANLAGE

SPEICHER





SOLAR ASSISTED LOW ENERGY DWELLINGS SURVEY

PROJECT TITLE

SOLARHAUS FREIBURG

Address

c/o Klaus Vanoli

Rebstockweg 5

D-7800 FREIBURG - Tiengen

MAIN PARTICIPANTS

	1	2	3
Name	Deutsche Forschungs- und Versuchsanstalt für Luft- u. Raumfahrt e.V.	IST Energietechnik GmbH Ritterweg 1	-Sol. En. Appl. Lab. Colorado State University Fort Collins Colorado, USA
Address	Institut für Technische Physik Pfaffenwaldring 38-40 7000 Stuttgart 80	7842 Kandern-Wollbach	-Philips Forschungslabor Aachen
Phone	0711 - 7832-485	07626 - 7097	-IEA - Task VI
Responsibility	Dr.-Ing. K.R. Schreitmüller	Dipl.-Phys. K. Vanoli	

PROJECT DESCRIPTION

CLIMATE	Latitude <u>47°59'20"N</u> Longitude <u>7°43'E</u> Altitude <u>218 m</u> DD <u>3150</u> Base Temp. <u>20 °C</u>
	Sunshine Hours July <u>266</u> January <u>55</u> Annual <u>1767</u> *) Source of data <u>courtesy Deutscher Wetterdienst/Solarhaus Freiburg-measurement</u> Urban <u> </u> Suburban <u> </u> Rural <u> X </u> 15 km south-west from Freiburg *) global radiation sum1180 kWh/m²yr
BUILDING	Floor area (heated) <u>641 m²</u> No. Occupants <u>25</u>
	Design Temperature internal w <u>20 °C</u> s <u>-</u> ° external w <u>-12 °C</u> s <u>28 °C</u> ° Mass type <u>limestone 24 cm/concrete</u> location <u>outer walls, floor and ceiling</u> South Glazing type <u>triple glazed windows (wood frame with rubber sealing)</u> area(south glass) <u>20 m²</u> % of total glass <u>44 %</u> night insulation <u> </u> shaded <u>south windows shaded by balconies</u> Heated Volume <u>1600 m³</u> Ventilation Rate <u>1</u> a.c.h.
SOLAR SYSTEM	System energy use(eg. heating) <u>domestic hot water and/or heating</u>
	Collector type <u>evac.tub. CORNING GLASS PHILIPS FORSCH.LAB.</u> area(net) <u>26.8 m²</u> orientation <u>192.6°</u> tilt <u>55°</u> Storage type <u>water DHW-System Heating-System</u> capacity <u>1.5 and 1 m³</u> Auxiliary System type <u>DHW electric/oil fired boiler</u> fuel type <u>oil</u> fuel cost <u>1978 .27 DM/</u> <u>Heating oil fired boiler</u> fuel type <u>oil</u> fuel cost <u>1980 .59 DM/</u>

PROJECT SCHEDULE

DATE MILESTONES	78	79	80	81	82	
Construction completion	01.09.1978					
Monitoring period		Feb. 1979			July	
Final reports			Status Seminar Report, Hamburg '80		Project summary	

Report availability subjects: Data acquisition; Progress & prelim. results; Description of solar systems; - of microprocessor control system & software; evaluation technique; modelling & simulation available from DFVLR or IST
(available from)

INSTRUMENTATION (existing or anticipated)

Approximate cost of instrumentation package 280.000,-- DM

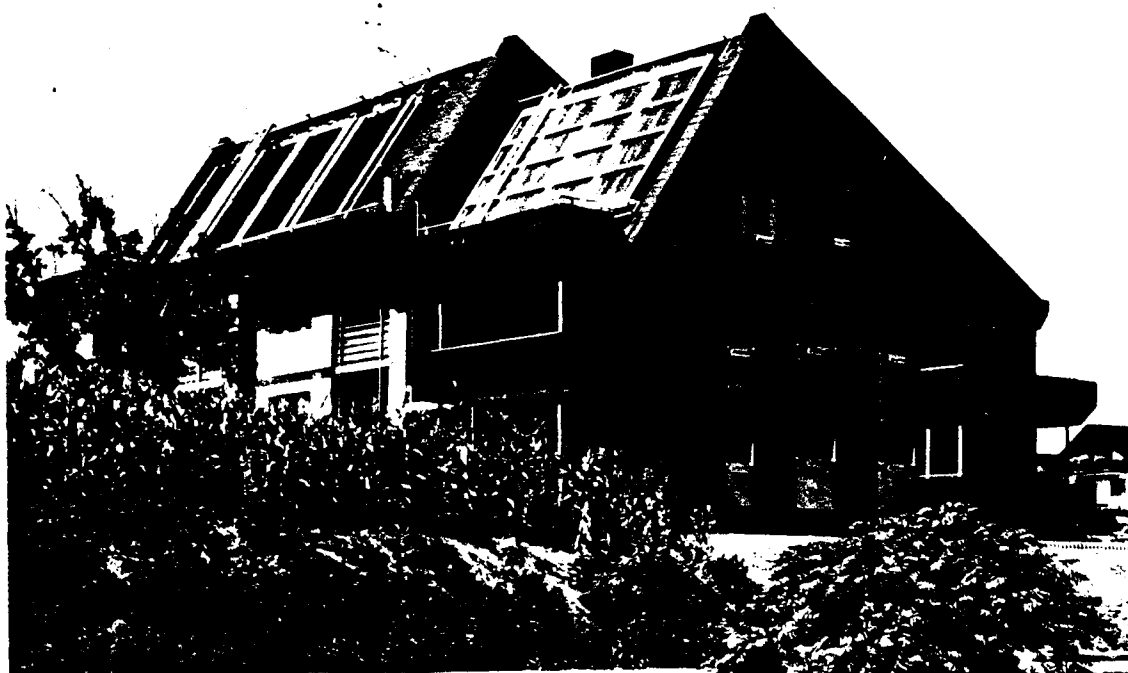
Description of data recording method measurement of 180 analogue signals by a scanner-volt-meter subsystem, under control of a user-programmable central computer

DATA RECORDED (the mean values of all data are recorded on 5 min. time base)

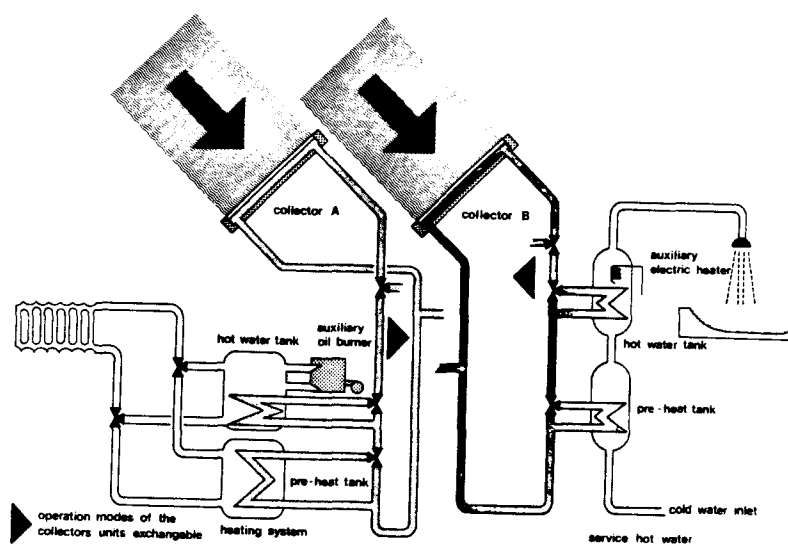
METEOROLOGICAL		Frequency of data recording	Accuracy of instrument
	Degree Days	<u>evaluated</u>	$\pm 0.1 \text{ }^{\circ}\text{C}$
	Outdoor Temperature	<u>5 min</u>	$\pm 0.1 \text{ }^{\circ}\text{C}$
	Incident radiation on horizontal surface	<u>5 min</u>	$\pm 2.0 \%$
	Incident radiation in plane of collector	<u>5 min</u>	$\pm 1.0 \%$
	Relative Humidity	<u>5 min</u>	$\pm 2.0 \%$
	Wind Speed	<u>5 min</u>	$\pm 2.0 \%$
SOLAR SYSTEM	Collectors		
	Flow rate entering collectors	<u>5 min</u>	$\pm 2.0 \%$
	Temperature entering & leaving collectors	<u>5 min</u>	$\pm 0.02 \text{ K}$
	Storage		
	Flow rate inputs to storage	<u>5 min</u>	$\pm 2.0 \%$
	Temperature entering & leaving storage	<u>5 min</u>	0.02 K
	Temperature readings in storage (XXXXXX) 4	<u>5 min</u>	0.1 K
	Auxiliary energy supplied to storage or	<u>recorded</u>	0.5% electr. aux.
	Space heat, Space cooling, Hot water Subsystems	<u>evaluated</u>	3.0% thermal aux.
	Flow rates entering subsystems	<u>5 min</u>	1.0%
BUILDING SYSTEM	Temperature entering & leaving subsystems	<u>5 min</u>	0.05 K
	Auxiliary energy supplied to subsystems	<u>evaluated</u>	3.0%
	Average DB inside temperature	<u>5 min</u>	0.1 K
	Infiltration load	<u> </u>	$3.0 - 5.0 \%$
	Auxiliary energy	<u> </u>	$2.0 - 3.0 \%$
	Operating energy	<u> </u>	
	Total building energy load	<u> </u>	
	Internal energy gains	<u> </u>	
	Solar gains	<u> </u>	
	Solar as a % of total load	<u> </u>	
	Thermal capacity of building	<u> </u>	
		<u> </u>	

evaluated from system parameters and/or recorded data

ILLUSTRATION



Solarhaus Freiburg with the Corning collector (left side) and the Philips collector (right side)



Scheme of the Solar and Conventional System (both collectors may be operated either independently - one furnishing the DHW system, the other one the heating system, and vice versa - or combined; controls done by a microprocessor system with 44 different operation modes)

SECTION II

Building Description

PROJECT	FLOOR AREA m ²	OCCUPANTS	DESIGN TEMPERATURE			
			INTERNAL		EXTERNAL	
			W °C	S °C	W °C	S °C
DENMARK						
Hjortekaer C	135	4 (SIM.)	21	2	-12	--
Hjortekaer F	176	4 (SIM.)	21	2	-12	--
ITALY						
Barra - Const.	130	2	--	--	--	--
Habitat	160	3	20	--	-12	--
JAPAN						
Aratani	320	8	18	28	-12	32
NETHERLANDS						
Bouwcentrum	230	4	20	--	-12	--
SWEDEN						
Bollebygd	140	4	20	--	-15	--
SUN SEC	160	3	20	--	-15	--
SWITZERLAND						
Begnins	210	2 - 3	18	24	-10	30
Les Gen./Coff	137	3 - 4	18	24	-10	30
Payrne Active	211	4 - 5	22	18	-20	30
Renens Passive	220	3 - 4	18	24	-10	30
Stiftung Sonnen.	440	19	22	--	-10	--
UNITED KINGDOM						
Linf. Milt. Keynes	120	4 - 5	18	--	5	--
Linf. Milt. Keynes 2	104	5	18	--	-1	--
Linf. Milt. Keynes 3	104	5	20	--	-1	--
Low En. Hse. Lab (HP)	100	---	20	--	-1	--
Low En. Hse. Lab (Solar)	88	---	20	--	-1	--
Pennyland	100	3 - 4	18	--	5	--
UNITED STATES						
A-Frame Ind.	---	2	--	--	--	--
Albuq. Western II	60/UNIT	---	24	25	-12	38
Cathedral Sq.	---	114	--	--	--	--
Fac. Development	104/UNIT	---	--	--	6	--
Forest City Dillon	12,750	188	19	25	-9	33
Hei Wai Wong	---	19	--	--	--	--
Matt Cannon	229	6 - 8	21	21	14	28
NBS Passive	138	0	18	28	-10	32
Saddle Hill 36	183	4	--	--	--	--
Saddle Hill 77	160	4	--	--	--	--
Sir Galahad Co.	151	1	19	--	-5	--
Solar House I	129	VAR.	22	--	-23	--
Solar House II	129	0	--	--	--	--
Stewart-Teele-Mitchell	179	4	--	--	-18	31
WEST GERMANY						
Aachen Solar House	116	4 (SIM.)	20	--	-12	--
Deizisau Sol. House	180	5	20	20	--	--
Essen Solar House	212	---	22	25	-2	29
FHT Solar House	1,650	---	20	22	--	--
Freiburg Solar House	641	25	20	--	-12	28

Building Description

PROJECT	SOUTHERN GLAZING				
	GLAZING PANES	AREA m ²	NIGHT INSUL.	% OF TOTAL GLAZING	SHADING
DENMARK					
Hjortekaer C	3 - 4	13.3	NO	55%	100%
Hjortekaer F	3	25.4	YES	93%	90%
ITALY					
Barra - Const.	2	15	YES	60%	---
Habitat	2	8.4	---	40%	SUMMER
JAPAN					
Aratani	3	54	YES	77%	S. LOUVER
NETHERLANDS					
Bouwcentrum	2	21.6	---	45%	---
SWEDEN					
Bollebygd	4	18	NO	75%	YES
SUN SEC	3	15	NO	90%	YES
SWITZERLAND					
Begnins	2	28	YES	40%	---
Les Gen./Coff	2	21.3	YES	67%	---
Payrne Active	2	---	---	---	---
Renens Passive	2	24	---	56%	---
Stiftung Sonnen.	2	24	YES	41.5%	0% - 100%
UNITED KINGDOM					
Linf. Milt. Keynes	2	18.4	---	40%	NO
Linf. Milt. Keynes 2	2	18	NO	80%	YES
Linf. Milt. Keynes 3	2	18	NO	80%	YES
Low En. Hse. Lab (HP)	1	5.5	---	54%	---
Low En. Hse. Lab (Solar)	1	3.7	YES	43%	---
Pennyland	1 - 2	9 - 13	YES	30% - 40%	NO
UNITED STATES					
A-Frame Ind.	---	---	---	---	---
Albuq. Western II	---	---	---	---	---
Cathedral Sq.	---	---	---	---	---
Fac. Development	---	---	---	---	---
Forest City Dillon	---	---	NO	---	NO
Hei Wai Wong	---	---	---	---	---
Matt Cannon	---	51	YES	---	10%
NBS Passive	2	32	YES	95%	YES
Saddle Hill 36	---	---	---	---	---
Saddle Hill 77	---	---	---	---	---
Sir Galahad Co.	---	7.5	NO	50%	NO
Solar House I	3	10	NO	35%	YES
Solar House II	2	10	NO	35%	YES
Stewart-Teele-Mitchell	---	---	---	---	---
WEST GERMANY					
Aachen Solar House	2	4.6	YES	40%	E & W
Deizisau Sol. House	2	11.4	YES	31%	---
Essen Solar House	2	---	---	---	---
FHT Solar House	---	---	---	---	---
Freiburg Solar House	3	20	---	44%	YES

Building Description

PROJECT	MASS		VENTILATION RATE (AIR CHANGE/HR.)	HEATED VOLUME m ³
	TYPE	LOCATION		
DENMARK				
Hjortekaer C	CONCRETE	FLOOR	.8	270
Hjortekaer F	CONCRETE	WALL/FL./CEIL.	.6	350
ITALY				
Barra - Const.	CONCRETE	WALL/FL.	1	380
Habitat	MASONRY/CONC.	WALL/FL.	VAR.	320
JAPAN				
Aratani	CONC. BLOCK	WALL	.3	912
NETHERLANDS				
Bouwcentrum	BRICK/CONC.	---	.5	660
SWEDEN				
Bollebygd	---	---	.4	---
SUN SEC	---	---	---	380
SWITZERLAND				
Begnins	CONCRETE	FL./WALL	.3 - .5	743
Les Gen./Coff	CONCRETE	FL./WALL	.3 - .5	319
Payrne Active	---	---	---	613
Renens Passive	CONCRETE	FL./WALL	.3 - .5	700
Stiftung Sonnen.	BRICK	---	.4	1100
UNITED KINGDOM				
Linf. Milt. Keynes	CONC. BLOCK	INNER SKIN	1	300
Linf. Milt. Keynes 2	BRICK/BLOCK	---	1	488
Linf. Milt. Keynes 3	BRICK/BLOCK	---	1	488
Low En. Hse. Lab (HP)	BRICK	---	1	235
Low En. Hse. Lab (Solar)	NO	---	1	207
Pennyland	DENSE CONC.	INNER SKIN	1	250
UNITED STATES				
A-Frame Ind.	---	---	---	---
Albuq. Western II	---	---	---	---
Cathedral Sq.	---	---	---	---
Fac. Development	---	---	---	---
Forest City Dillon	---	---	---	---
Hei Wai Wong	---	---	---	---
Matt Cannon	---	---	---	---
NBS Passive	MASONRY	---	1	370
Saddle Hill 36	---	---	---	---
Saddle Hill 77	---	---	---	---
Sir Galahad Co.	---	---	1.3	379
Solar House I	NO	---	---	---
Solar House II	NO	---	---	---
Stewart-Teele-Mitchell	---	---	---	---
WEST GERMANY				
Aachen Solar House	---	---	1 - 2	290
Deizisau Sol. House	STONE	---	---	400
Essen Solar House	---	---	---	---
FHT Solar House	---	---	---	6500
Freiburg Solar House	CONCRETE	WALL/FL./CEIL.	1	1600

Solar System Description

PROJECT	SYSTEM ENERGY USAGE	COLLECTOR			
		TYPE	AREA M ²	ORIENT- TATION	TILT DEGREES
DENMARK					
Hjortekaer C	H, DHW	FLAT PLATE	20	S	45°
Hjortekaer F	H, DHW	FLAT PLATE	19	S	45°
ITALY					
Barra - Const.	---	PASSIVE	30	S	90°
Habitat	HEATING	VARIES	41	S	60°
JAPAN					
Aratani	H, DHW	PASSIVE/FLAT PLATE	54/45	S	90°/67°
NETHERLANDS					
Bouwcentrum	HEATING	FLAT PLATE AIR	30	S	55°
SWEDEN					
Bollebygd	---	FLAT PLATE	28	S	70°
SUN SEC	---	FLAT PLATE AIR	32.4	S	70°
SWITZERLAND					
Begnins	HEATING	PASSIVE	28	S15°E	90°
Les Gen./Coff	H, DHW	FLAT PLATE AIR/WATER	14/23	SW/SE	90°/80°
Payrne Active	H, DHW	FLAT PLATE	20	S39°W	43°
Renens Passive	HEATING	PASSIVE	14	S30°W	90°
Stiftung Sonnen.	H, DHW	ENERGY ROOF	113	SE	27°
UNITED KINGDOM					
Linf. Milt. Keynes	HEATING	PASSIVE	---	---	90°
Linf. Milt. Keynes 2	H, DHW	FLAT PLATE	40	S	45°
Linf. Milt. Keynes 3	H, DHW	FLAT PLATE	18.5	S	45°
Low En. Hse. Lab (HP)	PREHEATING	---	63	S	54.5°
Low En. Hse. Lab (Solar)	H, DHW	FLAT PLATE	18	S	42°
Pennyland	HEATING	PASSIVE	---	---	---
UNITED STATES					
A-Frame Ind.	DHW	FLAT PLATE	6	S10°E	21°
Albuq. Western II	HEATING	CONCENTRATOR	541	S	35°
Cathedral Sq.	DHW	FLAT PLATE	170	S42°W	45°
Fac. Development	DHW	FLAT PLATE	49	S	46°
Forest City Dillon	DHW	FLAT PLATE	209	S	40°
Hei Wai Wong	DHW	FLAT PLATE	76	S	24°
Matt Cannon	H, DHW	FLAT PLATE	50	S	34°
NBS Passive	HEATING	PASSIVE	30	S	90°
Saddle Hill 36	H, DHW	FLAT PLATE	37	S	58°
Saddle Hill 77	DHW	FLAT PLATE	7	S	38°
Sir Galahad Co.	H, DHW	---	60	S	45°
Solar House I	H, C, DHW	EVAC. TUBE/FL. PLT.	75/71	S	45°
Solar House II	H, DHW	SOLERON 3000	58	S	45°
Stewart-Teele-Mitchell	H, DHW	FLAT PLATE	41	S	45°
WEST GERMANY					
Aachen Solar House	H, DHW	EVAC. TUBE	20.3	S	48°
Deizisau Sol. House	H, DHW	FLAT PLATE	56	S30°W	28°
Essen Solar House	H, DHW	DO-HP	65	SSW	48°
FHT Solar House	H, DHW	FLAT PLATE	436	S	10°
Freiburg Solar House	H, DHW	EVAC. TUBE	54	S13°W	55°

Solar System Description

PROJECT	STORAGE		AUXILIARY SYSTEM	
	TYPE	CAPACITY m ³	TYPE	FUEL
DENMARK				
Hjortekaer C	TANK	1.8	HT. PUMP/RESIST.	ELEC.
Hjortekaer F	TANK	1.5	BOILER	GAS
ITALY				
Barra - Const.	MASS	---	WOOD BURNER	WOOD
Habitat	TANK/BASIN	2/50	HEAT PUMP	ELEC.
JAPAN				
Aratani	WALL/TANK	---	BOILER	WASTE HEAT
NETHERLANDS				
Bouwcentrum	CONC. SLAB	---	FURNACE	GAS
SWEDEN				
Bollebygd	STEEL WATER TANK	3	FURNACE	WOOD/ELEC.
SUN SEC	STEEL WATER TANK	3	HT. PUMP/RESIST.	ELEC.
SWITZERLAND				
Begnins	FLOOR/CHIMNEY	10	RESISTANCE	ELEC.
Les Gen./Coff	TANK	3.7	WOOD BURNER	WOOD
Payrne Active	WATER AND BETON	16	BOILER	WOOD
Renens Passive	CONCRETE	---	FURNACE	GAS
Stiftung Sonnen.	WATER	1.2	FURN./HT. PUMP	OIL/ELEC.
UNITED KINGDOM				
Linf. Milt. Keynes	---	---	BOILER	GAS
Linf. Milt. Keynes 2	WATER	2	BOILER	---
Linf. Milt. Keynes 3	WATER	6.8	BOILER	GAS
Low En. Hse. Lab (HP)	NO	---	HEAT PUMP	ELEC.
Low En. Hse. Lab (Solar)	WATER	42.6	HEAT PUMP	ELEC.
Pennyland	---	---	FURNACE	GAS
UNITED STATES				
A-Frame Ind.	WATER TANK	.5	RESISTANCE	ELEC.
Albuq. Western II	CONC. TANK	228	BOILER	GAS
Cathedral Sq.	WATER	11	BOILER	GAS
Fac. Development	GLASS LINED TANK	4	RESISTANCE	ELEC.
Forest City Dillon	LIQUID	13	FURNACE	#2 OIL
Hei Wai Wong	WATER	5	HEATER	GAS/ELEC.
Matt Cannon	LIQUID	4	NONE	---
NBS Passive	SLAB/WALL	---	RESISTANCE	ELEC.
Saddle Hill 36	WATER	3	FURNACE	#2 OIL
Saddle Hill 77	WATER TANK	.5	HEATER	GAS
Sir Galahad Co.	STEEL WATER TANK	6	HT. PUMP/RESIST.	ELEC.
Solar House I	GALV. ST. WATER TANK	34	BOILER	GAS
Solar House II	PEBBLE BED	10.3	HEAT PUMP	ELEC.
Stewart-Teele-Mitchell	WATER	4	BOILER	GAS
WEST GERMANY				
Aachen Solar House	TANK	46	HEAT PUMP	ELEC.
Deizisau Sol. House	TANK	72	BOILER	ELEC.
Essen Solar House	---	---	---	ELEC.
FHT Solar House	---	---	DISTRICT HEAT	---
Freiburg Solar House	WATER	225	BOILER	OIL

Instrumentation Description

PROJECT	MONITOR PERIOD BEGINS	MONITOR PERIOD ENDS	INSTRUMENTATION	
			COST	DESCRIPTION
DENMARK				
Hjortekaer C	9-78	4-82	\$27-36,000	CASSETTES, TRANS. TO HARD DISC
Hjortekaer F	4-79	4-82	\$27-36,000	CASSETTES, TRANS. TO HARD DISC
ITALY				
Barra - Const.	1980	1982	\$6,000	DATA LOGGER, CHART RECORDER
Habitat	1977	---	\$40,000	HP 3052A, DATA ACQUISITION
JAPAN				
Aratani	1-80	---	---	EPLY RADIOM. + INT. + RECORD
NETHERLANDS				
Bouwcentrum	3-80	10-81	DFL 50,000	DATA LOGGER, CARTRIDGE STOR.
SWEDEN				
Bollebygd	1-79	4-81	60,000 DERS.	MANUAL ENERGY; CHART TEMP.
SUN SEC	4-80	10-81	---	MAG. TAPE CASSETTES
SWITZERLAND				
Begnins	11-78	6-80	\$20,000	64 CH COUNTER + INT. + MAG. RECORD
Les Gen./Coff	9-79	6-81	\$20,000	64 CH COUNTER + INT. + MAG. RECORD
Payrne Active	1980	1981	---	CASSETTE - TAPE
Renens Passive	9-80	1-82	SFR. 60,000	HP DATA ACQ. + CASSETTE RECORD
Stiftung Sonnen.	10-78	12-82	FR. 40,000	COUNTERS + RECORDERS
UNITED KINGDOM				
Linf. Milt. Keynes	1-81	12-82	6,000/UNIT	DATA LOGGER + MAG. CASSETTE
Linf. Milt. Keynes 2	---	---	45,000	DATA LOGGER + MAG. CASSETTE
Linf. Milt. Keynes 3	---	---	25,000	DIGITAL MAG. CASSETTE
Low En. Hse. Lab (HP)	---	---	25,000	PDP II DATA LOGGER
Low En. Hse. Lab (Solar)	---	---	25,000	PDP II DATA LOGGER
Pennyland	2-81	6-82	350/UNIT	INT. DISPLAY
UNITED STATES				
A-Frame Ind.	2-78	6-80	\$3,510	DATA ON TAPE, DAILY CPU
Albuq. Western II	1-78	8-80	---	DATA ON TAPE, DAILY CPU
Cathedral Sq.	6-79	8-80	---	DATA ON TAPE, DAILY CPU
Fac. Development	1-78	8-80	---	DATA ON TAPE, DAILY CPU
Forest City Dillon	1-79	12-80	\$30,000	---
Hei Wai Wong	10-77	8-80	---	DATA ON TAPE, DAILY CPU
Matt Cannon	5-78	---	---	DATA ON TAPE, DAILY CPU
NBS Passive	3-79	---	---	DATA ON TAPE, DAILY CPU
Saddle Hill 36	11-80	10-82	\$50,000	PH 2100, MAG. TAPE
Saddle Hill 77	1-79	---	---	DATA ON TAPE, DAILY CPU
Sir Galahad Co.	2-78	---	\$18,000	DATA ON TAPE, DAILY CPU
Solar House I	1-75	---	---	DORIC 220 DATA LOG. + TAPE RECORD
Solar House II	10-78	6-79	---	DIGITAL, PRINTER, TAPE DECK
Stewart-Teele-Mitchell	4-78	8-80	\$800	DATA ON TAPE, DAILY CPU
WEST GERMANY				
Aachen Solar House	1976	6-78	---	P855 COMPUTER
Deizisau Sol. House	7-76	7-79	90,000	STRIPCARD RECORDER
Essen Solar House	1977	1979	200,000 DM	---
FHT Solar House	1980	1982	70,000	---
Freiburg Solar House	2-79	7-82	280,000 DM	SCANNER UNDER CENTRAL COMP.

Meteorological Instrumentation

PROJECT	DEGREE DAYS	OUTDOOR TEMP.	HORIZ. INCID. RADIATION	INCID. COLLECTOR RADIATION	REL. HUM.	WIND SPEED
DENMARK						
Hjortekaer C	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.
Hjortekaer F	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.
ITALY						
Barra - Const.	---	1 HR.	---	1 HR.	---	---
Habitat	1 MIN.	1 MIN.	1 MIN.	1 MIN.	1 MIN.	CONT.
JAPAN						
Aratani	CONT.	CONT.	---	CONT.	---	---
NETHERLANDS						
Bouwcentrum	---	7 SEC.	---	7 SEC.	---	---
SWEDEN						
Bollebygd	---	CONT.	---	---	CONT.	---
SUN SEC	---	1 HR.	10 MIN.	10 MIN.	---	10 MIN.
SWITZERLAND						
Begnins	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Les Gen./Coff	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Payrne Active	15 MIN.	15 MIN.	15 MIN.	15 MIN.	15 MIN.	15 MIN.
Renens Passive	---	30 MIN.	---	30 MIN.	---	30 MIN.
Stiftung Sonnen.	---	CONT.	---	---	---	---
UNITED KINGDOM						
Linf. Milt. Keynes	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.
Linf. Milt. Keynes 2	1 DAY	1 HR.	2 MIN.	2 MIN.	1 HR.	1 HR.
Linf. Milt. Keynes 3	1 HR.	1 HR.	1 HR.	1 HR.	---	---
Low En. Hse. Lab (HP)	---	---	---	---	---	---
Low En. Hse. Lab (Solar)	---	---	---	---	---	---
Pennyland	---	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.
UNITED STATES						
A-Frame Ind.	---	320 SEC.	---	320 SEC.	---	---
Albuq. Western II	---	320 SEC.	---	320 SEC.	---	---
Cathedral Sq.	---	320 SEC.	---	320 SEC.	---	---
Fac. Development	---	320 SEC.	---	320 SEC.	---	---
Forest City Dillon	---	320 SEC.	---	320 SEC.	320 SEC.	320 SEC.
Hei Wai Wong	---	320 SEC.	---	320 SEC.	---	320 SEC.
Matt Cannon	---	320 SEC.	---	320 SEC.	---	---
NBS Passive	---	5 MIN.	---	---	---	---
Saddle Hill 36	---	320 SEC.	---	320 SEC.	---	320 SEC.
Saddle Hill 77	---	320 SEC.	---	320 SEC.	---	320 SEC.
Sir Galahad Co.	---	320 SEC.	---	320 SEC.	---	---
Solar House I	---	10 MIN.	10 MIN.	10 MIN.	10 MIN.	10 MIN.
Solar House II	---	300 SEC.	---	300 SEC.	300 SEC.	300 SEC.
Stewart-Teele-Mitchell	---	320 SEC.	---	300 SEC.	---	---
WEST GERMANY						
Aachen Solar House	---	10 MIN.	1 MIN.	1 MIN.	10 MIN.	1 MIN.
Deizisau Sol. House	---	CONT.	---	CONT.	---	---
Essen Solar House	---	1 MIN.	---	1 MIN.	15 MIN.	15 MIN.
FHT Solar House	5 MIN.	5 MIN.	5 MIN.	1 MIN.	5 MIN.	5 MIN.
Freiburg Solar House	---	5 MIN.	5 MIN.	5 MIN.	5 MIN.	5 MIN.

Solar System Instrumentation

PROJECT	COLLECTORS		STORAGE			
	FLOW RATE IN	TEMP. IN AND OUT	FLOW RATE IN	TEMP. IN AND OUT	TEMP. INSIDE	AUX. ENERGY INPUT
DENMARK						
Hjortekaer C	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.	---
Hjortekaer F	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.	10 SEC.
ITALY						
Barra - Const.	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.	---
Habitat	1 MIN.	1 MIN.	1 MIN.	1 MIN.	1 MIN.	1 MIN.
JAPAN						
Aratani	---	---	---	---	CONT.	---
NETHERLANDS						
Bouwcentrum	7 SEC.	7 SEC.	---	---	20 MIN.	---
SWEDEN						
Bollebygd	---	---	1 WEEK	1 WEEK	---	---
SUN SEC	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.	---
SWITZERLAND						
Begnins	---	---	---	---	---	---
Les Gen./Coff	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Payrne Active	15 MIN.	15 MIN.	15 MIN.	15 MIN.	15 MIN.	15 MIN.
Renens Passive	30 MIN.	30 MIN.	---	---	---	---
Stiftung Sonnen.	---	CONT.	---	CONT.	CONT.	CONT.
UNITED KINGDOM						
Linf. Milt. Keynes	---	---	---	---	---	---
Linf. Milt. Keynes 2	CONT.	CONT.	VAR.	VAR.	VAR.	VAR.
Linf. Milt. Keynes 3	1 HR.	1 HR.	---	---	1 HR.	1 HR.
Low En. Hse. Lab (HP)	---	---	---	---	---	---
Low En. Hse. Lab (Solar)	---	---	---	---	---	---
Pennyland	---	---	---	---	---	---
UNITED STATES						
A-Frame Ind.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Albuq. Western II	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Cathedral Sq.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Fac. Development	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Forest City Dillon	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.
Hei Wai Wong	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Matt Cannon	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
NBS Passive	VAR.	5 MIN.	---	---	5 MIN.	---
Saddle Hill 36	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Saddle Hill 77	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
Sir Galahad Co.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.
Solar House I	10 MIN.	10 MIN.	10 MIN.	10 MIN.	10 MIN.	10 MIN.
Solar House II	300 SEC.	300 SEC.	300 SEC.	300 SEC.	300 SEC.	---
Stewart-Teele-Mitchell	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.	---
WEST GERMANY						
Aachen Solar House	1 MIN.	1 MIN.	1 MIN.	1 MIN.	10 MIN.	10 MIN.
Deizisau Sol. House	1 DAY	CONT.	1 DAY	CONT.	---	1 DAY
Essen Solar House	15 MIN.	1 HR.	15 MIN.	1 MIN.	15 MIN.	CONT.
FHT Solar House	1 MIN.	1 MIN.	1 MIN.	1 MIN.	1 MIN.	---
Freiburg Solar House	5 MIN.	5 MIN.	5 MIN.	5 MIN.	5 MIN.	---

Solar System Instrumentation

PROJECT	HEATING, COOLING, HOT WATER SYSTEMS		
	SUBSYSTEM INPUT FLOW	TEMP. IN AND OUT	AUX. ENERGY SUPPLIED
DENMARK			
Hjortekaer C	10 SEC.	10 SEC.	10 SEC.
Hjortekaer F	10 SEC.	10 SEC.	10 SEC.
ITALY			
Barra - Const.	1 HR.	1 HR.	---
Habitat	1 MIN.	1 MIN.	1 MIN.
JAPAN			
Aratani	---	---	1 DAY
NETHERLANDS			
Bouwcentrum	7 SEC.	7 SEC.	7 SEC.
SWEDEN			
Bollebygd	1 WEEK	1 WEEK	1 WEEK
SUN SEC	1 HR.	1 HR.	1 HR.
SWITZERLAND			
Begnins	---	---	---
Les Gen./Coff	30 MIN.	30 MIN.	---
Payrne Active	15 MIN.	15 MIN.	15 MIN.
Renens Passive	---	---	---
Stiftung Sonnen.	CONT.	CONT.	CONT.
UNITED KINGDOM			
Linf. Milt. Keynes	---	---	---
Linf. Milt. Keynes 2	CONT.	CONT.	CONT.
Linf. Milt. Keynes 3	1 HR.	1 HR.	1 HR.
Low En. Hse. Lab (HP)	---	---	---
Low En. Hse. Lab (Solar)	---	---	---
Pennyland	---	---	---
UNITED STATES			
A-Frame Ind.	---	---	---
Albuq. Western II	320 SEC.	320 SEC.	320 SEC.
Cathedral Sq.	320 SEC.	320 SEC.	---
Fac. Development	320 SEC.	320 SEC.	320 SEC.
Forest City Dillon	320 SEC.	320 SEC.	320 SEC.
Hei Wai Wong	320 SEC.	320 SEC.	320 SEC.
Matt Cannon	320 SEC.	320 SEC.	320 SEC.
NBS Passive	CONT.	5 MIN.	5 MIN.
Saddle Hill 36	320 SEC.	320 SEC.	320 SEC.
Saddle Hill 77	320 SEC.	320 SEC.	320 SEC.
Sir Galahad Co.	320 SEC.	320 SEC.	320 SEC.
Solar House I	10 MIN.	10 MIN.	10 MIN.
Solar House II	300 SEC.	300 SEC.	300 SEC.
Stewart-Teele-Mitchell	320 SEC.	320 SEC.	320 SEC.
WEST GERMANY			
Aachen Solar House	10 MIN.	10 MIN.	10 MIN.
Deizisau Sol. House	1 DAY	CONT.	---
Essen Solar House	15 MIN.	1 MIN.	CONT.
FHT Solar House	1 MIN.	1 MIN.	1 MIN.
Freiburg Solar House	5 MIN.	5 MIN.	---

Building Instrumentation

PROJECT	INSIDE DB TEMPERATURE	INFIL. LOAD	AUXILIARY ENERGY	OPER. ENERGY	TOTAL BUILDING ENERGY USED
DENMARK					
Hjortekaer C	10 MIN.	10 MIN.	10 MIN.	10 MIN.	10 MIN.
Hjortekaer F	10 MIN.	10 MIN.	10 MIN.	10 MIN.	10 MIN.
ITALY					
Barra - Const.	1 HR.	---	1 DAY	---	1 MONTH
Habitat	1 MIN.	---	1 MIN.	1 MIN.	1 MIN.
JAPAN					
Aratani	CONT.	1 MONTH	1 DAY	---	1 MONTH
NETHERLANDS					
Bouwcentrum	7 SEC.	---	---	---	7 SEC.
SWEDEN					
Bollebygd	CONT.	---	1 WEEK	1 WEEK	---
SUN SEC	1 HR.	---	---	1 HR.	1 HR.
SWITZERLAND					
Begnins	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Les Gen./Coff	30 MIN.	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Payrne Active	15 MIN.	---	15 MIN.	15 MIN.	15 MIN.
Renens Passive	30 MIN.	---	---	---	---
Stiftung Sonnen.	CONT.	VAR.	CONT.	CONT.	CONT.
UNITED KINGDOM					
Linf. Milt. Keynes	1 HR.	1 HR.	1 HR.	1 HR.	1 HR.
Linf. Milt. Keynes 2	1 HR.	---	1 DAY	CONT.	1 DAY
Linf. Milt. Keynes 3	---	---	1 HR.	1 HR.	1 DAY
Low En. Hse. Lab (HP)	---	---	---	---	---
Low En. Hse. Lab (Solar)	---	---	---	---	---
Pennyland	1 WEEK	---	1 WEEK	---	1 WEEK
UNITED STATES					
A-Frame Ind.	---	---	---	---	---
Albuq. Western II	---	---	---	---	---
Cathedral Sq.	---	---	---	320 SEC.	---
Fac. Development	---	---	---	---	---
Forest City Dillon	---	---	---	---	---
Hei Wai Wong	---	---	---	---	---
Matt Cannon	---	---	---	---	---
NBS Passive	5 MIN.	---	CONT.	CONT.	---
Saddle Hill 36	320 SEC.	---	320 SEC.	320 SEC.	---
Saddle Hill 77	320 SEC.	320 SEC.	320 SEC.	320 SEC.	320 SEC.
Sir Galahad Co.	320 SEC.	---	320 SEC.	320 SEC.	---
Solar House I	10 MIN.	---	10 MIN.	10 MIN.	---
Solar House II	300 SEC.	---	300 SEC.	300 SEC.	---
Stewart-Teele-Mitchell	---	---	---	320 SEC.	---
WEST GERMANY					
Aachen Solar House	10 MIN.	---	10 MIN.	10 MIN.	10 MIN.
Deizisau Sol. House	CONT.	---	---	1 DAY	---
Essen Solar House	---	---	CONT.	1 MIN.	1 DAY
FHT Solar House	5 MIN.	---	---	---	---
Freiburg Solar House	5 MIN.	---	---	---	---

Building Instrumentation

PROJECT	INTERNAL GAINS	SOLAR GAINS	SOLAR % OF TOTAL LOAD	THERMAL CAP. OF BUILDING
DENMARK				
Hjortekaer C	10 MIN.	10 MIN.	---	---
Hjortekaer F	10 MIN.	10 MIN.	---	---
ITALY				
Barra - Const.	1 MONTH	1 MONTH	1 MONTH	---
Habitat	1 DAY	---	---	---
JAPAN				
Aratani	---	---	---	---
NETHERLANDS				
Bouwcentrum	---	---	7 SEC.	---
SWEDEN				
Bollebygd	---	---	---	---
SUN SEC	1 HR.	1 HR.	---	---
SWITZERLAND				
Begnins	30 MIN.	30 MIN.	30 MIN.	30 MIN.
Les Gen./Coff	30 MIN.	30 MIN.	30 MIN.	---
Payrne Active	---	15 MIN.	15 MIN.	---
Renens Passive	---	---	---	---
Stiftung Sonnen.	---	---	---	---
UNITED KINGDOM				
Linf. Milt. Keynes	1 HR.	1 HR.	1 HR.	---
Linf. Milt. Keynes 2	---	---	---	---
Linf. Milt. Keynes 3	1 HR.	1 HR.	1 DAY	1 DAY
Low En. Hse. Lab (HP)	---	---	---	---
Low En. Hse. Lab (Solar)	---	---	---	---
Pennyland	---	1 HR.	1 WEEK	---
UNITED STATES				
A-Frame Ind.	---	---	---	---
Albuq. Western II	---	---	---	---
Cathedral Sq.	---	---	---	---
Fac. Development	---	---	---	---
Forest City Dillon	---	---	---	---
Hei Wai Wong	---	---	---	---
Matt Cannon	---	---	---	---
NBS Passive	5 MIN.	5 MIN.	1 MONTH	1 MONTH
Saddle Hill 36	---	---	---	---
Saddle Hill 77	320 SEC.	320 SEC.	320 SEC.	320 SEC.
Sir Galahad Co.	---	---	---	---
Solar House I	---	---	---	---
Solar House II	---	---	---	---
Stewart-Teele-Mitchell	---	---	---	---
WEST GERMANY				
Aachen Solar House	10 MIN.	---	---	---
Deizisau Sol. House	---	---	---	---
Essen Solar House	---	1 MIN.	1 DAY	---
FHT Solar House	---	---	---	---
Freiburg Solar House	---	---	---	---