Rec. 9-9-86

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY

solar heating and cooling programme

task VIII

passive and hybrid solar low energy buildings

PERFORMANCE DATA SOURCES

january 1986

INTERNATIONAL ENERGY AGENCY
solar heating and cooling programme

task VIII
passive and hybrid solar low energy buildings

PERFORMANCE DATA SOURCES

PREPARED BY

Ove Mørck, TECHNICAL UNIVERSITY OF DENMARK

Michael J. Holtz, ARCHITECTURAL ENERGY CORPORATION, U.S.A

JANUARY 1986

THERMAL INSULATION LABORATORY
TECHNICAL UNIVERSITY OF DENMARK
Report No 175

ACKNOWLEDGMENTS

The report authors wish to acknowledge the assistance of Beth Sachs and Blair Hamilton of the Memphremagog Group in preparing the index lists in Chapter 3. Also, we would like to thank the representatives of Subtask A who completed the survey forms and reviewed the final report and Sheila Blum and Jean Mewshaw of International Planning Associates for their editorial assistance.

Printed at the
Thermal Insulation Laboratory,
Technical University
of Denmark

INTRODUCTION TO THE IEA SOLAR HEATING AND COOLING PROGRAMME

BACKGROUND

International Energy Agency was formed in November 1974 to establish cooperation among a number of industrialized countries in the vital area of energy policy. It is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). Twenty-one countries are presently members, with the Commission of the European Communities also participating in the work of the IEA under a special arrangement.

One element of the IEA's programme involves cooperation in the research and development of alternative energy resources in order to reduce excessive dependence on oil. A number of new and improved energy technologies which have the potential of making significant contributions to global energy needs were identified for collaborative efforts. The IEA Committee on Energy Research and Development (CRD), supported by a small Secretariat staff is the focus of IEA RD&D activities. Four Working Parties (in Conservation, Fossil Fuels, Renewable Energy, and Fusion) are charged with identifying new areas for cooperation and advising the CRD on policy matters in their respective technology areas.

SOLAR HEATING & COOLING AGREEMENT

Solar Heating and Cooling was one of the technologies selected for joint activities. During 1976-77, specific projects were identified in key areas of this field and a formal Implementing Agreement drawn up. The Agreement covers the obligations and rights of the Participants and outlines the the scope of each project or "task" in annexes to the document. There are now eighteen signatories to the Agreement:

Australia
Austria
Belgium
Canada
Denmark
Commission of the European Communities
Federal Republic of Germany
Greece
Italy
Japan
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States

The overall programme is managed by an Executive Committee, while the management of the individual tasks is the responsibility of Operating Agents. The tasks of the IEA Solar Heating and Cooling Programme, their respective Operating Agents, and current status (ongoing or completed) are as follows:

Task I	Investigation of the Performance of Solar Heating and Cooling Systems - Technical University of Denmark (Completed).
Task II	Coordination of Research and Development on Solar Heating and Cooling - Solar Research Laboratory - GIRIN, Japan (Completed).
Task III	Performance Testing of Solar Collectors - University College, Cardiff, U.K. (ongoing)
Task IV	Development of an Insolation Handbook and Instrument Package - U.S. Department of Energy (Completed).
Task V	Use of Existing Meteorological Information for Solar Energy Application Swedish Meteorological and Hydrological Institute (Completed).
Task VI	Performance of Solar Heating, Cooling, and Hot Water Systems Using Evacuated Collectors - U.S. Department of Energy (Ongoing).
Task VII	Central Solar Heating Plants with Seasonal Storage - Swedish Council for Building Research (Ongoing).
Task VIII	Passive and Hybrid Solar Low Energy Buildings - U.S. Department of Energy (Ongoing).
Task IX	Solar Radiation and Pyranometry Studies - Canadian Climate Centre (Ongoing).
Task X	Materials Research & Testing - Solar Research Laboratory, GIRIN, Japan (Ongoing).

TASK VIII - PASSIVE AND HYBRID SOLAR LOW ENERGY BUILDINGS

The Participants in Task VIII are involved in collaborative research to study the design integration issues associated with using passive and hybrid solar and energy conservation techniques in new residential buildings. The overall objective of Task VIII is to accelerate the development and use of passive and hybrid heated and cooled low energy buildings in the Participants' countries. The results will be an improved understanding of the design and performance of buildings using active and passive solar and energy conservation techniques, their interaction and effective combination in various climatic regions. The results will also verify that passive and hybrid solar low energy buildings can substantially reduce the building load and consumption of non-renewable energy over that of conventional buildings while maintaining acceptable levels of year-round comfort. The Subtasks of this project are:

- O. Technology Baseline Definition
- A. Performance Measurement and Analysis
- B. Modeling and Simulation
- C. Design Methods
- D. Building Design, Construction and Evaluation

The Participants in this Task are: Austria, Belgium, Canada, Denmark, Federal Republic of Germany, Italy, The Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United States and United Kingdom. Michael J. Holtz, A.I.A., Architectural Energy Corporation, serves as Operating Agent on behalf of the U.S. Department of Energy.

This report documents work carried out under Subtask A of this Task.

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This document presents the results of a survey of monitored passive and hybrid solar low energy residential buildings conducted within IEA countries during the period from autumn 1983 to spring 1985. The survey was undertaken as part of Subtask A, Performance Measurement and Analysis, of Task VIII, Passive and Hybrid Solar Low Energy Buildings of the IEA Solar Heating and Cooling Programme. One of the objectives of this Subtask is to report on the availability of data from monitored passive and hybrid solar low energy residential buildings in the member countries. The intent is to identify sources of high quality performance data for purposes of simulation and design tool evaluation, passive and hybrid system performance characterization and policy formulation. The major part of the report consists of building description forms which briefly describe the buildings, summarize performance, list available data and identify reference sources for further information. More detailed performance data is provided for 60 of the buildings. To assist the reader in findings projects of particular interest, an indexing system has been generated, using 16 different entries from the forms.

The objectives of the survey were:

1. To determine the availability of data from monitored projects in the IEA Task VIII member countries;

2. To identify data needs;

3. To make designers, builders and researchers aware of available data; and

4. To document and assess the performance of the surveyed buildings in order to make comparisons of passive/hybrid system performance in various climates.

The survey forms were generated and distributed to the participating countries of Task VIII. One survey form was used to identify sources of performance data and the other form to briefly report the performance of selected projects. The survey forms are included as Appendix A to this report.

The survey identified 181 monitored passive and hybrid solar residential buildings in seven countries for which performance data are available. Information from the survey forms was used to prepare the building description forms in Chapter 4 which describe the building, briefly summarize performance, list available data and identify reference sources for further information. Key information from these forms was reorganized into a set of index lists, presented in Chapter 3, which assist the reader in identifying the performance evaluation sites and data sets which may be of particular interest.

More detailed system and building descriptions and building performance information were included for 60 of the projects. These performance data forms are presented in Chapter 5 and provide illustrations and performance assessments for specific system types in the different climates.

Of the 181 reported projects, 148 are from the U.S. This clearly indicates a greater emphasis on performance monitoring in the U.S. in the past 5 years. However, the number of monitored European and New Zealand sites is increasing and a larger date base of quality data will soon be available from those countries.

The categories of passive heating systems in the surveyed projects and their distribution is shown in Figure 1.1.

As would be expected, the greatest number of monitored projects are for direct gain, mass wall and sunspace heating systems, the most popular passive system types. Limited performance data exists for water wall, hybrid, roof pond and other innovative systems, reflecting the current limited use and interest in these systems by designers and researchers.

Catagorization of the monitored sites by climate variables is useful in assessing data availability and data needs. Figures 1.2 and 1.3 show the distribution of projects plotted against annual global solar radiation and Heating Degree Days and Cooling Degree Days, respectively.

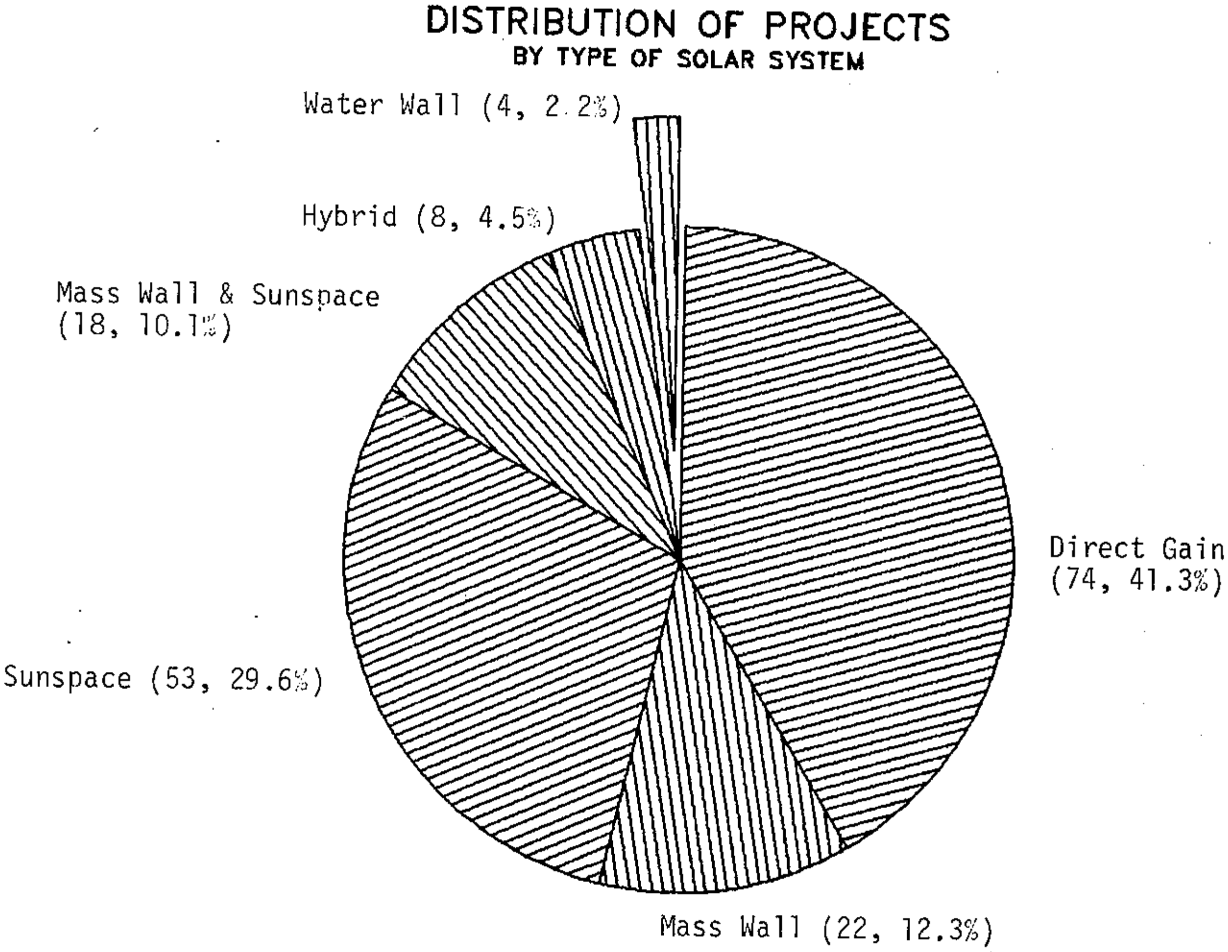


Figure 1.1 Distribution of Sites by Passive Heating System Type (absolute number, percentage).

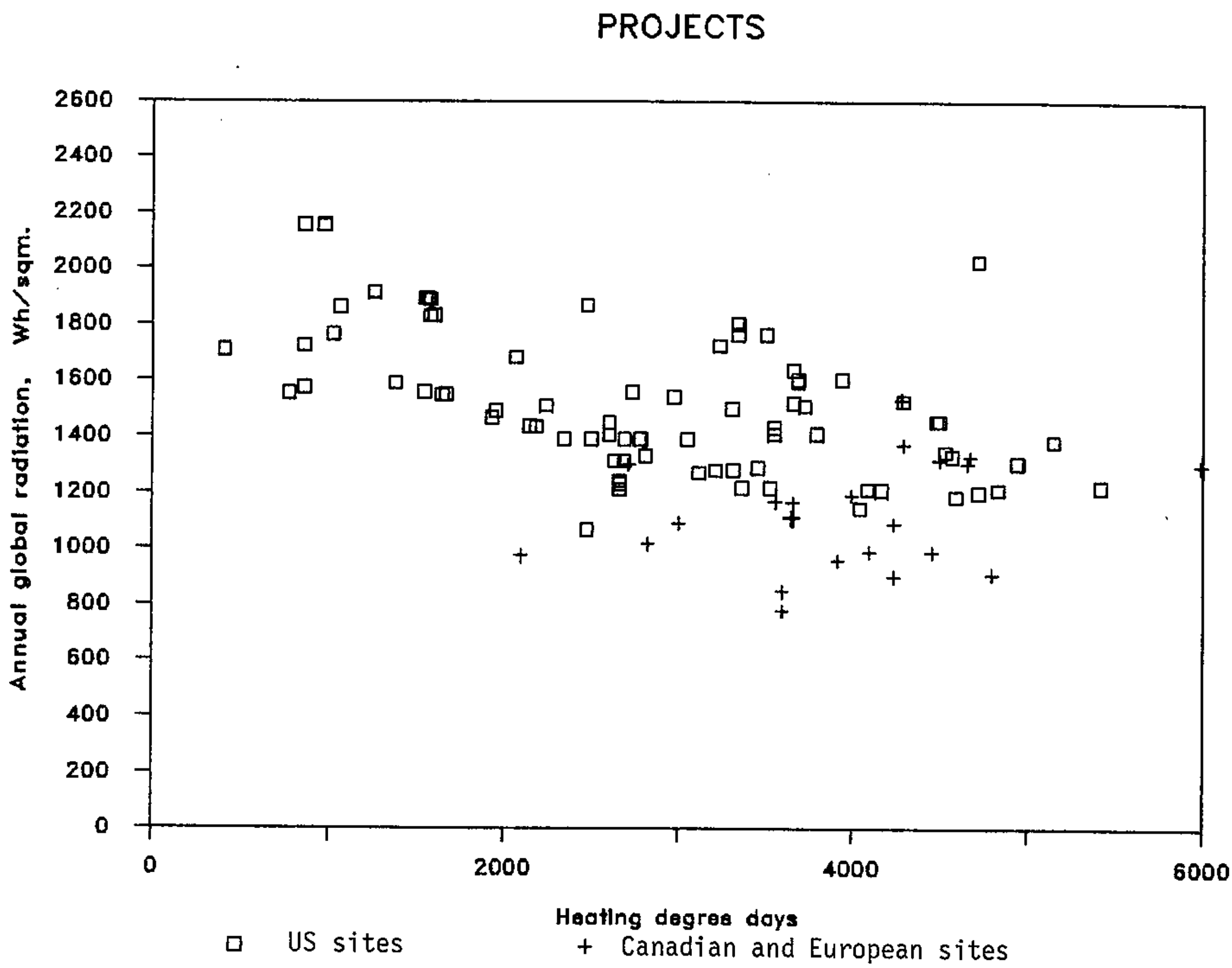


Figure 1.2 Distribution of Projects by Heating Degree Days vs. Annual Global Solar Radiation.

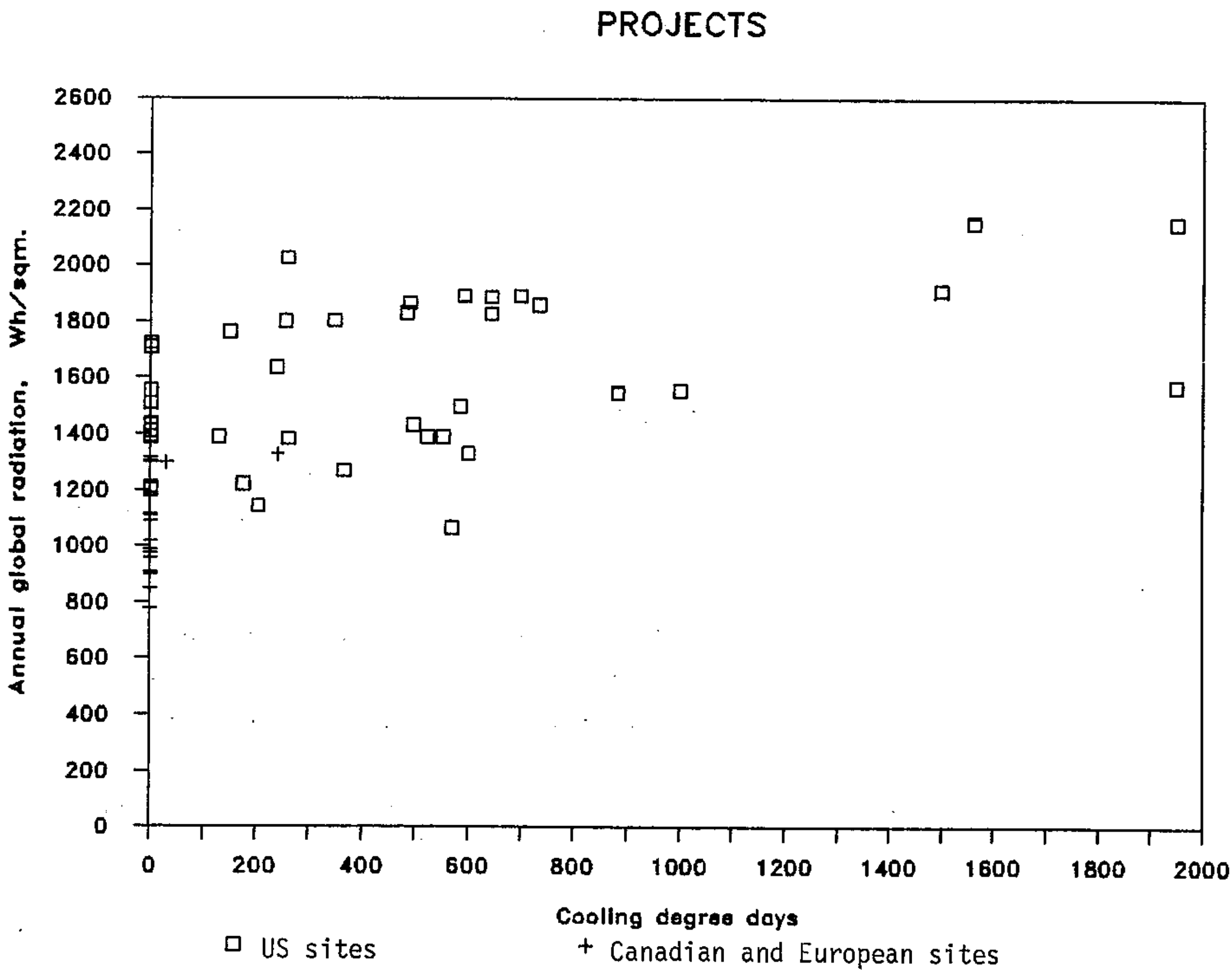


Figure 1.3 Distribution of Projects by Cooling Degree Days vs. Annual Global Solar Radiation.

Conclusions

A detailed assessment of the survey results was not performed. However, a review of the monitored projects reported in the surveys leads to the following general conclusions:

1. The majority of reported projects are from the United States. A clear need exists for additional monitored data from European climates.

2. The majority of the reported projects are for the most common passive heating system types - direct gain, thermal storage walls and sunspace.

3. An insufficient number of hybrid solar heating systems are reported to allow the performance comparison of this system type with either totally active or passive systems.

4. Little data are reported on the performance of roof ponds or water walls.

5. Data quality in general appears to be high. However, usefulness for purposes of simulation validation, design tool evaluation or system performance comparison can only be assessed on a case-by-case basis.

6. A need exists for the development and use of a consistent performance evaluation methodology to allow comparison of data among various countries.

The present survey has created an overview of available performance data on passive and hybrid solar low energy buildings in the IEA Task VIII member countries. This overview provides important guidance of the planning of future monitoring projects in this area.

2. INTRODUCTION

The absence of thermal performance data from monitored passive and hybrid solar residential buildings used to be a major obstacle to designers, builders, researchers, analysts and policy-makers seeking to determine the value of these energy saving concepts. Within the last five years, however, the number, location and types of passive and hybrid solar residential buildings monitored within IEA countries has grown dramatically. The number of monitored passive and hybrid solar buildings is currently estimated to be over 200. The issue has now become how to make data from selected monitored buildings available so that it can be further analyzed and used by designers, builders and researchers.

The purpose of this publication is to present and index sources of monitored performance data for passive and hybrid solar residential buildings in the countries participating in Subtask "A" of IEA Task VIII. Only buildings which have undergone six months of monitoring critical performance variables have been included in this report. Also, the quality of the data had to be high, and the monitored results fully documented with available data sets.

The survey information is presented in three parts. The first part, Chapter 3, is an index of 16 lists that tabulate the 181 buildings according to various characteristics - heating degree days, type of construction, auxiliary system type, and so on. The second part, Chapter 4, is a series of single page forms that describe each building, briefly summarize performance, list available data and identify reference sources for further information. The third part, Chapter 5, presents drawings and more detailed information on 60 of the monitored buildings.

The intended process for using this report is as follows:

1. Carefully define your requirements for the type of data needed, such as location, passive system type, building type, and so on.

2. Review the 16 lists in Chapter 3 to select the appropriate indices.

3. Review Chapters 4 and 5 to identify candidate monitored projects.

4. Rank the candidate monitored projects in descending order of usefulness relative to your data needs.

5. Contact the individual or organization identified as the project contact on the Project Summary Forms in Chapter 4 to obtain additional information on the monitored project and the availability of documentation.

6. Make arrangements to obtain the data and all necessary project documentation.

Data acquisition is an extremely difficult, time-consuming and expensive activity. Yet monitored data is indispensable for model validation, design tool evaluation and building performance evaluation/ comparison. This report is intended to bring possible sources of quality monitored data to the attention of those requiring such information. It is hoped that it will facilitate the acquisition of valuable measured performance information, saving time, money and avoiding unnecessary project duplication.

3. INDEX LISTS

This chapter contains 16 lists to assist in identifying particular performance evaluation sites and data sets which may be of interest. The following tabulations of site characteristics are included in the following pages:

To assist the reader in using and understanding the index lists, the following explanatory notes are provided.

1. Each site in the index lists has been assigned a site code. The first two characters of the code represent the country in which the site is located, i.e., BE = Belgium and CD = Canada. The last two characters of the code represent the site number, i.e., BE-02 is the second site in Belgium. Because there are so many sites in the U.S., an abbreviation for the state is also included. For example, US/AZ-01 is the first U.S. site in Arizona. The single-page data sheets in Chapter 4 are arranged in order of these site codes.

2. The "levels of monitoring" referred to in this report are based on the categories used in the U.S. (1). They are defined as follows:

Level "A"	typically over 100 sensors; hourly data; continuously measured infiltration; measured properties of materials.
Level "A-"	typically over 100 sensors; hourly data; one-time or intermittant infiltration measurement; assumed properties of materials.
Level "B+"	typically over 20 sensors; at least some hourly data; one-time measurements; monthly energy balances; measured indoor and outdoor environment.
Level "B"	typically over 20 sensors; one-time measurements; monthly energy balances; measured indoor and outdoor environment.
Level "B-"	similar to Level B but lacking full information to determine monthly energy balances.

3. In any list where a single building has multiple characteristics by which it might be listed, there are duplicate listings for the site, one under each characteristic.

4. Not all sites are found on all of the 16 lists. For any site this may either be because the particular characteristic does not apply to the site or because information on that characteristic for the site was not available.

REFERENCE(S)

1. M.J. Holtz and B. Hamilton:
PROGRAM AREA PLAN: PASSIVE SOLAR PERFORMANCE EVALUATION OF PASSIVE/HYBRID SOLAR BUILDINGS. Solar Energy Research Institute Report No: SERI/PR-721-788, October 1980.

LIST OF SITES BY LOCATION

BELGIUM			
*	BE-01	Nandrin Direct Gain/Sunspace	Nandrin, Belgium
*	BE-02	Chaumont Gistoux Solar House	Chaumont-Gistoux, Belgium
*	BE-03	Rosieres Solar House	Rosieres, Belgium
CANADA			
	CD-01	NRC Passive Solar Test Facility	Ottawa, Canada
	CD-02	Alberta Home Heat Research Fac.	Edmonton, Canada
DENMARK			
*	DK-01	Lyngby Solar House	Lyngby, Denmark
	DK-02	Lysoftevaenget	Lyngby, Denmark
	DK-03	SBI Low Energy House	Horsholm, Denmark
NORWAY			
*	NO-01	Ivilde Solar House	Ivilde, Voss, Norway
*	NO-02	Trondheim Test Building	Trondheim, Norway
	NO-03	Baerum County Low Energy House	Baerum County, Norway
*	NO-04	Double Shell House at As	As, Norway
*	NO-05	Heimdal Solar House #2	Tiller, Norway
*	NO-06	Heimdal Solar House #3	Tiller, Norway
*	NO-07	Heimdal Low Energy House 14	Tiller, Norway
	NO-08	Indre Ostfold Meier Solar Bldg.	Mysen, Norway
SWEDEN			
*	SW-01	Str. Lagenergiprojekt for Smahus	Vetlanda, Sweden
*	SW-02	Teleborg Passive Solar Home	Vaxjo, Sweden
*	SW-03	Fargelanda Passive Solar Home	Fargelanda, Sweden
*	SW-04	Valdemarsro Low Energy Houses	Malmo, Sweden
*	SW-05	Smalands Taberg Low Energy Homes	Taberg, Sweden
*	SW-06	Bramhult Solar Houses	Bramhult, Sweden
*	SW-07	Tarnan Solar Houses	Landskrona, Sweden
SWITZERLAND			
	CH-01	Dersbach Rowhouses	Hunenberg, Switzerland
	CH-02	Meggen Solar Apartment Bldg.	Meggen, Switzerland
	CH-03	Adliswil Solar Apartments	Adliswil, Switzerland
	CH-04	Courtelary Apartments	Courtelary, Switzerland
	CH-05	Cannobbio Test Cell #1	Canobbio, Switzerland
	CH-06	Cannobbio Test Cell #2	Canobbio, Switzerland
*	CH-07	Schaub Solar House	Rothenfluh, Switzerland
*	CH-08	Schafer Solar House	Binz, Switzerland
*	CH-09	Wieland Solar House	Oberglatt, Switzerland
*	CH-10	Gmur Solar House	Gonten, Switzerland

* Denotes projects presented in more detail in Chapter 5.

LIST OF SITES BY LOCATION

UNITED STATES - ARIZONA

	US/AZ-01	Passive Cooling Test Bldg. #1	Tucson, Arizona
	US/AZ-02	Passive Cooling Test Bldg. #2	Tucson, Arizona
	US/AZ-03	Passive Cooling Test Bldg. #3	Tucson, Arizona
	US/AZ-04	Fiesta Home	Phoenix, Arizona
	US/AZ-05	Hospitality Home	Phoenix, Arizona
*	US/AZ-06	Hullco Construction	Prescott, Arizona
	US/AZ-07	Payson House (Site WAA)	Payson, Arizona
	US/AZ-08	Solar Townhouse (Site WAD)	Glendale, Arizona
	US/AZ-09	Yacqui House (Site WAC)	Tucson, Arizona
	US/AZ-10	Solar Log House (Site WAE)	Cave Creek, Arizona
	US/AZ-11	U.S. Homes Control Home	Tucson, Arizona
	US/AZ-12	U.S. Homes Solar Home No. 1	Tucson, Arizona

UNITED STATES - CALIFORNIA

*	US/CA-01	Living Systems	Davis, California
	US/CA-02	Maeda/Nittler Suncatcher House	Davis, California
	US/CA-03	PP&L Test House #4	Crescent City, California
	US/CA-04	SMUD MB Residence	Elk Grove, California
	US/CA-05	SMUD YB Residence	Sacramento, California
	US/CA-06	Passive Solar House	Stockton, California
*	US/CA-07	Solar Duplex (Site WSA)	Davis, California
	US/CA-08	Colton Solar House (Site WSD)	Colton, California
	US/CA-09	Colton Conservation (Site WSE)	Colton, California
*	US/CA-10	Yreka House (Site WSF)	Yreka, California
*	US/CA-11	Eureka House (Site WSG)	Bayside, California
*	US/CA-12	Truckee House (Site WSH)	Truckee, California
	US/CA-13	Santa Barbara House (Site WSI)	Santa Barbara, California
	US/CA-14	Rio Linda Solar House (Site WSJ)	Rio Linda, California
*	US/CA-15	Sacramento Solar Condo (Site WSK)	Sacramento, California
	US/CA-16	Rio Linda Conservation (Site WSL)	Rio Linda, California
	US/CA-17	Sebastopol House (Site WSM)	Rio Linda, California

UNITED STATES - COLORADO

*	US/CO-01	Colorado Sunworks	Longmont, Colorado
*	US/CO-02	Boulder House (Site DMA)	Boulder, Colorado
	US/CO-03	Lafayette House (Site DMC)	Lafayette, Colorado
*	US/CO-04	Golden House (Site DMD)	Golden, Colorado
*	US/CO-05	Arvada House (Site DME)	Arvada, Colorado
	US/CO-06	Westminster House (Site DMF)	Westminster, Colorado
*	US/CO-07	Northglenn House (Site DMG)	Northglenn, Colorado
*	US/CO-08	Denver House #1 (Site DMH)	Denver, Colorado
*	US/CO-09	Denver House #2 (Site DMI)	Denver, Colorado
*	US/CO-10	Aurora House #1 (Site DMJ)	Aurora, Colorado
	US/CO-11	Aurora House #2 (Site DMK)	Aurora, Colorado
*	US/CO-12	Aurora House #3 (Site DML)	Aurora, Colorado
	US/CO-13	Tillotson House (Site DMM)	Nederland, Colorado
	US/CO-14	Paschall House (Site DMN)	Golden, Colorado
*	US/CO-15	Acorn House (Site MBA)	Boulder, Colorado
*	US/CO-16	Class A Test House	Golden, Colorado
	US/CO-17	REPEAT Facility	Fort Collins, Colorado

LIST OF SITES BY LOCATION

UNITED STATES - CONNECTICUT		
* US/CT-01	Tolland House (Site NEC)	Tolland, Connecticut
UNITED STATES - FLORIDA		
US/FL-01	FSEC Passive Cooling Laboratory	Cape Canaveral, Florida
UNITED STATES - GEORGIA		
US/GA-01	Photovoltaic House	Roswell, Georgia
US/GA-02	Seedorf House	Atlanta, Georgia
US/GA-03	Suwanne House (Site SSF)	Suwanee, Georgia
US/GA-04	Atlanta House (Site SSG)	Atlanta, Georgia
UNITED STATES - IOWA		
US/IA-01	Peosta House (Site MAA)	Peosta, Iowa
US/IA-02	Kirkwood House (Site MAB)	Cedar Rapids, Iowa
* US/IA-03	Wehner House	Iowa City, Iowa
UNITED STATES - IDAHO		
US/ID-01	Dan Smith House	Boise, Idaho
UNITED STATES - ILLINOIS		
* US/IL-01	Lo-Cal A	Champaign, Illinois
UNITED STATES - KANSAS		
US/KS-01	Quail Valley Conventional House	Overland Park, Kansas
US/KS-02	Quail Valley Solar House	Overland Park, Kansas
UNITED STATES - MASSACHUSETTS		
US/MA-01	Braintree Building (Site NEP)	Braintree, Massachusetts
US/MA-02	Mattapoisett Building (Site NES)	Mattapoisett, Massachusetts
US/MA-03	Cummington Building (Site NEU)	Cummington, Massachusetts
* US/MA-04	Hamilton House (Site NEA)	Hamilton, Massachusetts
* US/MA-05	Orange House (Site NEB)	Orange, Massachusetts
US/MA-06	Lexington House (Site NEJ)	Lexington, Massachusetts
US/MA-07	Carlisle House (Site NPV)	Carlisle, Massachusetts
UNITED STATES - MARYLAND		
US/MD-01	EER-2	Damascus, Maryland
US/MD-02	NBS Thermal Mass Test Bldg. #1	Gaithersburg, Maryland
US/MD-03	NBS Thermal Mass Test Bldg. #2	Gaithersburg, Maryland
US/MD-04	NBS Thermal Mass Test Bldg. #3	Gaithersburg, Maryland
US/MD-05	NBS Thermal Mass Test Bldg. #4	Gaithersburg, Maryland
US/MD-06	NBS Thermal Mass Test Bldg. #5	Gaithersburg, Maryland
US/MD-07	NBS Thermal Mass Test Bldg. #6	Gaithersburg, Maryland
* US/MD-08	NBS Passive Solar Test Building	Gaithersburg, Maryland
* US/MD-09	Rymark I	Frederick, Maryland
* US/MD-10	Rymark II	Frederick, Maryland
* US/MD-11	Rymark III	Frederick, Maryland
UNITED STATES - MAINE		
* US/ME-01	Topsham House (Site NEH)	Topsham, Maine

LIST OF SITES BY LOCATION

UNITED STATES - MICHIGAN			
	US/MI-01	Detroit Edison Passive Home	Troy, Michigan
UNITED STATES - MINNESOTA			
*	US/MN-01	Arno Kahn House	Hermantown, Michigan
	US/MN-02	Plymouth House (Site MAP)	Plymouth, Minnesota
	US/MN-03	Northfield House (Site MAN)	Northfield, Minnesota
	US/MN-04	Brainerd House (Site MAD)	Brainerd, Minnesota
	US/MN-05	Esko House (Site MAE)	Duluth, Minnesota
UNITED STATES - MONTANA			
	US/MT-01	Darcy House	Bozeman, Montana
	US/MT-02	Fowlkes House	Bozeman, Montana
	US/MT-03	Hughes Residence	Miles City, Montana
UNITED STATES - NEBRASKA			
*	US/NB-01	Coren House (Site MAM)	Lincoln, Nebraska
UNITED STATES - NEW HAMPSHIRE			
	US/NH-01	Northwood House (Site NEM)	Northwood, New Hampshire
UNITED STATES - NEW JERSEY			
*	US/NJ-01	Environmental Partnership	Cream Ridge, New Jersey
UNITED STATES - NEW MEXICO			
	US/NM-01	Balcomb House	Santa Fe, New Mexico
	US/NM-02	Hunn House	White Rock, New Mexico
UNITED STATES - NEW YORK			
*	US/NY-01	Gill Harrop House	Big Flats, New York
	US/NY-02	Niagara Mohawk House	Herkimer, New York
UNITED STATES - NORTH CAROLINA			
	US/NC-01	NCSU Solar House	Raleigh, North Carolina
	US/NC-02	Carrboro House (Site SSM)	Carrboro, North Carolina
*	US/NC-03	Black Mountain House (Site SSK)	Black Mountain, South Carolina
UNITED STATES - NORTH DAKOTA			
	US/ND-01	Fargo House (Site MBD)	Fargo, North Dakota
UNITED STATES - OHIO			
*	US/OH-01	Baker Construction	Cincinnati, Ohio
UNITED STATES - OKLAHOMA			
	US/OK-01	Edmond House (Site SSA)	Edmond, Oklahoma

LIST OF SITES BY LOCATION

UNITED STATES - OREGON			
	US/OR-01	Adair House	Hillsboro, Oregon
	US/OR-02	Conifer House	Hillsboro, Oregon
	US/OR-03	Edwards House	Hillsboro, Oregon
	US/OR-04	Shelter House	Hillsboro, Oregon
	US/OR-05	Waibel House	Hillsboro, Oregon
	US/OR-06	Cameo House	Hillsboro, Oregon
	US/OR-07	Hawley House	Hillsboro, Oregon
*	US/OR-08	Modena Homes	Eugene, Oregon
	US/OR-09	ODOE House #1	Tumalo, Oregon
	US/OR-10	ODOE House #2	Keizer, Oregon
	US/OR-11	ODOE House #3	West Eugene, Oregon
	US/OR-12	ODOE House #4	West Hills, Oregon
	US/OR-13	ODOE House #5	Sisters, Oregon
	US/OR-14	PP&L Solar House #1	Coos Bay, Oregon
	US/OR-15	PP&L Solar House #2	Bend, Oregon
	US/OR-16	PP&L Solar House #3	Grants Pass, Oregon
	US/OR-17	PP&L Retrofit House	Portland, Oregon
UNITED STATES - RHODE ISLAND			
	US/RI-01	Mastin Double Envelope House	Middletown, Rhode Island
*	US/RI-02	Jamestown House (Site NEL)	Jamestown, Rhode Island
UNITED STATES - SOUTH CAROLINA			
	US/SC-01	Manning House (Site SSJ)	Manning, South Carolina
UNITED STATES - TENNESSEE			
	US/TN-01	Tech House V	Knoxville, Tennessee
	US/TX-01	Houston House (Site SSB)	Houston, Texas
	US/TX-02	Passive Test Facility	San Antonio, Texas
	US/TX-03	Grapevine Passive Solar Homes	Grapevine, Texas
UNITED STATES - VIRGINIA			
*	US/VA-01	Roberts Home	Reston, Virginia
	US/VA-02	Usry Direct Gain (Site MBG)	Richmond, Virginia
	US/VA-03	Usry Solarium (Site MBY)	Richmond, Virginia
	US/VA-04	Stephens City House (Site SSL)	Stephens City, Virginia
*	US/VA-05	Richmond House (Site SSN)	Richmond, Virginia
UNITED STATES - VERMONT			
	US/VT-01	Blouin House	South Royalton, Vermont
*	US/VT-02	Newport House (Site NED)	Newport, Vermont
	US/VT-03	South Royalton House (Site NEK)	South Royalton, Vermont

* Denotes projects presented in more detail in Chapter 5.

LIST OF SITES BY LOCATION

UNITED STATES - WASHINGTON			
	US/WA-01	Hildahl Construction	Spokane, Washington
	US/WA-02	Aspen Homes	Spokane, Washington
	US/WA-03	B&B Enterprises	Spokane, Washington
	US/WA-04	Capp Homes	Spokane, Washington
	US/WA-05	Caravelle House	Spokane, Washington
	US/WA-06	Farrow Construction	Spokane, Washington
	US/WA-07	Montague Construction	Spokane, Washington
	US/WA-08	Roth Development	Spokane, Washington
	US/WA-09	Michael's Homes	Spokane, Washington
UNITED STATES - WISCONSIN			
*	US/WI-01	Eau Claire House (Site MAC)	Eau Claire, Wisconsin
	US/WI-02	Spencer House (Site MBB)	Spencer, Wisconsin
	US/WI-03	WP&L Beloit House	Beloit, Wisconsin
	US/WI-04	WP&L Fond-du Lac-House	Fond-du-Lac, Wisconsin
	US/WI-05	WP&L Janesville House	Janesville, Wisconsin
UNITED STATES - WYOMING			
	US/WY-01	PP&L House #5	Sheridan, Wyoming

LIST OF SITES BY LEVEL OF MONITORING

LEVEL	SITE	LEVEL	SITE
A+	US/CO-16	B+	US/CO-08
A	SW-05	B+	US/CO-09
A	US/CO-17	B+	US/CO-10
A	US/MD-08	B+	US/CO-11
A-	CD-01	B+	US/CO-12
A-	CD-02	B+	US/CO-13
A-	CH-05	B+	US/CO-14
A-	CH-06	B+	US/CO-15
A-	NO-08	B+	US/CT-01
A-	US/AZ-01	B+	US/GA-01
A-	US/AZ-02	B+	US/GA-03
A-	US/AZ-03	B+	US/GA-04
A-	US/FL-01	B+	US/IA-02
A-	US/IL-01	B+	US/IA-03
B+	BE-01	B+	US/MA-01
B+	BE-02	B+	US/MA-02
B+	BE-03	B+	US/MA-03
B+	SW-01	B+	US/MA-04
B+	SW-02	B+	US/MA-05
B+	SW-04	B+	US/MA-06
B+	US/AZ-06	B+	US/MD-02
B+	US/AZ-08	B+	US/MD-03
B+	US/CA-01	B+	US/MD-04
B+	US/CA-04	B+	US/MD-05
B+	US/CA-05	B+	US/MD-06
B+	US/CA-07	B+	US/MD-07
B+	US/CA-08	B+	US/MD-09
B+	US/CA-09	B+	US/MD-10
B+	US/CA-10	B+	US/MD-11
B+	US/CA-11	B+	US/ME-01
B+	US/CA-12	B+	US/MN-01
B+	US/CA-13	B+	US/MN-02
B+	US/CA-14	B+	US/MN-03
B+	US/CA-15	B+	US/MN-04
B+	US/CA-16	B+	US/MN-05
B+	US/CA-17	B+	US/NB-01
B+	US/CO-01	B+	US/NC-01
B+	US/CO-02	B+	US/NC-02
B+	US/CO-03	B+	US/NC-03
B+	US/CO-04	B+	US/ND-01
B+	US/CO-05	B+	US/NH-01
B+	US/CO-06	B+	US/NJ-01
B+	US/CO-07	B+	US/NM-01

LIST OF SITES BY LEVEL OF MONITORING (CONT'D)

LEVEL	SITE
B+	US/NY-01
B+	US/OH-01
B+	US/OK-01
B+	US/OR-01
B+	US/OR-02
B+	US/OR-03
B+	US/OR-04
B+	US/OR-05
B+	US/OR-06
B+	US/OR-07
B+	US/OR-08
B+	US/OR-14
B+	US/OR-15
B+	US/OR-16
B+	US/OR-17
B+	US/RI-02
B+	US/SC-01
B+	US/TX-01
B+	US/VA-01
B+	US/VA-02
B+	US/VA-03
B+	US/VA-04
B+	US/VA-05
B+	US/VT-02
B+	US/VT-03
B+	US/WA-01
B+	US/WA-02
B+	US/WA-03
B+	US/WA-04
B+	US/WA-05
B+	US/WA-06
B+	US/WA-07
B+	US/WA-08
B+	US/WA-09
B+	US/WI-01
B+	US/WI-02
B+	US/WY-01
B	CH-01
B	CH-02
B	CH-03
B	CH-04
B	DK-01
B	NO-01
B	NO-03
B	NO-04
B	NO-05
B	NO-06
B	NO-07

LEVEL	SITE
B	SW-03
B	SW-06
B	US/AZ-07
B	US/AZ-09
B	US/AZ-10
B	US/CA-02
B	US/CA-03
B	US/CA-06
B	US/IA-01
B	US/KS-01
B	US/KS-02
B	US/MA-07
B	US/MI-01
B	US/MT-02
B	US/NM-02
B	US/NY-02
B	US/OR-09
B	US/OR-10
B	US/OR-11
B	US/OR-12
B	US/OR-13
B	US/RI-01
B	US/TN-01
B	US/TX-02
B	US/VT-01
B	US/WI-03
B	US/WI-04
B	US/WI-05
B	DK-02
B	DK-03
B-	CH-07
B-	CH-08
B-	CH-09
B-	CH-10
B-	NO-02
B-	SW-07
B-	US/AZ-04
B-	US/AZ-05
B-	US/AZ-11
B-	US/AZ-12
B-	US/GA-02
B-	US/ID-01
B-	US/MD-01
B-	US/MT-01
B-	US/MT-03
B-	US/NC-01
B-	US/TX-03

LIST OF SITES BY HEATING DEGREE DAYS (BASE 18 DEGREES C)

HDD	SITE	HDD	SITE
5990	CD-02	3797	US/WA-09
5420	US/MN-01	3728	US/IA-01
5262	US/CO-13	3694	US/OR-13
5150	US/ND-01	3691	US/OR-15
4944	US/MN-04	3669	SW-05
4944	US/MN-05	3667	US/CO-17
4836	US/VT-02	3667	US/NB-01
4799	NO-02	3660	CH-03
4799	NO-05	3660	CH-08
4799	NO-06	3660	CH-09
4799	NO-07	3650	CH-01
4722	US/VT-01	3650	CH-02
4718	US/CA-12	3600	SW-01
4674	CD-01	3600	SW-06
4660	US/WI-01	3560	CH-07
4660	US/WI-02	3553	US/IA-02
4592	US/NY-02	3553	US/IA-03
4571	US/MN-03	3528	US/CT-01
4533	US/MN-02	3528	US/MA-05
4500	US/MT-01	3506	US/NM-02
4499	US/WI-04	3460	US/MI-01
4484	US/MT-02	3366	US/MA-03
4459	NO-04	3347	US/CO-01
4459	NO-08	3347	US/NM-01
4294	US/WI-03	3342	US/CO-02
4294	US/WI-05	3342	US/CO-03
4291	US/MT-03	3342	US/CO-04
4282	US/WY-01	3342	US/CO-05
4240	CH-10	3342	US/CO-06
4237	NO-03	3342	US/CO-07
4200	NO-01	3342	US/CO-08
4166	US/ME-01	3342	US/CO-09
4100	SW-02	3342	US/CO-10
4089	US/NH-01	3342	US/CO-11
4089	US/VT-03	3342	US/CO-12
4047	US/NY-01	3342	US/CO-14
4000	CH-04	3342	US/CO-15
3944	US/OR-09	3342	US/CO-16
3920	SW-03	3318	US/RI-02
3797	US/WA-01	3314	US/IL-01
3797	US/WA-02	3241	US/ID-01
3797	US/WA-03	3220	US/RI-01
3797	US/WA-04	3123	US/MA-04
3797	US/WA-05	3123	US/MA-06
3797	US/WA-06	3123	US/MA-07
3797	US/WA-07	3122	US/MA-01
3797	US/WA-08	3122	US/MA-02

LIST OF SITES BY HEATING DEGREE DAYS (BASE 18 DEGREES C)

HDD	SITE
3056	US/MD-01
3006	SW-04
3006	SW-07
2976	US/KS-01
2976	US/KS-02
2829	DK-01
2829	DK-02
2829	DK-03
2817	US/OH-01
2792	US/AZ-07
2789	US/MD-09
2789	US/MD-10
2789	US/MD-11
2783	US/MD-02
2783	US/MD-03
2783	US/MD-04
2783	US/MD-05
2783	US/MD-06
2783	US/MD-07
2783	US/VA-01
2739	US/OR-16
2720	CH-05
2720	CH-06
2696	US/OR-08
2694	US/OR-10
2662	US/OR-01
2662	US/OR-02
2662	US/OR-03
2662	US/OR-04
2662	US/OR-05
2662	US/OR-06
2662	US/OR-07
2662	US/OR-12
2662	US/OR-17
2633	US/OR-11
2604	US/CA-03
2604	US/OR-14
2506	US/CA-11
2500	US/VA-04
2477	US/NJ-01
2476	US/AZ-06
2347	US/MD-08
2246	US/NC-03
2188	US/VA-02
2188	US/VA-03
2147	US/VA-05
2100	BE-01
2100	BE-02
2100	BE-03
2069	US/OK-01
1952	US/NC-01
1952	US/NC-02
1932	US/TN-01
1917	US/CA-17
1667	US/GA-02
1645	US/GA-01
1645	US/GA-03
1645	US/GA-04
1601	US/CA-07
1601	US/CA-14
1601	US/CA-15
1601	US/CA-16
1579	US/CA-01
1579	US/CA-04
1579	US/CA-05
1566	US/CA-02
1550	US/CA-06
1548	US/CA-10
1380	US/SC-01
1262	US/TX-03
1066	US/CA-08
1066	US/CA-09
1028	US/CA-13
973	US/AZ-01
973	US/AZ-02
973	US/AZ-03
973	US/AZ-09
973	US/AZ-11
973	US/AZ-12
862	US/AZ-04
862	US/AZ-05
862	US/AZ-08
862	US/AZ-10
861	US/TX-02
776	US/TX-01
407	US/FL-01

LIST OF SITES BY COOLING DEGREE DAYS (BASE 18 DEGREES C)

CDD	SITE	CDD	SITE
1949	US/AZ-04	496	US/IA-03
1949	US/AZ-05	490	US/AZ-06
1949	US/AZ-08	483	US/CA-07
1944	US/AZ-10	483	US/CA-14
1563	US/AZ-01	483	US/CA-15
1563	US/AZ-02	483	US/CA-16
1563	US/AZ-03	419	US/CA-11
1563	US/AZ-09	419	US/CA-17
1563	US/AZ-11	368	US/AZ-07
1563	US/AZ-12	367	US/MA-01
1500	US/TX-03	367	US/MA-02
1002	US/CA-10	347	US/CO-02
883	US/GA-01	347	US/CO-03
883	US/GA-02	347	US/CO-04
736	US/CA-08	347	US/CO-05
736	US/CA-09	347	US/CO-06
700	US/CA-06	347	US/CO-07
644	US/CA-01	347	US/CO-08
644	US/CA-04	347	US/CO-09
644	US/CA-05	347	US/CO-10
600	US/OH-01	347	US/CO-11
592	US/CA-02	347	US/CO-12
584	US/IL-01	347	US/CO-14
569	US/NJ-01	347	US/CO-15
552	US/MD-02	347	US/CO-16
552	US/MD-03	262	US/ND-01
552	US/MD-04	260	US/CA-12
552	US/MD-05	256	US/CO-01
552	US/MD-06	242	CD-01
552	US/MD-07	239	US/CO-17
552	US/MD-08	205	US/NY-01
522	US/MD-09	176	US/MN-01
522	US/MD-10	149	US/CA-13
522	US/MD-11	129	US/OR-08
522	US/VA-01	30	CD-02

LIST OF SITES BY GLOBAL SOLAR RADIATION (KWh/m 2)

SITE	GSR	SITE	GSR
US/AZ-07	NO VALUE	US/OR-05	1213
US/CA-11	NO VALUE	US/OR-06	1213
US/CO-13	NO VALUE	US/OR-04	1213
US/AZ-10	NO VALUE	US/OR-02	1213
US/CA-17	NO VALUE	US/MA-03	1219
NO-04	NO VALUE	US/CT-01	1219
NO-01	NO VALUE	US/MA-05	1219
SW-05	NO VALUE	US/MN-01	1224
SW-06	780	US/OR-17	1230
SW-01	849	US/OR-12	1241
NO-03	902	US/MA-01	1272
NO-07	911	US/MA-02	1272
NO-06	911	US/MA-04	1272
NO-05	911	US/MA-07	1272
NO-02	912	US/MA-06	1272
SW-03	960	US/RI-01	1280
BE-02	975	US/RI-02	1281
BE-03	975	US/MI-01	1290
BE-01	975	CD-02	1298
SW-02	990	CH-05	1300
NO-08	990	CH-06	1300
DK-02	1018	US/WI-01	1304
DK-01	1018	US/WI-02	1304
DK-03	1018	US/MN-04	1307
US/NJ-01	1067	US/MN-05	1307
CH-10	1090	US/OR-11	1314
SW-04	1092	US/OR-10	1314
SW-07	1092	US/WI-04	1317
CH-03	1110	CD-01	1328
CH-01	1110	US/MN-03	1331
CH-09	1114	US/OH-01	1332
CH-02	1115	US/MN-02	1348
US/NY-01	1145	US/WI-05	1372
CH-08	1166	US/WI-03	1372
CH-07	1168	US/ND-01	1384
US/NY-02	1187	US/MD-09	1390
CH-04	1190	US/MD-11	1390
US/VT-01	1203	US/VA-01	1390
US/ME-01	1210	US/MD-10	1390
US/VT-02	1212	US/OR-08	1390
US/VT-03	1213	US/MD-05	1391
US/OR-03	1213	US/MD-04	1391
US/NH-01	1213	US/MD-03	1391

LIST OF SITES BY GLOBAL SOLAR RADIATION (KWh/m 2)

SITE	GSR	SITE	GSR
US/VA-04	1391	US/OR-09	1606
US/MD-06	1391	US/CO-17	1638
US/MD-02	1391	US/OK-01	1682
US/MD-07	1391	US/FL-01	1711
US/CA-03	1405	US/ID-01	1724
US/IA-02	1410	US/TX-02	1726
US/WA-04	1411	US/CA-13	1764
US/WA-09	1411	US/NM-02	1765
US/WA-01	1411	US/NM-01	1765
US/WA-02	1411	US/CO-01	1803
US/WA-05	1411	US/CO-09	1805
US/WA-06	1411	US/CO-14	1805
US/WA-07	1411	US/CO-03	1805
US/WA-03	1411	US/CO-02	1805
US/WA-08	1411	US/CO-12	1805
US/IA-03	1433	US/CO-10	1805
US/VA-02	1435	US/CO-07	1805
US/VA-03	1435	US/CO-06	1805
US/VA-05	1437	US/CO-16	1805
US/OR-14	1450	US/CO-05	1805
US/MT-02	1456	US/CO-15	1805
US/MT-01	1456	US/CO-04	1805
US/TN-01	1466	US/CO-08	1805
US/NC-02	1491	US/CO-11	1805
US/NC-01	1491	US/CA-05	1830
US/IL-01	1499	US/CA-04	1830
US/NC-03	1510	US/CA-07	1832
US/IA-01	1511	US/CA-14	1832
US/NB-01	1521	US/CA-15	1832
US/MT-03	1527	US/CA-16	1832
US/WY-01	1533	US/CA-09	1862
US/KS-02	1543	US/CA-08	1862
US/KS-01	1543	US/AZ-06	1867
US/GA-01	1548	US/CA-01	1889
US/GA-03	1548	US/CA-02	1892
US/GA-04	1548	US/CA-06	1893
US/GA-02	1549	US/TX-03	1913
US/TX-01	1556	US/CA-12	2028
US/OR-16	1559	US/AZ-02	2154
US/CA-10	1559	US/AZ-01	2154
US/AZ-08	1576	US/AZ-03	2154
US/AZ-04	1576	US/AZ-09	2155
US/SC-01	1589	US/AZ-05	2155

LIST OF SITES BY APERTURE/FLOOR AREA RATIO

RATIO	SITE
0.68	BE-01
0.42	US/MN-01
0.41	US/CA-02
0.40	US/AZ-06
0.39	SW-05
0.35	US/VA-01
0.33	US/CA-13
0.32	US/MD-08
0.31	BE-03
0.30	US/NY-01
0.29	US/MT-03
0.27	CH-10
0.26	US/RI-01
0.25	NO-05
0.25	NO-06
0.25	US/NJ-01
0.25	US/OH-01
0.25	US/CA-10
0.24	US/MA-01
0.24	US/AZ-07
0.23	US/CA-12
0.23	US/CO-13
0.23	BE-02
0.22	US/MA-02
0.22	US/CA-07
0.22	US/CO-17
0.22	US/IA-01
0.22	US/MI-01
0.21	US/VA-05
0.21	US/CA-03
0.21	US/NM-01
0.21	CH-09
0.20	US/VA-03
0.20	US/CO-01
0.19	US/NC-01
0.19	US/NM-02
0.19	US/MA-04
0.19	US/WI-01
0.19	US/VA-04
0.19	US/CA-04
0.19	US/OR-16
0.18	US/OR-15
0.18	US/OK-01
0.18	US/CO-08
0.18	US/CA-11
0.17	US/GA-01
0.17	NO-04
0.17	US/WY-01
0.17	US/WI-04
0.17	US/CO-11
0.16	US/GA-02
0.16	US/AZ-03
0.16	US/IA-03
0.16	US/OR-17
0.16	US/CA-01
0.16	US/SC-01
0.16	US/NH-01
0.16	SW-01
0.16	US/VA-02
0.15	US/MA-05
0.15	US/CA-15
0.15	US/CA-17
0.15	US/CO-06
0.15	US/CO-02
0.15	US/RI-02
0.15	SW-03
0.14	US/CA-05
0.14	US/CO-05
0.14	US/CO-15
0.14	US/MN-03
0.14	US/NB-01
0.14	US/OR-08
0.14	NO-02
0.14	NO-08
0.13	US/WA-01
0.13	US/AZ-10
0.13	US/NC-03
0.13	US/MA-03
0.13	US/NC-01
0.13	US/CT-01
0.13	US/MA-06
0.13	US/ME-01
0.12	US/CA-08
0.12	US/TN-01
0.12	US/CO-03
0.12	US/MD-11
0.12	US/MN-02
0.12	US/MA-07
0.12	US/AZ-09
0.11	DK-01
0.11	CD-02
0.11	US/WI-03
0.11	US/CO-04
0.11	US/CA-14
0.11	US/MD-06
0.11	US/AZ-04
0.11	US/CO-10
0.11	US/CO-07
0.11	CH-01
0.10	US/VT-03
0.10	US/WI-05
0.10	US/KS-02
0.10	US/AZ-08
0.10	CH-08
0.10	SW-07
0.10	US/IL-01
0.10	US/AZ-02
0.10	US/CO-09
0.09	US/AZ-12
0.09	CD-01
0.09	NO-07
0.09	US/CO-12
0.09	US/TX-01
0.09	US/IA-02
0.08	US/WI-02
0.08	US/MD-01
0.08	US/TX-03
0.08	US/MD-10
0.08	SW-02
0.07	US/OR-01
0.07	CH-06
0.07	US/TX-02
0.07	US/ND-01
0.07	US/CO-16
0.07	US/GA-03
0.07	US/NY-02
0.06	US/VT-02
0.05	US/MD-02
0.05	US/MD-03
0.05	US/MD-04
0.05	US/MD-05
0.05	US/MD-07
0.05	US/AZ-01
0.05	US/CO-14
0.05	CH-07
0.04	CH-02
0.04	US/GA-04
0.04	US/MD-09
0.04	DK-03
0.04	US/VT-01
0.03	SW-04
0.03	US/CA-16
0.03	SW-06
0.03	US/CA-09
0.02	CH-05
0.02	US/AZ-11

LIST OF SITES BY HEATED FLOOR AREA (M^2)

AREA	SITE	AREA	SITE	AREA	SITE
4500	DK-02	170	US/CO-02	120	NO-05
1040	NO-08	168	US/WI-01	120	NO-06
978	CH-02	168	BE-03	120	US/FL-01
861	SW-07	168	US/CA-03	119	US/CO-14
401	SW-05	167	US/CA-04	119	US/MN-03
368	US/GA-04	167	US/ND-01	118	US/CA-07
317	US/GA-01	165	BE-01	118	US/OR-01
306	US/CO-04	165	SW-06	117	SW-04
301	US/CO-05	162	US/CT-01	115	US/VA-05
273	US/MA-07	162	US/CO-12	115	US/MT-03
269	US/NE-01	160	CH-01	114	US/IA-02
269	US/MI-01	158	US/CA-01	113	SW-01
265	US/CO-07	158	US/IA-03	113	US/CA-14
257	US/CO-09	155	SW-02	112	US/VA-04
257	US/SC-01	155	US/CA-08	111	US/CA-16
240	BE-02	154	US/CA-09	111	US/TN-01
238	US/MD-01	153	US/MN-02	110	NO-04
232	US/CO-17	152	US/NC-02	110	US/RI-02
232	US/OK-01	151	US/TX-03	110	US/VA-02
218	US/CO-13	150	DK-01	108	US/CA-12
214	US/NM-01	150	US/CA-02	106	US/AZ-08
214	US/VA-01	149	US/OH-01	101	US/CO-08
211	US/GA-02	148	US/AZ-11	100	DK-03
209	US/KS-01	148	US/AZ-12	100	NO-03
205	US/MA-06	147	US/MD-09	98	CD-02
204	US/GA-03	147	US/MD-10	98	US/AZ-06
204	US/WY-01	147	US/MD-11	95	US/AZ-05
202	US/KS-02	145	US/VT-01	94	US/WI-02
200	US/CO-15	144	US/WI-03	93	US/AZ-01
200	US/OR-16	144	US/WI-05	93	US/AZ-02
196	US/TX-01	143	US/ME-01	93	US/AZ-03
195	US/MA-04	143	US/VA-03	93	US/AZ-09
195	US/CA-11	141	US/AZ-04	93	US/CO-16
190	US/NJ-01	140	NO-07	83	US/NC-03
190	CH-10	140	CH-07	83	US/NC-01
189	US/CO-11	140	CH-09	78	US/CA-13
188	US/NC-01	139	US/OR-08	74	US/TX-02
188	US/WI-04	139	US/CA-17	59	US/MA-03
187	US/NY-02	136	US/VT-03	48	US/MA-01
186	US/RI-01	134	US/VT-02	47	US/MA-02
186	US/AZ-10	132	US/CA-05	37	US/MD-02
182	US/NM-02	132	US/CA-15	37	US/MD-03
180	CH-08	128	US/WA-01	37	US/MD-04
179	US/NH-01	128	US/CA-10	37	US/MD-05
176	US/AZ-07	126	US/CO-03	37	US/MD-06
175	SW-03	126	US/NY-01	37	US/MD-07
174	US/CO-06	125	US/OR-15	31	US/MD-08
173	US/CO-01	125	US/MA-05	28	CD-01
172	US/OR-13	121	US/MN-01	17	NO-02
172	US/IL-01	121	US/OR-17	10	CH-05
171	US/IA-01	121	US/CO-10	10	CH-06

LIST OF SITES BY GLOBAL HEAT LOSS COEFFICIENT (W/DEGREE K)

GHLC	SITE CODE
19	NO-02
26	CD-01
41	US/MA-02
55	US/MA-03
59	US/MA-01
70	US/SC-01
74	US/MD-08
82	US/VA-01
85	SW-04
91	SW-01
100	NO-03
100	DK-03
115	US/MT-03
117	US/VT-02
119	US/WA-01
119	US/MN-02
120	SW-03
120	CD-02
125	US/MA-05
127	US/WI-02
130	DK-01
136	US/OR-11
137	US/CO-08
138	US/OR-01
140	US/NH-01
140	US/ID-01
144	SW-02
145	US/VT-03
145	SW-06
147	US/ME-01
148	BE-02
153	US/OH-01
153	US/ND-01
153	US/IA-02
158	US/OR-10
160	US/VA-04
163	US/WI-01
168	US/NC-03
176	US/RI-02
176	US/CA-16
179	US/NY-02
179	US/CA-15
183	US/TN-01
183	CH-09
186	US/CA-10
187	US/CO-10

GHLC	SITE CODE
191	CH-07
197	US/CO-11
212	US/CA-13
218	US/CA-12
220	US/CA-14
227	US/CA-05
232	US/CO-12
233	US/VA-05
244	US/IA-01
251	US/CT-01
252	US/NB-01
253	US/CO-09
262	US/MT-02
263	US/MA-04
265	US/CO-03
270	US/CA-02
277	US/CA-17
284	US/CO-06
290	US/CO-07
291	US/CA-07
292	US/TX-03
300	CH-10
307	US/CA-09
309	US/CO-02
309	BE-03
310	US/CA-08
322	US/OR-13
327	US/CO-15
331	US/MA-07
339	BE-01
339	US/OR-09
343	US/NC-02
364	US/GA-02
369	US/CO-04
371	CH-08
385	US/CA-04
403	US/OR-12
405	US/TX-01
413	US/CO-17
423	US/CO-05
426	US/AZ-07
443	US/GA-04
504	US/CA-11
530	US/GA-03
646	US/OK-01
830	SW-05

LIST OF SITES BY PASSIVE HEATING SYSTEM TYPE

PASSIVE HEATING SYSTEM TYPE	SITE CODE
convective air heater; mass wall; direct gain	US/AZ-04
convective air heater; direct gain; hybrid	CH-10
direct gain	CH-08
direct gain	DK-01
direct gain	DK-02
direct gain	NO-02
direct gain	NO-07
direct gain	NO-08
direct gain	SW-01
direct gain	SW-06
direct gain	US/AZ-09
direct gain	US/AZ-11
direct gain	US/CA-05
direct gain	US/CA-08
direct gain	US/CA-11
direct gain	US/CA-14
direct gain	US/CA-16
direct gain	US/CO-03
direct gain	US/CO-12
direct gain	US/CO-16
direct gain	US/GA-03
direct gain	US/IA-02
direct gain	US/IA-03
direct gain	US/IL-01
direct gain	US/KS-02
direct gain	US/MA-04
direct gain	US/MD-02
direct gain	US/MD-04
direct gain	US/MD-06
direct gain	US/MD-09
direct gain	US/MD-10
direct gain	US/MD-11
direct gain	US/MN-03
direct gain	US/MN-05
direct gain	US/NC-01
direct gain	US/NC-02
direct gain	US/ND-01
direct gain	US/NY-01
direct gain	US/NY-02
direct gain	US/OK-01
direct gain	US/OR-01
direct gain	US/OR-02
direct gain	US/OR-06
direct gain	US/OR-08
direct gain	US/OR-09
direct gain	US/OR-11
direct gain	US/OR-12
direct gain	US/TX-01
direct gain	US/VT-01
direct gain	US/VT-02
direct gain	US/VT-03
direct gain	US/WA-06

LIST OF SITES BY PASSIVE HEATING SYSTEM TYPE (CONT'D)

PASSIVE HEATING SYSTEM TYPE	SITE CODE
direct gain	CD-02
direct gain	DK-03
direct gain	NO-03
direct gain	SW-04
direct gain	US/AZ-02
direct gain	US/AZ-10
direct gain	US/CA-01
direct gain	US/CA-07
direct gain	US/CA-09
direct gain	US/CA-12
direct gain	US/CA-15
direct gain	US/CA-17
direct gain	US/CO-06
direct gain	US/CO-14
direct gain	US/MA-07
direct gain	US/MD-03
direct gain	US/MD-05
direct gain	US/MD-07
direct gain	US/WI-02
direct gain	US/WI-03
direct gain	US/WI-05
direct gain; convective air heater; hybrid	CH-10
direct gain; half mass wall	US/NC-03
direct gain; hybrid	CH-07
direct gain; hybrid	CH-09
direct gain; mass wall	US/CA-02
direct gain; mass wall	US/CA-04
direct gain; mass wall	US/CA-13
direct gain; mass wall	US/CO-10
direct gain; mass wall	US/CO-11
direct gain; mass wall	US/GA-01
direct gain; mass wall	US/IA-01
direct gain; mass wall	US/MA-01
direct gain; mass wall	US/MD-08
direct gain; mass wall	US/MN-02
direct gain; mass wall	US/MN-04
direct gain; mass wall	US/NM-02
direct gain; mass wall	US/VA-02
direct gain; mass wall (water)	US/VA-04
direct gain; mass wall (water)	US/VA-05
direct gain; mass wall; convective air heater	US/AZ-04
direct gain; roof pond	US/TX-02
direct gain; sunspace	BE-02
direct gain; sunspace	CD-01
direct gain; sunspace	CH-01
direct gain; sunspace	CH-05
direct gain; sunspace	NO-01
direct gain; sunspace	SW-03
direct gain; sunspace	US/AZ-01
direct gain; sunspace	US/CA-06
direct gain; sunspace	US/CO-05
direct gain; sunspace	US/CO-09
direct gain; sunspace	US/NM-01
direct gain; sunspace	US/OR-04

LIST OF SITES BY PASSIVE HEATING SYSTEM TYPE (CONT'D)

PASSIVE HEATING SYSTEM TYPE	SITE CODE
direct gain; sunspace	BE-01
direct gain; sunspace	CH-02
direct gain; sunspace	CH-04
direct gain; sunspace	CH-06
direct gain; sunspace	SW-02
direct gain; sunspace	SW-05
direct gain; sunspace	SW-07
direct gain; sunspace	US/CA-10
direct gain; sunspace	US/CO-01
direct gain; sunspace	US/CO-04
direct gain; sunspace	US/CO-15
direct gain; sunspace	US/CT-01
direct gain; sunspace	US/GA-02
direct gain; sunspace	US/GA-04
direct gain; sunspace	US/MA-06
direct gain; sunspace	US/MD-01
direct gain; sunspace	US/ME-01
direct gain; sunspace	US/MN-01
direct gain; sunspace	US/NH-01
direct gain; sunspace	US/OR-05
direct gain; sunspace	US/OR-07
direct gain; sunspace	US/RI-02
direct gain; sunspace	US/TX-03
direct gain; sunspace	US/VA-03
direct gain; sunspace	US/WA-01
direct gain; sunspace	US/WI-01
direct gain; sunspace; double shell	NO-04
direct gain; sunspace; mass wall	BE-03
direct gain; sunspace; mass wall	US/AZ-07
direct gain; sunspace; mass wall	US/CA-03
direct gain; sunspace; mass wall	US/CO-07
direct gain; sunspace; mass wall	US/CO-13
direct gain; sunspace; mass wall	US/CO-17
direct gain; sunspace; mass wall	US/ID-01
direct gain; sunspace; mass wall	US/MA-03
direct gain; sunspace; mass wall	US/MI-01
direct gain; sunspace; mass wall	US/NC-01
direct gain; sunspace; mass wall	US/NE-01
direct gain; sunspace; mass wall	US/OR-13
direct gain; sunspace; mass wall	US/OR-16
direct gain; sunspace; mass wall	US/WY-01
direct gain; sunspace; vertical rockbed	US/MA-02
direct gain; water wall	US/MT-02
double shell; direct gain; sunspace	NO-04
double shell; sunspace	NO-05
double shell; sunspace	NO-06
hybrid; direct gain	CH-07
hybrid; direct gain	CH-09
hybrid; direct gain; convective air heater	CH-10
mass wall	US/NJ-01
mass wall	US/OR-03
mass wall	US/VA-01
mass wall	US/WA-03
mass wall	US/WI-04

PASSIVE HEATING SYSTEM TYPE	SITE CODE
mass wall (water); direct gain	US/VA-04
mass wall (water); direct gain	US/VA-05
mass wall; "Clear View" solar collector	US/AZ-03
mass wall; convective air heater; direct gain	US/AZ-04
mass wall; direct gain	US/CA-02
mass wall; direct gain	US/CA-04
mass wall; direct gain	US/CA-13
mass wall; direct gain	US/CO-10
mass wall; direct gain	US/CO-11
mass wall; direct gain	US/GA-01
mass wall; direct gain	US/IA-01
mass wall; direct gain	US/MA-01
mass wall; direct gain	US/MD-08
mass wall; direct gain	US/MN-02
mass wall; direct gain	US/MN-04
mass wall; direct gain	US/NC-03
mass wall; direct gain	US/NM-02
mass wall; direct gain	US/VA-02
mass wall; direct gain; sunspace	BE-03
mass wall; direct gain; sunspace	US/AZ-07
mass wall; direct gain; sunspace	US/CA-03
mass wall; direct gain; sunspace	US/CO-07
mass wall; direct gain; sunspace	US/CO-13
mass wall; direct gain; sunspace	US/CO-17
mass wall; direct gain; sunspace	US/ID-01
mass wall; direct gain; sunspace	US/MA-03
mass wall; direct gain; sunspace	US/MI-01
mass wall; direct gain; sunspace	US/NB-01
mass wall; direct gain; sunspace	US/NC-01
mass wall; direct gain; sunspace	US/OR-13
mass wall; direct gain; sunspace	US/OR-16
mass wall; direct gain; sunspace	US/WY-01
mass wall; sunspace	US/AZ-06
mass wall; sunspace	US/OH-01
mass wall; sunspace	US/OR-15
mass wall; sunspace	US/SC-01
roof pond; direct gain	US/TX-02
sunspace	CH-03
sunspace	US/AZ-08
sunspace	US/CO-08
sunspace	US/MA-05
sunspace	US/MT-01
sunspace	US/MT-03
sunspace	US/OR-10
sunspace	US/OR-17
sunspace	US/RI-01
sunspace	US/WA-02
sunspace	US/WA-04
sunspace	US/WA-07
sunspace	US/WA-08
sunspace	US/WA-09

LIST OF SITES BY PASSIVE HEATING SYSTEM TYPE (CONT'D)

PASSIVE HEATING SYSTEM TYPE	SITE CODE
sunspace	US/WA-05
sunspace; direct gain	BE-01
sunspace; direct gain	BE-02
sunspace; direct gain	CD-01
sunspace; direct gain	CH-01
sunspace; direct gain	CH-02
sunspace; direct gain	CH-04
sunspace; direct gain	CH-05
sunspace; direct gain	CH-06
sunspace; direct gain	NO-01
sunspace; direct gain	SW-02
sunspace; direct gain	SW-03
sunspace; direct gain	SW-05
sunspace; direct gain	SW-07
sunspace; direct gain	US/AZ-01
sunspace; direct gain	US/CA-06
sunspace; direct gain	US/CA-10
sunspace; direct gain	US/CO-01
sunspace; direct gain	US/CO-04
sunspace; direct gain	US/CO-05
sunspace; direct gain	US/CO-09
sunspace; direct gain	US/CO-15
sunspace; direct gain	US/CT-01
sunspace; direct gain	US/GA-02
sunspace; direct gain	US/GA-04
sunspace; direct gain	US/MA-06
sunspace; direct gain	US/MD-01
sunspace; direct gain	US/ME-01
sunspace; direct gain	US/MN-01
sunspace; direct gain	US/NH-01
sunspace; direct gain	US/NM-01
sunspace; direct gain	US/OR-04
sunspace; direct gain	US/OR-05
sunspace; direct gain	US/OR-07
sunspace; direct gain	US/RI-02
sunspace; direct gain	US/TX-03
sunspace; direct gain	US/VA-03
sunspace; direct gain	US/WA-01
sunspace; direct gain	US/WI-01
sunspace; double shell	NO-05
sunspace; double shell	NO-06
sunspace; double shell; direct gain	NO-04
sunspace; mass wall	US/AZ-06
sunspace; mass wall	US/OH-01
sunspace; mass wall	US/OR-15
sunspace; mass wall	US/SC-01
sunspace; mass wall; direct gain	BE-03
sunspace; mass wall; direct gain	US/ID-01
sunspace; mass wall; direct gain	US/MA-03
sunspace; mass wall; direct gain	US/MI-01
sunspace; mass wall; direct gain	US/WY-01

LIST OF SITES BY PASSIVE HEATING SYSTEM TYPE (CONT'D)

PASSIVE HEATING SYSTEM TYPE	SITE CODE
sunspace; mass wall; direct gain	US/AZ-07
sunspace; mass wall; direct gain	US/CA-03
sunspace; mass wall; direct gain	US/CO-07
sunspace; mass wall; direct gain	US/CO-13
sunspace; mass wall; direct gain	US/CO-17
sunspace; mass wall; direct gain	US/NE-01
sunspace; mass wall; direct gain	US/NC-01
sunspace; mass wall; direct gain	US/OR-13
sunspace; mass wall; direct gain	US/OR-16
sunspace; vertical rockbed; direct gain	US/MA-02
sunspace; vertical wall collector	US/CO-02
sunspace; water wall	US/OR-14
vertical rockbed; direct gain; sunspace	US/MA-02
vertical wall collector; sunspace	US/CO-02
water wall	US/TN-01
water wall; direct gain	US/MT-02
water wall; sunspace	US/OR-14

LIST OF SITES BY PASSIVE COOLING SYSTEM TYPE

PASSIVE COOLING SYSTEM TYPE	SITE CODE
earth contact	NO-01
earth contact	US/MT-03
earth contact; evaporative; ventilation	US/AZ-02
earth contact; radiation; evaporative; ventilation	US/AZ-01
earth contact; shading	US/MA-04
earth contact; shading; ventilation	US/CO-01
earth contact; shading; ventilation	US/CO-10
earth contact; ventilation	US/CO-02
earth contact; ventilation	US/CO-04
earth contact; ventilation	US/CO-17
earth contact; ventilation	US/GA-02
earth contact; ventilation	US/NC-01
earth contact; ventilation	US/NH-01
earth contact; ventilation	US/RI-01
earth cooling tube	US/ID-01
evaporative	US/AZ-03
evaporative	US/AZ-05
evaporative	US/AZ-12
evaporative	US/VT-01
evaporative; ventilation	US/AZ-09
evaporative; ventilation; earth contact	US/AZ-02
evaporative; ventilation; earth contact; radiation	US/AZ-01
evaporative; ventilation; shading	US/AZ-08
radiation; evaporative; ventilation; earth contact	US/AZ-01
regenerative rock bed	US/VA-03
shading	US/CA-16
shading	US/CT-01
shading	US/IL-01
shading	US/KS-02
shading	US/MA-06
shading	US/MN-02
shading	US/MN-03
shading	US/MN-05
shading	US/OK-01
shading	US/OR-08
shading; earth contact	US/MA-04
shading; evaporative; ventilation	US/AZ-08
shading; ventilation	US/AZ-06
shading; ventilation	US/CA-01
shading; ventilation	US/CA-02
shading; ventilation	US/CA-15
shading; ventilation	US/CO-05
shading; ventilation	US/CO-06
shading; ventilation	US/CO-08
shading; ventilation	US/CO-09
shading; ventilation	US/CO-15
shading; ventilation	US/IA-03
shading; ventilation	US/MD-10
shading; ventilation	US/MN-01
shading; ventilation; earth contact	US/CO-01

LIST OF SITES BY PASSIVE COOLING SYSTEM TYPE (CONT'D)

PASSIVE COOLING SYSTEM TYPE	SITE CODE
shading; ventilation; earth contact	US/CO-10
sky radiation; ventilation	US/TX-02
thermal chimney; ventilation	US/CA-07
ventilation; earth contact	US/CO-02
ventilation; earth contact	US/CO-04
ventilation; earth contact	US/CO-17
ventilation; earth contact	US/GA-02
ventilation; earth contact	US/NC-01
ventilation; earth contact	US/NH-01
ventilation; earth contact	US/RI-01
ventilation; earth contact; evaporative	US/AZ-02
ventilation; earth contact; radiation; evaporative	US/AZ-01
ventilation; earth contact; shading	US/CO-01
ventilation; earth contact; shading	US/CO-10
ventilation; evaporative	US/AZ-09
ventilation; shading	US/AZ-06
ventilation; shading	US/CA-01
ventilation; shading	US/CA-02
ventilation; shading	US/CA-15
ventilation; shading	US/CO-05
ventilation; shading	US/CO-06
ventilation; shading	US/CO-08
ventilation; shading	US/CO-09
ventilation; shading	US/CO-15
ventilation; shading	US/IA-03
ventilation; shading	US/MD-10
ventilation; shading	US/MN-01
ventilation; shading; evaporative	US/AZ-08
ventilation; sky radiation	US/TX-02
ventilation; thermal chimney	US/CA-07

Note: All other buildings use ventilation only as primary cooling system

LIST OF SITES BY OTHER PASSIVE COMPONENTS

OTHER PASSIVE COMPONENTS	SITE CODE
atrium roof vent	US/CA-06
exterior greenhouse shades	US/AZ-06
exterior shades; movable insulation	US/GA-01
insulating/reflective exterior panels	US/CO-07
movable insulation	CH-08
movable insulation	US/AZ-07
movable insulation	US/CA-04
movable insulation	US/CA-05
movable insulation	US/CA-07
movable insulation	US/CA-14
movable insulation	US/CO-01
movable insulation	US/CO-03
movable insulation	US/CO-04
movable insulation	US/CO-06
movable insulation	US/CO-11
movable insulation	US/CO-13
movable insulation	US/CO-15
movable insulation	US/CT-01
movable insulation	US/GA-03
movable insulation	US/GA-04
movable insulation	US/KS-02
movable insulation	US/MA-04
movable insulation	US/MA-05
movable insulation	US/MD-01
movable insulation	US/MD-10
movable insulation	US/ME-01
movable insulation	US/MN-01
movable insulation	US/MN-02
movable insulation	US/MN-03
movable insulation	US/MN-04
movable insulation	US/MT-02
movable insulation	US/MT-03
movable insulation	US/NC-01
movable insulation	US/NC-01
movable insulation	US/NC-03
movable insulation	US/ND-01
movable insulation	US/NY-01
movable insulation	US/OH-01
movable insulation	US/OK-01
movable insulation	US/OR-08
movable insulation	US/SC-01
movable insulation	US/TN-01
movable insulation	US/VA-01
movable insulation	US/VA-04
movable insulation	US/VA-05
movable insulation	US/WA-01
movable insulation	US/WI-01
movable insulation	US/WI-02
movable insulation	US/WI-03
movable insulation	US/WI-04

LIST OF SITES BY OTHER PASSIVE COMPONENTS (CONT'D)

OTHER PASSIVE COMPONENTS	SITE CODE
movable insulation	US/WI-05
movable insulation; exterior shades	US/GA-01
movable insulation; reflective shades	US/IA-03
movable insulation; reflectors	US/CA-01
movable insulation; reflectors	US/CA-02
movable insulation; reflectors	US/CA-08
movable insulation; thermal chimney	US/GA-02
reflective louvre blinds	US/MD-11
reflective shades; movable insulation	US/IA-03
reflectors; movable insulation	US/CA-01
reflectors; movable insulation	US/CA-02
reflectors; movable insulation	US/CA-08
shading devices in sunspace	SW-07
thermal chimney; movable insulation	US/GA-02
wing walls for natural ventilation	US/FL-01

LIST OF SITES BY THERMAL STORAGE MATERIALS

THERMAL STORAGE MATERIALS	SITE CODE
adobe wall; concrete slab	US/CA-12
adobe wall; concrete slab	US/CA-17
adobe walls; brick floor	US/AZ-01
adobe walls; rock bed	US/NM-01
asbestos cement	CH-03
brick	DK-03
brick wall	SW-03
brick walls	DK-02
brick & concrete wall; tile & concrete floor	US/CO-04
brick & tile floor; concrete walls; rock bed	US/AZ-06
brick chimney; concrete slab	US/MA-06
brick chimney; concrete slab	US/AZ-07
brick chimney; concrete slab; tile	US/MA-07
brick faced concrete wall; concrete slab	US/CT-01
brick fireplace; phase change rods; concrete floor	US/GA-01
brick floor & walls; concrete	US/CO-05
brick floor; adobe walls	US/AZ-01
brick floor; concrete block walls; water tubes	US/NH-01
brick floor; concrete wall; rock bed	US/NB-01
brick on wall & floor; concrete wall	US/CO-10
brick over concrete floor slab	US/GA-03
brick veneer & concrete wall; tiled concrete floor	US/CO-07
brick veneer wall; concrete wall; concrete slab	US/CO-12
brick veneer walls; rock bin	US/CO-06
brick wall; concrete slab	US/TX-03
brick wall; concrete slab	US/CO-17
brick wall; concrete slab; tile	US/WY-01
brick wall; tiled concrete slab	US/CO-09
brick wall; tiled concrete slab	US/CO-03
brick walls; concrete floor	US/WI-01
brick; concrete block; concrete slab	US/SC-01
bricks on floor	US/CO-16
clay block and plaster interior walls; concrete floor; rockbed	CH-07
clay block and plaster interior walls; concrete floor	CH-08
clay block and plaster interior walls; concrete floor; rockbed	CH-09
clay block and plaster interior walls; concrete floor	CH-10
concrete	US/WI-04
concrete	CH-05
concrete	CH-06
concrete	NO-08
concrete	US/MN-04
concrete block	US/AZ-12
concrete block	US/VA-02
concrete block	US/AZ-02
concrete block mass wall; concrete slab	US/CA-13
concrete block wall; tile on concrete slab	US/CA-03
concrete block walls	US/IA-02
concrete block walls; concrete slab	US/MD-07
concrete block walls; concrete slab	US/MA-04
concrete block walls; concrete slab	US/MN-01
concrete block walls; concrete slab	US/MD-05
concrete block walls; concrete slab	US/MD-08

LIST OF SITES BY THERMAL STORAGE MATERIALS (CONT'D)

THERMAL STORAGE MATERIALS	SITE CODE
concrete block walls; concrete slab	US/MD-04
concrete block walls; concrete slab	US/NC-03
concrete block walls; water tubes; brick floor	US/NH-01
concrete block; concrete slab; brick	US/SC-01
concrete floor (hollow)	NO-02
concrete floor; brick fireplace; phase change rods	US/GA-01
concrete floor; brick walls	US/WI-01
concrete floor; clay block and plaster interior walls	CH-08
concrete floor; clay block and plaster interior walls	CH-10
concrete floor; clay block and plaster interior walls; rockbed	CH-07
concrete floor; clay block and plaster interior walls; rockbed	CH-09
concrete floor; concrete walls	US/MI-01
concrete floor; stone fireplace	US/KS-02
concrete interior walls; concrete slab	SW-05
concrete masonry	US/VA-01
concrete masonry floor	US/WI-03
concrete mass wall - 5.5 m^2, 300 mm thick	US/AZ-04
concrete mass wall; phase-change rods	US/NJ-01
concrete slab	US/OR-13
concrete slab	US/IA-01
concrete slab	US/NC-01
concrete slab	US/AZ-09
concrete slab	US/MD-06
concrete slab	US/OR-09
concrete slab	US/MD-03
concrete slab	US/NC-02
concrete slab	US/MD-02
concrete slab	US/OR-12
concrete slab	US/OR-10
concrete slab	CH-04
concrete slab	US/CA-11
concrete slab	SW-01
concrete slab	US/CA-04
concrete slab	US/CA-16
concrete slab	US/CA-15
concrete slab	US/OR-01
concrete slab	SW-04
concrete slab & walls; rock bed	US/NC-01
concrete slab and wall	SW-06
concrete slab; adobe wall	US/CA-17
concrete slab; adobe wall	US/CA-12
concrete slab; brick chimney	US/MA-06
concrete slab; brick chimney	US/AZ-07
concrete slab; brick veneer wall; concrete wall	US/CO-12
concrete slab; brick wall	US/TX-03
concrete slab; brick wall	US/CO-17
concrete slab; brick-faced concrete wall	US/CT-01
concrete slab; brick; concrete block	US/SC-01
concrete slab; concrete block mass wall	US/CA-13
concrete slab; concrete block walls	US/MN-01
concrete slab; concrete block walls	US/MD-04
concrete slab; concrete block walls	US/NC-03
concrete slab; concrete block walls	US/MD-08

LIST OF SITES BY THERMAL STORAGE MATERIALS (CONT'D)

THERMAL STORAGE MATERIALS	SITE CODE
concrete slab; concrete block walls	US/MD-07
concrete slab; concrete block walls	US/MD-05
concrete slab; concrete block walls	US/MA-04
concrete slab; concrete interior walls	SW-05
concrete slab; concrete wall	US/MT-03
concrete slab; concrete wall	US/NY-01
concrete slab; concrete wall	US/MA-05
concrete slab; concrete wall	US/MA-01
concrete slab; concrete wall	US/MA-03
concrete slab; concrete walls	US/CA-08
concrete slab; interior brick walls	US/CA-14
concrete slab; masonry walls	BE-03
concrete slab; rock bed	US/AZ-08
concrete slab; rock bed; water tubes	US/CA-06
concrete slab; rock storage wall	US/MA-02
concrete slab; sand	US/NY-02
concrete slab; sand	US/RI-01
concrete slab; tile	US/OR-15
concrete slab; tile; brick chimney	US/MA-07
concrete slab; tile; brick wall	US/WY-01
concrete slab; tile; mass wall	US/OR-16
concrete slab; tile; stone chimney	US/OK-01
concrete slab; water drums	US/CA-10
concrete slab; water drums	US/OR-08
concrete slab; water tanks	US/OR-17
concrete slab; water tubes	US/CA-01
concrete slab; water tubes	US/CA-07
concrete slab; water tubes	US/IA-03
concrete slab; water tubes	US/CA-02
concrete slab; water wall	US/CA-05
concrete slab; water wall	US/VA-04
concrete wall	US/CO-13
concrete wall with selective surface	US/CO-11
concrete wall; brick on wall and floor	US/CO-10
concrete wall; concrete slab	US/MT-03
concrete wall; concrete slab	US/MA-03
concrete wall; concrete slab	US/NY-01
concrete wall; concrete slab	US/MA-01
concrete wall; concrete slab	US/MA-05
concrete wall; concrete slab; brick veneer wall	US/CO-12
concrete wall; phase change rods	US/OH-01
concrete wall; rock bed; brick floor	US/NB-01
concrete walls & slab; rock bed; water tubes	US/CO-02
concrete walls & slab; water drums	US/CO-01
concrete walls; concrete floor	US/MI-01
concrete walls; concrete slab	US/CA-08
concrete walls; rockbed; brick and tile floor	US/AZ-06
concrete; brick floor & walls	US/CO-05
earth	NO-06
earth under crawl space	US/MT-01
interior brick walls; concrete slab	US/CA-14
lightweight building materials	US/KS-01
lightweight building materials	US/TX-02
lightweight building materials	US/VT-03

LIST OF SITES BY THERMAL STORAGE MATERIALS (CONT'D)

THERMAL STORAGE MATERIALS	SITE CODE
lightweight building materials	US/WA-01
lightweight building materials	US/MD-01
lightweight building materials	US/MD-10
lightweight building materials	US/IL-01
lightweight building materials	US/VT-01
lightweight building materials	US/CA-09
lightweight building materials	US/OR-11
lightweight building materials	US/AZ-10
lightweight building materials	US/MD-09
lightweight building materials	US/RI-02
lightweight building materials	US/ME-01
lightweight building materials	US/VT-02
lightweight building materials	US/TX-01
lightweight building materials	US/AZ-11
lightweight building materials	NO-07
lightweight building materials	US/MN-02
lightweight building materials	US/MN-05
lightweight building materials	US/WI-02
masonry	CH-02
masonry walls and floor	CH-01
masonry walls and floor	BE-01
masonry walls and floor	BE-02
masonry walls; concrete slab	BE-03
mass wall; concrete slab; tile	US/OR-16
phase change container wall	US/ND-01
phase change rods; concrete floor; brick fireplace	US/GA-01
phase change rods; concrete wall	US/OH-01
phase change storage tiles in ceiling	US/MD-11
phase-change rods; concrete mass wall	US/NJ-01
rock	NO-01
rock bed	US/AZ-05
rock bed	US/CO-08
rock bed	US/VA-03
rock bed	US/WI-05
rock bed	SW-02
rock bed	NO-04
rock bed; adobe walls	US/NM-01
rock bed; brick floor; concrete wall	US/NB-01
rock bed; brick and tile floor; concrete walls	US/AZ-06
rock bed; water tubes; concrete walls and slab	US/CO-02
rock bed; clay block and plaster interior walls; concrete floor	CH-07
rock bed; clay block and plaster interior walls; concrete floor	CH-09
rock bed; concrete slab	US/AZ-08
rock bed; concrete slab and walls	US/NC-01
rock bed; rock wall	US/NM-02
rock bed; water containers	US/AZ-03
rock bed; water tubes; concrete slab	US/CA-06
rock bin; brick veneer walls	US/CO-06
rock storage wall; concrete slab	US/MA-02
rock wall; rock bed	US/NM-02
sand; concrete slab	US/RI-01
sand; concrete slab	US/NY-02
stone chimney; concrete slab; tile	US/OK-01

LIST OF SITES BY THERMAL STORAGE MATERIALS (CONT'D)

THERMAL STORAGE MATERIALS	SITE CODE
stone fireplace; concrete floor	US/KS-02
tile & concrete floor; brick and concrete wall	US/CO-04
tile floor	US/CO-15
tile on concrete floor	US/ID-01
tile on concrete floor	US/GA-04
tile on concrete floor; water tubes	US/GA-02
tile on concrete slab; concrete block wall	US/CA-03
tile on lightweight concrete floor	DK-01
tile; brick chimney; concrete slab	US/MA-07
tile; brick wall; concrete slab	US/WY-01
tile; concrete slab	US/OR-15
tile; mass wall; concrete slab	US/OR-16
tile; stone chimney; concrete slab	US/OK-01
tiled concrete floor; brick veneer & concrete wall	US/CO-07
tiled concrete slab; brick wall	US/CO-09
tiled concrete slab; brick wall	US/CO-03
water containers; rock bed	US/AZ-03
water drums	NO-05
water drums; concrete slab	US/CA-10
water drums; concrete slab	US/OR-08
water drums; concrete walls and slab	US/CO-01
water tanks; concrete slab	US/OR-17
water tubes	US/TN-01
water tubes	US/MT-02
water tubes; brick floor; concrete block walls	US/NH-01
water tubes; concrete slab	US/CA-01
water tubes; concrete slab	US/CA-02
water tubes; concrete slab	US/CA-07
water tubes; concrete slab	US/IA-03
water tubes; concrete slab; rock bed	US/CA-06
water tubes; concrete walls and slab; rock bed	US/CO-02
water tubes; tile on concrete floor	US/GA-02
water wall	US/OR-14
water wall	US/VA-05
water wall; concrete slab	US/VA-04
water wall; concrete slab	US/CA-05

LIST OF SITES BY TYPE OF CONSTRUCTION

CONSTRUCTION TYPE	SITE CODE	CONSTRUCTION TYPE	SITE CODE
adobe	US/AZ-01	wood frame	NO-02
adobe; wood frame	US/NM-01	wood frame	US/MN-03
asbestos-cement modules	CH-03	wood frame	NO-07
brick veneer; wood frame	US/TX-01	wood frame	US/MT-01
brick veneer; wood frame	US/TX-03	wood frame	US/MT-02
brick veneer; wood frame	US/GA-04	wood frame	SW-02
brick wall with cavity	DK-03	wood frame	SW-04
brick wall	CH-04	wood frame	US/NC-01
concrete	DK-01	wood frame	US/AZ-03
concrete block	US/AZ-02	wood frame	US/NC-02
concrete block	US/AZ-11	wood frame	US/AZ-08
concrete block	US/AZ-12	wood frame	US/NC-03
concrete block; wood frame	US/CA-06	wood frame	US/CA-01
concrete prefab	CH-06	wood frame	US/ND-01
concrete prefab	CH-05	wood frame	US/CA-03
concrete; wood frame	SW-06	wood frame	US/NE-01
concrete; wood frame	US/MT-03	wood frame	US/CA-05
concrete; wood frame	US/NC-01	wood frame	US/NJ-01
concrete; wood frame	SW-05	wood frame	US/CA-12
log	US/AZ-10	wood frame	US/NM-02
log	US/MD-06	wood frame	US/CA-14
masonry	DK-02	wood frame	US/NY-02
masonry	BE-01	wood frame	US/CA-16
masonry	US/MA-04	wood frame	US/OH-01
masonry	US/VA-01	wood frame	US/CO-02
masonry	BE-03	wood frame	US/OR-01
masonry	BE-02	wood frame	US/CO-04
masonry	US/CA-08	wood frame	US/OR-08
masonry	CH-01	wood frame	US/CO-06
masonry	US/CA-10	wood frame	US/OR-09
masonry	CH-02	wood frame	US/CO-08
masonry	US/CO-01	wood frame	US/OR-10
masonry	US/MD-04	wood frame	US/CO-10
masonry	US/AZ-06	wood frame	US/OR-11
masonry	US/MD-07	wood frame	US/CO-12
masonry	US/CA-11	wood frame	US/OR-12
masonry	US/CA-09	wood frame	US/CO-14
masonry	US/MD-05	wood frame	US/OR-15
masonry; post & beam	US/NH-01	wood frame	US/CO-16
masonry; wood frame	US/NY-01	wood frame	US/OR-16
masonry; wood frame	US/CO-17	wood frame	US/GA-01
masonry; wood frame	NO-05	wood frame	US/RI-01
masonry; wood frame	NO-06	wood frame	US/GA-03
masonry; wood frame	CH-07	wood frame	US/RI-02
masonry; wood frame	CH-08	wood frame	US/IA-02
masonry; wood frame	CH-09	wood frame	US/SC-01
masonry; wood frame	CH-10	wood frame	US/ID-01
post & beam	US/OK-01	wood frame	US/TN-01
post & beam	US/FL-01	wood frame	US/KS-01
post & beam; masonry	US/NH-01	wood frame	US/TX-02
wood frame	US/CT-01	wood frame	US/MA-01
wood frame	US/MN-02	wood frame	US/VA-02

CONSTRUCTION TYPE	SITE CODE	CONSTRUCTION TYPE	SITE CODE
wood frame	US/MA-03	wood frame	US/MD-08
wood frame	US/VA-03	wood frame	US/CO-11
wood frame	US/MA-06	wood frame	US/ME-01
wood frame	US/VA-04	wood frame	US/MD-03
wood frame	US/MD-01	wood frame	US/CO-13
wood frame	US/VA-05	wood frame	CD-01
wood frame	US/MD-09	wood frame	US/IA-01
wood frame	US/VT-02	wood frame	NO-01
wood frame	US/MD-11	wood frame	US/MA-02
wood frame	US/VT-03	wood frame	CD-02
wood frame	NO-03	wood frame	US/MD-10
wood frame	US/WA-01	wood frame	US/VT-01
wood frame	SW-03	wood frame	US/MD-02
wood frame	US/WI-01	wood frame	US/AZ-04
wood frame	US/AZ-07	wood frame	US/MA-07
wood frame	US/WI-02	wood frame	US/IL-01
wood frame	US/CA-02	wood frame	SW-01
wood frame	US/WI-03	wood frame	US/AZ-05
wood frame	US/CA-07	wood frame	US/OR-13
wood frame	US/WI-04	wood frame (double envelope	NO-04
wood frame	US/CA-15	wood frame (double envelope	US/MN-01
wood frame	US/WI-05	wood frame; adobe	US/NM-01
wood frame	US/CO-03	wood frame; brick veneer	US/GA-04
wood frame	US/WY-01	wood frame; brick veneer	US/TX-01
wood frame	US/CO-07	wood frame; brick veneer	US/TX-03
wood frame	SW-07	wood frame; concrete	SW-05
wood frame	US/MI-01	wood frame; concrete	SW-06
wood frame	US/AZ-09	wood frame; concrete	US/NC-01
wood frame	US/CO-15	wood frame; concrete	US/MT-03
wood frame	US/CA-04	wood frame; concrete block	US/CA-06
wood frame	US/GA-02	wood frame; masonry	CH-07
wood frame	US/CA-13	wood frame; masonry	CH-08
wood frame	US/IA-03	wood frame; masonry	CH-09
wood frame	US/CA-17	wood frame; masonry	CH-10
wood frame	US/KS-02	wood frame; masonry	NO-05
wood frame	US/CO-05	wood frame; masonry	NO-06
wood frame	US/MA-05	wood frame; masonry	US/CO-17
wood frame	US/CO-09	wood frame; masonry	US/NY-01

LIST OF SITES BY AUXILIARY FUEL TYPE

FUEL	SITE CODE	FUEL	SITE CODE
electric	CD-01	electric	US/MD-05
electric	CD-02	electric	US/MD-06
electric	CH-01	electric	US/MD-07
electric	CH-02	electric	US/MD-08
electric	CH-05	electric	US/MD-09
electric	CH-06	electric	US/MD-10
electric	DK-01	electric	US/MD-11
electric	DK-03	electric	US/ME-01
electric	NO-02	electric	US/MN-05
electric	NO-03	electric	US/NC-01
electric	NO-04	electric	US/NC-01
electric	NO-05	electric	US/NC-02
electric	NO-06	electric	US/NC-03
electric	NO-07	electric	US/NE-01
electric	NO-08	electric	US/NH-01
electric	SW-01	electric	US/NY-01
electric	SW-05	electric	US/NY-02
electric	SW-06	electric	US/OK-01
electric	SW-07	electric	US/OR-01
electric	US/AZ-08	electric	US/OR-03
electric	US/AZ-09	electric	US/OR-04
electric	US/AZ-10	electric	US/OR-05
electric	US/AZ-11	electric	US/OR-06
electric	US/AZ-12	electric	US/OR-07
electric	US/CA-03	electric	US/OR-08
electric	US/CA-06	electric	US/OR-09
electric	US/CA-15	electric	US/OR-10
electric	US/CA-17	electric	US/OR-11
electric	US/CO-02	electric	US/OR-12
electric	US/CO-13	electric	US/OR-13
electric	US/CO-14	electric	US/OR-14
electric	US/CO-15	electric	US/OR-15
electric	US/CO-16	electric	US/OR-16
electric	US/CO-17	electric	US/OR-17
electric	US/CT-01	electric	US/RI-01
electric	US/GA-01	electric	US/RI-02
electric	US/GA-02	electric	US/SC-01
electric	US/IA-01	electric	US/TX-03
electric	US/IA-02	electric	US/VA-01
electric	US/ID-01	electric	US/VA-02
electric	US/KS-01	electric	US/VA-03
electric	US/KS-02	electric	US/VA-04
electric	US/MA-01	electric	US/VA-05
electric	US/MA-02	electric	US/VT-01
electric	US/MA-04	electric	US/VT-02
electric	US/MA-05	electric	US/VT-03
electric	US/MA-07	electric	US/WA-04
electric	US/MD-01	electric	US/WA-06
electric	US/MD-02	electric	US/WY-01
electric	US/MD-03	electric; propane	US/GA-03
electric	US/MD-04	electric; wood	SW-02

LIST OF SITES BY AUXILIARY FUEL TYPE (CONT'D)

FUEL	SITE CODE
electric; wood	US/AZ-06
electric; wood	US/CA-04
electric; wood	US/CA-10
electric; wood	US/CA-11
electric; wood	US/CA-12
electric; wood	US/MI-01
electric; wood	US/MN-01
electric; wood	US/MT-01
electric; wood	US/MT-03
electric; wood	US/ND-01
electric; wood	US/NM-01
electric; wood	US/OH-01
gas	US/CA-02
gas	US/CA-07
gas	US/CA-13
gas	US/CA-14
gas	US/CA-16
gas	US/CO-03
gas	US/CO-05
gas	US/CO-06
gas	US/CO-07
gas	US/CO-08
gas	US/CO-09
gas	US/CO-11
gas	US/CO-12
gas	US/GA-04
gas	US/IL-01
gas	US/MA-06
gas	US/MN-02
gas	US/MN-03
gas	US/MN-04
gas	US/NM-02
gas	US/OR-02
gas	US/TX-01
gas	US/WA-01
gas	US/WA-02
gas	US/WA-03
gas	US/WA-05
gas	US/WA-07
gas	US/WA-08
gas	US/WA-09
gas	US/WI-03
gas	US/WI-04
gas	US/WI-05
gas; wood	BE-03
gas; wood	US/CA-01
gas; wood	US/CA-05
gas; wood	US/CO-01
gas; wood	US/CO-04
gas; wood	US/CO-10
gas; wood	US/IA-03
oil	CH-03
oil	CH-04
oil	DK-02
propane	US/AZ-07
propane	US/CA-09
propane	US/MA-03
propane	US/WI-01
propane	US/WI-02
propane; electric	US/GA-03
propane; wood	US/NJ-01
wood	BE-01
wood	CH-07
wood	CH-08
wood	CH-09
wood	CH-10
wood	SW-03
wood	US/CA-08
wood	US/MT-02
wood; electric	SW-02
wood; electric	US/AZ-06
wood; electric	US/CA-04
wood; electric	US/CA-10
wood; electric	US/CA-11
wood; electric	US/CA-12
wood; electric	US/MI-01
wood; electric	US/MN-01
wood; electric	US/MT-01
wood; electric	US/MT-03
wood; electric	US/ND-01
wood; electric	US/NM-01
wood; electric	US/OH-01
wood; gas	BE-03
wood; gas	US/CA-01
wood; gas	US/CA-05
wood; gas	US/CO-01
wood; gas	US/CO-04
wood; gas	US/CO-10
wood; gas	US/IA-03
wood; propane	US/NJ-01

LIST OF SITES BY AUXILIARY SYSTEM TYPE

AUXILIARY SYSTEM TYPE	SITE CODE
baseboard	CD-01
baseboard	NO-02
baseboard	SW-01
baseboard	US/AZ-08
baseboard	US/AZ-09
baseboard	US/CA-03
baseboard	US/CO-02
baseboard	US/CO-13
baseboard	US/CO-17
baseboard	US/CT-01
baseboard	US/MA-05
baseboard	US/NC-01
baseboard	US/NC-03
baseboard	US/NH-01
baseboard	US/NY-01
baseboard	US/RI-02
baseboard	US/VA-04
baseboard	US/VA-05
baseboard	US/VT-01
baseboard	US/VT-02
baseboard	US/VT-03
baseboard; stove	US/CA-10
baseboard; stove	US/CA-12
baseboard; stove	US/MN-01
baseboard; stove	US/MT-01
baseboard; stove	US/ND-01
baseboard; stove	US/OH-01
baseboard; stove; fireplace	US/NM-01
baseboard; wall heater	US/OR-07
baseboards; heat pump; stove	US/VA-01
evaporative cooler	US/AZ-11
evaporative cooler	US/AZ-12
fireplace; baseboard; stove	US/NM-01
fireplace; forced air-furnace	US/IA-03
fireplace; heat pump	US/MI-01
fireplace; hydronic	US/CA-08
fireplace; hydronic	US/CO-01
floor heaters	US/OR-04
forced air - furnace	CD-02
forced air - furnace	US/AZ-07
forced air - furnace	US/CA-02
forced air - furnace	US/CA-09
forced air - furnace	US/CA-13
forced air - furnace	US/CA-16
forced air - furnace	US/CO-03
forced air - furnace	US/CO-04
forced air - furnace	US/CO-05
forced air - furnace	US/CO-06
forced air - furnace	US/CO-07
forced air - furnace	US/CO-08
forced air - furnace	US/CO-09
forced air - furnace	US/CO-11
forced air - furnace	US/CO-12
forced air - furnace	US/CO-15
forced air - furnace	US/GA-03
forced air - furnace	US/GA-04
forced air - furnace	US/IA-01
forced air - furnace	US/IA-02
forced air - furnace	US/IL-01
forced air - furnace	US/MD-02
forced air - furnace	US/MD-03
forced air - furnace	US/MD-04
forced air - furnace	US/MD-05
forced air - furnace	US/MD-06
forced air - furnace	US/MD-07
forced air - furnace	US/MD-09
forced air - furnace	US/MD-10
forced air - furnace	US/MD-11
forced air - furnace	US/MN-02
forced air - furnace	US/MN-03
forced air - furnace	US/MT-02
forced air - furnace	US/NC-02
forced air - furnace	US/NM-02
forced air - furnace	US/NY-02
forced air - furnace	US/OK-01
forced air - furnace	US/OR-02
forced air - furnace	US/OR-05
forced air - furnace	US/OR-06
forced air - furnace	US/OR-08
forced air - furnace	US/OR-14
forced air - furnace	US/OR-15
forced air - furnace	US/OR-16
forced air - furnace	US/SC-01
forced air - furnace	US/TX-01
forced air - furnace	US/WA-01
forced air - furnace	US/WA-02
forced air - furnace	US/WA-03
forced air - furnace	US/WA-05
forced air - furnace	US/WA-06
forced air - furnace	US/WA-07
forced air - furnace	US/WA-08
forced air - furnace	US/WA-09
forced air - furnace	US/WI-01
forced air - furnace	US/WI-02
forced air - furnace	US/WI-03
forced air - furnace	US/WI-04

LIST OF SITES BY AUXILIARY SYSTEM TYPE (CONT'D)

AUXILIARY SYSTEM TYPE	SITE CODE	AUXILIARY SYSTEM TYPE	SITE CODE
forced air - furnace	US/WI-05	radiant ceiling; stove	US/AZ-06
forced air - furnace	US/WY-01	radiant ceiling; stove	US/CA-11
forced air - furnace;fireplace	US/IA-03	radiant heaters	US/CO-14
forced air - furnace; stove	BE-01	resistance	US/RI-01
forced air - furnace; stove	SW-02	resistance heater	CH-05
forced air - furnace; stove	US/CO-10	resistance heater	CH-06
forced air - furnace; stove	US/NJ-01	resistance heater	NO-03
heat pump	US/AZ-10	resistance heater	NO-04
heat pump	US/CA-06	resistance heater	NO-05
heat pump	US/CA-15	resistance heater	NO-06
heat pump	US/GA-01	resistance heater	NO-07
heat pump	US/MA-04	resistance heater	US/CA-17
heat pump	US/MA-07	resistance heater	US/MD-08
heat pump	US/MD-01	resistance heater	US/GA-02
heat pump	US/NC-01	stove	CH-07
heat pump	US/TX-03	stove	CH-08
heat pump	US/VA-02	stove	CH-09
heat pump	US/VA-03	stove	CH-10
heat pump	US/WA-04	stove; baseboard	US/CA-10
heat pump	US/NE-01	stove; baseboard	US/CA-12
heat pump; fireplace	US/MI-01	stove; baseboard	US/MN-01
heat pump; hydronic	CH-01	stove; baseboard	US/MT-01
heat pump; hydronic	SW-07	stove; baseboard	US/ND-01
heat pump; resistance furnace	US/KS-01	stove; baseboard	US/NM-01
heat pump; resistance furnace	US/KS-02	stove; baseboard	US/OH-01
heat pump; stove	US/CA-04	stove; heat pump	US/VA-01
heat pump; stove	US/MT-03	stove; forced air-furnace	BE-01
heat pump; stove; baseboard	US/VA-01	stove; forced air-furnace	SW-02
hydronic	BE-02	stove; forced air-furnace	US/CO-10
hydronic	CH-02	stove; forced air-furnace	US/NJ-01
hydronic	CH-03	stove; heat pump	US/CA-04
hydronic	CH-04	stove; heat pump	US/MT-03
hydronic	SW-06	stove; hydronic	BE-03
hydronic	US/MA-03	stove; radiant ceiling	US/AZ-06
hydronic	US/MA-06	stove; radiant ceiling	US/CA-11
hydronic	SW-03	wall furnace	US/CA-07
hydronic	SW-04	wall furnace; wood stove	US/CA-01
hydronic; fireplace	US/CA-08	wall furnace; wood stove	US/CA-05
hydronic; fireplace	US/CO-01	wall heater	US/CA-14
hydronic; heat pump	CH-01	wall heater	US/OR-03
hydronic; heat pump	SW-07	wall heater; baseboard	US/OR-07
hydronic; stove	BE-03	wall heaters	US/MN-05
radiant	SW-05	wall heaters	US/OR-01
radiant ceiling	DK-03	wood stove; wall furnace	US/CA-01
radiant ceiling	US/MA-01	wood stove; wall furnace	US/CA-05
radiant ceiling panels	US/MA-02		

LIST OF SITES BY BUILDING TYPE

BUILDING TYPE	SITE CODE
attached (row) house	CH-01
attached (row) house	CH-02
attached (row) house	CH-04
attached (row) house	DK-03
attached (row) house	SW-04
attached (row) house	SW-05
attached (row) house	SW-07
attached (row) house	US/AZ-08
attached (row) house	US/CA-15
attached (row) house	US/CO-08
detached test building	CD-01
detached test building	CH-05
detached test building	CH-06
detached test building	US/AZ-01
detached test building	US/AZ-02
detached test building	US/AZ-03
detached test building	US/MD-02
detached test building	US/MD-03
detached test building	US/MD-04
detached test building	US/MD-05
detached test building	US/MD-06
detached test building	US/MD-07
detached test buildings - 4 units	NO-02
detached test buildings - 4 units	US/MD-08
detached test buildings - 6 units	CD-02
duplex	US/CA-07
duplex, mobile home	US/WI-02
multiple-unit housing	CH-03
multiple-unit housing	US/MA-02
multiple-unit housing - 4 units	US/MA-03
multiple-unit housing - 8 units	US/MA-01
multiple-unit housing - 70 units	DK-02
reconfigurable test building	US/CO-17
reconfigurable test building	US/FL-01

NOTE: All other buildings are single detached houses.

4. BUILDING AND SYSTEM DESCRIPTION FORMS

This chapter contains the building system description forms for each of the monitored passive and hybrid solar projects. The information for these forms was obtained from the original survey completed by the IEA Task VIII participants. Information not listed on the form was not received from the respondents. The building system description form is organized into nine categories:

1. Name
2. Location
3. Climate
4. Building Description
5. Passive Solar System
6. Monitoring
7. Performance
8. Reports
9. Notes

The language of the available reports is indicated in parentheses after the bibliographic reference. All United States reports are in English.

SITE CODE: BE-01

SITE NAME: Nandrin Direct Gain/Sunspace
LOCATION: Nandrin, Belgium

CONTACT: C.R.A.
ADDRESS: Batiment Vinci
Place du Levant, 1
1348. Louvain-la-Neuve,
Belgium

TELEPHONE:

CLIMATE
Heating Degree Days: 2100
Cooling Degree Days:
Global Solar Radiation: 975 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: masonry
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): wood; liquid
Auxiliary System(s): woodstove; forced air-furnace
Number of Occupants: 4
Conditioned Floor Area: 165 m²
Aperture/Floor Area Ratio: 0.68
Global Heat Loss Coefficient: 339 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: masonry walls and floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 12/82 to 5/83
Format of Data: computer tape
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 35%; Internal Gains: 14%; Auxiliary: 51%.

REPORTS
Concours Habitat Thermique, rapport de synthese.
Available from: Region Wallonne-Cabinet du Ministre Busquin, rue du Commerce, 31, 1040 Bruxelles, Belgique. (French)

NOTES
Most auxiliary heat provided by woodstove. Sunspace is used primarily for horticulture.

SITE CODE: BE-02

SITE NAME: Chaumont Gistoux Solar House
LOCATION: Chaumont-Gistoux, Belgium

CONTACT: C.R.A.
ADDRESS: Batiment Vinci
Place du Levant, 1
1348. Louvain-la-Neuve,
Belgium

TELEPHONE:

CLIMATE
Heating Degree Days: 2100
Cooling Degree Days:
Global Solar Radiation: 975 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: masonry
Ground Coupling: basement
Number of Stories: 2.5
Auxiliary Fuel(s): liquid fuel
Auxiliary System(s): hydronic
Number of Occupants: 3
Conditioned Floor Area: 240 m²
Aperture/Floor Area Ratio: 0.23
Global Heat Loss Coefficient: 148 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: masonry walls and floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 12/82 to 5/83
Format of Data: computer tape
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 39%; Internal Gains: 21%; Auxiliary: 40%.

REPORTS
Concours Habitat Thermique, rapport de synthese.
Available from: Region Wallonne-Cabinet du Ministre Busquin, rue du Commerce, 31, 1040 Bruxelles, Belgique. (French)

NOTES
House also has active solar system with 52 m² flat plate collectors and 30 cubic meters of water storage. Dominant passive system is sunspace with 33m² aperture and 16m² floor area.

SITE CODE: BE-03

SITE NAME: Rosieres Solar House
LOCATION: Rosieres, Belgium

CONTACT: C.R.A.
ADDRESS: Batiment Vinci
Place du Levant, 1
1348. Louvain-la-Neuve,
Belgium
TELEPHONE:

CLIMATE

Heating Degree Days:	2100
Cooling Degree Days:	
Global Solar Radiation:	975 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	masonry
Ground Coupling:	slab on grade
Number of Stories:	3
Auxiliary Fuel(s):	gas; wood
Auxiliary System(s):	hydronic; woodstove
Number of Occupants:	4
Conditioned Floor Area:	168 m²
Aperture/Floor Area Ratio:	0.31
Global Heat Loss Coefficient:	309 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace; trombe wall
Passive Cooling System Type(s):	
Thermal Storage Material:	slab on grade; masonry walls
Other Passive Component(s):	

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/82 to 5/83
Format of Data:	computer tape
Quality of Data:	

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 32%; Internal Gains: 16%; Auxiliary: 52%.

REPORTS
Concours Habitat Thermique, rapport de synthese.
Available from: Region Wallonne-Cabinet du Ministre Busquin, rue du Commerce, 31, 1040 Bruxelles, Belgique. (French)

NOTES
The sunspace has a 37 m² aperture and a 20 m² floor area. The Trombe wall has a 14m² collection area and is 40 cm thick.

SITE CODE: CD-01

SITE NAME:	NRC Passive Solar Test Fac.	CONTACT:	Sherif Barakat
LOCATION:	Ottawa, Canada	ADDRESS:	Thermal Performance Section Div. of Bldg. Research NRCC Ottawa, Canada K1A OR6
		TELEPHONE:	

CLIMATE

Heating Degree Days:	4674
Cooling Degree Days:	242
Global Solar Radiation:	1328 kWh/m²

BUILDING DESCRIPTION

Building Type:	detached test buildings
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard heaters
Number of Occupants:	0
Conditioned Floor Area:	28 m²
Aperture/Floor Area Ratio:	0.09
Global Heat Loss Coefficient:	26 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	varies
Other Passive Component(s):	

MONITORING

Level of Monitoring:	A-
Monitoring Period:	11/80 to 4/82
Format of Data:	computer tape
Quality of Data:	

PERFORMANCE

REPORTS

NRC Passive Solar Test Facility, Performance Summary. Available from: S. Barakat, Thermal Performance Section, Division of Bldg. Research, NRCC, Ottawa, Canada K1A OR6. (English)

NOTES

Facility consists of four 2-zone test units and 4 single-room units. Data has been collected for different types and amounts of storage for both direct gain and sunspace configurations.

SITE CODE: CD-02

SITE NAME: Alberta Home Heat Res. Fac.
LOCATION: Edmonton, Canada

CONTACT: J.D. Dale
ADDRESS: Dept. of Mech. Engineering
Univ. of Alberta
Edmonton, Alberta
Canada

TELEPHONE:

CLIMATE

Heating Degree Days:	5990
Cooling Degree Days:	30
Global Solar Radiation:	1298 kWh/m²

BUILDING DESCRIPTION

Building Type:	detached test buildings - 6 units
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	forced air - furnace
Number of Occupants:	0
Conditioned Floor Area:	98 m²
Aperture/Floor Area Ratio:	0.11
Global Heat Loss Coefficient:	120 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	
Thermal Storage Material:	
Other Passive Component(s):	

MONITORING

Level of Monitoring:	A-
Monitoring Period:	1979 to present
Format of Data:	computer tape
Quality of Data:	

PERFORMANCE

REPORTS
Annual Report on the Alberta Home Heating Research Facility 1979-80, 1980-81, 1981-1982. Available from: J.D.Dale, Dept. of Mechanical Engineering, University of Alberta, Edmonton, Alberta. (English)

NOTES
Facility consists of 6 detached test buildings. Description is for one unit only.

SITE CODE: DK-01

SITE NAME: Lyngby Solar House
LOCATION: Lyngby, Denmark

CONTACT: Lars Olsen
ADDRESS: Thermal Insulation
Technical University
2800 Lyngby
Denmark

TELEPHONE: 02 883511

CLIMATE
Heating Degree Days: 2829
Cooling Degree Days:
Global Solar Radiation: 1018 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: light weight concrete
Ground Coupling: insulated slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s):
Number of Occupants: 2
Conditioned Floor Area: 150 m²
Aperture/Floor Area Ratio: 0.11
Global Heat Loss Coefficient: 130 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material: tile on lightweight concrete floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/82 to 9/83
Format of Data:
Quality of Data: 14 variables monitored continuously over 10 months
3 additional variables were monitored monthly

PERFORMANCE
Annual Heating Energy Balance - Passive Solar: 25%; Internal Gains: 20%; Auxiliary: 55%. All monthly mean living space temperatures were between 17 degrees C and 27 degrees C. Only briefly during July and December do interior temperatures exceed the upper and lower user accepted limits.

REPORTS
Birkerod Solhus, Niels Mejlhede Jensen, Thermal Insulation Laboratory, Technical University of Denmark, Report NR 145, 1983. (Danish)
NOTES

SITE CODE: DK-02

SITE NAME: Lystoftevaenget
LOCATION: Lyngby, Denmark

CONTACT: Thomas Pederson
ADDRESS: Dominia A/S
Studiestraede 38
1455 Kobenhavn
Denmark
TELEPHONE: 01 134546

CLIMATE
Heating Degree Days: 2829
Cooling Degree Days:
Global Solar Radiation: 1018 kWh/m²

BUILDING DESCRIPTION
Building Type: multi-family - 70 apartments
Construction Type: masonry
Ground Coupling: insulated slab on grade
Number of Stories: 2
Auxiliary Fuel(s): oil
Auxiliary System(s): oil burner
Number of Occupants: 1-4 (varies by unit)
Conditioned Floor Area: 4500 m²
Aperture/Floor Area Ratio: varies by apartment unit
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material: brick (walls)
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 9/82 to 6/84
Format of Data:
Quality of Data: indoor dry bulb and auxiliary heating were monitored on a monthly basis over 21 months

PERFORMANCE

REPORTS
None as of June 1985.

NOTES

SITE CODE: DK-03

SITE NAME: SBI Low Energy House
LOCATION: Horsholm, Denmark

CLIMATE
Heating Degree Days: 2829
Cooling Degree Days:
Global Solar Radiation: 1018 kWh/m²

CONTACT: Niels Erik Andersen
ADDRESS: SBI
Danish Bldg. Research Inst.
P.O.Box 119
DK 2970, Horsholm
Denmark
TELEPHONE: 02-865533

BUILDING DESCRIPTION
Building Type: row house
Construction Type: brick wall with cavity
Ground Coupling: insulated slab on grade
Number of Stories: 1.5
Auxiliary Fuel(s): electric
Auxiliary System(s): radiant ceiling
Number of Occupants: 2
Conditioned Floor Area: 100 m²
Aperture/Floor Area Ratio: 0.04
Global Heat Loss Coefficient: 100 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material: brick
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 1978 to 1983
Format of Data: hard copy
Quality of Data: 5 electricity consumption meters monitored auxiliary & water heating, lights & appliances over nearly 5 yrs

PERFORMANCE

REPORTS
SBI Low Energy House Model-79. Available from: SBI, P.O. Box 119, DK 2970, Horsholm, Denmark. (English)

NOTES
This is a low energy, well insulated row house with adjoining walls on north and west sides.

SITE CODE: NO-01

SITE NAME: Ivilde Solar House
LOCATION: Ivilde, Voss, Norway

CONTACT: M. Ringheim
ADDRESS: Kilde
Box 229
5701 Voss, Norway

TELEPHONE:

CLIMATE
Heating Degree Days: 4200
Cooling Degree Days:
Global Solar Radiation:

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: basement
Number of Stories: 4
Auxiliary Fuel(s):
Auxiliary System(s):
Number of Occupants: 4
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): earth contact
Thermal Storage Material: rock
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 1/81 to 1/83
Format of Data: hard copy
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 12%; Internal Gains: 51%; Auxiliary: 37%. The cost of providing the solar heat gain, including solar aperture, storage and associated living space, is similar on a KWh basis, to the cost of electric heating.

REPORTS
Enkel utnytting ay solvarme i bustadhus." Available from: KILDE, N-5701 Voss, Norway. (Norwegian)

NOTES
The monitoring was carried out to determine the solar heat gain improvements due to minor modifications to a commonly used building design. The rock storage was not insulated at time of monitoring.

SITE CODE: NO-02

SITE NAME: Trondheim Test Building
LOCATION: Trondheim, Norway

CONTACT: Johannes Gunnarshaug
ADDRESS: SINTEF Division 62
7034 Trondheim-NTH
Norway

TELEPHONE: 07-592620

CLIMATE
Heating Degree Days: 4799
Cooling Degree Days:
Global Solar Radiation: 912 kWh/m²

BUILDING DESCRIPTION
Building Type: 4 unit test building
Construction Type: wood frame
Ground Coupling: unheated crawl space
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): baseboards
Number of Occupants: 0
Conditioned Floor Area: 17 m²
Aperture/Floor Area Ratio: 0.14
Global Heat Loss Coefficient: 19 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material: hollow concrete floor; ceiling panels (in Section C)
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 1978 to 1980
Format of Data: hard copy
Quality of Data: approximately 9 variables measured for each test section

PERFORMANCE
Active thermal storage mass did not significantly reduce heating load, although it did increase comfort. Increased south glazing significantly increased the heat load.

REPORTS
Lavenergibygninger STF62 A30012." Available from: SINTEF 62, 7034 Trondheim - NTH, Norway. (Norwegian)

NOTES
north and a south room. The two middle sections are the subject of this report. One section (B) has been constructed with the economically optimum level of insulation, the other (C) the same as B with hollow concrete panels in floor and ceiling. Both are compared to the reference section A. Sections B and C each have south window area equal to 4 times the north window area. Window area in section is equally divided between north and south. Night insulation is not used.
The global heat loss coefficient shown above is for Section B. In section C it is 10 W/degree K.

SITE CODE: NO-03

SITE NAME: Baerum County Low Energy House
LOCATION: Baerum County, Norway

CONTACT: Arne P. Eggen
ADDRESS: Oslo School of Arch.
Oslo, Norway

CLIMATE
Heating Degree Days: 4237 at base 18 C (3774 at base =7 C)
Cooling Degree Days:
Global Solar Radiation: 902 kWh/m²

TELEPHONE:

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling:
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 2 to 5
Conditioned Floor Area: 100 m²
Aperture/Floor Area Ratio: 0.00
Global Heat Loss Coefficient: 100 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 1984 to present
Format of Data:
Quality of Data: 24 variables are monitored at 1 minute & 15 minute intervals

PERFORMANCE

Not available

REPORTS
"Energiriktige boliger i Bærum, EBIB Hoslemarka"
NOXES Prosjektrapport nr. 8, Bærum kommune, 1982

SITE CODE: NO-04

SITE NAME: Double Shell House at As
LOCATION: As, Norway

CONTACT: Nils Skaarer
ADDRESS: N.L.H.
1430 As, Norway

CLIMATE
Heating Degree Days: 4459 at base 18 C (3903 at base =7 C)
Cooling Degree Days:
Global Solar Radiation:

TELEPHONE: 02-942252

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; "double envelope"
Ground Coupling:
Number of Stories: 1.5
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 3
Conditioned Floor Area: 110 m^2
Aperture/Floor Area Ratio: 0.17
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace; double shell
Passive Cooling System Type(s): ventilation
Thermal Storage Material: rock bed
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 1978 to 1980
Format of Data:
Quality of Data: 24 variables monitored at 60 minute intervals over a 2 year period

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 42%; Internal Gains: 22%; Auxiliary: 36%. The building works best in mid-winter.

REPORTS
Ressvesvennlige Boligformer." Report No. 4, 1980. Available from: Norges Landbrukshegskole, 1430 As, Norway. (Norwegian)

NOTES
The house has a 45 m^2 active solar collector mounted at 45 degrees and integral with the roof. The passive components have a total south aperture area of 18.9 m^2.

SITE CODE: NO-05

SITE NAME: Heimdal Solar House #2
LOCATION: Tiller, Norway

CONTACT: Johannes Gunnarshaug
ADDRESS: SINTEF Division 62
7034 Trondheim-NTH
Norway
TELEPHONE: 07-592620

CLIMATE
Heating Degree Days: 4799 at base temp. 18 C
Cooling Degree Days:
Global Solar Radiation: 911 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; masonry "double envelope"
Ground Coupling:
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 4
Conditioned Floor Area: 120 m²
Aperture/Floor Area Ratio: 0.25
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): sunspace; double shell
Passive Cooling System Type(s): ventilation
Thermal Storage Material: water drums
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 10/82 to 5/84
Format of Data: hard copy; computer tape
Quality of Data: 18 variables monitored at 60 minute intervals for for 19 months spanning 2 heating seasons

PERFORMANCE
On a typical summer day the sunspace temperature remains above 30 degrees C for 8 hours, and peaks above 45 degrees C. On a typical winter day the sunspace temperature appears to remain mid-way between indoor and outdoor temperatures.

REPORTS
"Energisparing i småhus - erfaringer, anbefalinger, sluttrapport, delrapport 11"
H. Granum, H. Raaen, STF62 A 86004, Trondheim 1986.

NOTES
The sunspace covers the entire second floor on the south side. Warm air from the top of the sunspace is drawn down along the north roof and wall into the water barrel storage.

SITE CODE: NO-06

SITE NAME: Heimdal Solar House #3
LOCATION: Tiller, Norway

CONTACT: Johannes Gunnarshaug
ADDRESS: SINTEF Division 62
7034 Trondheim-NTH
Norway
TELEPHONE: 07-592620

CLIMATE
Heating Degree Days: 4799 at base temp. 18 C
Cooling Degree Days:
Global Solar Radiation: 911 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; masonry "double envelope"
Ground Coupling:
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 4
Conditioned Floor Area: 120 m²
Aperture/Floor Area Ratio: 0.25
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): sunspace; double shell
Passive Cooling System Type(s): ventilation
Thermal Storage Material: earth
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 10/82 to 5/83
Format of Data: hard copy; computer tape
Quality of Data: 16 variables monitored at 15 and 60 minute intervals over 19 months spanning 2 heating seasons

PERFORMANCE
Report: Dec. 1986

REPORTS
"Energisparing i småhus - erfaringer, anbefalinger, sluttrapport, Delrapport 22"
H. Granum, H. Raaen, STF62 A86004, Trondheim 1986

NOTES
The sunspace covers the entire second floor on the south side. The sunspace acts as a preheater for a vertical and roof sloped collector. Warm air is drawn down along the north sloping roof and wall into a water/air heat exchanger. Warmed water is pumped in a closed loop through an insulated volume of soil.

SITE CODE: NO-07

SITE NAME: Heimdal Low Energy House 14
LOCATION: Tiller, Norway

CONTACT: Helge Raaen
ADDRESS: SINTEF Division 62
7034 Trondheim-NTH
Norway
TELEPHONE: 07-892620

CLIMATE
Heating Degree Days: 4799 at base temp. 18 C
Cooling Degree Days:
Global Solar Radiation: 911 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 4
Conditioned Floor Area: 140 m²
Aperture/Floor Area Ratio: 0.09
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: light weight building components
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 10/82 to 5/84
Format of Data: hard copy; computer tape
Quality of Data: 16 variables monitored over 2 heating seasons and intervening summer period

PERFORMANCE

REPORTS
"Energisparing i småhus - erfaringer, anbefalinger, sluttrapport, Delrapport 11"
H. Granum, H. Raaen, STF62 A8600, Trondheim 1986

NOTES
The house is equipped with a heat exchange/heat pump for hot water supply.

SITE CODE: NO-08

SITE NAME: Indre Ostfold Meier Solar Bldg.
LOCATION: Mysen, Norway

CONTACT: Meierienes Bygningskoncor
ADDRESS: Breigt. 10
Vaterland, Oslo 1
Norway
TELEPHONE: 02-676880

CLIMATE
Heating Degree Days: 4459 at base 18 (3950 at base 17
Cooling Degree Days:
Global Solar Radiation: 990 kWh/m²

BUILDING DESCRIPTION
Building Type:
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s):
Number of Occupants:
Conditioned Floor Area: 1040 m²
Aperture/Floor Area Ratio: 0.14
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s):
Thermal Storage Material: concrete
Other Passive Component(s):

MONITORING
Level of Monitoring: A-
Monitoring Period:
Format of Data: hard copy; computer tape
Quality of Data: 64 variables monitored every 20 minutes

PERFORMANCE

REPORTS

NOTES
This building is equipped with a 200 m² active vertical solar collector feeding a 4.1 cubic meter thermal storage of calcium chloride hexahydrate.

SITE CODE: SW-01

SITE NAME: Str. Lagenergiprojekt for Smahus
LOCATION: Vetlanda, Sweden

CONTACT: Bertil Jonsson
ADDRESS: Lund Inst. of Technology
Division of Bldg. Tech.
P.O. Box 725
S-22007 LUND, Sweden
TELEPHONE:

CLIMATE
Heating Degree Days: 3600
Cooling Degree Days:
Global Solar Radiation: 849 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): baseboard
Number of Occupants: 5
Conditioned Floor Area: 113 m²
Aperture/Floor Area Ratio: 0.16
Global Heat Loss Coefficient: 91 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 11/76 to 3/79
Format of Data:
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 14%; Internal Gains: 34%; Auxiliary: 52%.

REPORTS
STR Lagenergiprojekt for smahus, Vetlanda 1977-79. BKL 1979:11 (Swedish)
Address: Lund Inst. of Technology, Division of Building Tech. P.O. B 725, S-220 07 LUND Sweden

NOTES

SITE CODE: SW-02

SITE NAME: Teleborg Passive Solar Home
LOCATION: Vaxjo, Sweden

CONTACT: Ake Blomsterberg
ADDRESS: Statens Provningsanstalt
Box 857
S-501 15 Boras, Sweden
TELEPHONE: 033-16 5000

CLIMATE

Heating Degree Days:	4100
Cooling Degree Days:	
Global Solar Radiation:	990 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	
Number of Stories:	1
Auxiliary Fuel(s):	electric; wood
Auxiliary System(s):	forced air; stove
Number of Occupants:	1
Conditioned Floor Area:	155 m²
Aperture/Floor Area Ratio:	0.08
Global Heat Loss Coefficient:	144 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	rock bed
Other Passive Component(s):	

MONITORING

Level of Monitoring:	B+
Monitoring Period:	1/82 to 12/82
Format of Data:	computer tape
Quality of Data:	

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 30%; Internal Gains: 26%; Auxiliary: 44%. Sunspace is used most of year with no auxiliary heat, and contributed 4600 KWh to living space.

REPORTS
Passive Solar Technology - Description and evaluation of a one-family house in Vaxjo; Blomsterberg, A. et al., Swedish Council for Building Research, R16: 1984. (Swedish)

A Low Energy Passive Solar House in Sweden, Blomsterberg, A. et al., Proceedings of 9th Passive Solar Conference, USA, 1984. (English)

NOTES

SITE CODE: SW-03

SITE NAME: Fargelanda Passive Solar Home
LOCATION: Fargelanda, Sweden

CONTACT: Hans Eek
ADDRESS: EFEM Architecture Office
Brogatan 2
413 01 Goteborg
Sweden
TELEPHONE:

CLIMATE
Heating Degree Days: 3920
Cooling Degree Days:
Global Solar Radiation: 960 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling:
Number of Stories: 2
Auxiliary Fuel(s): wood
Auxiliary System(s): hydronic
Number of Occupants: 5
Conditioned Floor Area: 175 m²
Aperture/Floor Area Ratio: 0.15
Global Heat Loss Coefficient: 120 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: brick wall
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 8/82 to 12/80
Format of Data: hard copy
Quality of Data:

PERFORMANCE

REPORTS
SOL, TYNGD OCH VARME, Swedish Council for Building Research, T7: 1982. (Swedish)
99 STOCKHOLM

NOTES

SITE CODE: SW-04

SITE NAME: Valdemarsro Low Energy Houses
LOCATION: Malmo, Sweden

CONTACT: Egon Lange
ADDRESS: Lund Institute of Technology
Dept. of Bldg. Science
P.O.Box 725
S-22007 LUND, Sweden

TELEPHONE: 076-10 70 00

CLIMATE

Heating Degree Days:	3006
Cooling Degree Days:	
Global Solar Radiation:	1092 kWh/m²

BUILDING DESCRIPTION

Building Type:	row houses
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	
Auxiliary System(s):	hydronic
Number of Occupants:	3 per house
Conditioned Floor Area:	117 m²
Aperture/Floor Area Ratio:	0.03
Global Heat Loss Coefficient:	85 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete slab
Other Passive Component(s):	

MONITORING

Level of Monitoring:	B+
Monitoring Period:	11/80 to 7/82
Format of Data:	hard copy; computer tape
Quality of Data:	

PERFORMANCE
Mean indoor temperature for the year is 22.5 degrees. The hot water heating system pipes were found to have uncontrolled heat losses to the homes, even when radiators were turned off. Solar gains resulted mostly in higher temperatures, not a reduction in auxiliary energy use.

REPORTS

NOTES
The project consists of 32 units, 8 of which were monitored at a B+ level. The other units were monitored at a lower level every 15 days. District heating used for all units. Performance results above are for one of the units.

SITE CODE: SW-05

SITE NAME: Smalands Taberg Low Energy Homes
LOCATION: Taberg, Sweden

CONTACT: Bertil Fredlund
ADDRESS: Lund Institute of Technology
Dept. of Bldg. Science
P.O.Box 725
S-22007 LUND, Sweden

TELEPHONE: 046-10 70 00

CLIMATE
Heating Degree Days: 3669
Cooling Degree Days:
Global Solar Radiation:

BUILDING DESCRIPTION
Building Type: row houses
Construction Type: wood frame; concrete
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): radiant
Number of Occupants: 25 per house
Conditioned Floor Area: 401 m²
Aperture/Floor Area Ratio: 0.39
Global Heat Loss Coefficient: 830 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab; interior walls
Other Passive Component(s):

MONITORING
Level of Monitoring: A
Monitoring Period: 5/81 to 5/83
Format of Data: computer tape
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 16%; Internal Gains: 48%; Auxiliary Heat: 36%.

REPORTS
Energy Conservation, Moisture and Thermal Climate in Buildings, Lund Institute of Technology, BKL 1983:1. (Swedish)

Glazed in Spaces, Christerson, M., Olsen, P., Lund Institute of Technology, BKL 1984:7. (Swedish)

NOTES
Description and performance results above are for whole structure, which is made up of four, attached, terraced houses.

SITE CODE: SW-06

SITE NAME: Bramhult Solar Houses
LOCATION: Bramhult, Sweden

CONTACT: Knut-Olov Lagerkvist
ADDRESS: Statens provningsanstalt
Box 857
S-501-15 Boras, Sweden
TELEPHONE: 033-16 5000

CLIMATE
Heating Degree Days: 3600
Cooling Degree Days:
Global Solar Radiation: 780 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; concrete
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): hydronic
Number of Occupants: 3 per house
Conditioned Floor Area: 165 m²
Aperture/Floor Area Ratio: 0.03
Global Heat Loss Coefficient: 145 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab and wall
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/79 to 10/80
Format of Data: hard copy; computer tape
Quality of Data:

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 27%; Internal Gains: 37%; Auxiliary Heat: 36%.

REPORTS
Heat from solar energy and air with storage in water and ice, Swedish Council for Building Research, D11: 1981. (English)

NOTES
Project is six single-unit houses. Dominant solar system uses 141 m² flat-plate solar collectors with storage in water and ice.

SITE CODE: SW-07

SITE NAME: Tarnan Solar Houses
LOCATION: Landskrona, Sweden

CONTACT: Maria Christerson
ADDRESS: Lund Institute of Technology
Dept. of Bldg. Science
P.O. Box 725
S-22007 LUND, Sweden
TELEPHONE: 046-10 96 62

CLIMATE
Heating Degree Days: 3006
Cooling Degree Days:
Global Solar Radiation: 1092 kWh/m²

BUILDING DESCRIPTION
Building Type: row houses
Construction Type: wood frame
Ground Coupling:
Number of Stories: 2.5
Auxiliary Fuel(s): electric
Auxiliary System(s): hydronic - heat pump
Number of Occupants: 18 (total for all units)
Conditioned Floor Area: 861 m²
Aperture/Floor Area Ratio: 0.10
Global Heat Loss Coefficient: 945 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s): shading devices in sunspace

MONITORING
Level of Monitoring: B-
Monitoring Period: 5/83 to 5/85
Format of Data: hard copy; computer tape
Quality of Data:

PERFORMANCE
Shading devices have kept summer temperature in sunspace from rising more than 3 degrees above ambient on a typical day.

REPORTS

NOTES
Project is row housing surrounding a glazed courtyard. Description and performance results are for all buildings combined.

SITE CODE: CH-01

SITE NAME: Dersbach Rowhouses
LOCATION: Hunenberg, Switzerland

CONTACT: K.Menti, W.Stalder
ADDRESS: Amrein & Martinelli & Menti
Bruchstr. 77
CH-6003, Luzern
Switzerland
TELEPHONE: 041-22 27 61

CLIMATE
Heating Degree Days: 3650
Cooling Degree Days:
Global Solar Radiation: 1110 kWh/m²

BUILDING DESCRIPTION
Building Type: row houses
Construction Type: masonry
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): hydronic - heat pump
Number of Occupants: 2
Conditioned Floor Area: 160 m²
Aperture/Floor Area Ratio: 0.11
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s):
Thermal Storage Material: masonry walls and floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/83 to 4/84
Format of Data: hard copy; computer tape
Quality of Data:

PERFORMANCE

REPORTS
Available from: K. Menti, Ebnetweg 10, CH-6045, Meggen, Switzerland. (French)

NOTES
Description is for one of several units in a row house arrangement.

SITE CODE: CH-02

SITE NAME: Meggen Solar Apartment Bldg.
LOCATION: Meggen, Switzerland

CONTACT: K.Menti, W.Stalder
ADDRESS: Amrein & Martinelli & Menti
Bruchstr. 77
CH-6003, Luzern
Switzerland
TELEPHONE: 041-22 27 61

CLIMATE
Heating Degree Days: 3650
Cooling Degree Days:
Global Solar Radiation: 1115 kWh/m²

BUILDING DESCRIPTION
Building Type: row houses
Construction Type: masonry
Ground Coupling:
Number of Stories: 4
Auxiliary Fuel(s): electric
Auxiliary System(s): electric; hydronic
Number of Occupants: 16 (total of all units)
Conditioned Floor Area: 978 m²
Aperture/Floor Area Ratio: 0.04
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s):
Thermal Storage Material: masonry
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/83 to 4/84
Format of Data: hard copy; computer tape
Quality of Data:

PERFORMANCE

REPORTS
Available from: K. Menti, Ebnetweg 10, CH-6045, Meggen, Switzerland. (French)

NOTES
Description is for entire building which is composed of 5 separate units.

SITE CODE: CH-03

SITE NAME: Adliswil Solar Apartments
LOCATION: Adliswil, Switzerland

CONTACT: A. Eggenberger
ADDRESS: Eggenberger Bauphysik AG
Brunnmattstr. 6
CH-3400, Burgdorf
Switzerland
TELEPHONE: 034-22 06 61

CLIMATE
Heating Degree Days: 3660
Cooling Degree Days:
Global Solar Radiation: 1110 kWh/m²

BUILDING DESCRIPTION
Building Type: terrace apartments
Construction Type: asbestos-cement modules
Ground Coupling:
Number of Stories: 7
Auxiliary Fuel(s): oil
Auxiliary System(s): hydronic
Number of Occupants: 2 per house
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): sunspace
Passive Cooling System Type(s):
Thermal Storage Material: asbestos cement
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/83 to 4/84
Format of Data: hard copy; computer tape
Quality of Data: 11 variables measured

PERFORMANCE

REPORTS
Available from: Eggenberger Bauphysik AG, Brunnmattstr. 6, CH-3400, Burgdorf, Switzerland. (German)

NOTES
Total of 7 apartments in a 7 story terraced building. Each house occupies one story. Sunspace faces almost due west.

SITE CODE: CH-04

CONTACT: A. Eggenberger
ADDRESS: Eggenberger Bauphysik AG
Brunnmattstr. 6
CH-3400, Burgdorf
Switzerland
TELEPHONE: 034-22 06 61

SITE NAME: Courtelary Apartments
LOCATION: Courtelary, Switzerland

CLIMATE
Heating Degree Days: 4000
Cooling Degree Days:
Global Solar Radiation: 1190 kWh/m²

BUILDING DESCRIPTION
Building Type: row houses
Construction Type: brickwall
Ground Coupling: insulated concrete slab
Number of Stories: 3
Auxiliary Fuel(s): oil
Auxiliary System(s): hydronic
Number of Occupants: 2 per house
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s):
Thermal Storage Material: concrete slab floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 11/83 to 4/84
Format of Data: hard copy; computer tape
Quality of Data: 12 variables measured hourly

PERFORMANCE

REPORTS
Available from: Eggenberger Bauphysik AG, Brunnmattstr. 6, CH-3400, Burgdorf, Switzerland. (German)

NOTES
There are 2 apartments per story in a 3 story building.

SITE CODE: CH-05

SITE NAME: Cannobbio Test Cell #1
LOCATION: Canobbio, Switzerland

CONTACT: Dr. C. Spinedi
ADDRESS: Laboratorio di fisica terr.
CH-Canobbio
Switzerland

TELEPHONE:

CLIMATE
Heating Degree Days: 2720
Cooling Degree Days:
Global Solar Radiation: 1300 kWh/m²

BUILDING DESCRIPTION
Building Type: test cell
Construction Type: concrete prefab
Ground Coupling: insulated slab
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 0
Conditioned Floor Area: 10 m²
Aperture/Floor Area Ratio: 0.02
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s):
Thermal Storage Material: concrete
Other Passive Component(s):

MONITORING
Level of Monitoring: A-
Monitoring Period: 10/82 to 4/84
Format of Data: hard copy; computer tape
Quality of Data: approximately 50 variables monitored

PERFORMANCE

REPORTS
Available from: C. Spinedi, Instituto Cantonale Tecnico - Sperimentale
CH-6952 Canobbio, Switzerland. (Italian)

NOTES

SITE CODE: CH-06

SITE NAME: Cannobbio Test Cell #2
LOCATION: Canobbio, Switzerland

CONTACT: Dr. C. Spinedi
ADDRESS: Laboratorio di fisica terr.
CH-Canobbio
Switzerland

TELEPHONE:

CLIMATE
Heating Degree Days: 2720
Cooling Degree Days:
Global Solar Radiation: 1300 kWh/m²

BUILDING DESCRIPTION
Building Type: test cell
Construction Type: concrete prefab
Ground Coupling: insulated slab
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance heater
Number of Occupants: 0
Conditioned Floor Area: 10 m²
Aperture/Floor Area Ratio: 0.07
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s):
Thermal Storage Material: concrete
Other Passive Component(s):

MONITORING
Level of Monitoring: A-
Monitoring Period: 10/82 to 4/84
Format of Data: hard copy; computer tape
Quality of Data: approximately 50 variables monitored

PERFORMANCE

REPORTS
Available from: C. Spinedi, Instituto Cantonale Tecnico - Sperimentale
CH-6952 Canobbio, Switzerland. (Italian)

NOTES

SITE CODE: CH-07

SITE NAME: Schaub Solar House
LOCATION: Rothenfluh, Switzerland

CONTACT: Prof. H. H. Hauri
ADDRESS: Inst. F. Hochbautechnik ETH
8093 Zurich
Switzerland

TELEPHONE: 01-377 2855

CLIMATE
Heating Degree Days: 3560
Cooling Degree Days:
Global Solar Radiation: 1168 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; masonry
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): wood
Auxiliary System(s): woodstove (convector central heating)
Number of Occupants: 2
Conditioned Floor Area: 140 m²
Aperture/Floor Area Ratio: 0.05
Global Heat Loss Coefficient: 191 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; hybrid
Passive Cooling System Type(s):
Thermal Storage Material: clay block and plaster interior walls; concrete floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 1981 to 1983
Format of Data: hard copy; disk
Quality of Data: 15 min. scans for 5 weeks, daily totals for 2 heating seasons; over 30 variables monitored

PERFORMANCE

REPORTS
Available from: Prof. H. H. Hauri, Inst. F. Hochbautechnik ETH,
8093 Zurich, Switzerland. (German)

NOTES

SITE CODE: CH-08

SITE NAME: Schafer Solar House
LOCATION: Binz, Switzerland

CONTACT: Prof. H. H. Hauri
ADDRESS: Inst. F. Hochbautechnik ETH
8093 Zurich
Switzerland

TELEPHONE: 01-377 2855

CLIMATE

Heating Degree Days:	3660
Cooling Degree Days:	
Global Solar Radiation:	1166 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame; masonry
Ground Coupling:	slab on grade
Number of Stories:	1.5
Auxiliary Fuel(s):	wood
Auxiliary System(s):	woodstove (convector central heating)
Number of Occupants:	4
Conditioned Floor Area:	180 m²
Aperture/Floor Area Ratio:	0.10
Global Heat Loss Coefficient:	371 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	
Thermal Storage Material:	clay block and plaster interior walls; concrete floor
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B-
Monitoring Period:	1981 to 1983
Format of Data:	hard copy; disk
Quality of Data:	15 min. scans for 3 weeks, daily totals for 2 heating seasons; over 23 variables monitored

PERFORMANCE

REPORTS
Available from: Prof. H. H. Hauri, Inst. F. Hochbautechnik ETH, 8093 Zurich, Switzerland. (German)

NOTES

SITE CODE: CH-09

SITE NAME: Wieland Solar House
LOCATION: Oberglatt, Switzerland

CONTACT: Prof. H. H. Hauri
ADDRESS: Inst. F. Hochbautechnik ETH
8093 Zurich
Switzerland

TELEPHONE: 01-377 2855

CLIMATE
Heating Degree Days: 3660
Cooling Degree Days:
Global Solar Radiation: 1114 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; masonry
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): wood
Auxiliary System(s): woodstove (convector central heating)
Number of Occupants: 3
Conditioned Floor Area: 140 m²
Aperture/Floor Area Ratio: 0.21
Global Heat Loss Coefficient: 183 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; hybrid
Passive Cooling System Type(s):
Thermal Storage Material: clay block and plaster interior walls; concrete floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 1982 to 1983
Format of Data: hard copy; disk
Quality of Data: 15 min. scans for 6 weeks, daily totals for 2 heating seasons; over 30 variables monitored

PERFORMANCE

REPORTS
Available from: Prof. H. H. Hauri, Inst. F. Hochbautechnik ETH, 8093 Zurich, Switzerland. (German)

NOTES

SITE CODE: CH-10

SITE NAME: Gmur Solar House
LOCATION: Gonten, Switzerland

CONTACT: Prof. H. H. Hauri
ADDRESS: Inst. F. Hochbautechnik ETH
8093 Zurich
Switzerland

TELEPHONE: 01-377 2855

CLIMATE
Heating Degree Days: 4240
Cooling Degree Days:
Global Solar Radiation: 1090 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame; masonry
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): wood
Auxiliary System(s): woodstove (convector central heating)
Number of Occupants: 5
Conditioned Floor Area: 190 m²
Aperture/Floor Area Ratio: 0.27
Global Heat Loss Coefficient: 300 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; convective air heater; hybrid
Passive Cooling System Type(s):
Thermal Storage Material: clay block and plaster interior walls; concrete floor
Other Passive Component(s):

MONITORING
Level of Monitoring: B-
Monitoring Period: 1981 to 1983
Format of Data: hard copy; disk
Quality of Data: 15 min. scans for 6 weeks, daily totals for 2 heating seasons; over 35 variables monitored

PERFORMANCE

REPORTS
Available from: Prof. H. H. Hauri, Inst. F. Hochbautechnik ETH, 8093 Zurich, Switzerland. (German)

NOTES

SITE CODE: US/AZ-07

SITE NAME: Payson House (Site WAA)	CONTACT: Donald Osborn
LOCATION: Payson, Arizona	ADDRESS: Solar Energy Res. Facility University of Arizona Tucson, AZ 85721
	TELEPHONE: (602) 626-0184

CLIMATE

Heating Degree Days:	2792
Cooling Degree Days:	368
Global Solar Radiation:	

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	propane
Auxiliary System(s):	forced air
Number of Occupants:	3
Conditioned Floor Area:	176 m^2
Aperture/Floor Area Ratio:	0.24
Global Heat Loss Coefficient:	426 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace; mass wall
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	brick chimney; concrete slab
Other Passive Component(s):	movable insulation on all glazing

MONITORING

Level of Monitoring:	B
Monitoring Period:	1/82 to 6/83
Format of Data:	9-track magnetic tape may be available
Quality of Data:	data not available in SERI Class B Data Base; duration and quality not determined

PERFORMANCE

REPORTS

Monitoring of Arizona Solar Design Homes - Final Phase.
From: Solar Energy Research Facility, University of Arizona, Tucson, AZ 85721

NOTES

Monitored with standard SERI Class B procedures.

SITE CODE: US/AZ-09

SITE NAME: Yacqui House (Site WAC)
LOCATION: Tucson, Arizona

CONTACT: Donald Osborn
ADDRESS: Solar Energy Res. Facility
University of Arizona
Tucson, AZ 85721

TELEPHONE: (602) 626-0184

CLIMATE

Heating Degree Days:	973
Cooling Degree Days:	1563
Global Solar Radiation:	2155 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard heaters
Number of Occupants:	
Conditioned Floor Area:	93 m²
Aperture/Floor Area Ratio:	0.12
Global Heat Loss Coefficient:	

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	evaporative; ventilation
Thermal Storage Material:	concrete slab
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B
Monitoring Period:	6/82 to late 1983
Format of Data:	9-track magnetic tape may be available
Quality of Data:	data not available in SERI Class B Data Base; duration and quality not determined

PERFORMANCE

REPORTS
Monitoring of Arizona Solar Design Homes - Final Phase.
From: Solar Energy Research Facility, University of Arizona, Tucson, AZ 85721.

NOTES

SITE CODE: US/CA-04

SITE NAME:	SMUD MB Residence	CONTACT:	Martha McCarthy
LOCATION:	Elk Grove, California	ADDRESS:	Statewide Energy Consortium Bldg. T-14 California State University Fullerton, CA
		TELEPHONE:	(714) 773-2884

CLIMATE
Heating Degree Days: 1579
Cooling Degree Days: 644
Global Solar Radiation: 1830 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): electric; wood
Auxiliary System(s): heat pump; wood stove
Number of Occupants: 4
Conditioned Floor Area: 167 m²
Aperture/Floor Area Ratio: 0.19
Global Heat Loss Coefficient: 385 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 3/82 to 3/83
Format of Data: hard copy
Quality of Data:

PERFORMANCE

REPORTS
Report will be available after September 1983 from the Department of Energy.

NOTES
Monitoring similar to standard SERI Class B procedures.

SITE CODE: US/CA-09

SITE NAME: Colton Conservation (Site WSE)
LOCATION: Colton, California

CONTACT: Solar Group
ADDRESS: Physics Department
California State University
6000 J Street
Sacramento, CA 95819

TELEPHONE: (916) 454-6518

CLIMATE

Heating Degree Days:	1066
Cooling Degree Days:	736
Global Solar Radiation:	1862 kWh/m^2

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	masonry
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	propane
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	154 m^2
Aperture/Floor Area Ratio:	0.03
Global Heat Loss Coefficient:	307 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	7/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	good continuous year of data

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 35%; Internal Gains: 46%; Auxiliary: 18%. Despite the much smaller aperture and thermal mass of this house, it achieved energy savings almost equal to site US/CA-08.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

Performance of Passive Solar and Energy Conserving Houses in California, Mahajan, S., C. Newcomb, M. Shea, and D. Mort, Nov. 1983, SERI/STR-254-2017, Golden, CO: Solar Energy Research Institute.

NOTES
This is a reference conservation design similar to site US/CA-08.

SITE CODE: US/CA-15

SITE NAME: Sacramento Solar Condo (Site WSK)
LOCATION: Sacramento, California

CONTACT: Solar Group
ADDRESS: Physics Department
California State University
6000 J Street
Sacramento, CA 95819

TELEPHONE: (916) 454-6518

CLIMATE
Heating Degree Days: 1601
Cooling Degree Days: 483
Global Solar Radiation: 1832 kWh/m²

BUILDING DESCRIPTION
Building Type: central unit of 6 unit building
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): heat pump (forced air)
Number of Occupants: 1
Conditioned Floor Area: 132 m²
Aperture/Floor Area Ratio: 0.15
Global Heat Loss Coefficient: 179 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation; shading
Thermal Storage Material: concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 12/81 to 3/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: ten months of almost continuous data

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 25%; Internal Gains: 36%; Auxiliary: 39%. The relatively low heat loss coefficient kept the purchased energy low despite the low solar contribution. Interior temperatures were very stable.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

Performance of Passive Solar and Energy Conserving Houses in California, Mahajan, S., C. Newcomb, M. Shea, and D. Mort, Nov. 1983, SERI/STR-254-2017, Golden, CO: Solar Energy Research Institute

NOTES

SITE CODE: US/CA-16

SITE NAME: Rio Linda Conservation (Site WSL)
LOCATION: Rio Linda, California

CONTACT: Solar Group
ADDRESS: Physics Department
California State University
6000 J Street
Sacramento, CA 95819

TELEPHONE: (916) 454-6518

CLIMATE

Heating Degree Days:	1601
Cooling Degree Days:	483
Global Solar Radiation:	1832 kWh/m²

BUILDING DESCRIPTION

Building Type:	Single dwelling
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	3
Conditioned Floor Area:	111 m²
Aperture/Floor Area Ratio:	0.03
Global Heat Loss Coefficient:	176 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	shading
Thermal Storage Material:	concrete slab
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	2/82 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	nine months of almost continuous data

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 6%; Internal Gains: 50%; Auxiliary: 44%. Largely due to a smaller heat loss rate, this house used less auxiliary heat than the otherwise similar solar design, site US/CA-14.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/CO-02

SITE NAME: Boulder House (Site DMA)
LOCATION: Boulder, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard
Number of Occupants:	4
Conditioned Floor Area:	170 m²
Aperture/Floor Area Ratio:	0.15
Global Heat Loss Coefficient:	309 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	sunspace; vertical wall collector
Passive Cooling System Type(s):	ventilation; earth contact
Thermal Storage Material:	concrete walls & slab; rock bed; water tubes
Other Passive Component(s):	vertical wall collector

MONITORING

Level of Monitoring:	B+
Monitoring Period:	6/81 to 10/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	3 months of data missing over 16 month period

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 58%; Internal Gains: 30%; Auxiliary: 12%. Indoor temperatures are low, averaging 18 degrees C.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
Individually controlled electric room heaters.

SITE CODE: US/CO-03

SITE NAME: Lafayette House (Site DMC)
LOCATION: Lafayette, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	bermed slab
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	126 m²
Aperture/Floor Area Ratio:	0.12
Global Heat Loss Coefficient:	265 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	brick wall; tiled concrete slab
Other Passive Component(s):	insulating shades on south

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	2 months of data missing over 12 month period

PERFORMANCE
The solar component provided 56% of the heating load from December through February.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al.
US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The building was unoccupied during the heating season, thus some rooms were not fully heated. The average temperature in January on the main floor was 15 degrees C.

SITE CODE: US/CO-04

SITE NAME: Golden House (Site DMD)
LOCATION: Golden, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	natural gas; wood
Auxiliary System(s):	forced air
Number of Occupants:	3
Conditioned Floor Area:	306 m²
Aperture/Floor Area Ratio:	0.11
Global Heat Loss Coefficient:	369 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation; earth contact
Thermal Storage Material:	brick & concrete wall; tile & concrete floor
Other Passive Component(s):	insulating shutters on south

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/81 to 6/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	2 years continuous data available

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 61%; Internal Gains: 13%; Auxiliary: 26%. Ceiling fans in solarium appear to distribute heat evenly and eliminate overheating.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The above energy balance was before building was occupied. After occupancy the solar component dropped to 50% because the indoor temperature was maintained 2 degrees higher.

SITE CODE: US/CO-05

SITE NAME: Arvada House (Site DME)
LOCATION: Arvada, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	301 m²
Aperture/Floor Area Ratio:	0.14
Global Heat Loss Coefficient:	423 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation; shading
Thermal Storage Material:	concrete basement; brick floor & walls
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	January and June data missing from 14 months of data collection

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 50%; Internal Gains: 15%; Auxiliary: 35%. The building has a high heat loss coefficient due to high infiltration.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
Most of main floor is a large room receiving gain through the sunspace, from skylights and other south windows. House mainly occupied on weekends. Sunspace doors to house interior only opened on sunny days during weekends, thus warming interior. Closed sunspace overheated on sunny weekdays, often exceeding 32 degrees C.

SITE CODE: US/CO-06

SITE NAME: Westminster House (Site DMF)
LOCATION: Westminster, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	174 m²
Aperture/Floor Area Ratio:	0.15
Global Heat Loss Coefficient:	284 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation; shading
Thermal Storage Material:	brick veneer walls; rock bin
Other Passive Component(s):	insulated shades on south

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/81 to 6/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	1 month of data missing from 23 months of continuous monitoring

PERFORMANCE

Despite a solar aperture of 15% of floor area, the solar performance was disappointing with less than 40% of mid-winter heating load met by the passive system. Rock bin storage system did not function adequately, causing heavily glazed living room to overheat often above 29 degrees C. The house experienced large temperature swings.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/CO-07

SITE NAME: Northglenn House (Site DMG)
LOCATION: Northglenn, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3342
Cooling Degree Days: 347
Global Solar Radiation: 1805 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: basement
Number of Stories: 2
Auxiliary Fuel(s): natural gas
Auxiliary System(s): forced air
Number of Occupants: 3
Conditioned Floor Area: 265 m²
Aperture/Floor Area Ratio: 0.11
Global Heat Loss Coefficient: 290 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace; mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material: brick veneer & concrete wall; tiled concrete floor
Other Passive Component(s): insulating/reflective (exterior) panels

MONITORING
Level of Monitoring: B+
Monitoring Period: 4/81 to 9/82
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: 13 months of continuous data available

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 49%; Internal Gains: 19%; Auxiliary: 32%. The performance might have been better if the insulating panels had been used regularly. The interior temperature was kept high, averaging 22 degrees C during the heating season.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The solarium is 2 stories high. Destratification ductwork is tied to the return-air plenum for the furnace.

SITE CODE: US/CO-08

SITE NAME: Denver House #1 (Site DMH)
LOCATION: Denver, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	multi-unit (central)
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	1
Conditioned Floor Area:	101 m²
Aperture/Floor Area Ratio:	0.18
Global Heat Loss Coefficient:	137 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	sunspace
Passive Cooling System Type(s):	ventilation; shading
Thermal Storage Material:	rock bed
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	10/81 to 6/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	2 months of data missing in 20 months of continuous monitoring

PERFORMANCE
The sunspace temperature is allowed to float. However, living zone temperatures did not exceed 24 degrees C. Heating Season Energy Balance - Passive Solar: 56%; Internal Gains: 23%; Auxiliary: 20%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
This is a townhouse with common east and west walls. The attached sunspace is two stories high, separated from main house by a brick wall.

SITE CODE: US/CO-09

SITE NAME: Denver House #2 (Site DMI)
LOCATION: Denver, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3342
Cooling Degree Days: 347
Global Solar Radiation: 1805 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: basement
Number of Stories: 1
Auxiliary Fuel(s): natural gas
Auxiliary System(s): forced air
Number of Occupants: 2
Conditioned Floor Area: 257 m²
Aperture/Floor Area Ratio: 0.10
Global Heat Loss Coefficient: 253 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation; shading
Thermal Storage Material: brick wall; tiled concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 4/81 to 10/82
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: 15 months of continuous data available

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 29%; Internal Gains: 38%; Auxiliary: 37%. The passive contribution was only 15% in December. The living room temperature occasionally exceeded 27 degrees C due to solar gains.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
Solar aperture is 9% of the floor area.

SITE CODE: US/CO-10

SITE NAME: Aurora House #1 (Site DMJ)
LOCATION: Aurora, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	gas; wood
Auxiliary System(s):	forced air; radiant stove
Number of Occupants:	2
Conditioned Floor Area:	121 m²
Aperture/Floor Area Ratio:	0.11
Global Heat Loss Coefficient:	187 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; mass wall
Passive Cooling System Type(s):	ventilation; earth contact; shading
Thermal Storage Material:	brick on wall & floor; concrete wall
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	6/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	15 months of continuous data available

PERFORMANCE
The Heating Season Energy Balance is uncertain because a woodstove was used during the whole winter period. Estimates of wood heat in the auxiliary give the following Heating Season Energy Balance - Passive Solar 50%; Internal Gains: 21%; Auxiliary: 29%. 'Interior temperatures were kept relatively cool, averaging 17.8 degrees C.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984.

NOTES
The house has a garage along the west wall and a north side air-lock entry way.

SITE CODE: US/CO-11

SITE NAME: Aurora House #2 (Site DMK)
LOCATION: Aurora, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	3
Conditioned Floor Area:	189 m²
Aperture/Floor Area Ratio:	0.17
Global Heat Loss Coefficient:	197 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; mass wall
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete wall with selective surface
Other Passive Component(s):	reflective interior curtains; insulating drapes

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	2 months of missing data in 16 months of monitoring

PERFORMANCE

Solar provided about 50% of the January-February heating load. Due to improper operation of the reflective curtains and a leaky mass wall ventilator.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al., US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

The mass wall is two and a half stories high. Aperture area is 17% of the floor area. The reflective curtains were not always correctly operated during winter, resulting in decreased solar performance and large temperature swings.

SITE CODE: US/CO-12

SITE NAME: Aurora House #3 (Site DML)
LOCATION: Aurora, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	natural gas
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	162 m²
Aperture/Floor Area Ratio:	0.09
Global Heat Loss Coefficient:	232 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	brick veneer wall; concrete wall & slab in basement
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	6/81 to 9/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	2 months of missing data in 14 months of monitoring

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 51%; Internal Gains: 18%; Auxiliary: 31%. North bedrooms remained typically 11 degrees C cooler than the family room on sunny winter days.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The solar aperture is 9% of the floor area.

SITE CODE: US/CO-13

SITE NAME: Tillotson House (Site DMM)
LOCATION: Nederland, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 5262
Cooling Degree Days:
Global Solar Radiation:

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade with north berm
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboards
Number of Occupants:	3
Conditioned Floor Area:	218 m^2
Aperture/Floor Area Ratio:	0.23
Global Heat Loss Coefficient:	

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace; mass wall
Passive Cooling System Type(s):	none
Thermal Storage Material:	concrete wall
Other Passive Component(s):	insulating shades & shutters

MONITORING

Level of Monitoring:	B+
Monitoring Period:	since 1/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	1 month of data missing in 10 months monitoring, monitoring is continuing

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 53%; Internal Gains: 34%; Auxiliary: 13%. Indoor temperatures stay very comfortable.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al., US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The building has a partial north berm.

SITE CODE: US/CO-15

SITE NAME: Acorn House (Site MBA)
LOCATION: Boulder, Colorado

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3342
Cooling Degree Days:	347
Global Solar Radiation:	1805 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	forced air (switched to natural gas)
Number of Occupants:	varies
Conditioned Floor Area:	200 m²
Aperture/Floor Area Ratio:	0.14
Global Heat Loss Coefficient:	327 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation; shading
Thermal Storage Material:	tile floor in solarium
Other Passive Component(s):	insulating night curtain on solarium glazing

MONITORING

Level of Monitoring:	B+
Monitoring Period:	11/81 to 6/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	monitoring period: 11/81 to 6/83; information completeness of data is not available

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 65%; Internal Gains: 9%; Auxiliary: 26%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
This is a manufactured panelized house with a 2 story solarium. The solarium is open to the living area and can be vented to the attic. Occupancy is atypical. It is a sales model, thus unoccupied during the night. The thermostat setting was about 13 degrees C.

SITE CODE: US/CT-01

SITE NAME: Tolland House (Site NEC)
LOCATION: Tolland, Connecticut

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3528
Cooling Degree Days:	
Global Solar Radiation:	1219 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard
Number of Occupants:	4
Conditioned Floor Area:	162 m²
Aperture/Floor Area Ratio:	0.13
Global Heat Loss Coefficient:	251 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	shading
Thermal Storage Material:	brick faced concrete wall; concrete slab floor
Other Passive Component(s):	insulating drapes & sliding panels for windows

MONITORING

Level of Monitoring:	B+
Monitoring Period:	9/81 to 4/83
Format of Data:	9-track magnetic tapes; hard copy
Quality of Data:	1 month missing data (available soon) in 21 continuous months of monitoring

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 29%; Internal Gains: 24%; Auxiliary: 46%. Occupants kept north bedroom doors closed, thus solar gain had little effect on these rooms where the day time temperature would drop below 15 degrees C even on sunny days.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
Two sets of sliding glass doors provide some control over heat flows between the sunspace and other zones.

SITE CODE: US/FL-01

SITE NAME:	FSEC Passive Cooling Laboratory	CONTACT:	Florida Solar Energy Center
LOCATION:	Cape Canaveral, Florida	ADDRESS:	300 State Road 401 Cape Canaveral, FL 32920

CLIMATE

Heating Degree Days:	407		
Cooling Degree Days:			
Global Solar Radiation:	1711 kWh/m²	TELEPHONE:	(305)783-0300

BUILDING DESCRIPTION

Building Type:	reconfigurable test building
Construction Type:	post & beam
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	
Auxiliary System(s):	
Number of Occupants:	
Conditioned Floor Area:	120 m²
Aperture/Floor Area Ratio:	
Global Heat Loss Coefficient:	variable

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	none
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	none
Other Passive Component(s):	wing walls for natural ventilation

MONITORING

Level of Monitoring:	A-
Monitoring Period:	since 1982
Format of Data:	9-track magnetic tape
Quality of Data:	high quality detailed data collection for intermittent short periods

PERFORMANCE

REPORTS

Wing Walls to Improve Natural Ventilation; Full Scale Results and Other Reports.
From: Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL 32920

NOTES

Performance testing is ongoing. The facility is unoccupied.

SITE CODE: US/GA-03

SITE NAME: Suwanne House (Site SSF)
LOCATION: Suwanee, Georgia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	1645
Cooling Degree Days:	
Global Solar Radiation:	1548 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	unheated basement
Number of Stories:	2
Auxiliary Fuel(s):	electric; propane
Auxiliary System(s):	furnace; resistance heater
Number of Occupants:	2
Conditioned Floor Area:	204 m²
Aperture/Floor Area Ratio:	0.07
Global Heat Loss Coefficient:	530 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	brick over concrete floor slab
Other Passive Component(s):	night insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/82 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	5 months continuous data available beginning in January, 1983

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 24%; Internal Gains: 21%; Auxiliary: 55%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al., US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/GA-04

SITE NAME: Atlanta House (Site SSG)
LOCATION: Atlanta, Georgia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 1645
Cooling Degree Days:
Global Solar Radiation: 1548 kWh/m^2

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame (brick veneer)
Ground Coupling: unheated basement; crawl space
Number of Stories: 1
Auxiliary Fuel(s): gas
Auxiliary System(s): forced air central furnace
Number of Occupants: 3
Conditioned Floor Area: 368 m^2
Aperture/Floor Area Ratio: 0.04
Global Heat Loss Coefficient: 443 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: tiled concrete floor
Other Passive Component(s): night insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 3/82 to 9/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: 6 months continuous data available for the 1982-83 heating season

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 23%; Internal Gains: 26%; Auxiliary: 50%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al., US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
The sunspace is incorporated into the living zone, but can be separated by glass doors. Two ceiling fans can be used to adjust comfort levels.

SITE CODE: US/IA-01

SITE NAME: Peosta House (Site MAA)
LOCATION: Peosta, Iowa

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3728
Cooling Degree Days:
Global Solar Radiation: 1511 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling:
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air
Number of Occupants: 4
Conditioned Floor Area: 171 m²
Aperture/Floor Area Ratio: 0.22
Global Heat Loss Coefficient: 244 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B
Monitoring Period: 5/81 to ?
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: Extent of usable data unknown

PERFORMANCE

REPORTS
A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/MA-01

SITE NAME: Braintree Building (Site NEP)
LOCATION: Braintree, Massachusetts

CONTACT: Marlene Hoey
ADDRESS: Braintree Housing Auth.
25 Russell Street
Braintree, MA 02184

TELEPHONE: (617) 848-1484

CLIMATE

Heating Degree Days:	3122
Cooling Degree Days:	367
Global Solar Radiation:	1272 kWh/m²

BUILDING DESCRIPTION

Building Type:	multifamily (8 units)
Construction Type:	wood frame
Ground Coupling:	
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	radiant ceiling
Number of Occupants:	1
Conditioned Floor Area:	48 m²
Aperture/Floor Area Ratio:	0.24
Global Heat Loss Coefficient:	59 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; mass wall
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete slab; concrete wall
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/82 to 2/84
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	majority of data available for at least 5 months (1982-83 heating season)

PERFORMANCE

REPORTS

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

NOTES

SITE CODE: US/MA-02

SITE NAME:	Mattapoisett Building (Site NES)	CONTACT:	June Mendell
LOCATION:	Mattapoisett, Massachusetts	ADDRESS:	Mattapoisett Housing Auth. Town Hall P.O. Box 358 Mattapoisett, MA 02739
		TELEPHONE:	(617) 727-5448

CLIMATE

Heating Degree Days:	3122
Cooling Degree Days:	367
Global Solar Radiation:	1272 kWh/m²

BUILDING DESCRIPTION

Building Type:	multifamily
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	radiant ceiling panels
Number of Occupants:	
Conditioned Floor Area:	47 m²
Aperture/Floor Area Ratio:	0.22
Global Heat Loss Coefficient:	41 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace; vertical rockbed
Passive Cooling System Type(s):	none
Thermal Storage Material:	concrete slab; rock storage wall
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	1/83 to ?/84
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	

PERFORMANCE

REPORTS
Report available from MA Executive Office of Energy Resources, 100 Cambridge St., Room 1500, Boston, MA 02202.

NOTES

SITE CODE: US/MA-03

SITE NAME: Cummington Building (Site NEU)
LOCATION: Cummington, Massachusetts

CONTACT: Thomas Nagle
ADDRESS: Hampshire County Regional Housing Authority
99 Main Street
Northampton, MA 01060
TELEPHONE: (413) 527-9357

CLIMATE
Heating Degree Days: 3366
Cooling Degree Days:
Global Solar Radiation: 1219 kWh/m²

BUILDING DESCRIPTION
Building Type: multifamily (4 units)
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): propane
Auxiliary System(s): pulse-fired boiler
Number of Occupants:
Conditioned Floor Area: 59 m²
Aperture/Floor Area Ratio: 0.13
Global Heat Loss Coefficient: 55 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace; mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab; concrete wall
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 4/83 to ?/84
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:

PERFORMANCE

REPORTS
Report available from MA Executive Office of Energy Resources, 100 Cambridge St., Room 1500, Boston, MA 02202.

NOTES

SITE CODE: US/MA-04

SITE NAME: Hamilton House (Site NEA)
LOCATION: Hamilton, Massachusetts

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3123
Cooling Degree Days:
Global Solar Radiation: 1272 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: masonry
Ground Coupling: slab on grade; earth sheltered
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): heat pump
Number of Occupants: 3
Conditioned Floor Area: 195 m²
Aperture/Floor Area Ratio: 0.19
Global Heat Loss Coefficient: 263 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): earth contact; shading
Thermal Storage Material: concrete block; concrete slab
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/81 to 5/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available, 4 months of 81-82 & 5 months of 82-83 heating seasons

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 26%; Internal Gains: 18%; Auxiliary: 56%. The house has a relatively low infiltration rate, due to the extensive use of earth berming. However, heat loss coefficient is relatively high because of the large glazing area. The solar contribution was 34% of the heating load in January but decreased in spring, probably because of large overhang above the major direct gain component. The building's ability to retain solar heat was disappointing, as the auxiliary heaters activated soon after sundown on sunny winter days. This should improve with the use of night insulation.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/MA-05

SITE NAME: Orange House (Site NEB)
LOCATION: Orange, Massachusetts

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3528
Cooling Degree Days:
Global Solar Radiation: 1219 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: basement
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): baseboard
Number of Occupants: 3
Conditioned Floor Area: 125 m²
Aperture/Floor Area Ratio: 0.15
Global Heat Loss Coefficient: 125 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete wall; concrete slab
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 9/81 to 8/82
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data for 12 consecutive months, except for Oct. and Dec.

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 47%; Internal Gains: 17%; Auxiliary: 36%. The average interior temperature of this house was maintained at 21 degrees C over the heating season. The living zone temperature was quite stable despite large sunspace temperature swings.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES
Internal gains were quite low due to the location of some major appliances in the basement.

SITE CODE: US/MA-06

SITE NAME: Lexington House (Site NEJ)
LOCATION: Lexington, Massachusetts

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 3123
Cooling Degree Days:
Global Solar Radiation: 1272 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: unheated basement
Number of Stories: 2
Auxiliary Fuel(s): natural gas
Auxiliary System(s): baseboard (hydronic)
Number of Occupants: 3
Conditioned Floor Area: 205 m²
Aperture/Floor Area Ratio: 0.13
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): shading
Thermal Storage Material: brick chimney; concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 2/82 to 5/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: building monitored for 15 months, but only 9 are presently in data archive

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 16%; Internal Gains: 42%; Auxiliary: 43%. House was heated for less than $200 in 1982-83.

REPORTS
Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/MA-07

SITE NAME: Carlisle House (Site NPV)
LOCATION: Carlisle, Massachusetts

CONTACT: MA Institute of Technology
ADDRESS: Lincoln Laboratory
Lexington, MA 02173

TELEPHONE: (617)862-5500

CLIMATE
Heating Degree Days: 3123
Cooling Degree Days:
Global Solar Radiation: 1272 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: basement
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): heat pump
Number of Occupants:
Conditioned Floor Area: 273 m²
Aperture/Floor Area Ratio: 0.12
Global Heat Loss Coefficient: 331 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: brick chimney; concrete slab; tile
Other Passive Component(s): none

MONITORING
Level of Monitoring: B
Monitoring Period: 4/81 to ?
Format of Data: 9-track magnetic tape; 1600 BPI; EBCDIC
Quality of Data: high-quality data at 6 minute intervals for over one year with very few data gaps

PERFORMANCE

REPORTS
Class B Passive Solar Monitoring of the PV House in Carlisle, MA, Duffy, J.,
From: Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401

NOTES
Some wood was burned for auxiliary heating. Monitoring of this house concentrated on a 93 m² photovoltaic array, but also includes 22 variables regarding heating/cooling performance.

SITE CODE: US/ME-01

SITE NAME: Topsham House (Site NEH)
LOCATION: Topsham, Maine

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	4166
Cooling Degree Days:	
Global Solar Radiation:	1210 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	basement
Number of Occupants:	2
Conditioned Floor Area:	143 m²
Aperture/Floor Area Ratio:	0.13
Global Heat Loss Coefficient:	147 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/81 to 5/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	majority of 4 months data from 1981-82 & 8 months data from 82-83 heating seasons

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 43%; Internal Gains: 15%; Auxiliary 42%. The greenhouse provided significant heat to the house on sunny days, but the lack of thermal storage caused rapid cooling of both the house and greenhouse at night.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/NH-01

SITE NAME: Northwood House (Site NEM)
LOCATION: Northwood, New Hampshire

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 4089
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	post and beam; masonry
Ground Coupling:	basement
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard
Number of Occupants:	3
Conditioned Floor Area:	179 m²
Aperture/Floor Area Ratio:	0.16
Global Heat Loss Coefficient:	140 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation; earth contact
Thermal Storage Material:	brick floor; concrete block walls; water tubes
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/81 to 2/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	data collected for 15 months, but summer data may not be available

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 43%; Internal Gains: 17%; Auxiliary: 40%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

NOTES
The sunspace was kept relatively warm so plants could be grown, reducing the potential heat delivered to the living space. The house is heavily earth-bermed.

SITE CODE: US/NC-02

SITE NAME: Carrboro House (Site SSM)
LOCATION: Carrboro, North Carolina

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden,CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 1952
Cooling Degree Days:
Global Solar Radiation: 1491 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air
Number of Occupants:
Conditioned Floor Area: 152 m²
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient: 343 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/81 to 12/82
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: 7 months of reasonably complete data (one full heating season)

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 29%; Internal Gains: 43%; Auxiliary: 28%. Daily temperature swings were large. Interior temperature was very even. In January, for instance, temperatures frequently fell below 15 degrees and over 27 degrees C.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/NC-03

SITE NAME:	Black Mountain House (Site SSK)	CONTACT:	Building Systems Branch
LOCATION:	Black Mountain, South Carolina	ADDRESS:	Solar Energy Research Inst. 1617 Cole Blvd. Golden, CO 80401

CLIMATE

Heating Degree Days: 2246

Cooling Degree Days:

Global Solar Radiation: 1510 kWh/m²

TELEPHONE: (303)231-7186

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	electric resistance
Auxiliary System(s):	baseboards
Number of Occupants:	2
Conditioned Floor Area:	83 m²
Aperture/Floor Area Ratio:	0.13
Global Heat Loss Coefficient:	168 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; half mass wall
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete block walls; concrete slab
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	10/81 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	although spread over 2 years, data available for every month of year

PERFORMANCE

Heating Season Energy Balance - Passive Solar - 36%; Internal Gains: 31%; Auxiliary: 33%. Relatively stable interior temperatures maintained.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/ND-01

SITE NAME: Fargo House (Site MBD)
LOCATION: Fargo, North Dakota

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7062

CLIMATE

Heating Degree Days:	5150
Cooling Degree Days:	262
Global Solar Radiation:	1384 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	
Number of Stories:	2
Auxiliary Fuel(s):	electric; wood
Auxiliary System(s):	baseboard; wood stove
Number of Occupants:	2
Conditioned Floor Area:	167 m²
Aperture/Floor Area Ratio:	0.07
Global Heat Loss Coefficient:	153 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	phase change container wall
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	2/82 to 6/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	majority of data for 5 month period

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 53%; Internal Gains: 21%; Auxiliary 25%.

REPORTS

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

NOTES

SITE CODE: US/OK-01

SITE NAME: Edmond House (Site SSA)
LOCATION: Edmond, Oklahoma

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 2069
Cooling Degree Days:
Global Solar Radiation: 1682 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: post & beam
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air
Number of Occupants: 4
Conditioned Floor Area: 232 m²
Aperture/Floor Area Ratio: 0.18
Global Heat Loss Coefficient: 646 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): shading
Thermal Storage Material: concrete slab; tile; stone chimney
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 12/81 to 9/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: data recorded for 13 months; quality questionable

PERFORMANCE

REPORTS
A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/OR-01

SITE NAME: Adair House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208
TELEPHONE: (303) 230-5544

CLIMATE

Heating Degree Days:	2662
Cooling Degree Days:	
Global Solar Radiation:	1213 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	crawlspace; partial floor slab over decking
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	wall heaters
Number of Occupants:	2
Conditioned Floor Area:	118 m²
Aperture/Floor Area Ratio:	0.07
Global Heat Loss Coefficient:	138 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete slab
Other Passive Component(s):	

MONITORING

Level of Monitoring:	B+
Monitoring Period:	10/82 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	majority of data available for one year

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-02

SITE NAME: Conifer House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208
TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): gas
Auxiliary System(s): forced air
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 10/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for one year

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-03

SITE NAME: Edwards House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208

TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s): wall heater
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 10/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for one year

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-04

SITE NAME: Shelter House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208

TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s): floor heaters
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 8/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for 10 months

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-05

SITE NAME: Waibel House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208
TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 10/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for one year

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-06

SITE NAME: Cameo House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208

TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 8/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for ten months

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-07

SITE NAME: Hawley House
LOCATION: Hillsboro, Oregon

CONTACT: Mark McKinstry MS-PEGB
ADDRESS: Bonneville Power Admin.
Box 3621
Portland, OR 97208

TELEPHONE: (303) 230-5544

CLIMATE
Heating Degree Days: 2662
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type:
Ground Coupling:
Number of Stories:
Auxiliary Fuel(s): electric
Auxiliary System(s): baseboards; wall heater
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; sunspace
Passive Cooling System Type(s): ventilation
Thermal Storage Material:
Other Passive Component(s):

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/82 to 10/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: majority of data available for one year

PERFORMANCE

REPORTS
Bonneville Power Administration report to be published.

NOTES

SITE CODE: US/OR-08

SITE NAME: Modena Homes
LOCATION: Eugene, Oregon

CONTACT: National Solar Data Network
ADDRESS: U.S. Dept. of Energy
Argonne National Lab
9700 South Cass Avenue
Argonne, IL 60439
TELEPHONE:

CLIMATE
Heating Degree Days: 2696
Cooling Degree Days: 129
Global Solar Radiation: 1390 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: slab on grade
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): furnace
Number of Occupants: 2
Conditioned Floor Area: 139 m²
Aperture/Floor Area Ratio: 0.14
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): shading
Thermal Storage Material: concrete slab; water drums
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 10/80 to 5/81
Format of Data: hard copy or 9-track tape may be available
Quality of Data: majority of data for one full heating season

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 16%; Internal Gains: 39%; Auxiliary: 41%.

REPORTS
Comparative Report: Performance of Passive Solar Space Heating Systems, From: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

NOTES
The indoor temperature was maintained very high in this house. Movable insulation jammed and was not entirely effective. Significant shading by external obstructions limited solar input.

SITE CODE: US/OR-09

SITE NAME: ODOE House #1
LOCATION: Tumalo, Oregon

CONTACT: David Robison
ADDRESS: Oregon Dept. of Energy
Room 102
Labor & Industries Bldg.
Salem, OR 97310
TELEPHONE: (503) 378-4040

CLIMATE
Heating Degree Days: 3944
Cooling Degree Days:
Global Solar Radiation: 1606 kWh/m^2

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: concrete block foundation
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s):
Number of Occupants:
Conditioned Floor Area:
Aperture/Floor Area Ratio:
Global Heat Loss Coefficient: 339 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: concrete slab
Other Passive Component(s):

MONITORING
Level of Monitoring: B
Monitoring Period: 4/81 to 3/82
Format of Data: hard copy available; magnetic tape or diskette possible
Quality of Data: hourly data for a full year on 7 variables
adequate for energy balance

PERFORMANCE

REPORTS
Passive Solar Monitoring Project - Final Report, Oregon Dept. of Energy, Room 102, Labor and Industries Building, Salem, OR 97310.

NOTES

SITE CODE: US/RI-02

SITE NAME: Jamestown House (Site NEL)
LOCATION: Jamestown, Rhode Island

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	3318
Cooling Degree Days:	
Global Solar Radiation:	1281 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboard
Number of Occupants:	0
Conditioned Floor Area:	110 m²
Aperture/Floor Area Ratio:	0.15
Global Heat Loss Coefficient:	176 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	11/81 to 1/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	good continuous data for last half of 81-82 and 1st half of 1982-83 heating seasons

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 34%; Internal Gains: 4%; Auxiliary 62%. House was unoccupied, so internal gains are very low. Also, the temperature was allowed to float some months and sometimes went below 10 degrees C.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

Summer data was collected, but is not presently in archive.

SITE CODE: US/SC-01

SITE NAME: Manning House (Site SSJ)
LOCATION: Manning, South Carolina

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 1380
Cooling Degree Days:
Global Solar Radiation: 1589 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: vented crawl space
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): resistance forced air
Number of Occupants:
Conditioned Floor Area: 28 m²
Aperture/Floor Area Ratio: 1.48
Global Heat Loss Coefficient: 70 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): sunspace; mass wall
Passive Cooling System Type(s): ventilation
Thermal Storage Material: brick; concrete block; concrete slab
Other Passive Component(s): movable insulation

MONITORING
Level of Monitoring: B+
Monitoring Period: 12/81 to 9/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: limited months of data in archive

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 38%; Internal Gains: 29%; Auxiliary: 33%.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/TX-01

SITE NAME: Houston House (Site SSB)
LOCATION: Houston, Texas

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	776
Cooling Degree Days:	
Global Solar Radiation:	1556 kWh/m^2

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame (brick veneer)
Ground Coupling:	slab on grade
Number of Stories:	2
Auxiliary Fuel(s):	gas
Auxiliary System(s):	central furnace
Number of Occupants:	2
Conditioned Floor Area:	196 m^2
Aperture/Floor Area Ratio:	0.09
Global Heat Loss Coefficient:	405 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	1/83 to 5/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	although monitored for longer, only 4 months of data in data base (2/83-5/83)

PERFORMANCE

REPORTS

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/VA-02

SITE NAME: Usry Direct Gain (Site MBG)
LOCATION: Richmond, Virginia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7062

CLIMATE
Heating Degree Days: 2188
Cooling Degree Days:
Global Solar Radiation: 1435 kWh/m²

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: crawl space
Number of Stories: 1
Auxiliary Fuel(s): electric
Auxiliary System(s): forced air - heat pump
Number of Occupants: 0
Conditioned Floor Area: 110 m²
Aperture/Floor Area Ratio: 0.16
Global Heat Loss Coefficient:

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain; mass wall
Passive Cooling System Type(s):
Thermal Storage Material: concrete block
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 7/82 to 9/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:

PERFORMANCE

REPORTS

NOTES

SITE CODE: US/VA-03

SITE NAME: Usry Solarium (Site MBY)
LOCATION: Richmond, Virginia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7062

CLIMATE

Heating Degree Days:	2188
Cooling Degree Days:	
Global Solar Radiation:	1435 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	crawl space
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	forced air - heat pump
Number of Occupants:	0
Conditioned Floor Area:	143 m²
Aperture/Floor Area Ratio:	0.20
Global Heat Loss Coefficient:	

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	regenerative rock bed
Thermal Storage Material:	rock bed
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	4/82 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	

PERFORMANCE

REPORTS

NOTES

SITE CODE: US/VA-04

SITE NAME: Stephens City House (Site SSL)
LOCATION: Stephens City, Virginia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	2500
Cooling Degree Days:	
Global Solar Radiation:	1391 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	slab on grade
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	resistance - baseboard heaters
Number of Occupants:	2
Conditioned Floor Area:	112 m²
Aperture/Floor Area Ratio:	0.19
Global Heat Loss Coefficient:	160 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; mass wall (water)
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	concrete slab; water wall
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	10/81 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	9 months data in archive

PERFORMANCE
Heating Season Energy Balance - Passive Solar: 22%; Internal Gains: 38%; Auxiliary: 40%.

REPORTS
Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402.

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/VA-05

SITE NAME: Richmond House (Site SSN)
LOCATION: Richmond, Virginia

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	2147
Cooling Degree Days:	
Global Solar Radiation:	1437 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	vented crawl space
Number of Stories:	2
Auxiliary Fuel(s):	electric
Auxiliary System(s):	resistance - baseboard heaters
Number of Occupants:	3
Conditioned Floor Area:	115 m²
Aperture/Floor Area Ratio:	0.21
Global Heat Loss Coefficient:	233 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; mass wall (water)
Passive Cooling System Type(s):	
Thermal Storage Material:	water wall
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	10/81 to 9/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	data collected for 18 continuous months but only 12 in data base at present (summer missing)

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 45%; Internal Gains: 24%; Auxiliary: 30%. The large thermal mass maintained comfortable temperatures without overheating. A nighttime temperature setback allowed temperature in the bedrooms to drop below 15 degrees C on cloudy winter days.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/VT-02

SITE NAME: Newport House (Site NED)
LOCATION: Newport, Vermont

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	4836
Cooling Degree Days:	
Global Solar Radiation:	1212 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	1
Auxiliary Fuel(s):	electric
Auxiliary System(s):	baseboards
Number of Occupants:	1
Conditioned Floor Area:	134 m²
Aperture/Floor Area Ratio:	0.06
Global Heat Loss Coefficient:	117 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	none

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/81 to 1/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	9 months of good data in archive

PERFORMANCE

Solar affects were primarily during the day with little storage.

REPORTS

Passive Solar Performance: Summary of 1982-83 Class B Results, SERI, US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984.

NOTES

SITE CODE: US/VT-03

SITE NAME: South Royalton House (Site NEK)
LOCATION: South Royalton, Vermont

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401
TELEPHONE: (303)231-7186

CLIMATE
Heating Degree Days: 4089
Cooling Degree Days:
Global Solar Radiation: 1213 kWh/m^2

BUILDING DESCRIPTION
Building Type: single detached
Construction Type: wood frame
Ground Coupling: insulated slab foundation
Number of Stories: 2
Auxiliary Fuel(s): electric
Auxiliary System(s): baseboards
Number of Occupants: 4
Conditioned Floor Area: 136 m^2
Aperture/Floor Area Ratio: 0.10
Global Heat Loss Coefficient: 145 W/degree K

PASSIVE SOLAR SYSTEMS
Passive Heating System Type(s): direct gain
Passive Cooling System Type(s): ventilation
Thermal Storage Material: lightweight building materials
Other Passive Component(s): none

MONITORING
Level of Monitoring: B+
Monitoring Period: 11/81 to 1/83
Format of Data: 9-track magnetic tape, 1600 or 6250 BPI
Quality of Data: data collected for 15 months but 6 intermittent months not in archive

PERFORMANCE
Heating Season Energy Balance - Passive Solar - 19%; Internal Gains: 34%; Auxiliary: 47%. The second floor experienced large temperature swings and significant overheating, which reduced solar performance.

REPORTS
Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/WI-01

SITE NAME: Eau Claire House (Site MAC)
LOCATION: Eau Claire, Wisconsin

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7186

CLIMATE

Heating Degree Days:	4660
Cooling Degree Days:	
Global Solar Radiation:	1304 kWh/m²

BUILDING DESCRIPTION

Building Type:	single detached
Construction Type:	wood frame
Ground Coupling:	basement
Number of Stories:	1
Auxiliary Fuel(s):	propane
Auxiliary System(s):	forced air
Number of Occupants:	2
Conditioned Floor Area:	168 m²
Aperture/Floor Area Ratio:	0.19
Global Heat Loss Coefficient:	163 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain; sunspace
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	brick walls; concrete floor
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	5/81 to 7/82
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	majority of 5 months of continuous data available

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 26%; Internal Gains: 17%; Auxiliary: 56%. Due to the efficiency of the building envelope, the auxiliary heating needs were low for such a cold climate. The solar component contributed 26% of the winter heating load. Although the solarium temperature fluctuated a great deal, the temperature in the rest of the house was more stable and comfortable.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

SITE CODE: US/WI-02

SITE NAME: Spencer House (Site MBB)
LOCATION: Spencer, Wisconsin

CONTACT: Building Systems Branch
ADDRESS: Solar Energy Research Inst.
1617 Cole Blvd.
Golden, CO 80401

TELEPHONE: (303)231-7062

CLIMATE

Heating Degree Days:	4660
Cooling Degree Days:	
Global Solar Radiation:	1304 kWh/m²

BUILDING DESCRIPTION

Building Type:	duplex, mobile home
Construction Type:	wood frame
Ground Coupling:	crawl space
Number of Stories:	1
Auxiliary Fuel(s):	propane
Auxiliary System(s):	forced air
Number of Occupants:	varies
Conditioned Floor Area:	94 m²
Aperture/Floor Area Ratio:	0.08
Global Heat Loss Coefficient:	127 W/degree K

PASSIVE SOLAR SYSTEMS

Passive Heating System Type(s):	direct gain
Passive Cooling System Type(s):	ventilation
Thermal Storage Material:	lightweight building materials
Other Passive Component(s):	movable insulation

MONITORING

Level of Monitoring:	B+
Monitoring Period:	12/81 to 1/83
Format of Data:	9-track magnetic tape, 1600 or 6250 BPI
Quality of Data:	limited data in archive

PERFORMANCE

Heating Season Energy Balance - Passive Solar: 34%; Internal Gains: 4%; Auxiliary: 62%. Much of the relatively small heat loss is due to infiltration. With the building unoccupied the internal temperature was allowed to float, and without significant mass it often exceeded 27 degrees C. Such overheating would normally result in venting, thus reducing the net solar gains.

REPORTS

Passive Solar Performance: Summary of 1981-82 Class B Results, Swisher et al. US Superintendent of Documents, Govt. Printing Office, Washington, DC 20402

A Guide to Using the Class B Passive Solar Performance Data, William A. Kolar, SERI/SP-254-2248, Solar Energy Research Institute, 1984

NOTES

5. PERFORMANCE DATA FOR SYSTEM EVALUATION FORMS

This chapter contains more detailed information on some of the monitored buildings described in Chapter 4. Drawings and photographs are presented to more fully illustrate the architectural character of the passive solar homes. Also, performance data is presented for a typical summer and winter day and for annual energy performance. Findings from the monitoring program are also summarized. Together, this information provides greater insight into the design, construction, operation and performance of the monitored passive solar projects than provided in Chapter 4. This information should assist the reader in selecting candidate projects from which to obtain performance data.

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

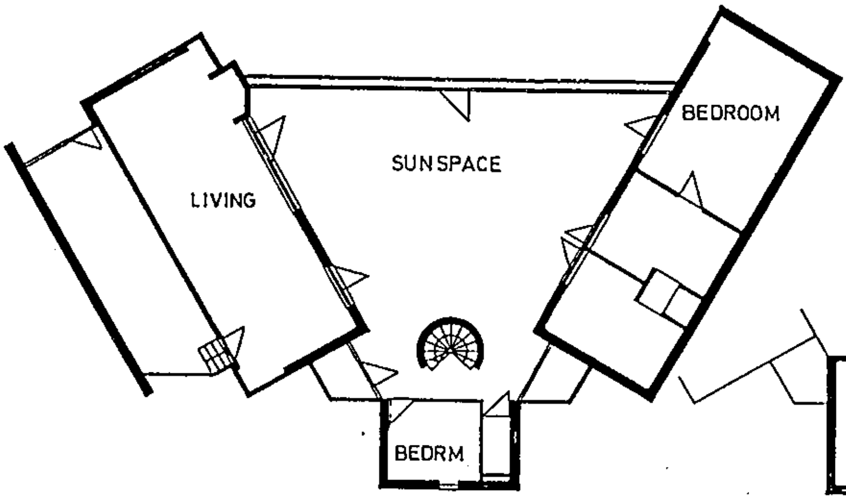
PROJECT TITLE

BE-01

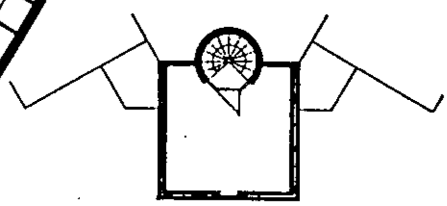
Direct gain house with integrated sunspace.

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

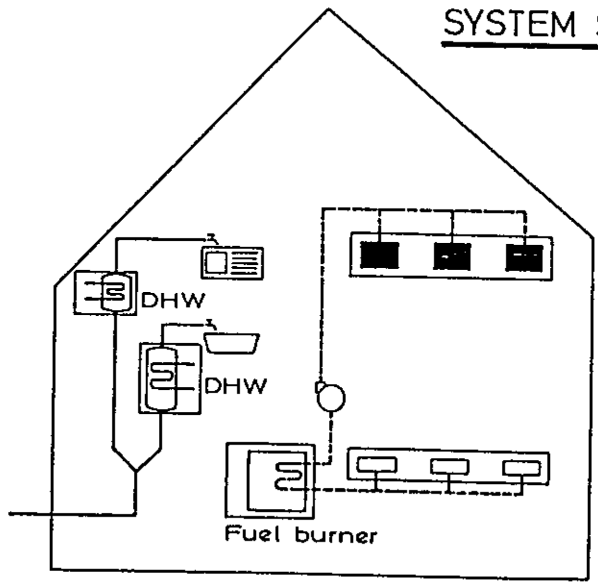


1st LEVEL

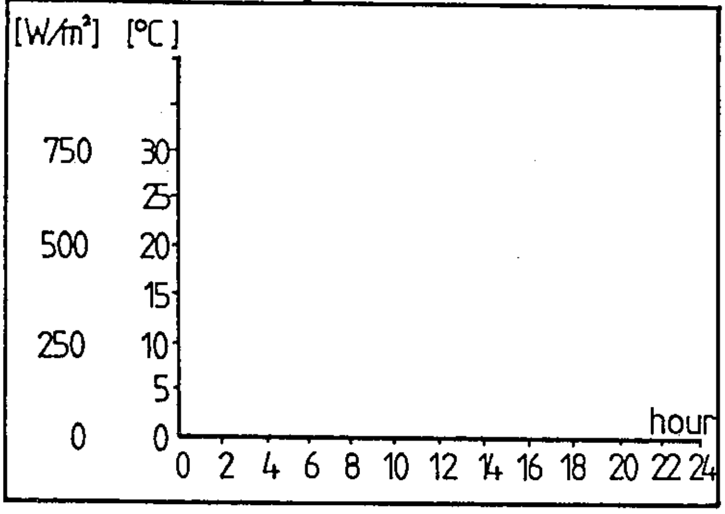


2nd LEVEL

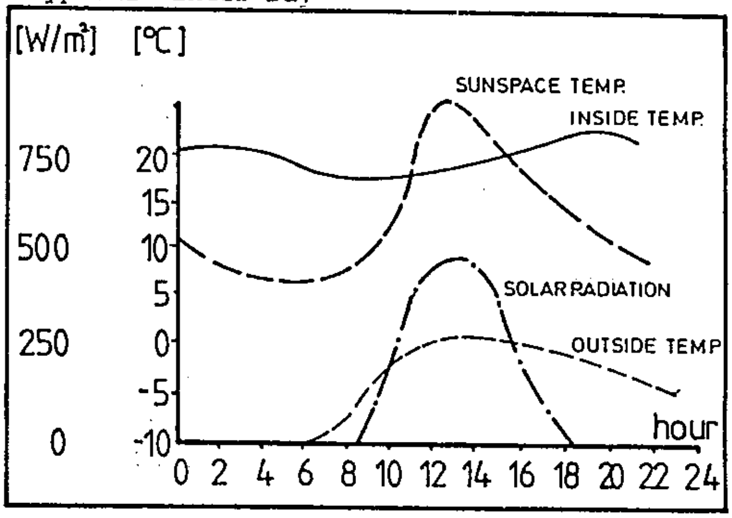
SYSTEM SCHEMATIC



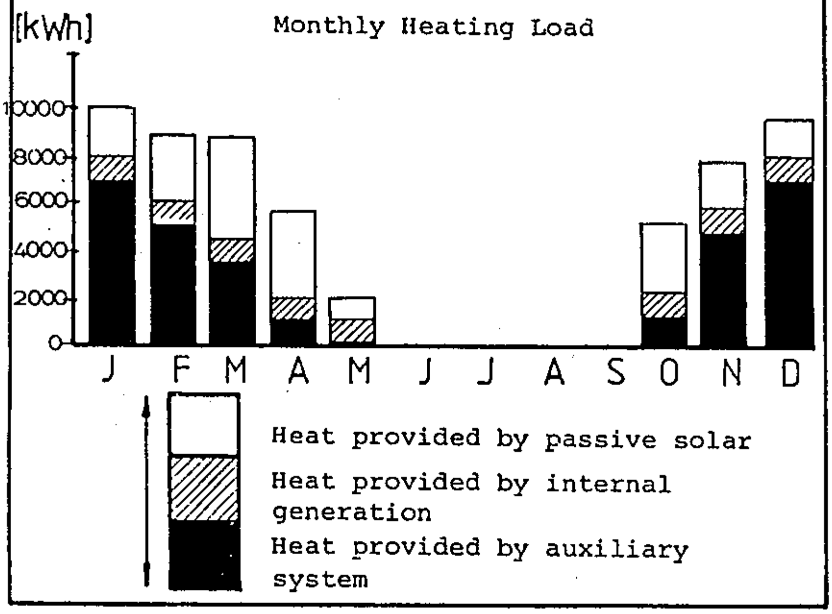
Typical Summer Day



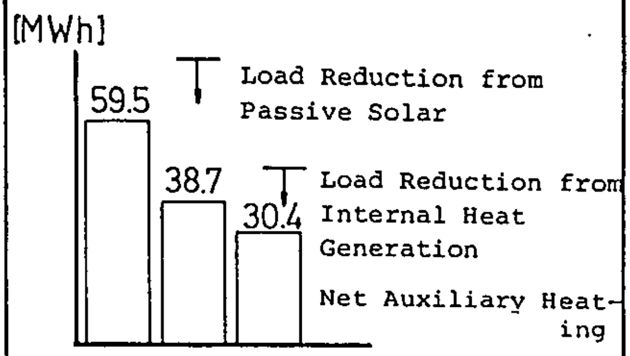
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	35 %
Heating Load Provided by Internal Generation	14 %
Heating Load Provided by Auxiliary Heating	51 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The sunspace is the most important area of this house and has essentialy an horticultural reason.

It's also important to note that the auxiliary heating provides for a very big part form the wood owen wich is placed in the living.

Source of Information:

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

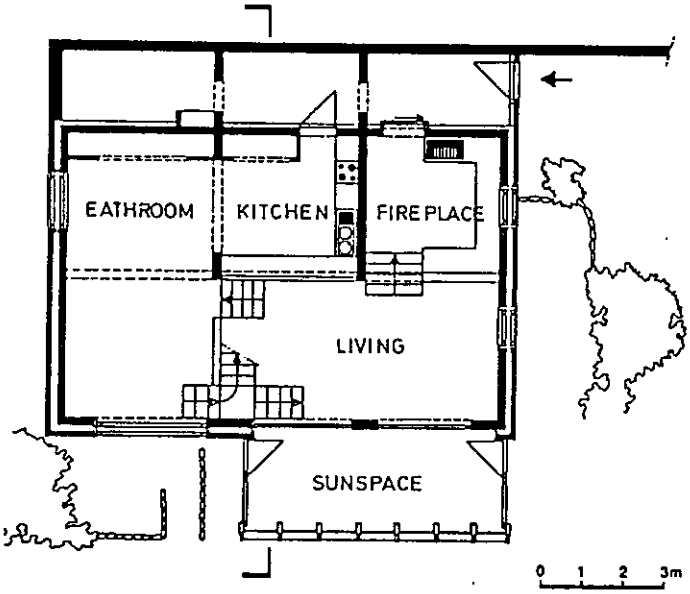
PROJECT TITLE

BE-02

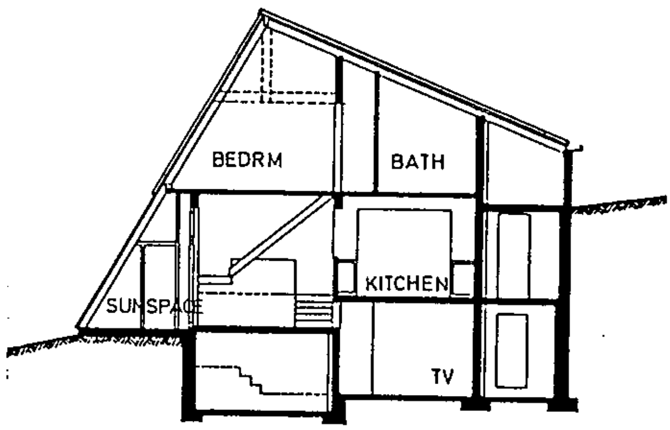
Direct gain house with added sunspace and solar collector.

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

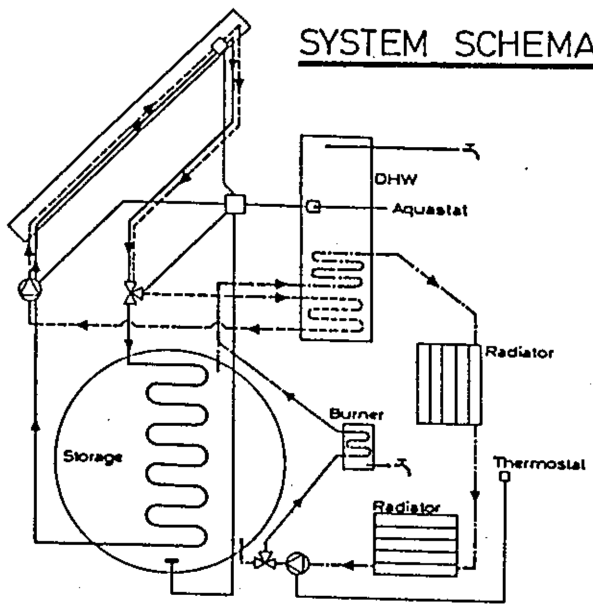


GROUND FLOOR



SECTION

SYSTEM SCHEMATIC



Collectors :

1. sunspace ($33m^2$) with mass wall storage.
2. solar collector with water storage ($30m^3$)

Distribution :

1. radiation and convection from wall storage
2. radiators using energy from the water storage

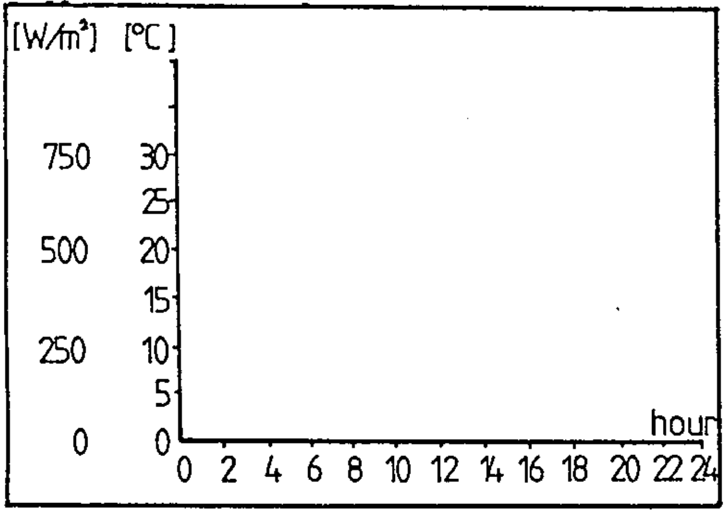
Auxiliary : fuel burner

DHW : from the same solar collector

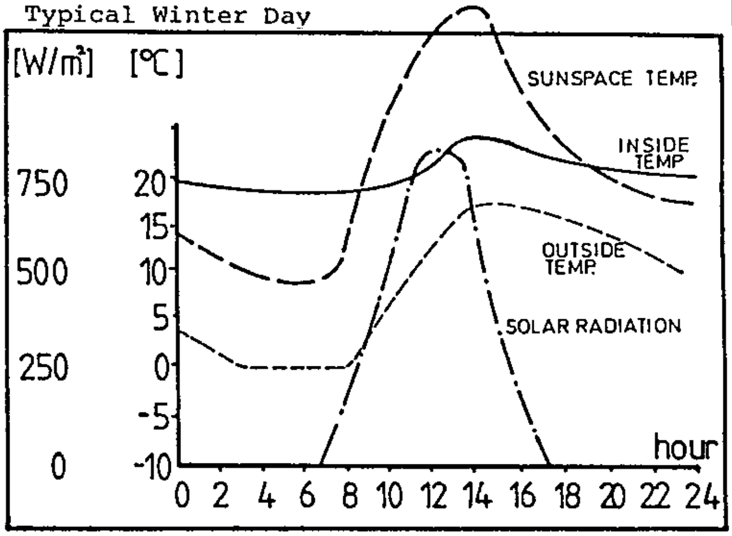
Controls :

- always priority to DHW boiler
- differential thermostat to control storage or burner

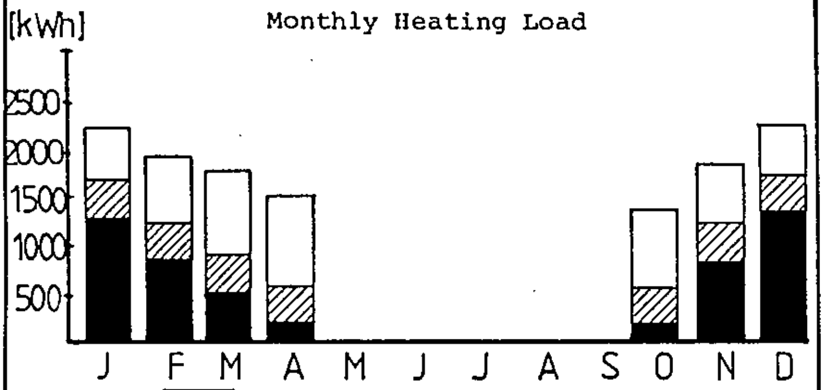
Typical Summer Day



Typical Winter Day



Performance Summary

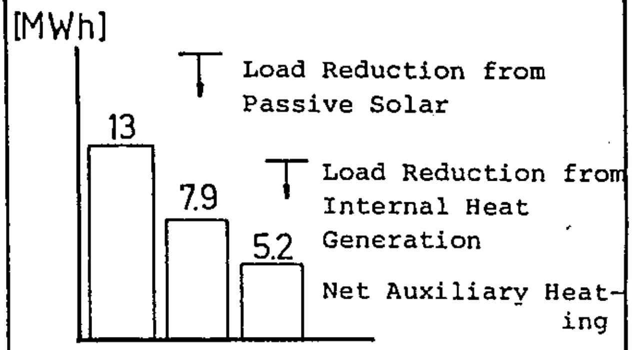


Heat provided by passive solar

Heat provided by internal generation

Heat provided by auxiliary system

Annual Summary



Heating Load Provided by Passive Solar	39 %
Heating Load Provided by Internal Generation	21 %
Heating Load Provided by Auxiliary Heating	40 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The direct solar gains were essentialy researched during the pré-design of the house (choice of materiels, orientation of glazing, attached sunspace). The monitoring has schown a very low energy load so that on a economical point of vue, the active system (solar collector) can difficultly be justified.

Source of Information:

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

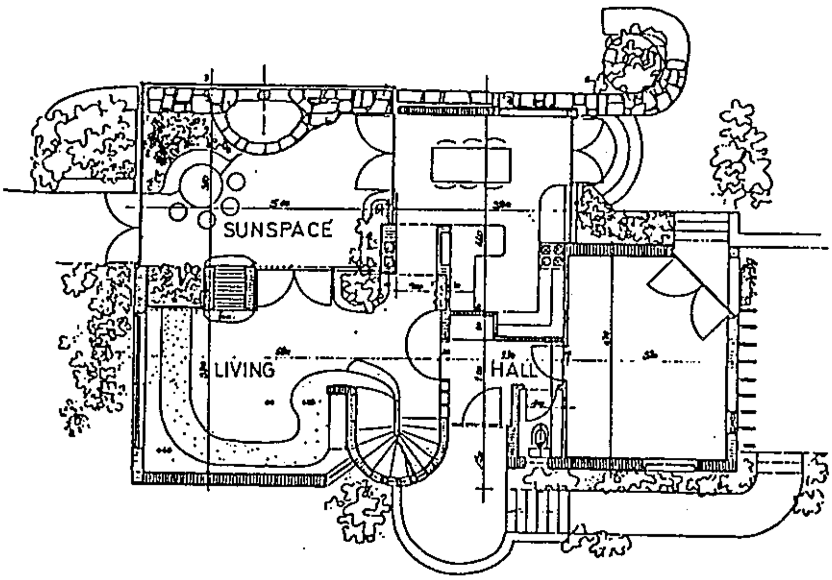
PROJECT TITLE

BE-03

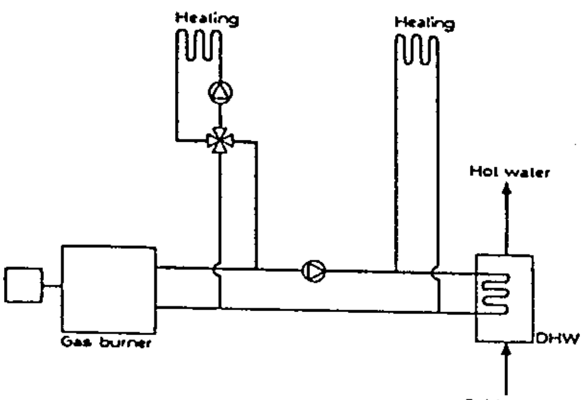
Direct gain house with integrated sunspace and trombe wall.

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

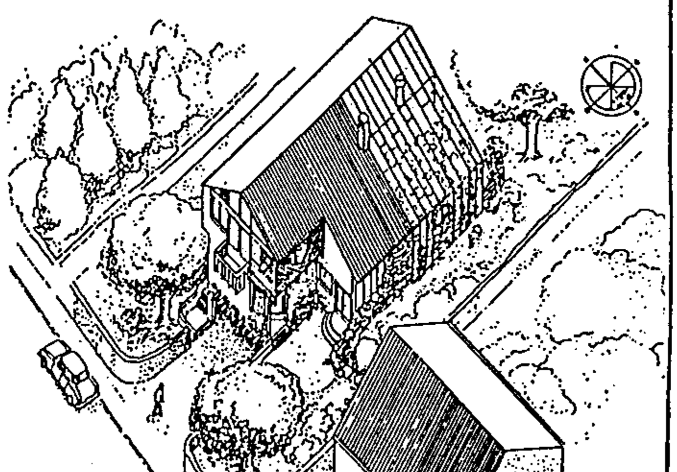


GROUND FLOOR

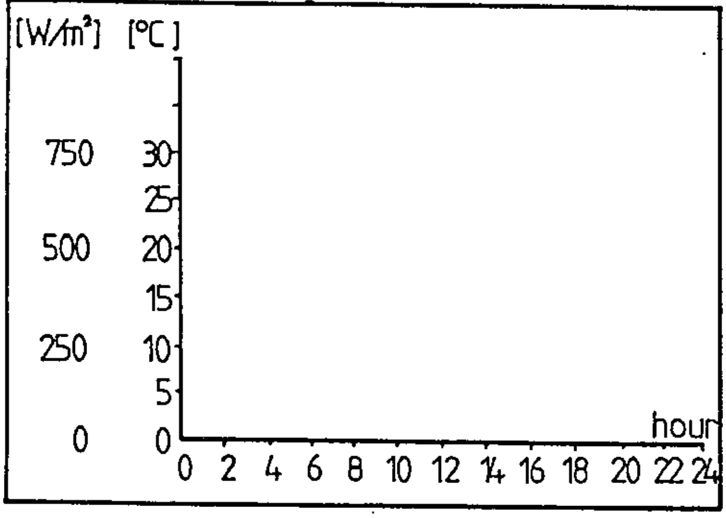


SYSTEM SCHEMATIC

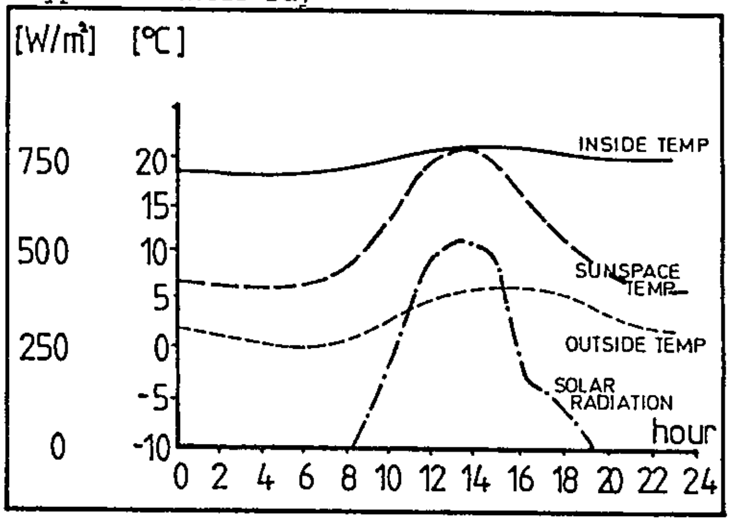
AXONOMETRY



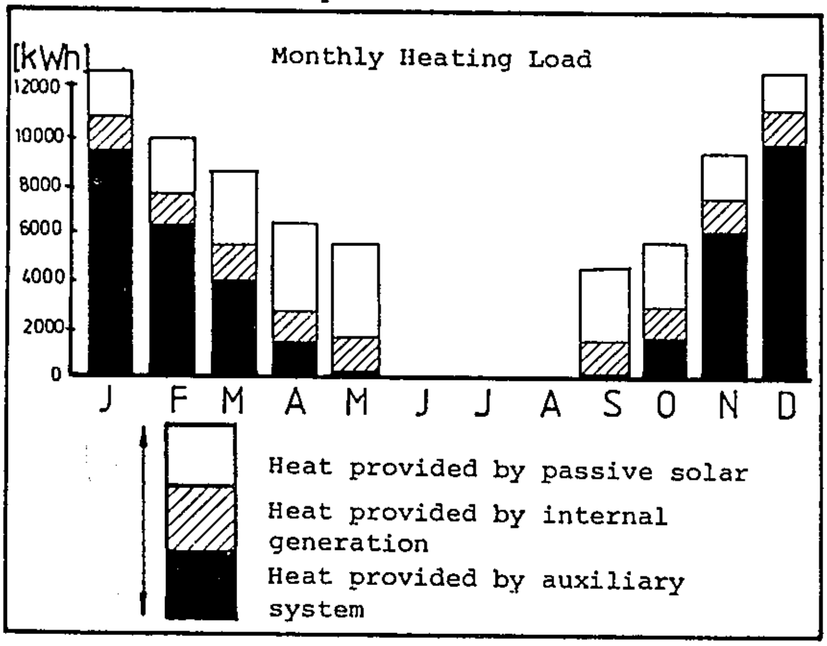
Typical Summer Day



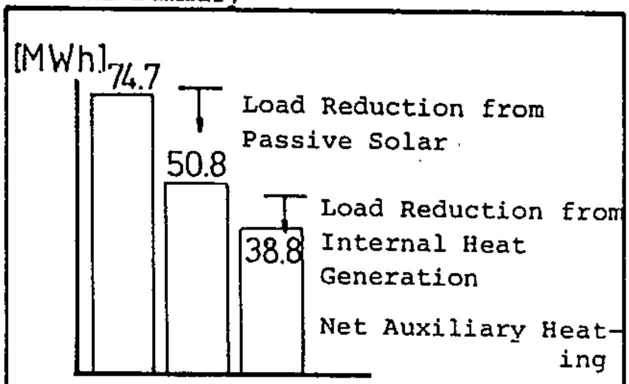
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	32 %
Heating Load Provided by Internal Generation	16 %
Heating Load Provided by Auxiliary Heating	52 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The direct solar gains were essentialy researched during the predesign of the house.

The integrated sunspace has two functions :

- solar captor and horticultural

That's the reason why it's necessary to maintain there 10°C minimum.

The hot water production needs to use continually the gaz burner as shown with system schematic. That system has to be modify.

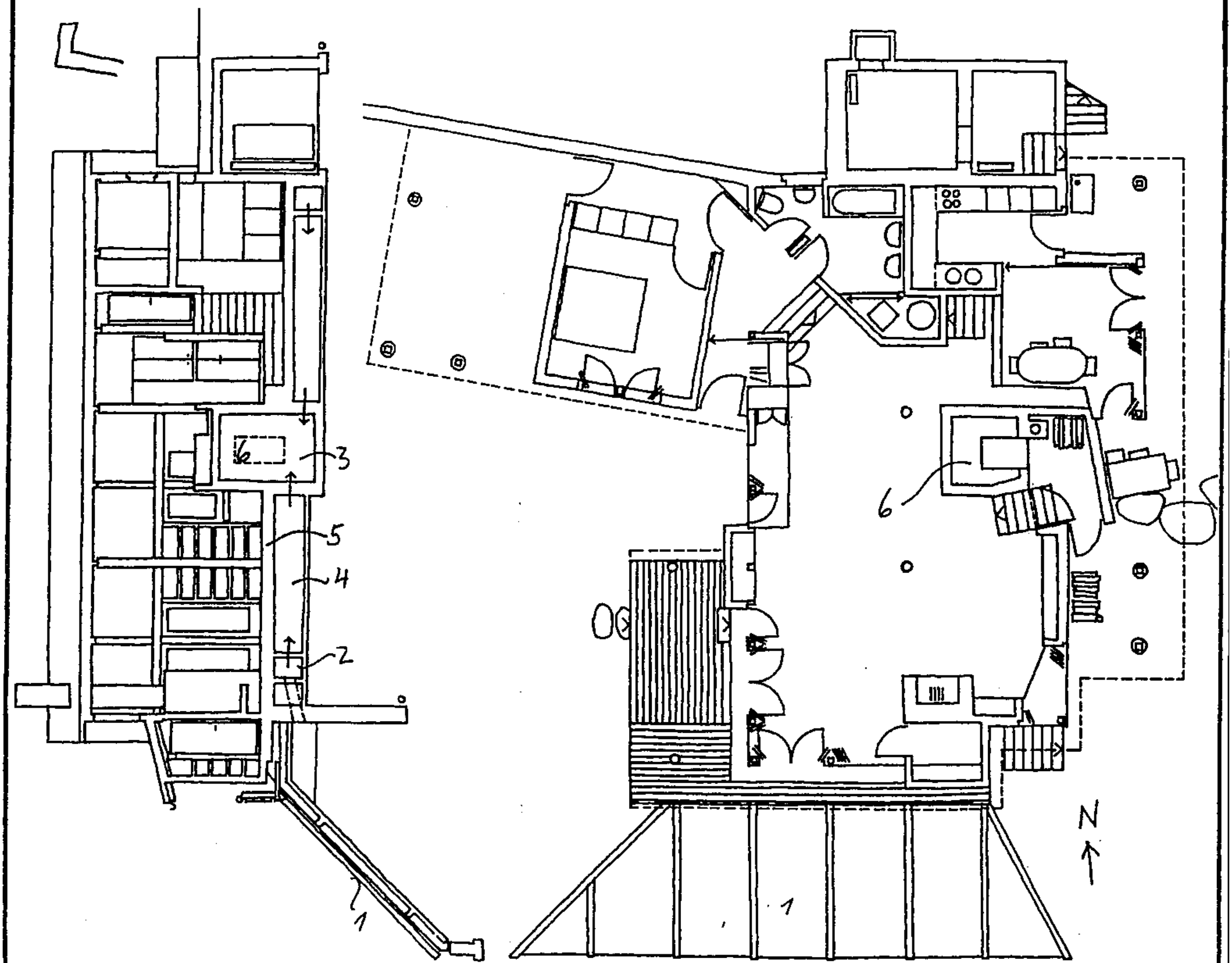
Finaly, it's a pity that the house is not better insulated.

Source of Information:

CH-07

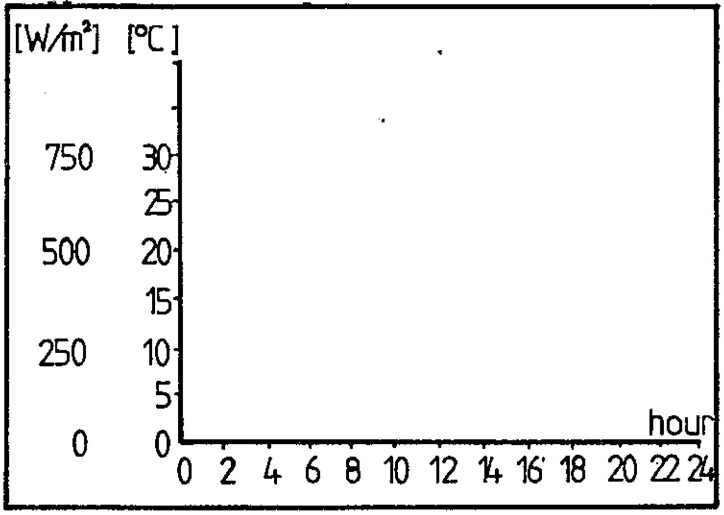
NEFF 181

House P. Schaub, Rothenfluh

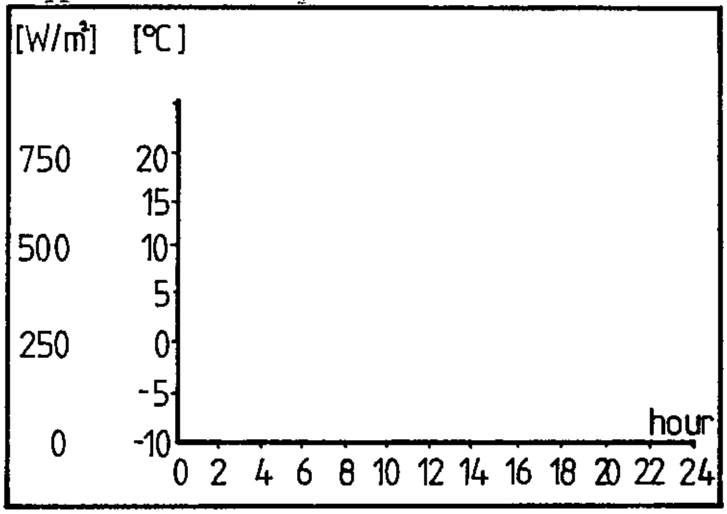


1 Collector
2 Hot air
3 Cold air
4 Rockbed
5 Floor with passive discharge
6 Stove

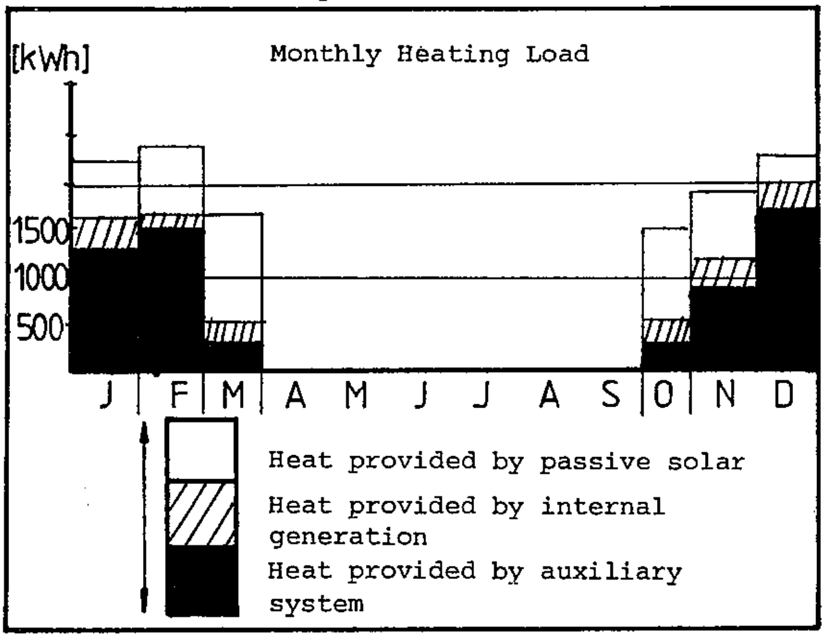
Typical Summer Day



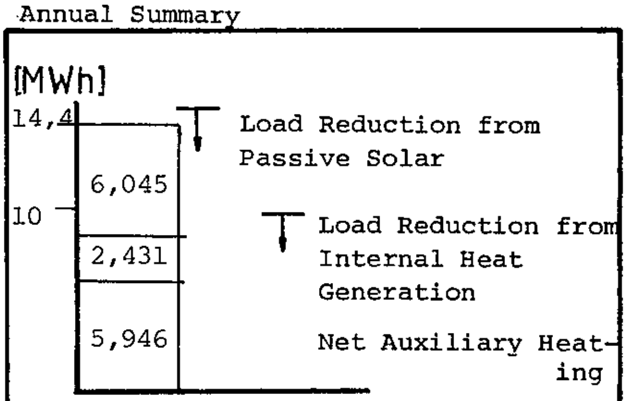
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	42 %
Heating Load Provided by Internal Generation	17 %
Heating Load Provided by Auxiliary Heating	41 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Mean indoor temp. over 24h and total heating period 18,6 °C

Cost of solar system 8,5 % of total

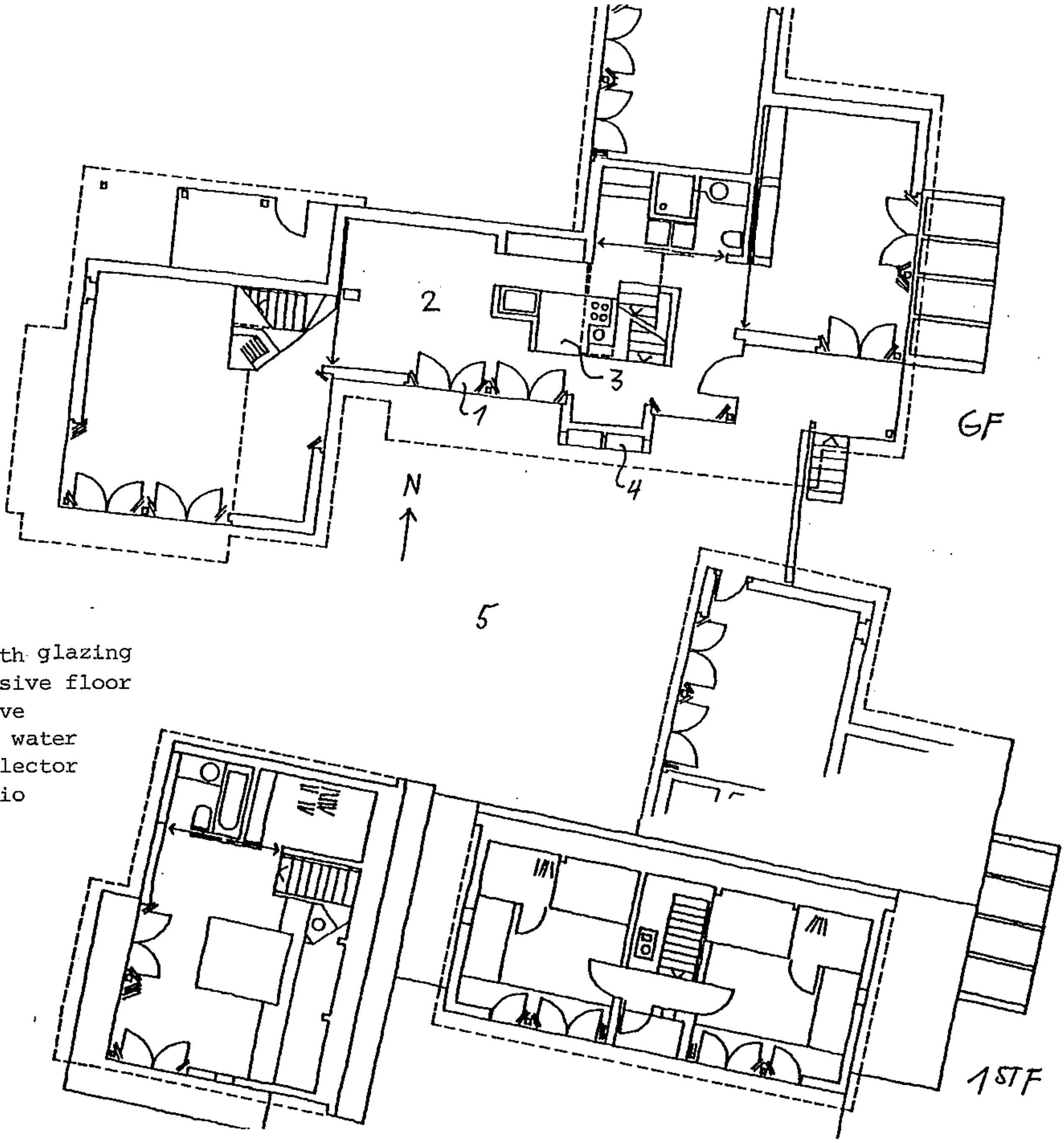
House works well and is liked by users

Source of Information:

CH-08

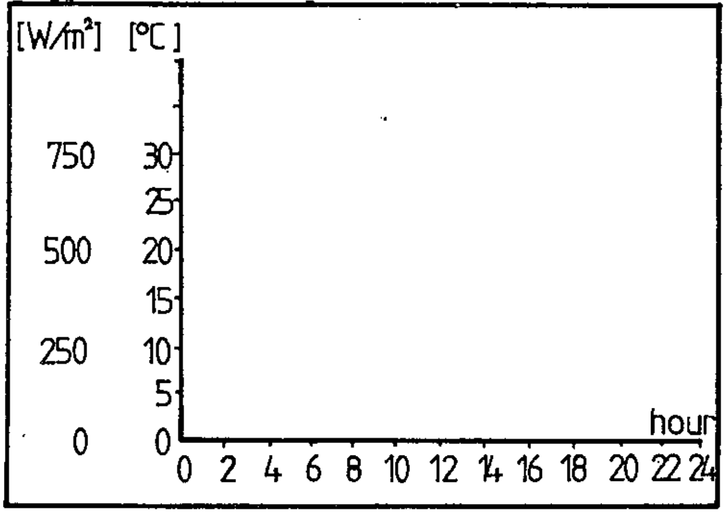
NEFF 181

House S. Schäfer, Binz

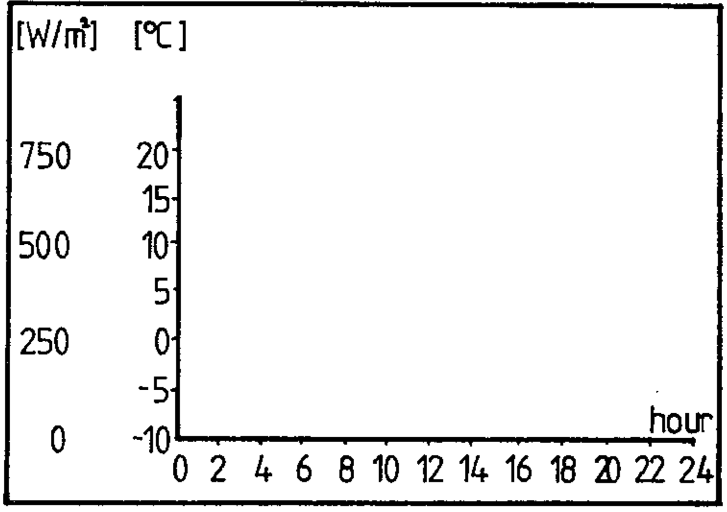


1 South glazing
2 Massive floor
3 Stove
4 Hot water collector
5 Patio

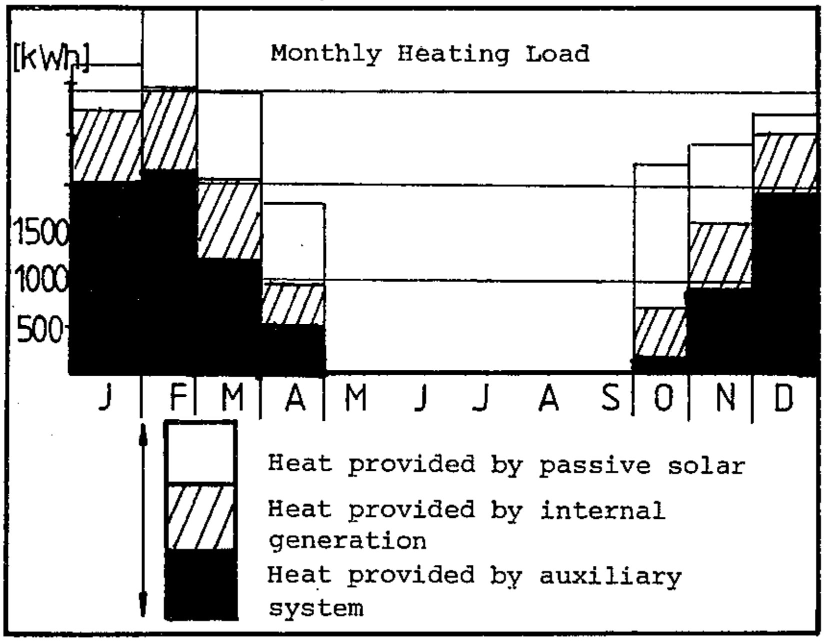
Typical Summer Day



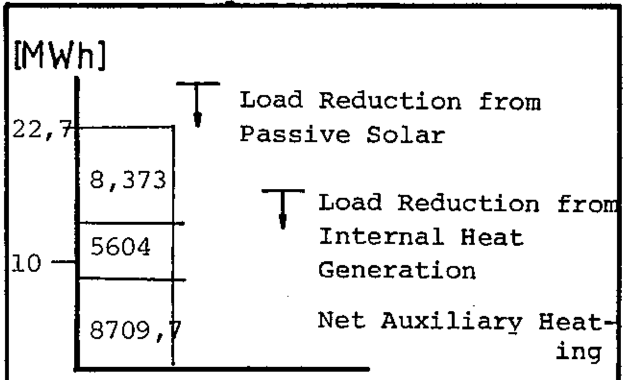
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	37 %
Heating Load Provided by Internal Generation	25 %
Heating Load Provided by Auxiliary Heating	38 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Mean indoor temp. over 24h and total heating period 15,5 °C

Cost of solar system (only insul. shutters) 3 %

House is relatively cool because user prefers heating less and saving wood, which he chops himself.

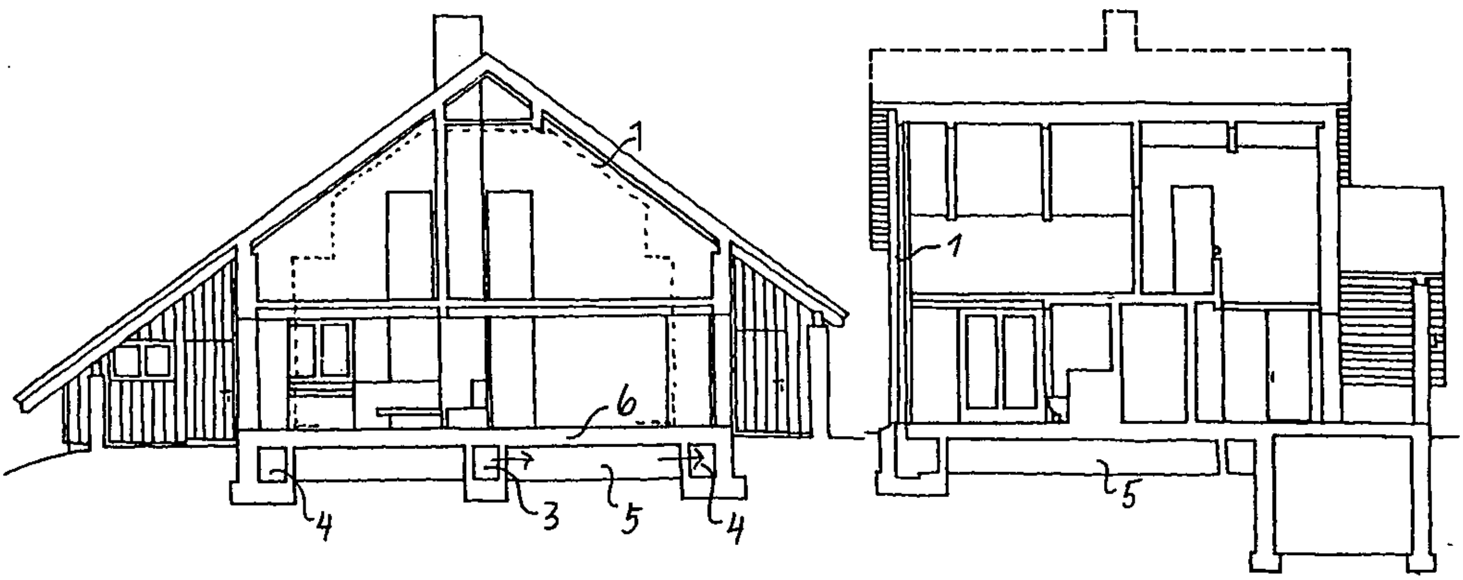
Source of Information:

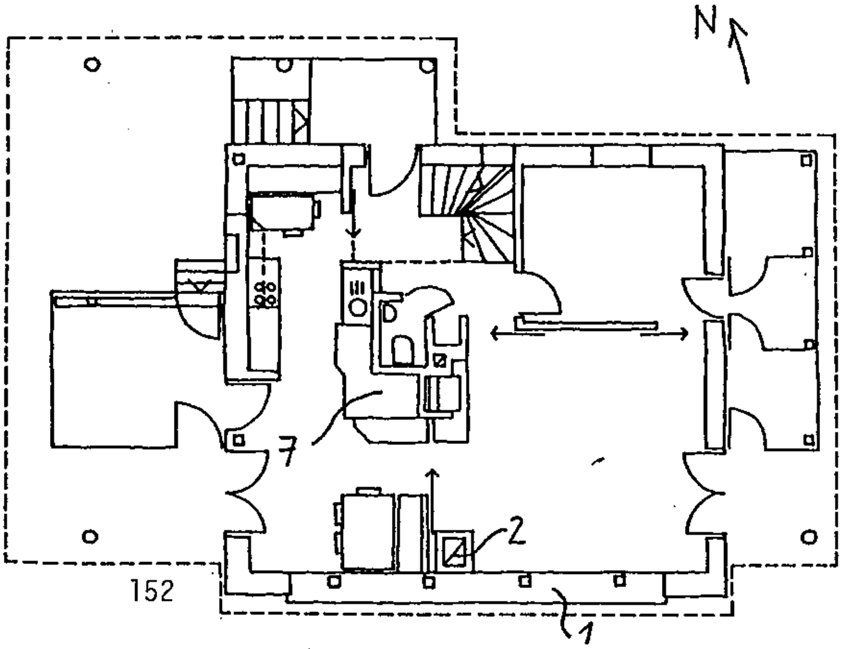
Passive and Hybrid Solar Low Energy Buildings

CH-09

NEFF 181

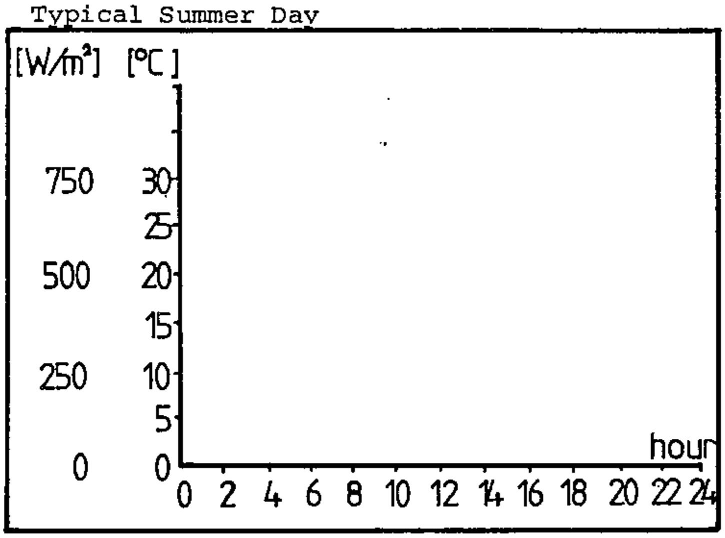
House M. Wieland, Oberglatt



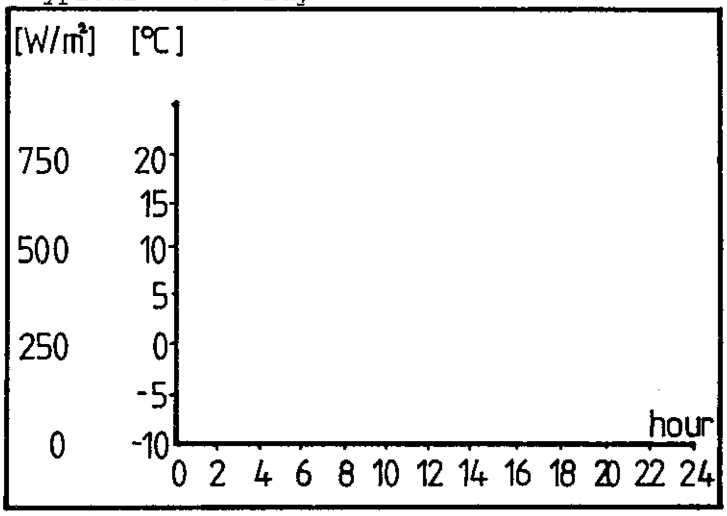


1 Collector-window
2 Hot-air-duct
3 " " -distributor
4 Return-air
5 Rock bed
6 Floor with passive discharge
7 Stove

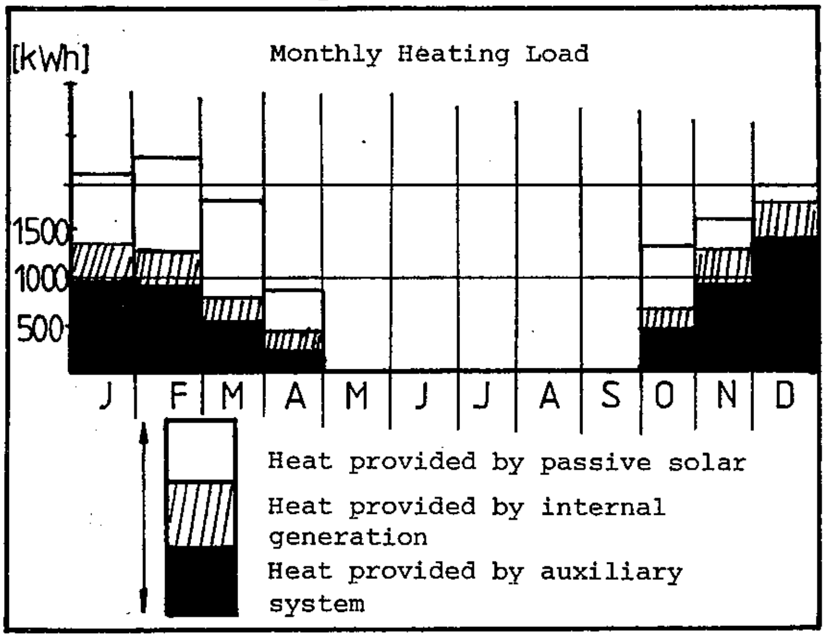
Typical Summer Day



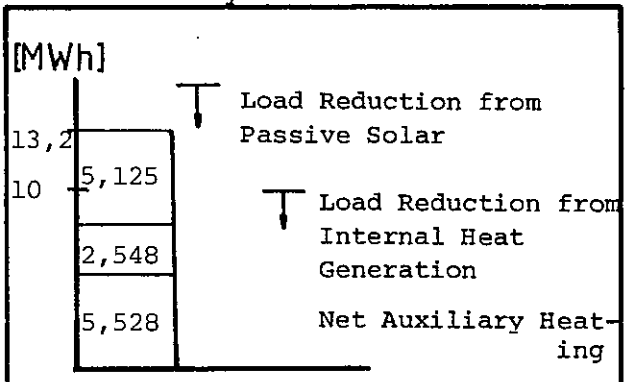
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	42 %
Heating Load Provided by Internal Generation	19 %
Heating Load Provided by Auxiliary Heating	39 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Mean indoor temp. over 24h and total heating period 18,2°C

Cost solar system 12 % of total

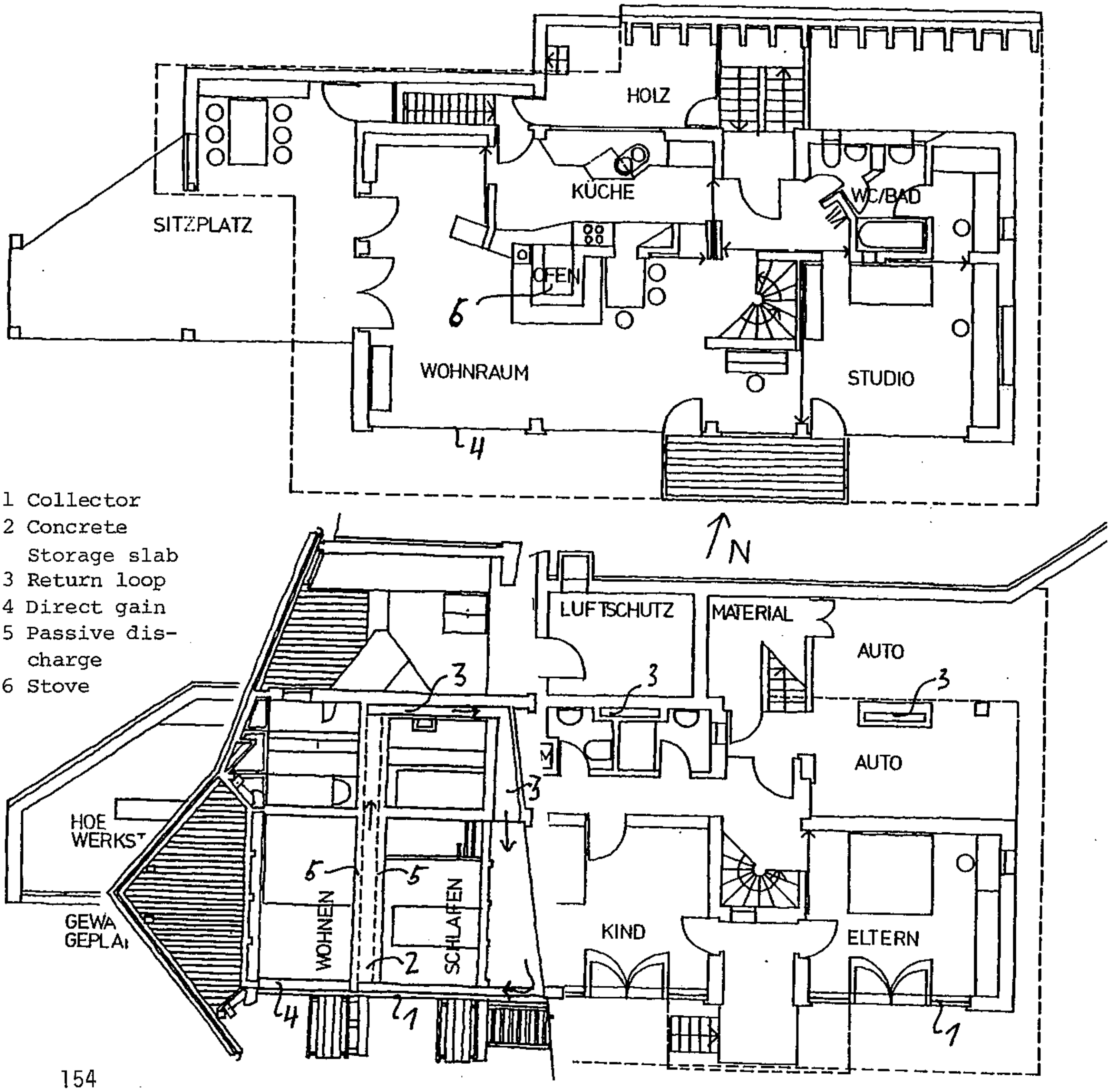
House works well and is liked by users

Source of Information:

Passive and Hybrid Solar Low Energy Buildings

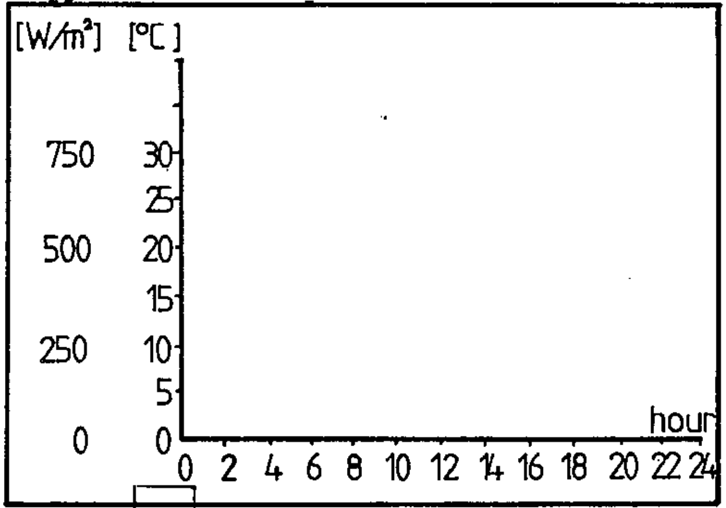
CH-10 NEFF 181

House Dr. H. Gmür, Gonten

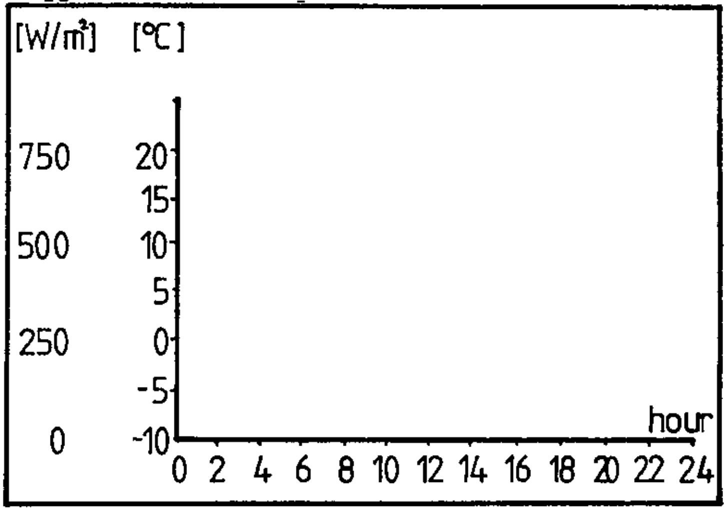


1 Collector
2 Concrete Storage slab
3 Return loop
4 Direct gain
5 Passive discharge
6 Stove

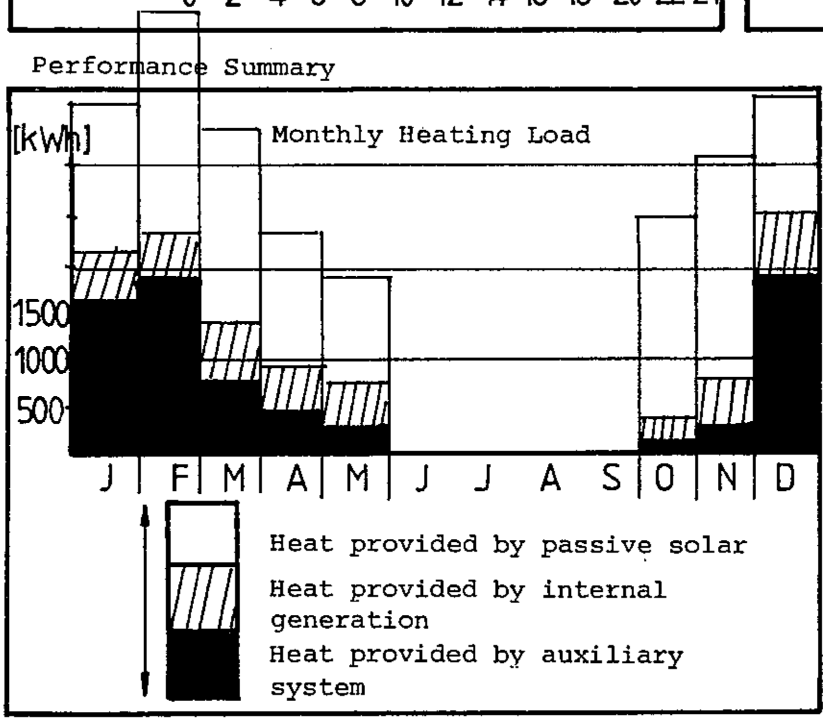
Typical Summer Day



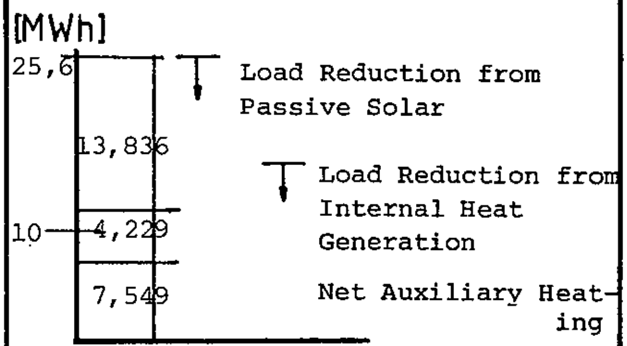
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	54 %
Heating Load Provided by Internal Generation	16,5 %
Heating Load Provided by Auxiliary Heating	29,5 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Mean indoor temp. over 24 h and total heating period 18,9°C

Cost of solar system 11 % of total

House works well and is liked by users

Source of Information:

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

IEA
BOLAR R&D

Passive and Hybrid Solar Low Energy Buildings

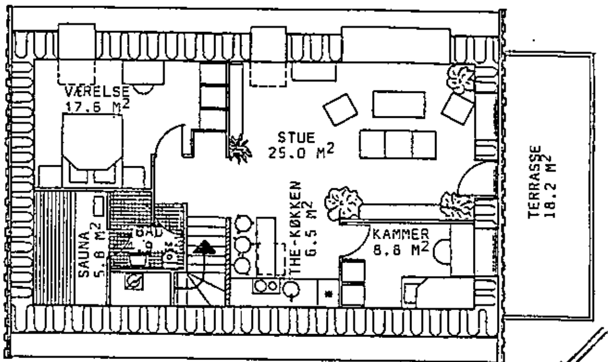
Performance data for systems evaluation

PROJECT TITLE — PASSIVE SOLAR HOUSE

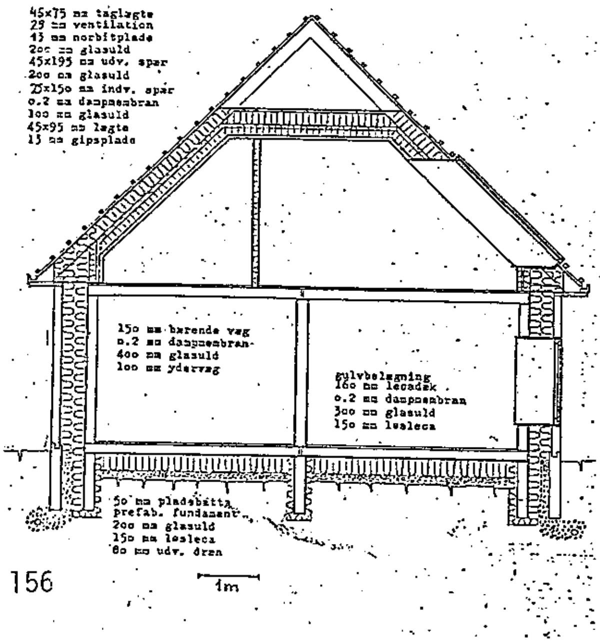
DK-01

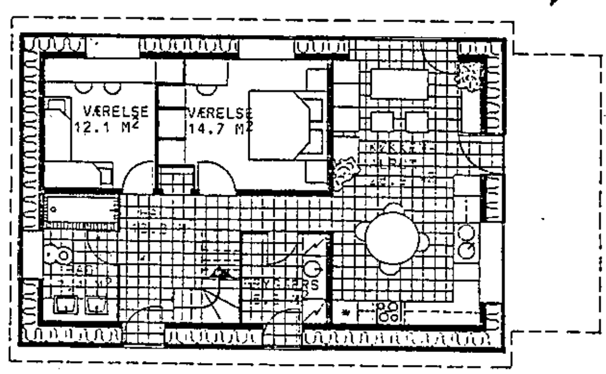
BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)



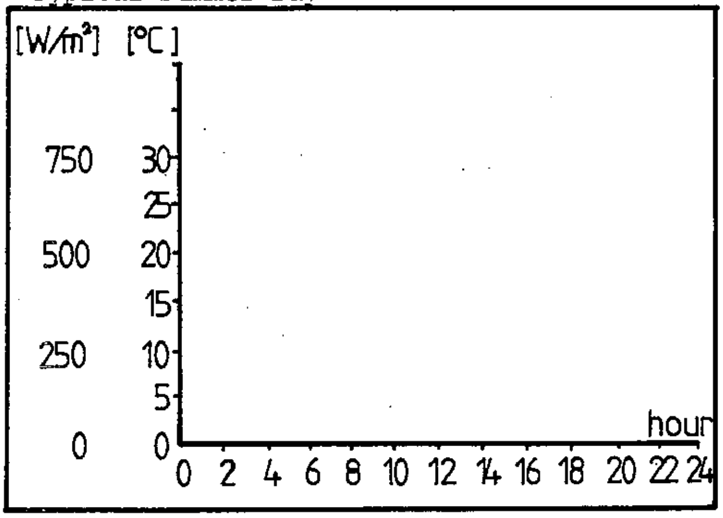
TAGETAGE 1:100



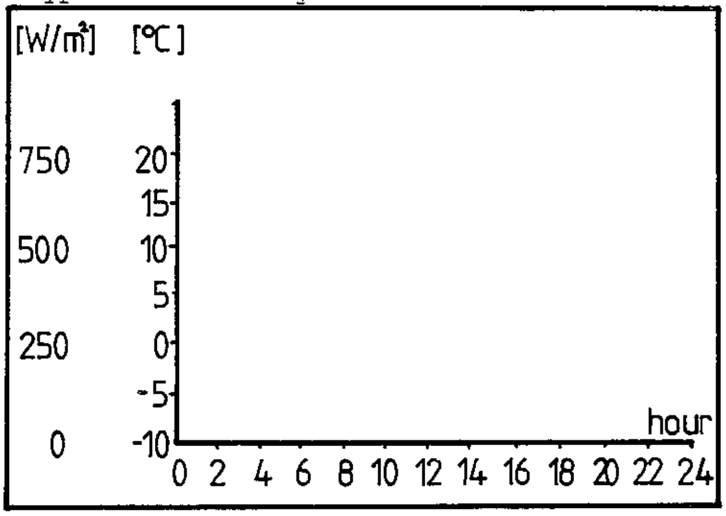


STUEPLAN 1:100

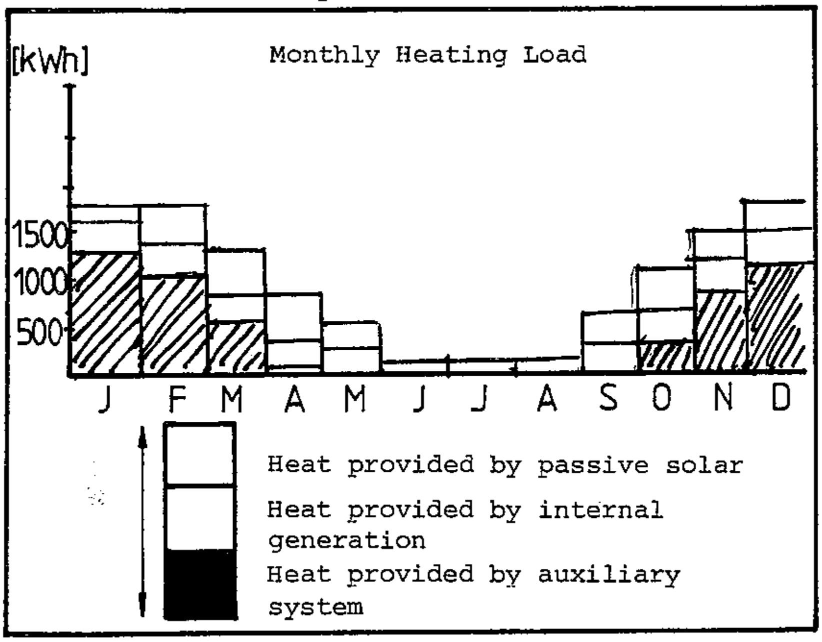
Typical Summer Day



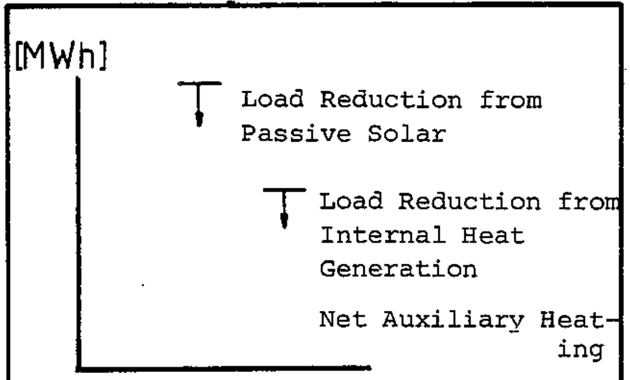
Typical Winter Day



Performance Summary



Annual Summary

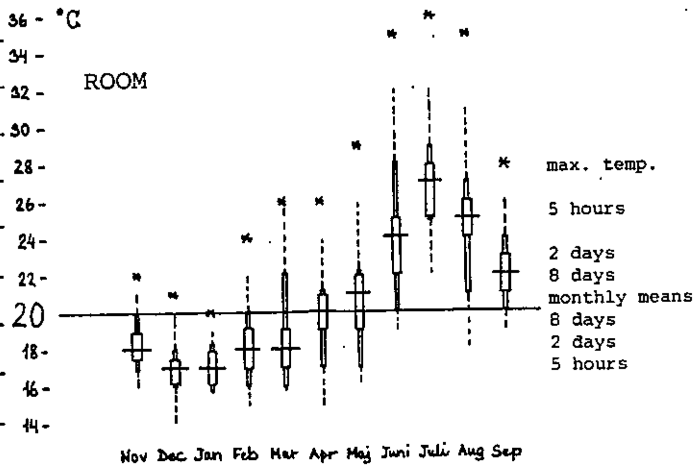


Heating Load Provided by Passive Solar	25 %
Heating Load Provided by Internal Generation	20 %
Heating Load Provided by Auxiliary Heating	55 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

thermal comfort with room temperatures 15-35°C accepted

by users



Source of Information:

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

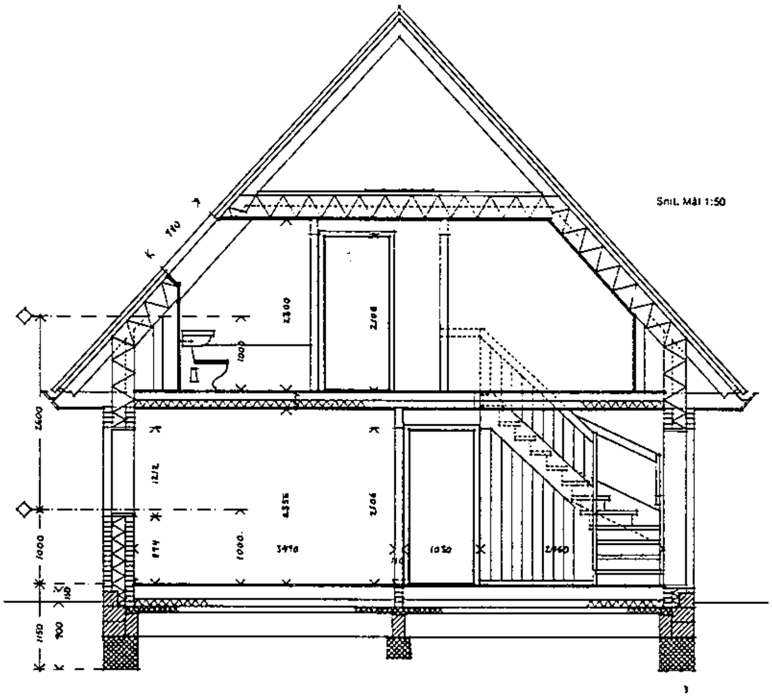
PROJECT TITLE

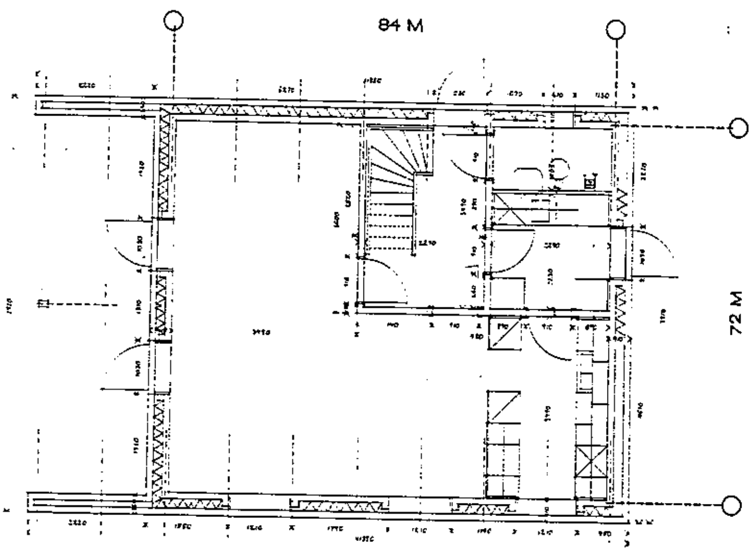
SBI Low Engergy House Model 79
- with a 410 mm cavity brick wall

DK-03

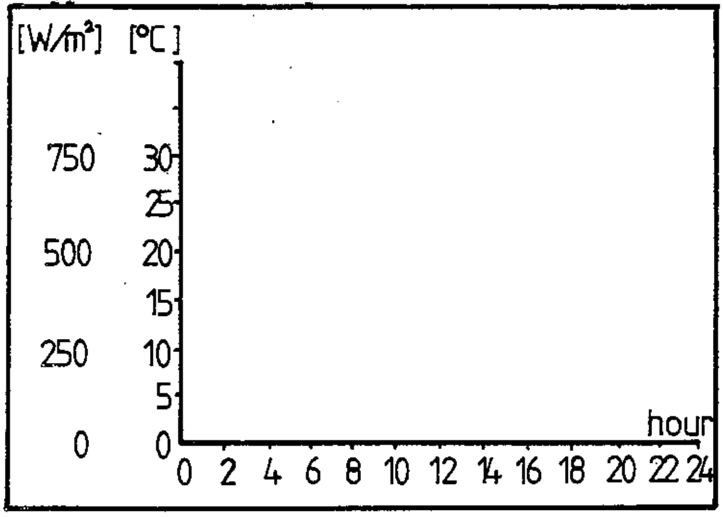
BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

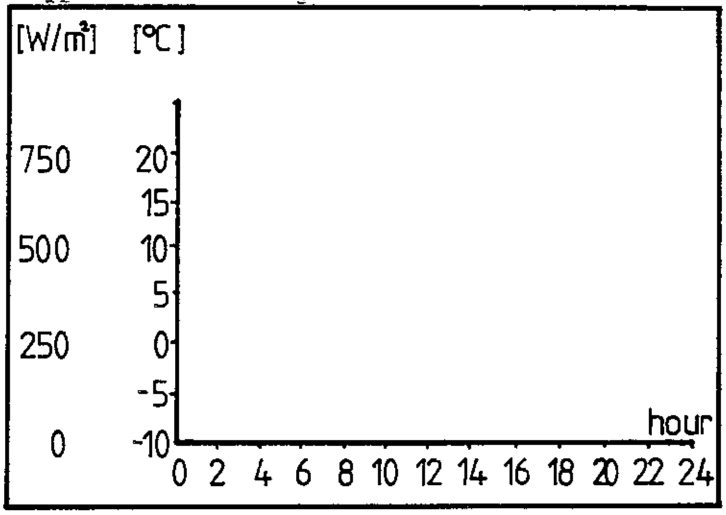




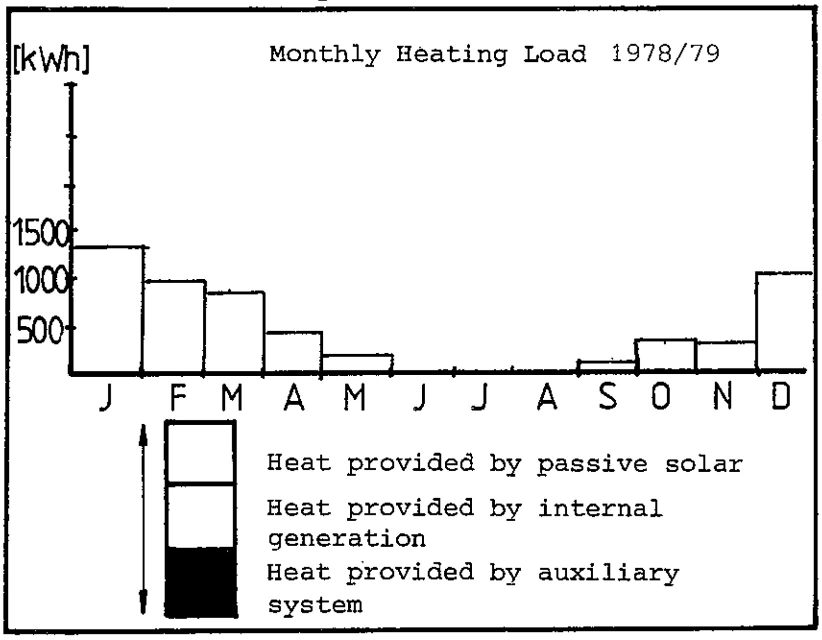
Typical Summer Day



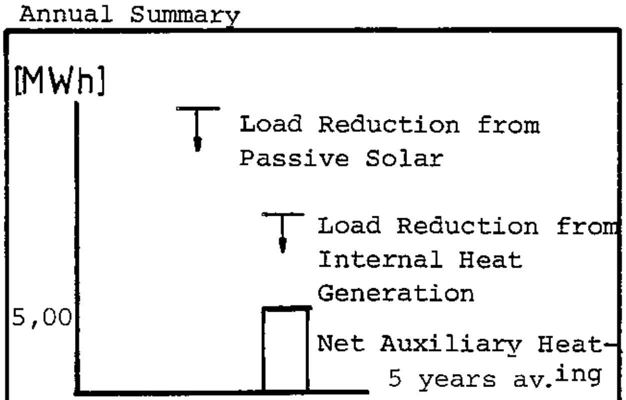
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	%

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The primary objective of this project was to develop a set of construction details for highly insulated cavity walls in low rise buildings. The details developed are applicable to other housing types as well. Measured heating energy consumption close to predicted.

Source of Information: SBI, postbox 119, DK 2970 Hørsholm, Danmark

IEA SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

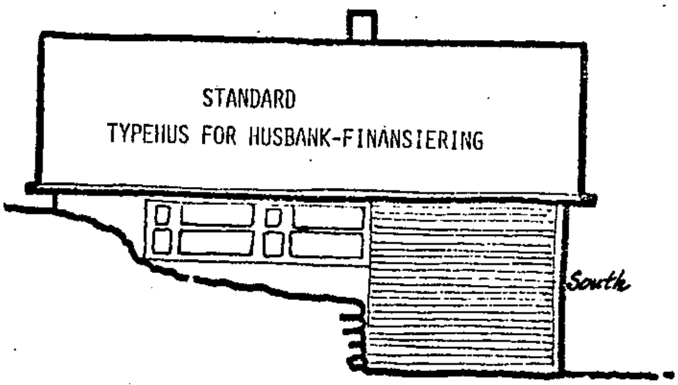
PROJECT TITLE — PASSIVE SOLAR HEATING IN A PRIVATE DWELLING

NO-01

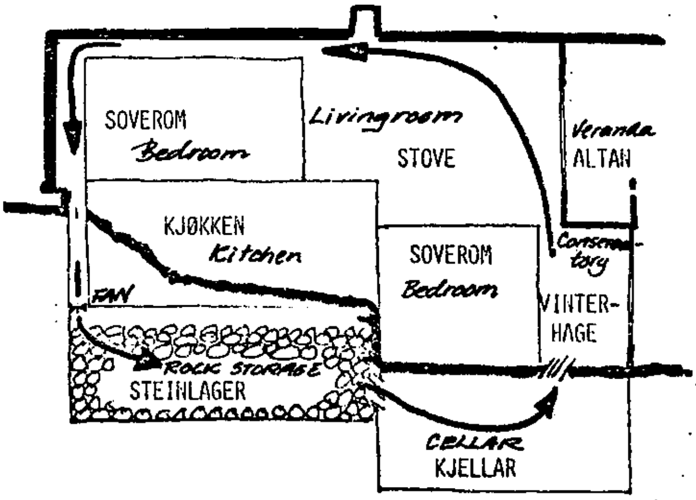
BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

ORIGINAL DESIGN:-

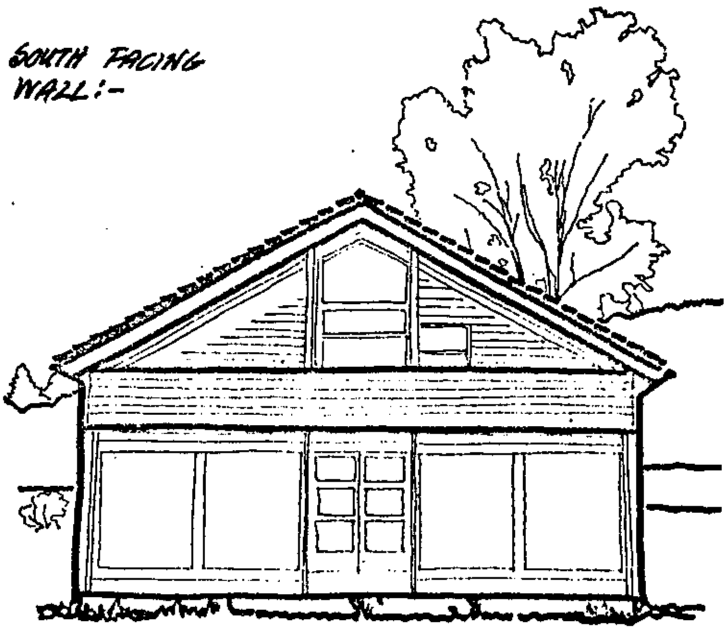


MODIFIED BUILDING:-

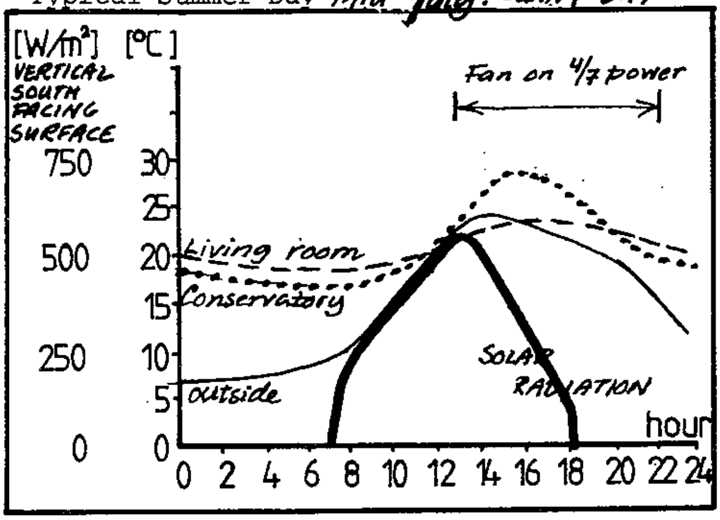


What solar enerergy gains can be obtained by relatively small modifications to a commonly used building design?
This question was the starting point for the project.

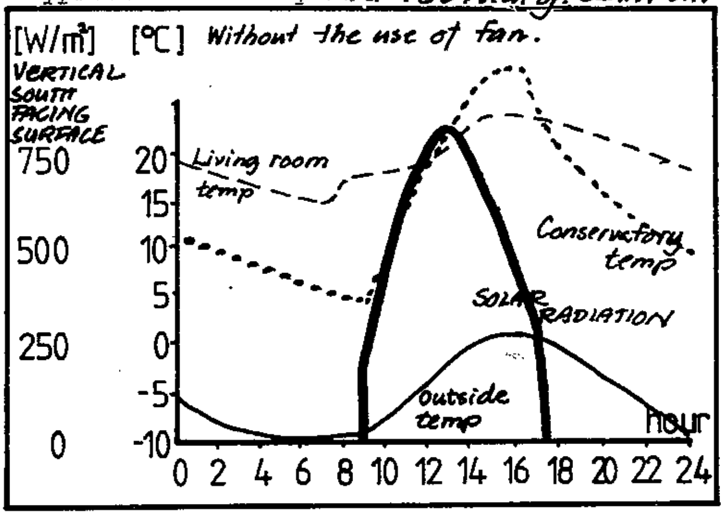
SOUTH FACING WALL:-



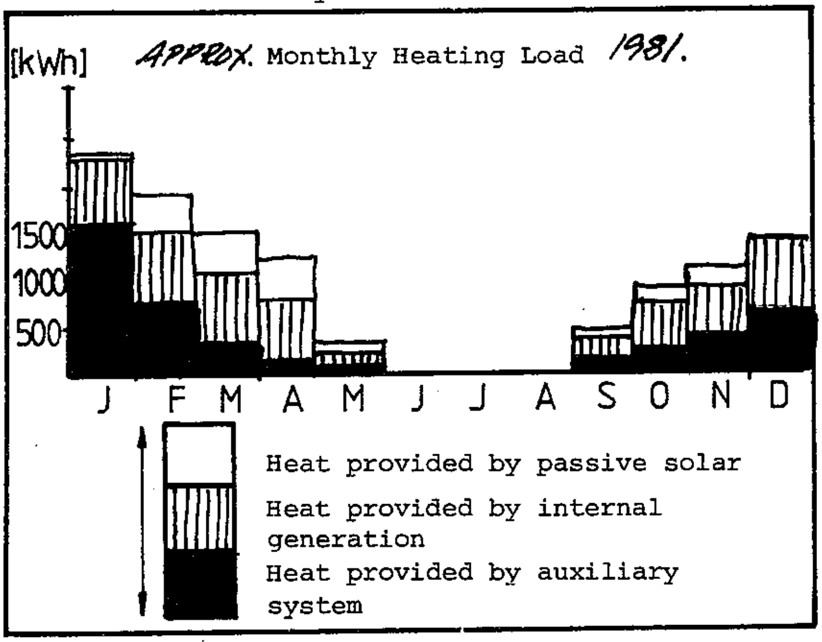
Typical Summer Day *Mid-July. SUNNY DAY*



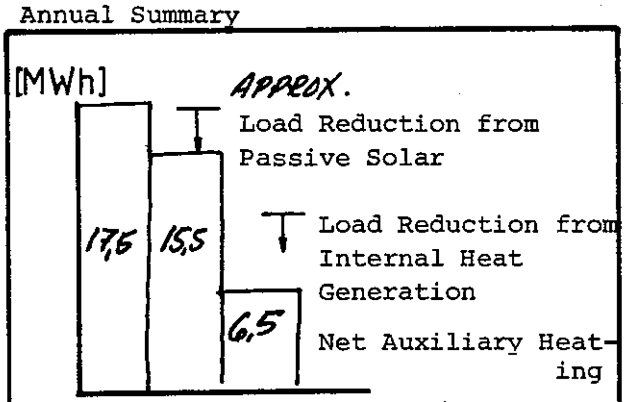
Typical Winter Day *Mid-February. SUNNY DAY*



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	≈12 %
Heating Load Provided by Internal Generation	≈51 %
Heating Load Provided by Auxiliary Heating	≈37 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The building modifications have resulted in significant solar energy gains, but have also resulted in additional living space, a veranda and additional cellar space, for a total cost of approx. 45000 kr (1980). For a similar buildings on more suitable foundations it should be possible to obtain similar results at 60%-70% of the costs. By estimating a user value for the additional living space, the kWh price for solar energy will be similar to the electricity price.

By use of solar energy and wood plus improved insulation it is not difficult to reduce the demand for electricity/oil heating in a dwelling by 50% relative to the typical 1950-80 dwelling. The rock heat storage is not yet insulated, and has mainly acted as a cooling source on very hot days.

Source of Information: *KILDE report 60 (Aug. 1982)*

Passive and Hybrid
Solar Low Energy Buildings

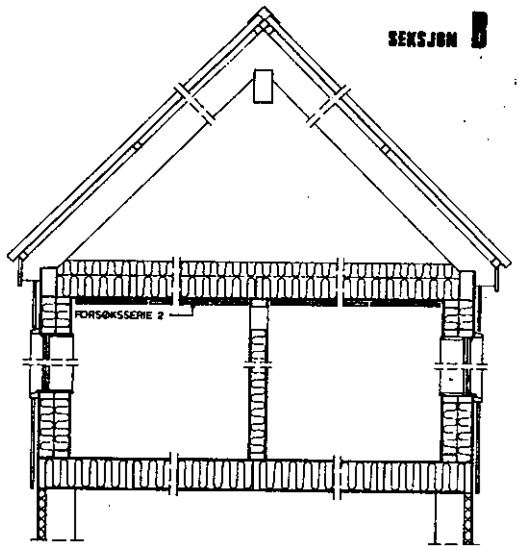
Performance data for systems evaluation

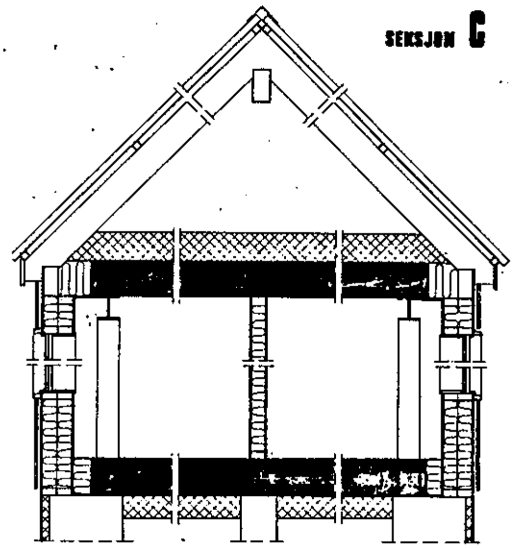
PROJECT TITLE — Low Energy Buldings

Address: SINTEF 62
7034 Trondheim - NTH
NORWAY

NO-02

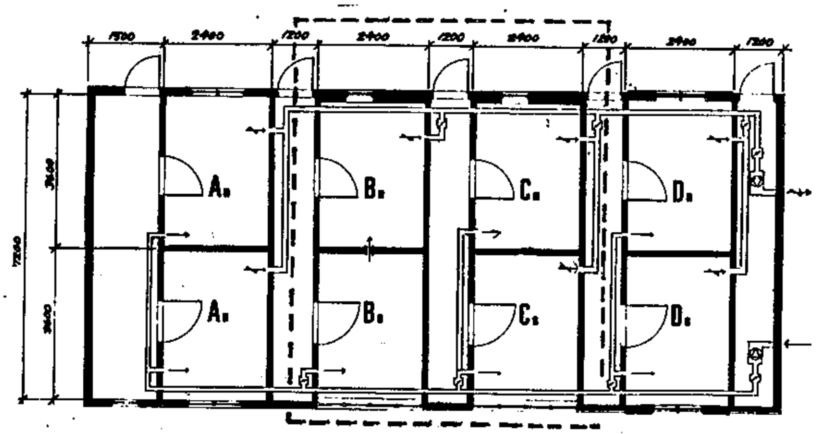
BUILDING AND SYSTEM DESCRIPTION





270 mm concrete slabs in floor and ceiling.

TEST HOUSE

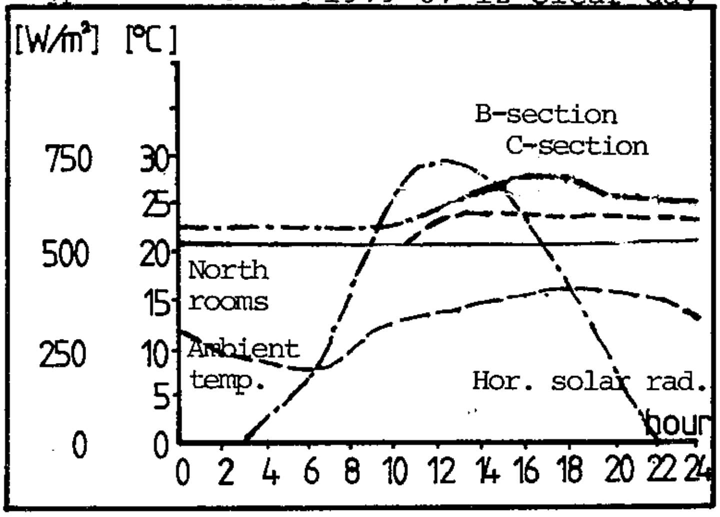


SECTION A: REFERENCE SECTION (100/150) (100%)
B: ECONOMIC OPTIMAL INSULATION (200/250) (46%)
C: AS B + HEAT CAPACITY (HOLLOW CONCRETE PANELS IN FLOOR AND CEILING) (–)
D: DOUBLE SHELTER SOLAR SYSTEM (57%)

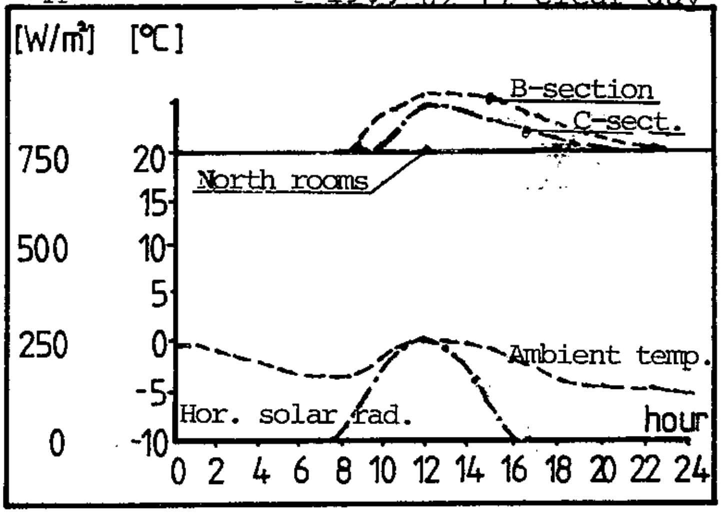
Different designs for the ventilation-syst. have been used. Compare B and C. Both systems have been used both in B and C.

Note: Solar shadings are steered by termostats. The set points in sections B and C are a couple of degrees different.

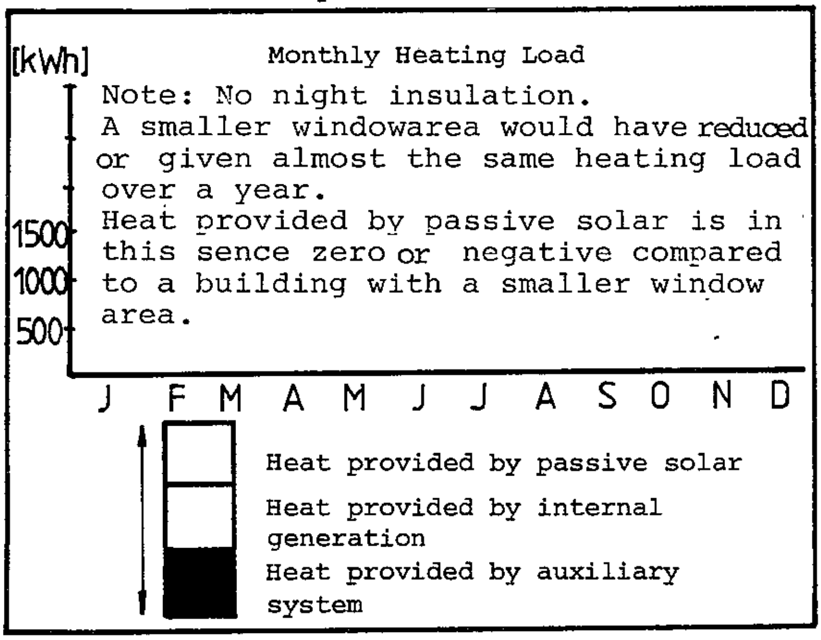
Typical Summer Day 1979-07-12 Clear day



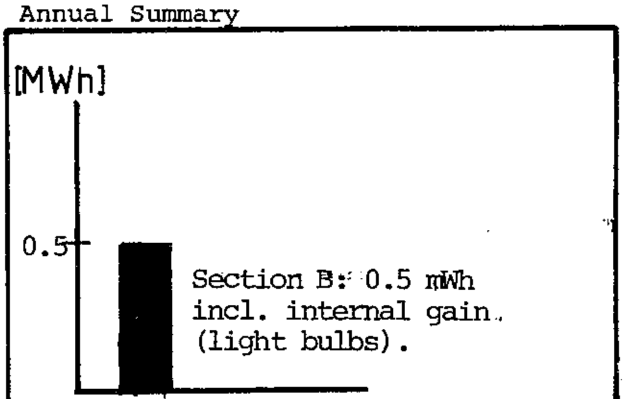
Typical Winter Day 1979-02-17 Clear day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	100 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

- South romm in reference section (A) has lower demand than north room (same window area)
- South room in section B and C consumed more energy than north room (windowarea south 4* window area north). There is no night insulation. This means net heat loss even through "good" windows (K=1,0 W/m^2K)
- Active mass does not reduce the heating demand (signiticantly), though the comfort level in C is much better than in B
- Extra insulations works! B 46 % of A.
- Due to technical problems in construction, the heat loss in sect. C is too large. Problems: Cold bridges, air leakages both to rooms and inside insulations.

Source of Information: "Lavenergibygninger" STF62 A80012, Trondheim 1980-10-31. F. Salvesen, J. Gunnarshaug

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

Passive and Hybrid Solar Low Energy Buildings

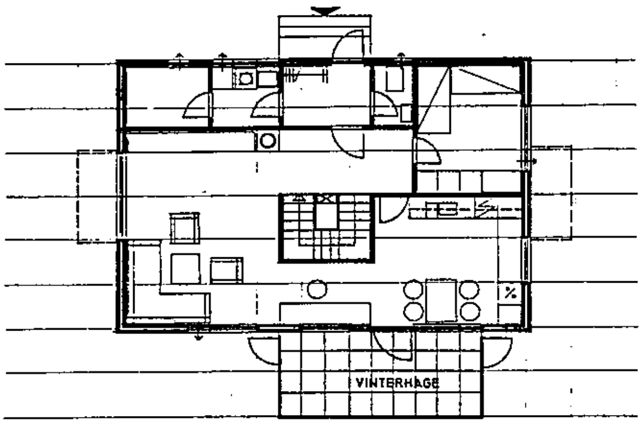
Performance data for systems evaluation

PROJECT TITLE

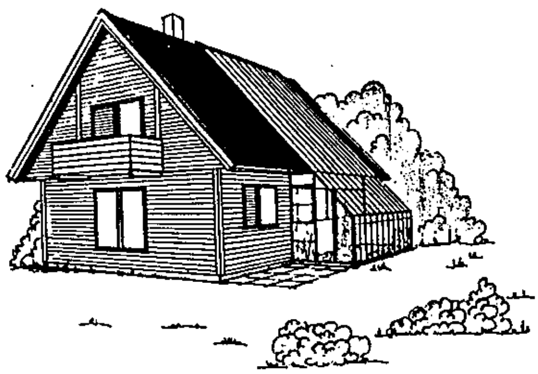
NO-04

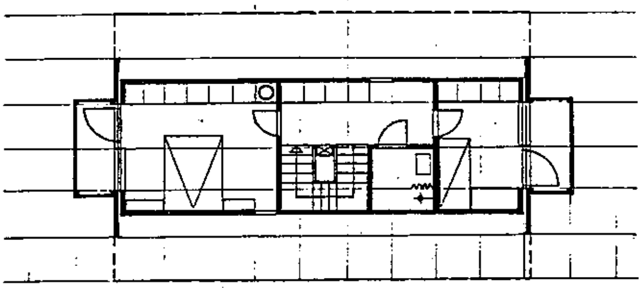
DOUBLE SHELL HOUSE AT ÅS
DANSKERUD
1430 ÅS, NORWAY

BUILDING AND SYSTEM DESCRIPTION



PLAN 1.FLOOR





PLAN 2.FLOOR

COLLECTORS:

SUNSPACE 14 m²
AIR COLLECTOR 45 m²

STORAGE:

ROCK BED 13 m³

DISTRIBUTION:

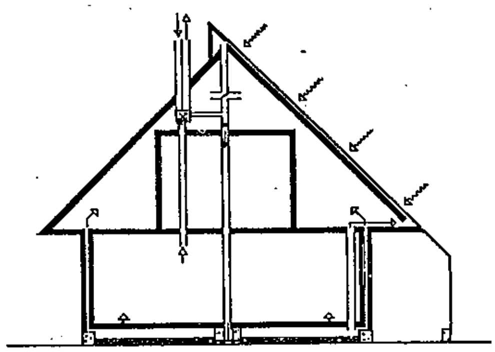
CLOSED LOOP CIRCULATION – FROM COLLECTOR VIA STORAGE TO AIRSPACE IN WALLS AND ATTIC.

VENTILATION:

FRESH AIR SUPPLIED VIA SOLAR HEAT LOOP.

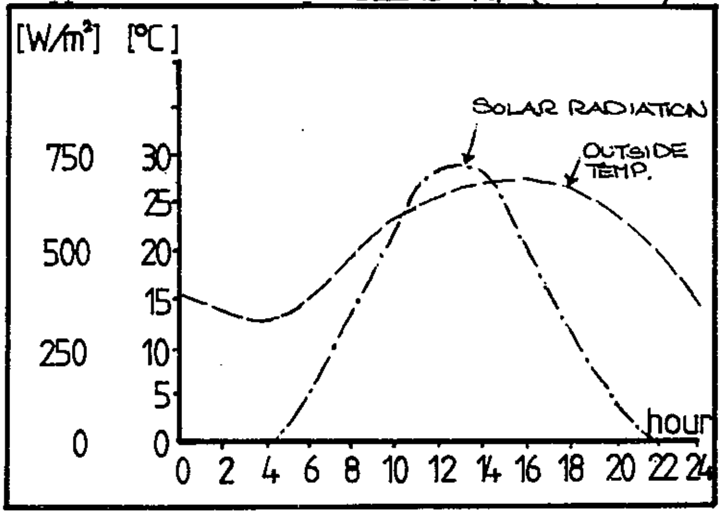
PREHEATING OF HOT WATER:

150 M POLYETHYLENE PIPE IN ROCK STORAGE.

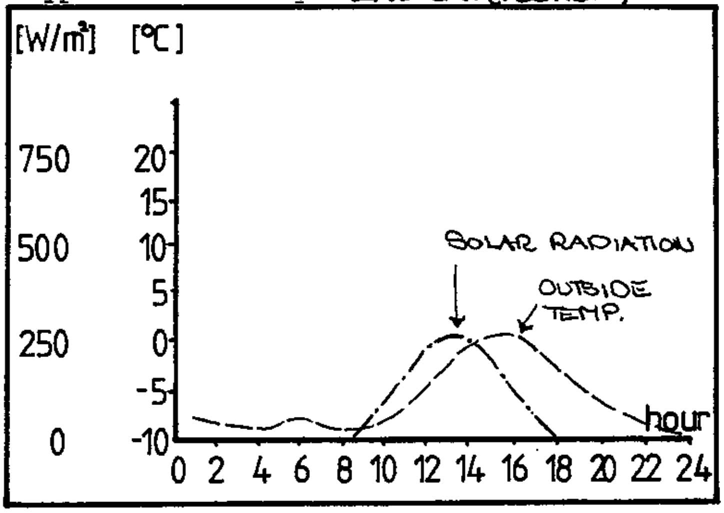


 SECTION

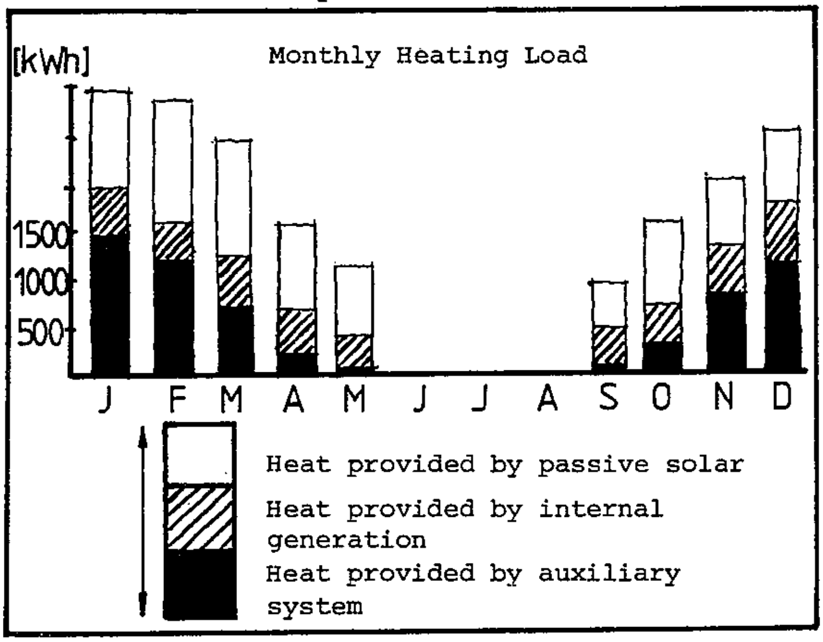
Typical Summer Day CLEAR DAY (JULY 10TH)



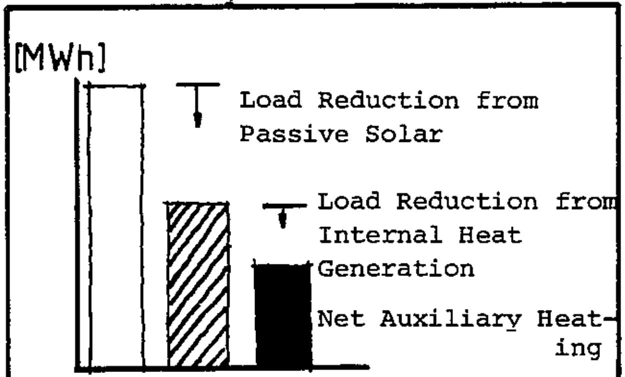
Typical Winter Day CLEAR DAY (FEB. 16TH)



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	42 %
Heating Load Provided by Internal Generation	22 %
Heating Load Provided by Auxiliary Heating	36 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

- THE BUILDING HAS A CONSIDERABLY LOWER HEATING NEED THAN OTHER BUILDINGS WITH COMPARABLE INSULATION STANDARDS. THIS IS IN PART DUE TO THE DOUBLE SHELL CONSTRUCTION, WHICH ELIMINATES HEAT LOSS TO THE GROUND, AND WHICH PROVIDES PREHEATING OF THE VENTILATION AIR.
- THE BUILDING WORKS MOST FULLY DURING THE MIDDLE OF THE WINTER, WHEN CONVENTIONAL SOLAR SYSTEMS PRODUCE THE LEAST AMOUNT OF ADDITIONAL ENERGY AT THESE LATITUDES.
- THE PREHEATING OF HOT WATER DOES NOT FUNCTION SATISFACTORILY, AS THE HEAT FLOW FROM THE ROCK BED TO THE GROUND DURING THE SUMMER IS GREATER THAN EXPECTED.
- THE COSTS INVOLVED ARE QUITE HIGH, BUT ARE JUSTIFIED BY THE FACT THAT THE BUILDING IS A PROTOTYPE.

Source of Information: "RESSURSVENNLIGE BOLIGFORMER" REPORT NO. 4

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid Solar Low Energy Buildings

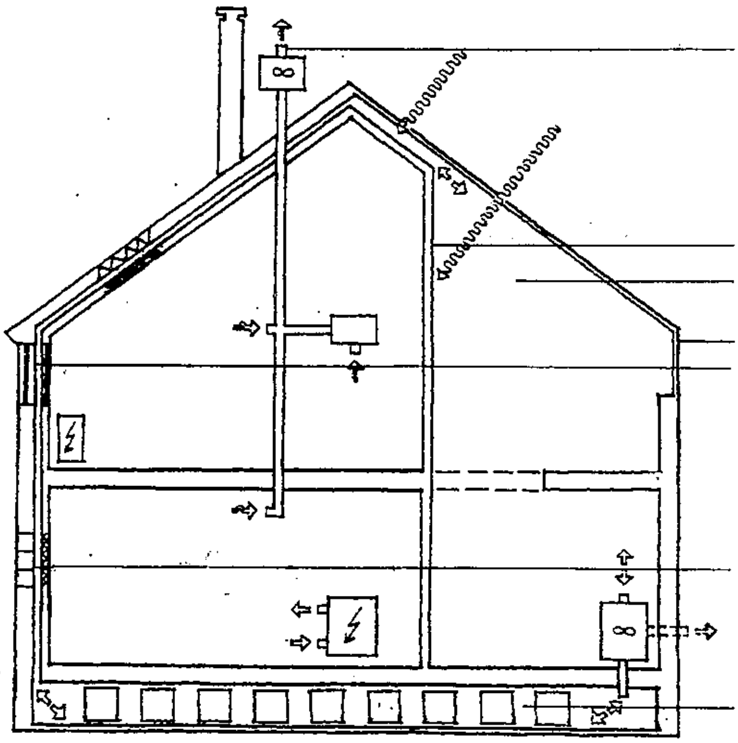
Performance data for systems evaluation

PROJECT TITLE

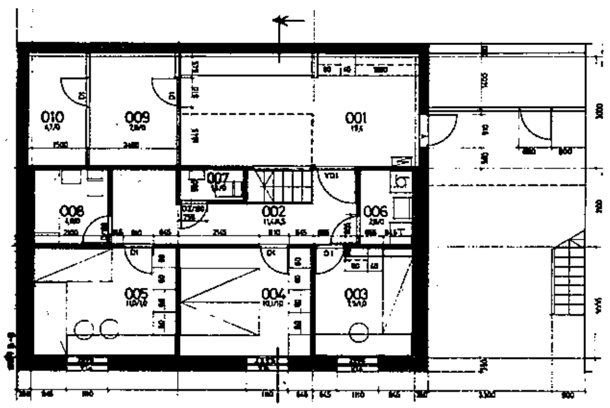
SOLAR HOUSE NO. 2, HEIMDAL
TONSTADGRENDA 3
7075 TILLER, NORWAY

NO-05

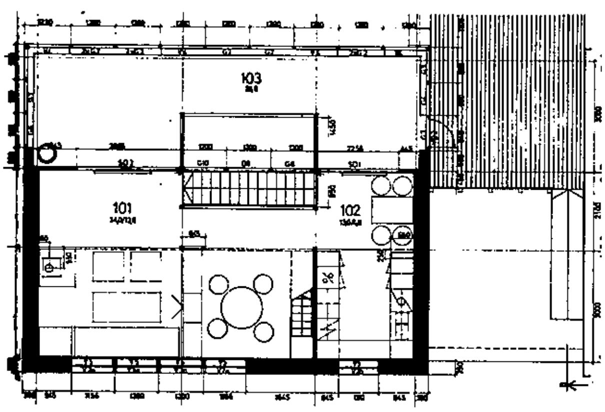
BUILDING AND SYSTEM DESCRIPTION



SECTION

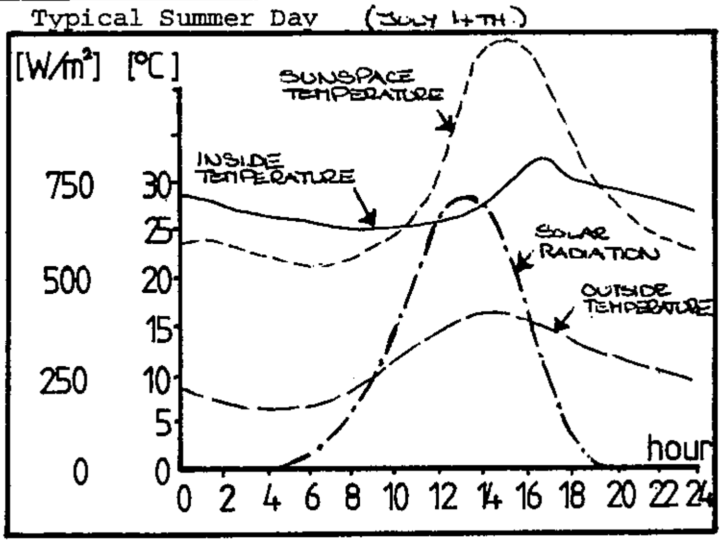


1. FLOOR PLAN

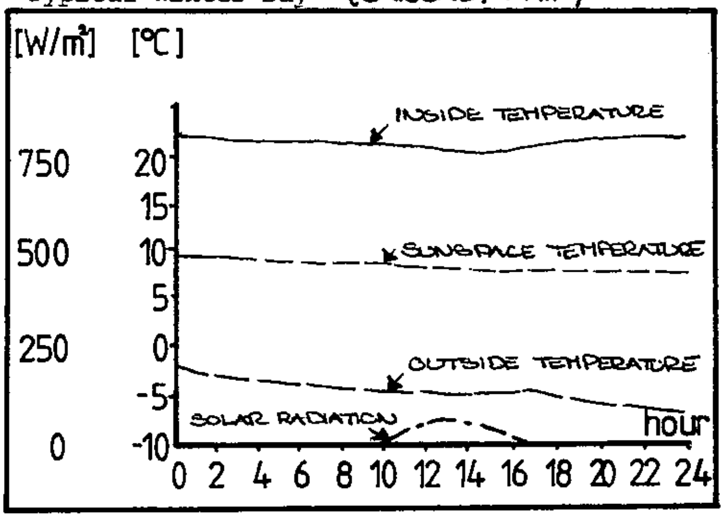


2. FLOOR PLAN

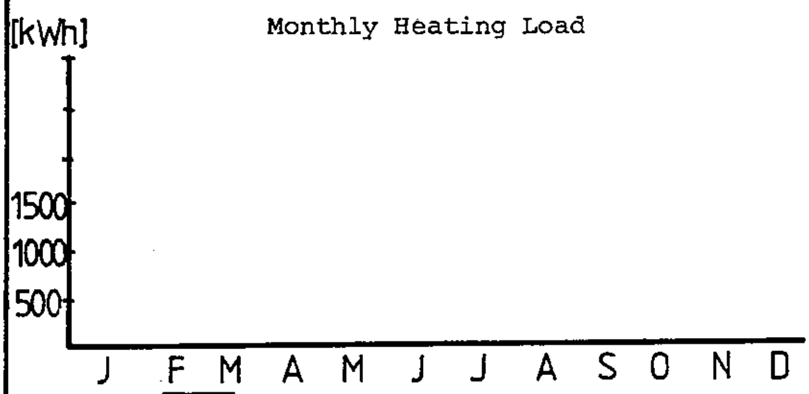
Typical Summer Day (July 14th)



Typical Winter Day (January 14th)



Performance Summary

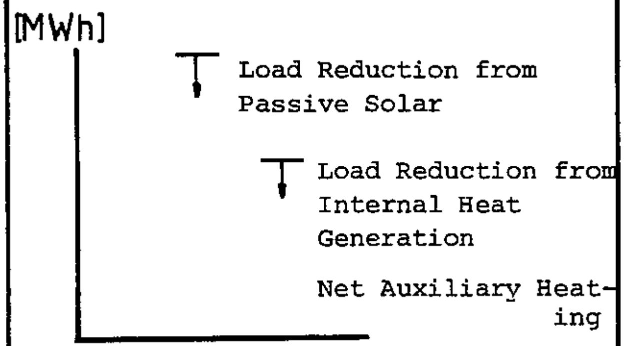


Heat provided by passive solar

Heat provided by internal generation

Heat provided by auxiliary system

Annual Summary



Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	%

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Thermal comfort: Winter, spring, fall: Good

Summer: Some overheating

Good, after the system was rebuilt

User acceptance: Good

Costs, energy use: No conclusions yet available

Source of Information: ________

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid Solar Low Energy Buildings

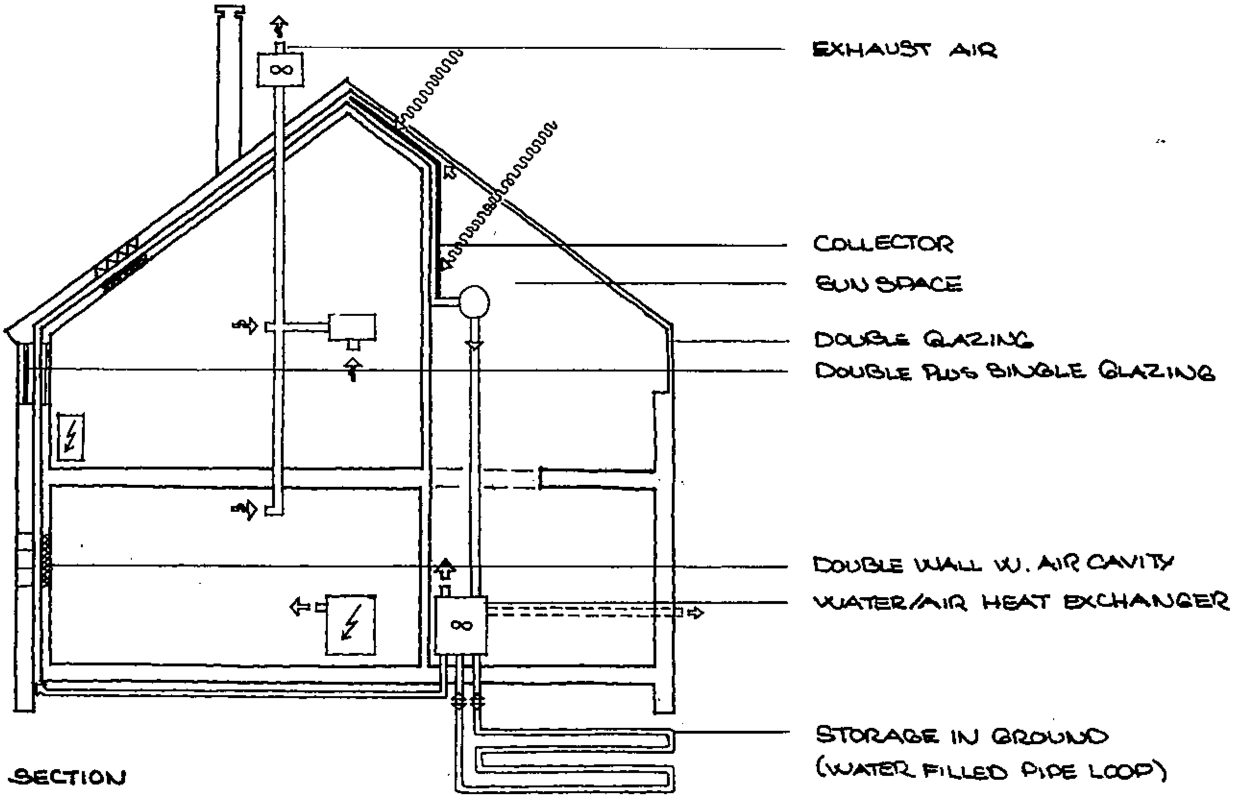
Performance data for systems evaluation

PROJECT TITLE

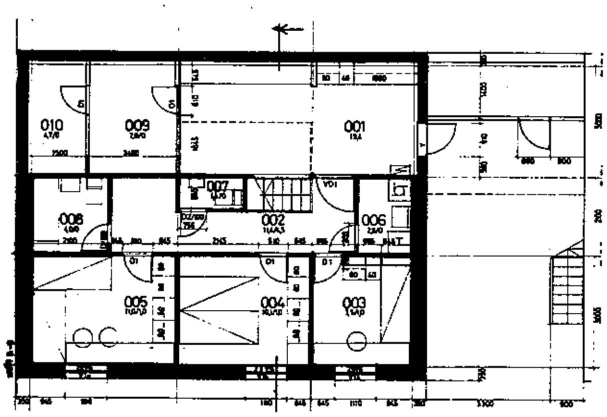
NO-06

SOLAR HOUSE NO. 3, HEIMDAL
TONSTADGRENDA 5
7075 TILLER, NORWAY

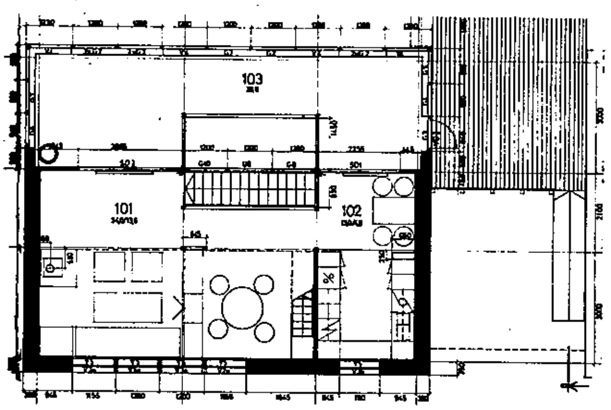
BUILDING AND SYSTEM DESCRIPTION



SECTION

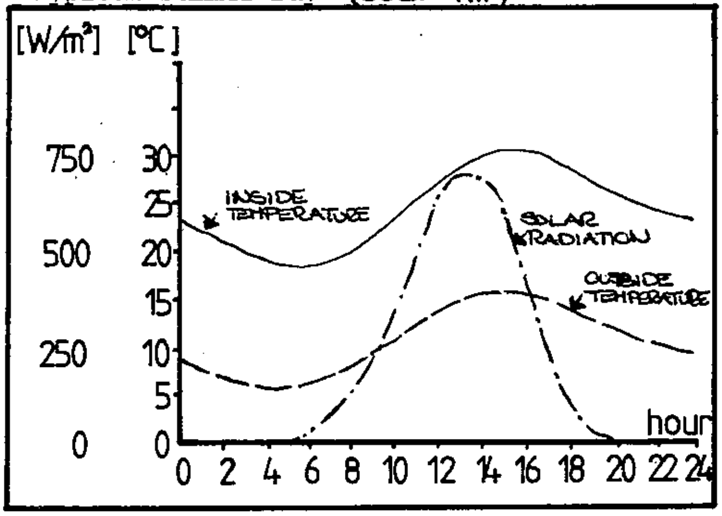


1. FLOOR PLAN

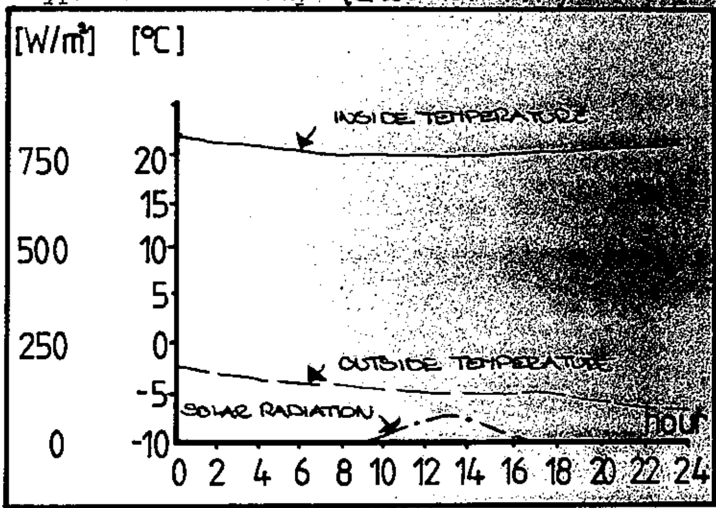


2. FLOOR PLAN

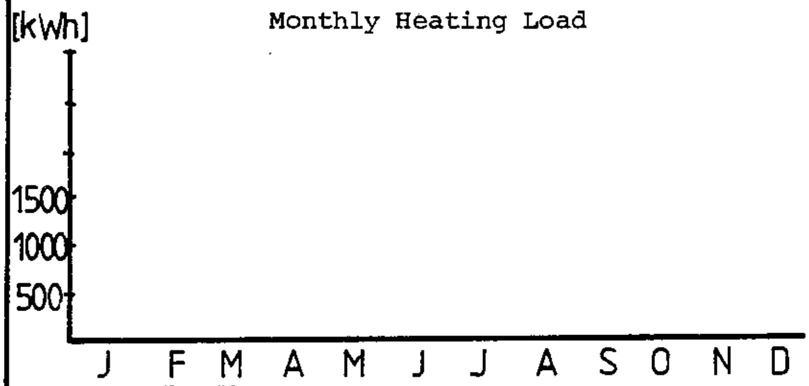
Typical Summer Day (JULY 4TH)



Typical Winter Day (JANUARY 14TH)



Performance Summary

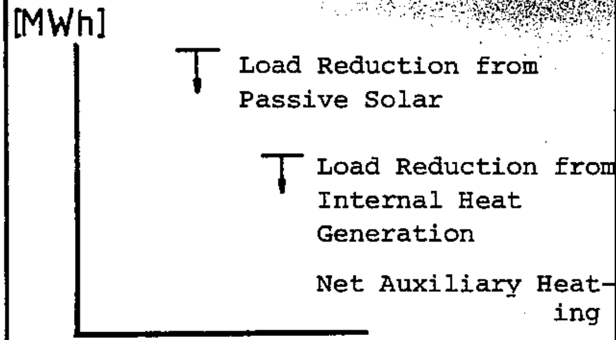


Heat provided by passive solar

Heat provided by internal generation

Heat provided by auxiliary system

Annual Summary



Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	%

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Thermal comfort: good

User acceptance: good

Costs, energy use: No conclusions yet available

Source of Information:

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

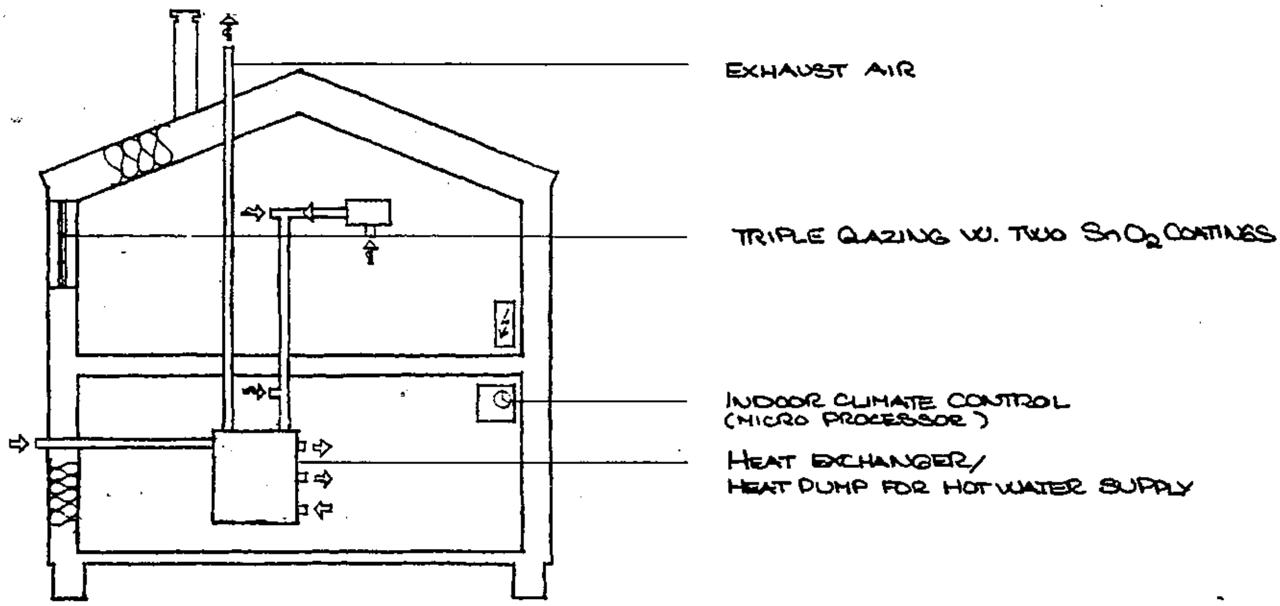
Performance data for systems evaluation

PROJECT TITLE

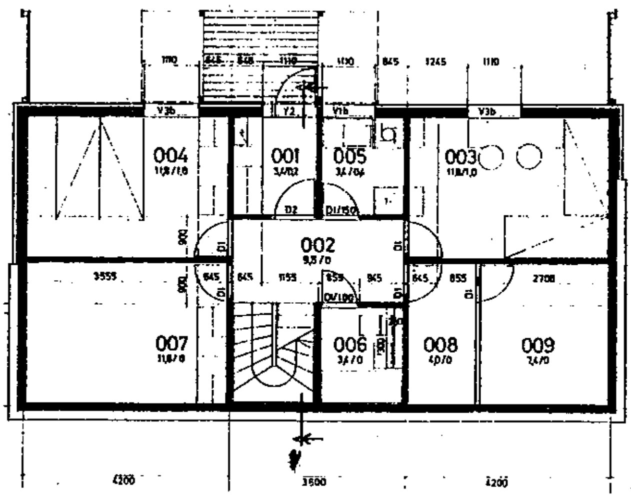
NO-07

LOW ENERGY HOUSE No. 14, HEIMDAL
TONSTADGRENDA 19
7075 TILLER, NORWAY

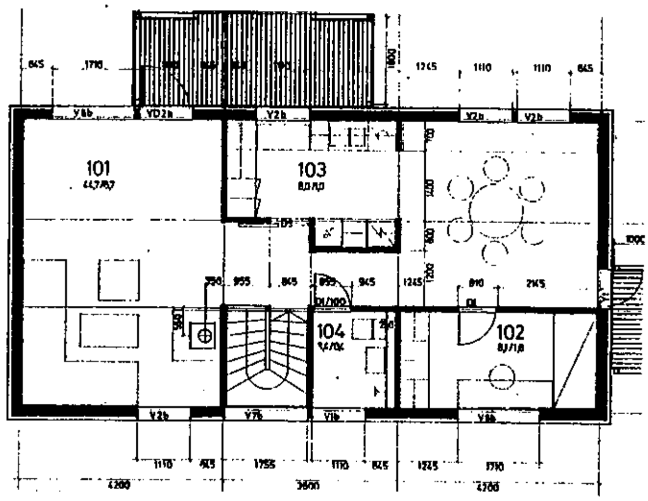
BUILDING AND SYSTEM DESCRIPTION



SECTION

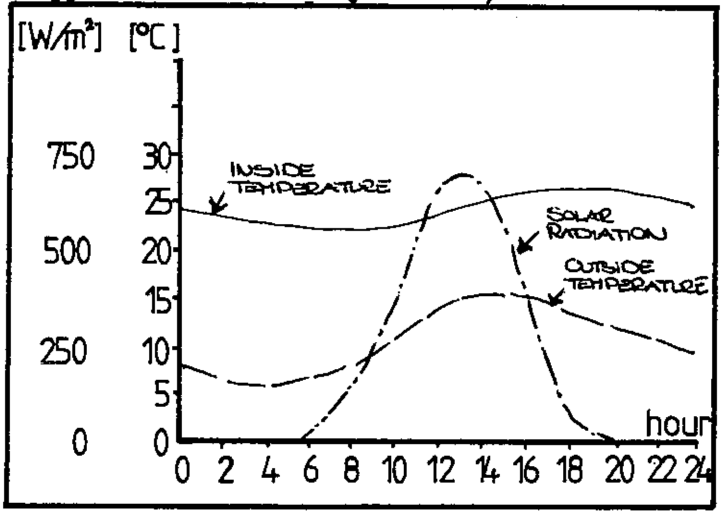


1. FLOOR PLAN

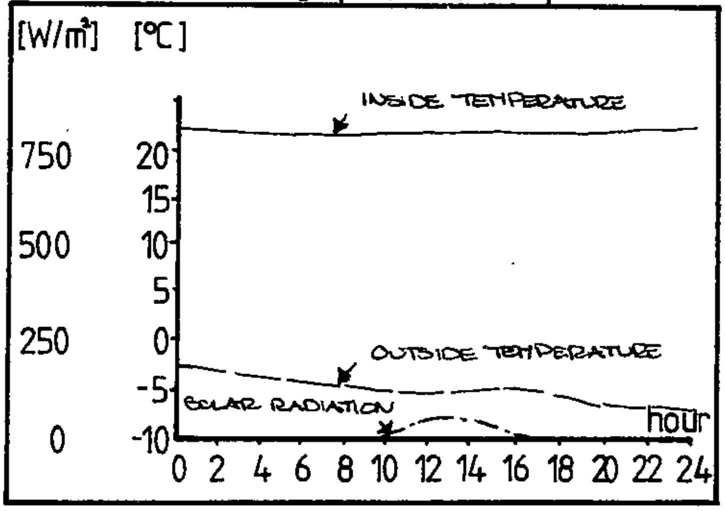


2. FLOOR PLAN

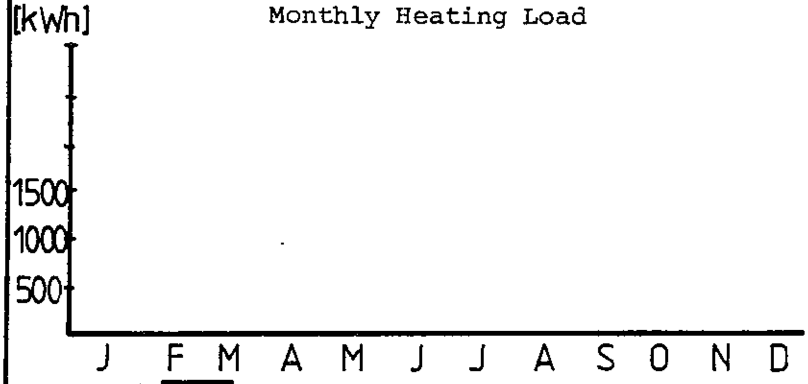
Typical Summer Day (JULY 4TH)



Typical Winter Day (JANUARY 14TH)



Performance Summary

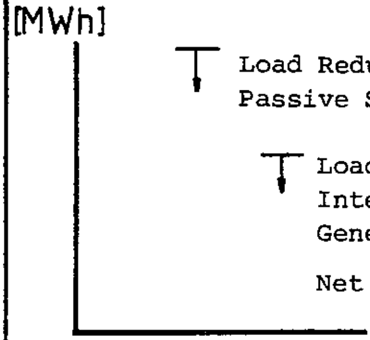


Heat provided by passive solar

Heat provided by internal generation

Heat provided by auxiliary system

Annual Summary



Load Reduction from Passive Solar

Load Reduction from Internal Heat Generation

Net Auxiliary Heating

Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	%

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Energy savings cost due to extra insulation: 0.45 kr/kWh (7% real interest rate)

Energy saved due to extra insulation: 6000 kWh

Energy savings cost due to exaust air/domestic hot water heat pump: 0.75 kr/kWh

Another similar system at the site is more cost effective (0.40 kr/kWh)

Energy saved due to heat pump: 2000 kWh

Night set back: 0.35-0.40 kr kWh

Energy saved due to night set back: 1000 kWh

Heating: 7000 kWh/year, domestic hot water: 2000 kWh/year

Lights, appliances, etc: 7000 kWh

Thermal comfort: satisfactory - som overheating, winter: good

User acceptance: good

Source of Information: "Energisparing i småhus, erfaringer, anbefalinger, sluttrapport". Delrapport 11, STE62 A86004, SINTEF, TRONDHEIM, 1986.

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

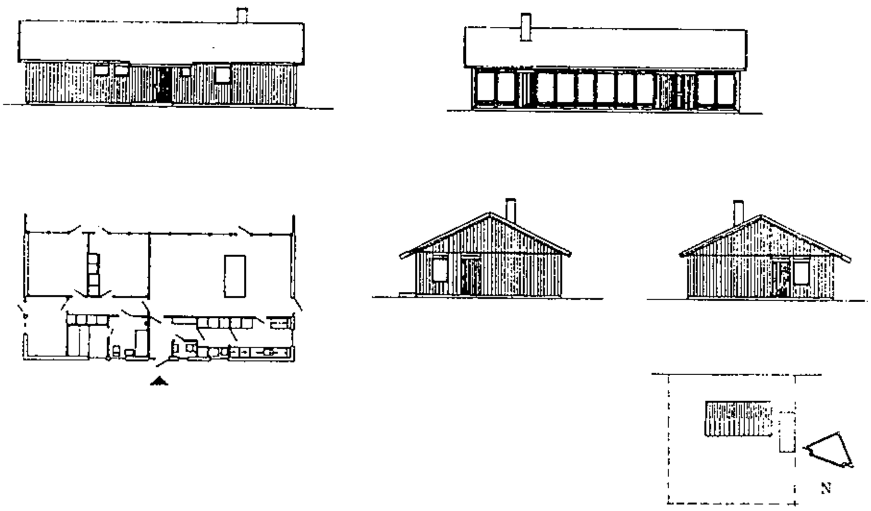
Performance data for systems evaluation

PROJECT TITLE STR, LÅGENERGIPROJEKT FÖR SMÅHUS.

SW-01

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)



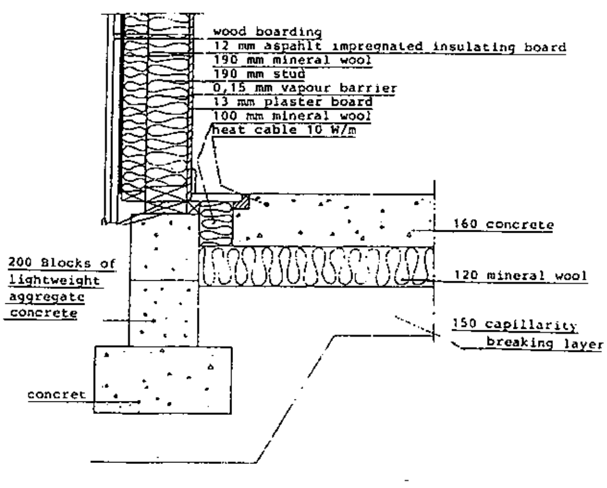
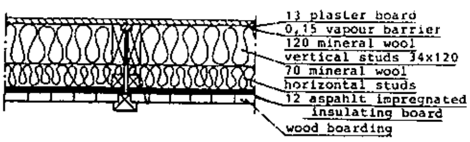
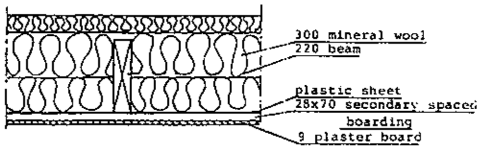


FIG.4.4 Foundation

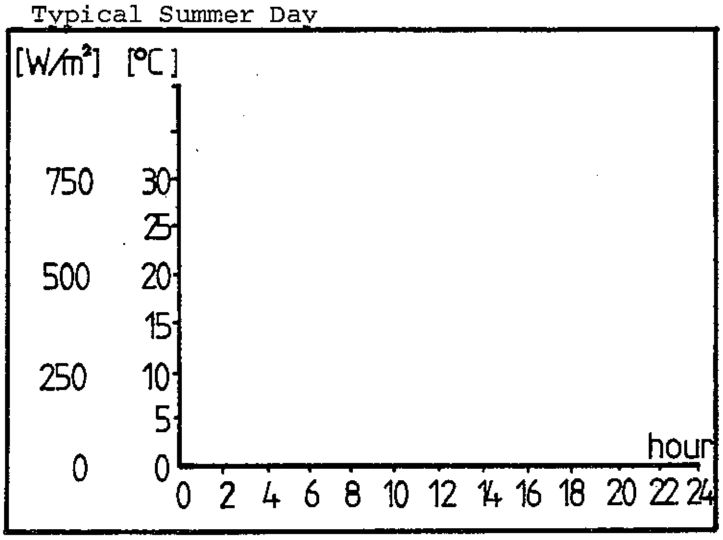


Wall structure

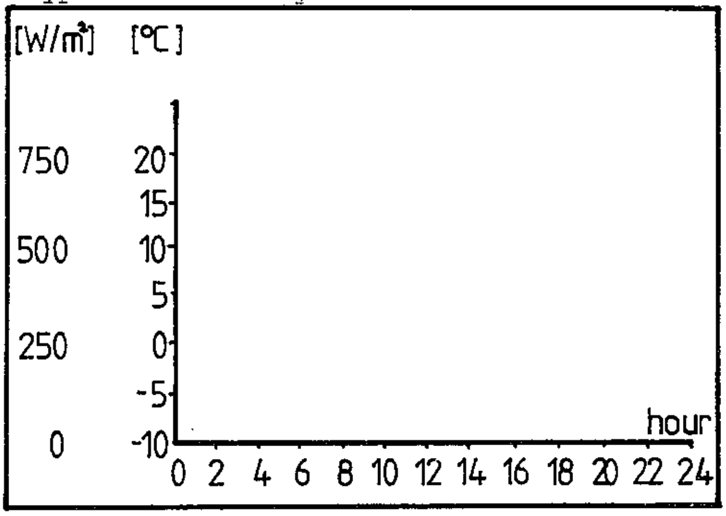


Ceiling structure

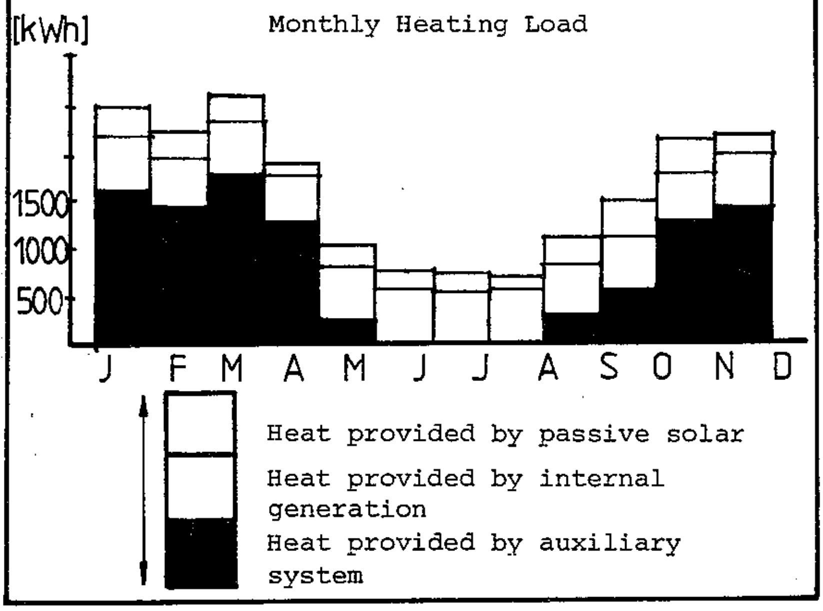
Typical Summer Day



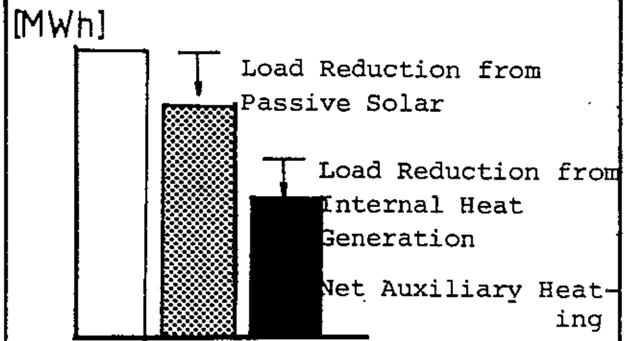
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	14 %
Heating Load Provided by Internal Generation	34 %
Heating Load Provided by Auxiliary Heating	52 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Overheating hasn't been a problem. In one year the indoor temperature has been higher than +26 C only during a couple of days. This happened when the house was unoccupied. Once the house is occupied, the occupants can be expected to use curtains and open windows in order to lower the temperature. The mechanical ventilation rate can be controlled by the occupants. During nights the system was usually turned off as the supply devices were too noisy.

Source of Information: Report "BKL 1979:11" Lund institute of technology.

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

IEA SOLAR R&D

Passive and Hybrid Solar Low Energy Buildings

Performance data for systems evaluation

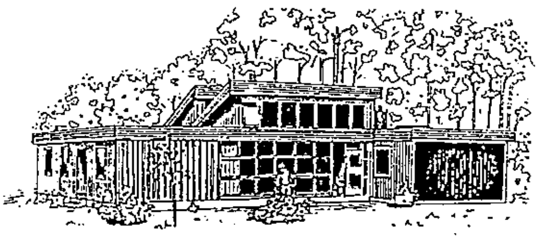
PROJECT TITLE

Passive Solar technology in Teleborg in Växjö.

SW-02

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)



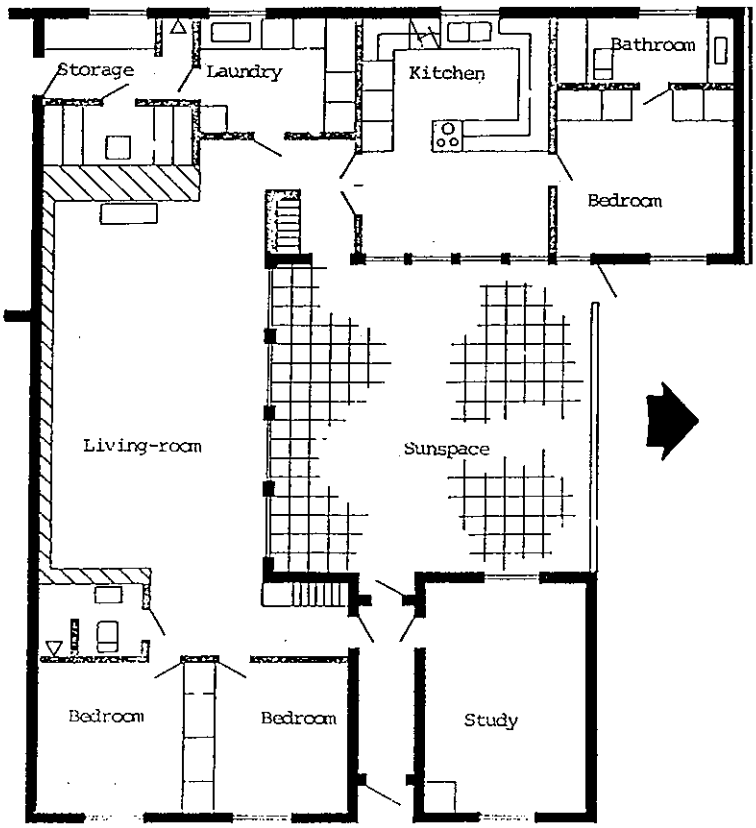


Figure 1. The Ulmås house

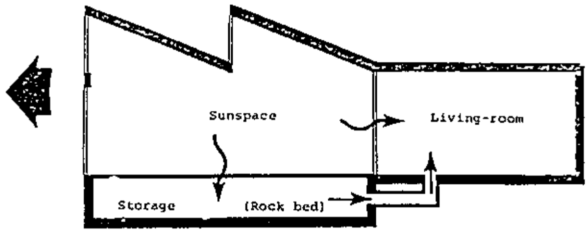


Figure 2. Solar heating system.

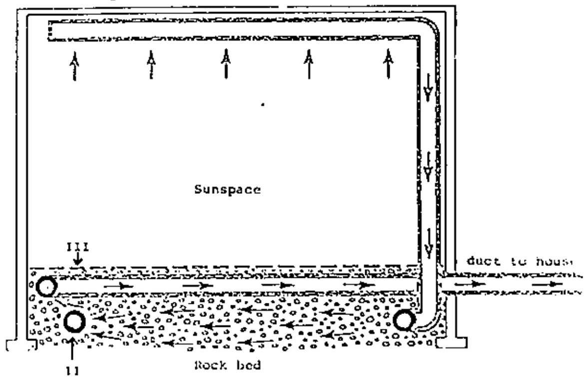
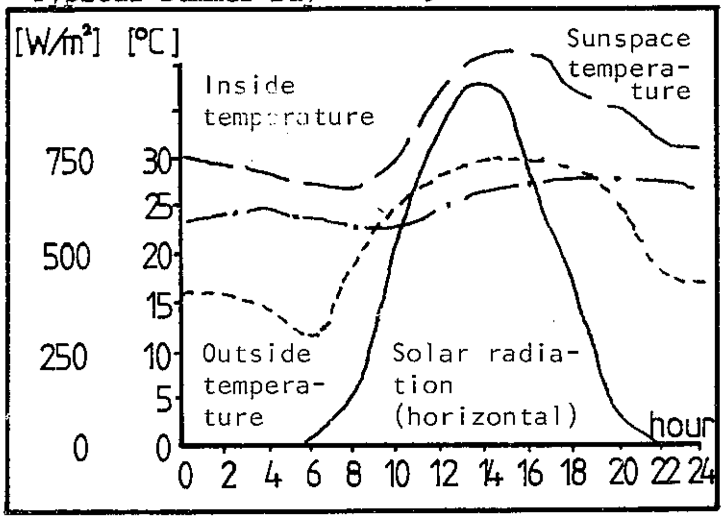
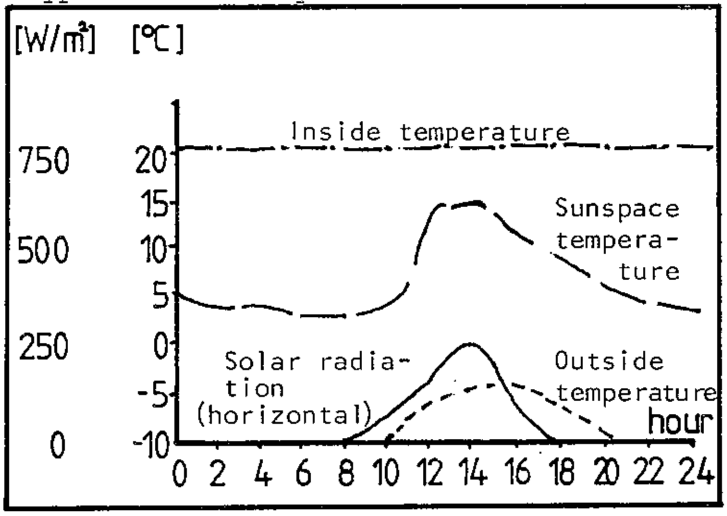


Figure 3. Sunspace with rock bed.

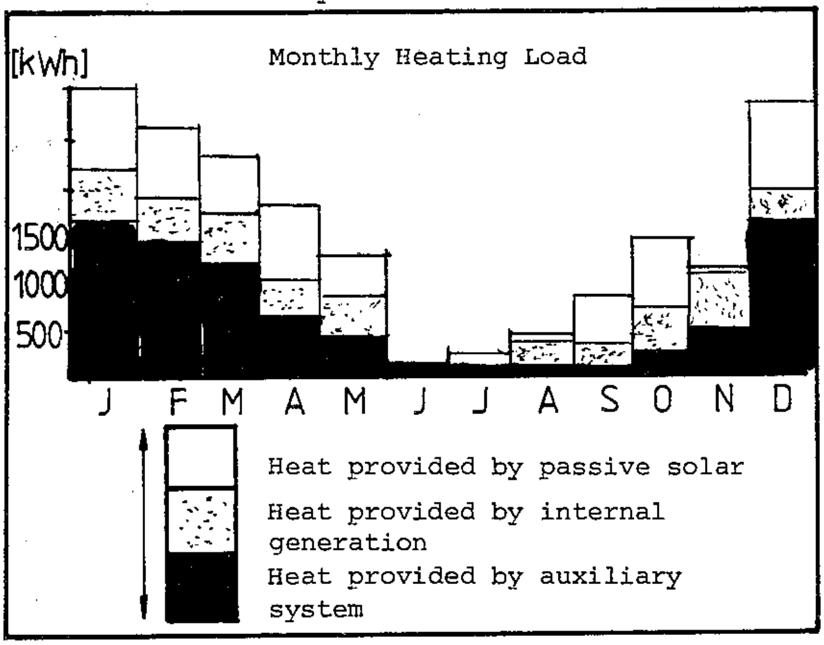
Typical Summer Day 820805



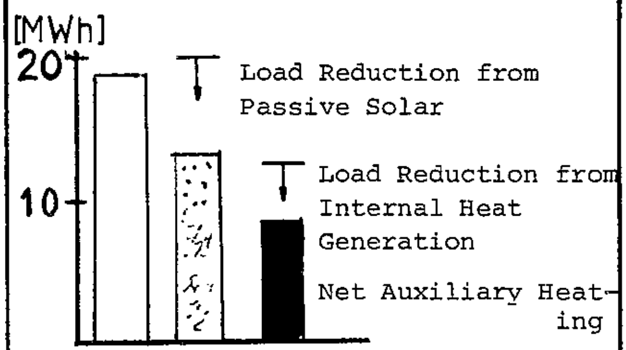
Typical Winter Day 820201



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	30 %
Heating Load Provided by Internal Generation	26 %
Heating Load Provided by Auxiliary Heating	44 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The sunspace is an area which can be used as a living space during most of the year. An area wich doesn't require any space-heating, instead it contributes to the space-heating of the building itself. This contribution was 4600 kWh.

The indoor temperature (excl. sunspace) rarely went above +30 °C thanks to the sunspace working as a thermal buffer.

Thermal shutters should be installed in the sunspace to decrease night time heat losses. During the summer when it is sunny and warm the sunspace should be opened i.e. the whole south window of the sunspace should be pushed aside and the windows up by the roof opened.

Source of Information:

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

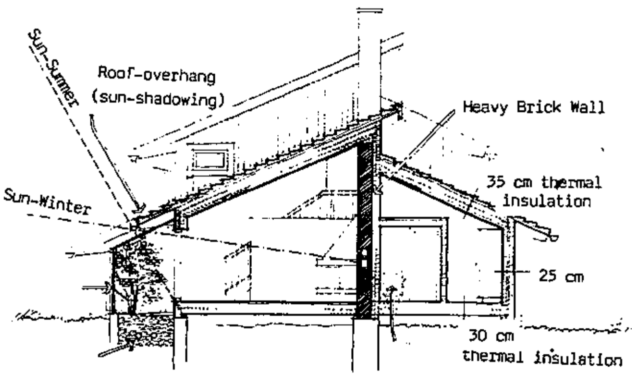
Passive and Hybrid Solar Low Energy Buildings

Performance data for systems evaluation

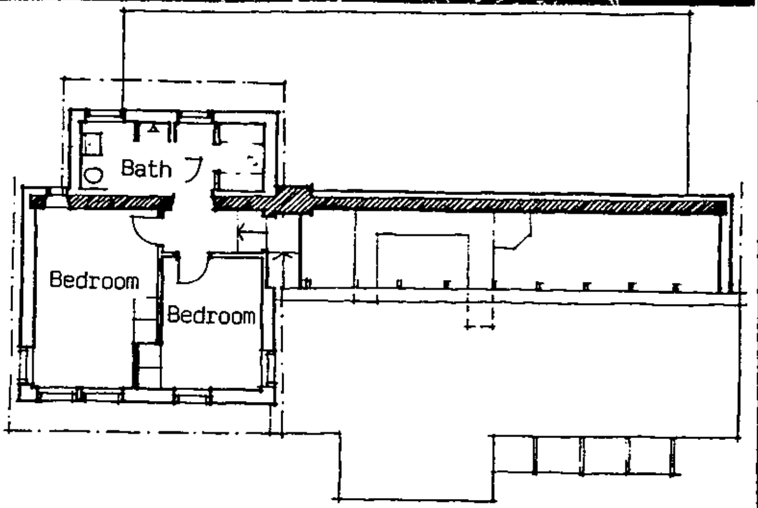
PROJECT TITLE — PASSIVE SOLAR ONE FAMILY HOUSE WITH GREENHOUSE AND SOLID BRICKWALL IN FÄRGELANDA, SWEDEN

SW-03

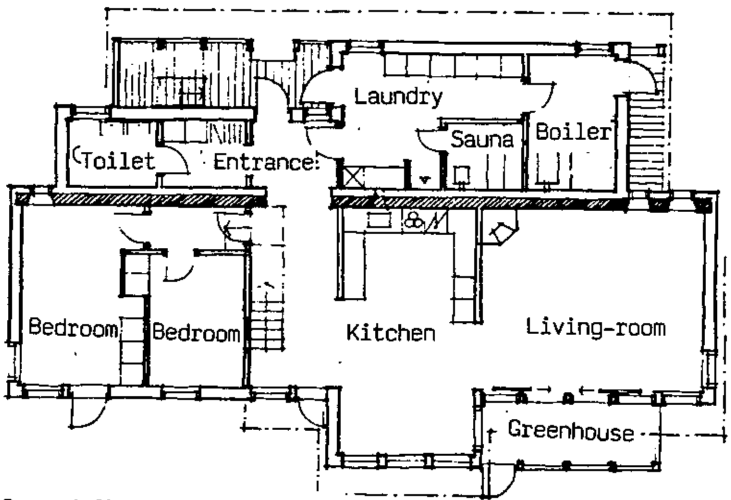
BUILDING AND SYSTEM DESCRIPTION



Sektion

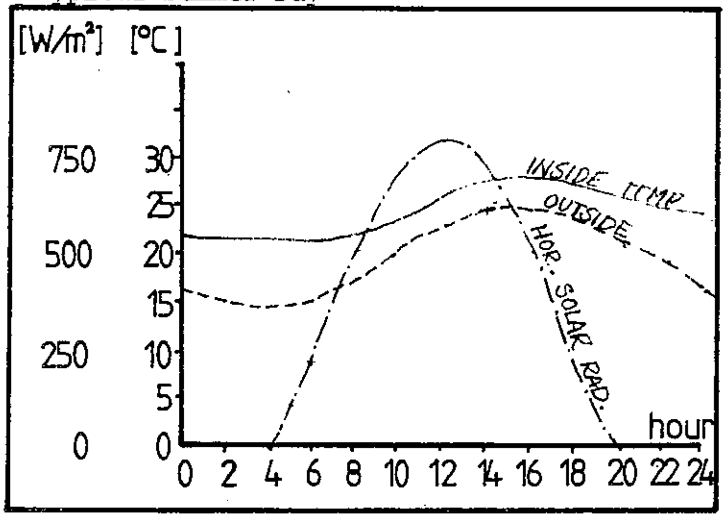


first Floor

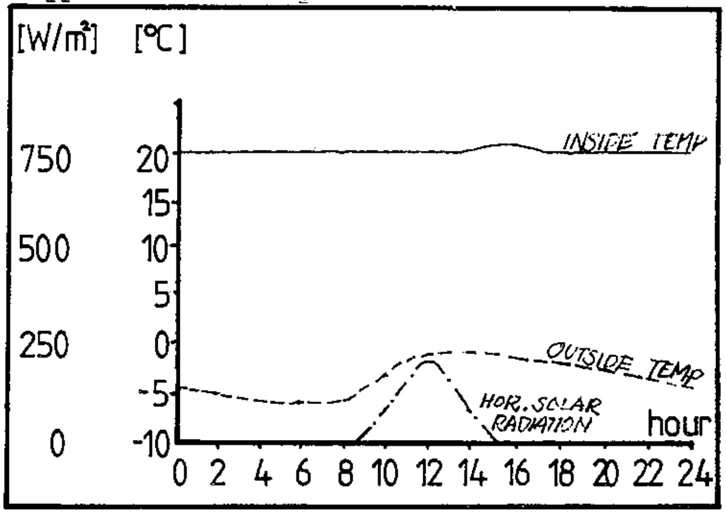


Ground floor Shedule 1:200

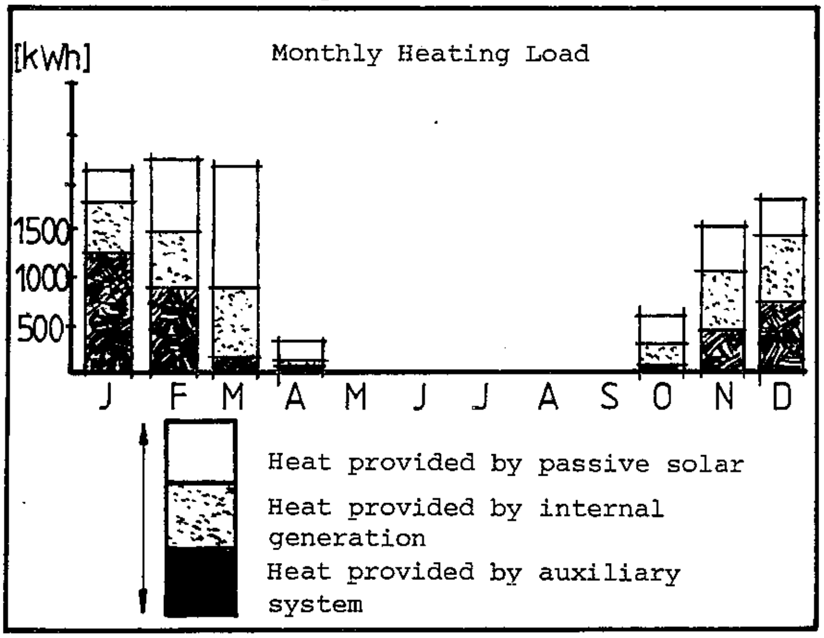
Typical Summer Day



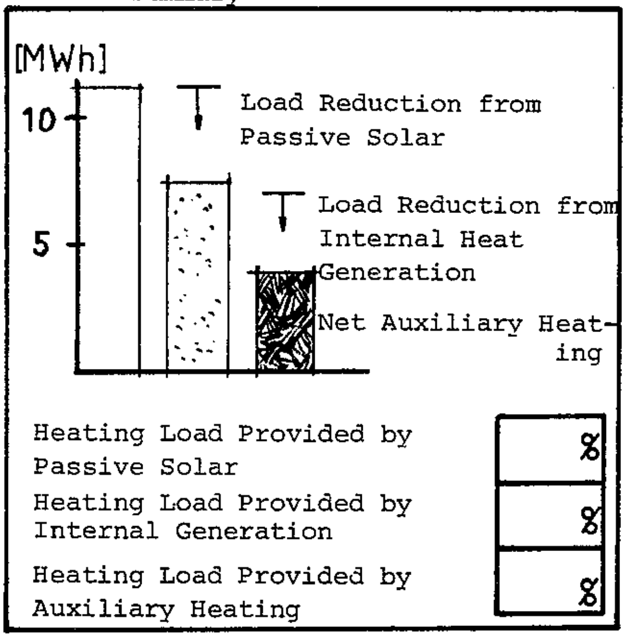
Typical Winter Day



Performance Summary



Annual Summary



CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Thanks to the solid brickwall which makes the temperature-variation even, the thermal comfort in the house is high. During the summer hardly no sun radiaton gets into the house, because the windows are effectively shadowed, which makes the house more comfortable than comparable standard houses. No auxiliary cooling is needed. The users accept a temperature-variation of 20-24°C during the winter, which makes the energy needed for heating low, 2500 - 5000 kWh/year.

The house is financed with ordinary governmental housing loans and is not especially expensive, compared with an ordinary house.

Source of Information:

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

Passive and Hybrid Solar Low Energy Buildings

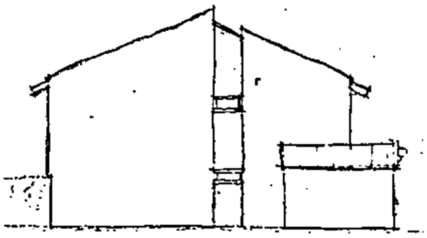
Performance data for systems evaluation

PROJECT TITLE VALDEMARSRO - LOW ENERGY TERRACED HOUSES

SW-04

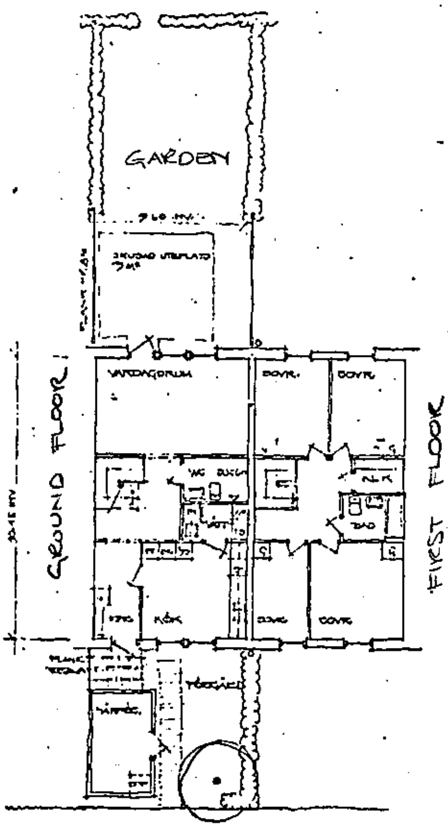
BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

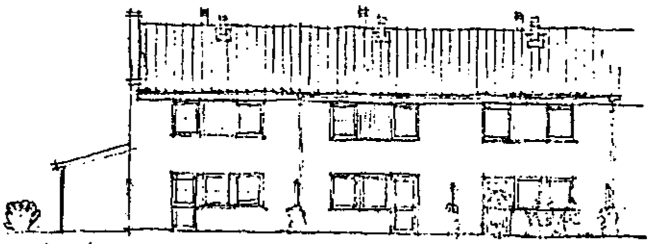


FACADE, GABLES

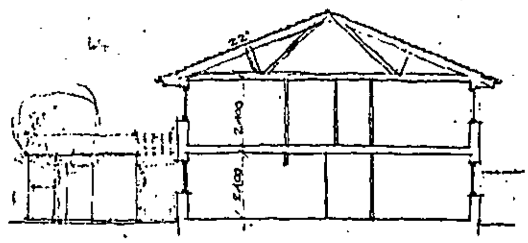
FACADE, SOUTH WEST



FOOTPATH



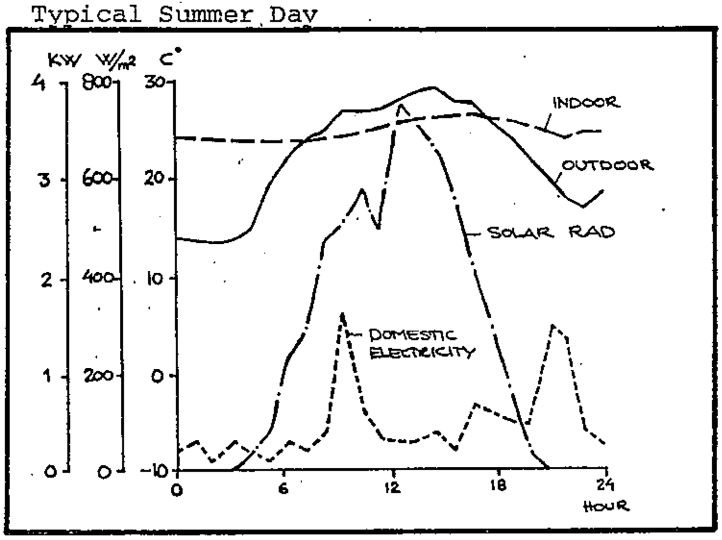
FACADE, NORTH EAST



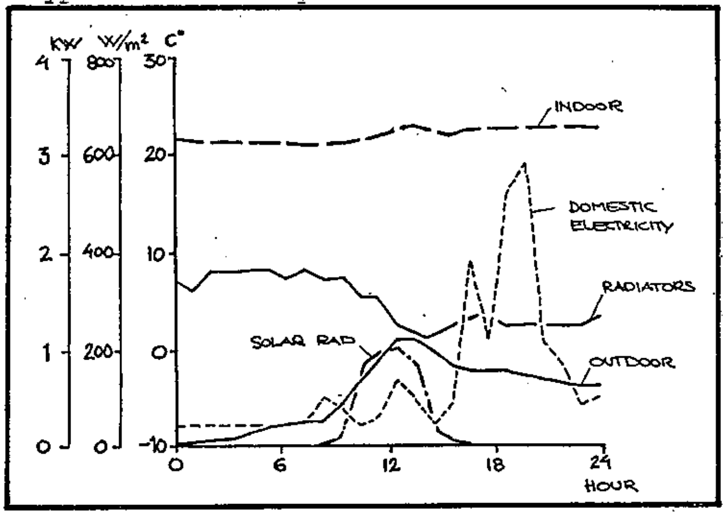
SECTION

PLANS

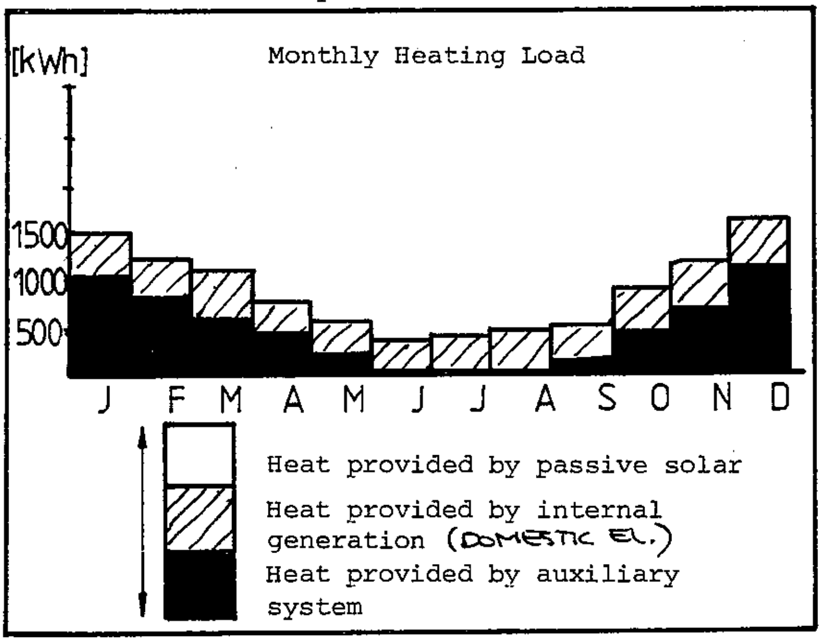
Typical Summer Day



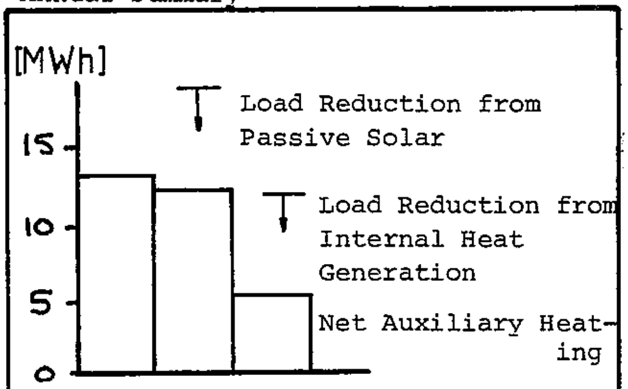
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	8 %
Heating Load Provided by Internal Generation (EL.+PERS)	51 %
Heating Load Provided by Auxiliary Heating	41 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

The figures are measured data from our special monitored measuring-house witch is a gable house. The mean indoor temperature during this year was 22.5 C. The insulation and tightness of the houses and the heat recovery on the ventilation have reached the expectations and the heat power required in the houses is not higher than calculated. The water-carried radiator system however has uncontrolled losses of heat through insufficiently insulated hot water pipes. Even when all the radiators are turned off, the hot water pipes are emitting large amounts of heat. This problem causes a limited heat control. Free heat like solar radiation, domestic electricity and heat from people does not lead to a redu tion of the energy consumption. The only result is a rise of the indoor temperature.

Source of Information: EGON LANGE

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

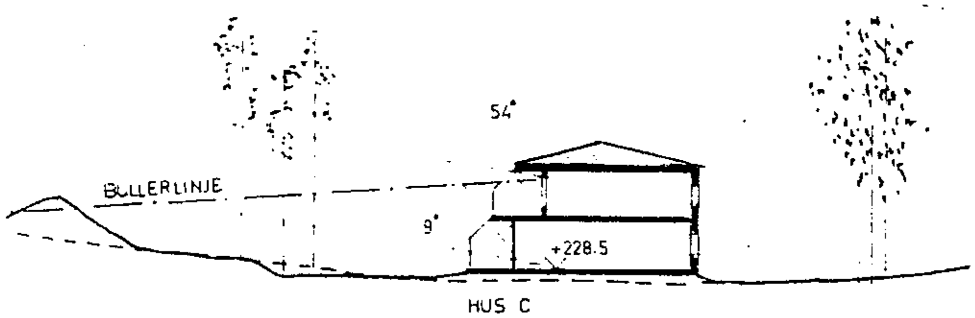
PROJECT TITLE

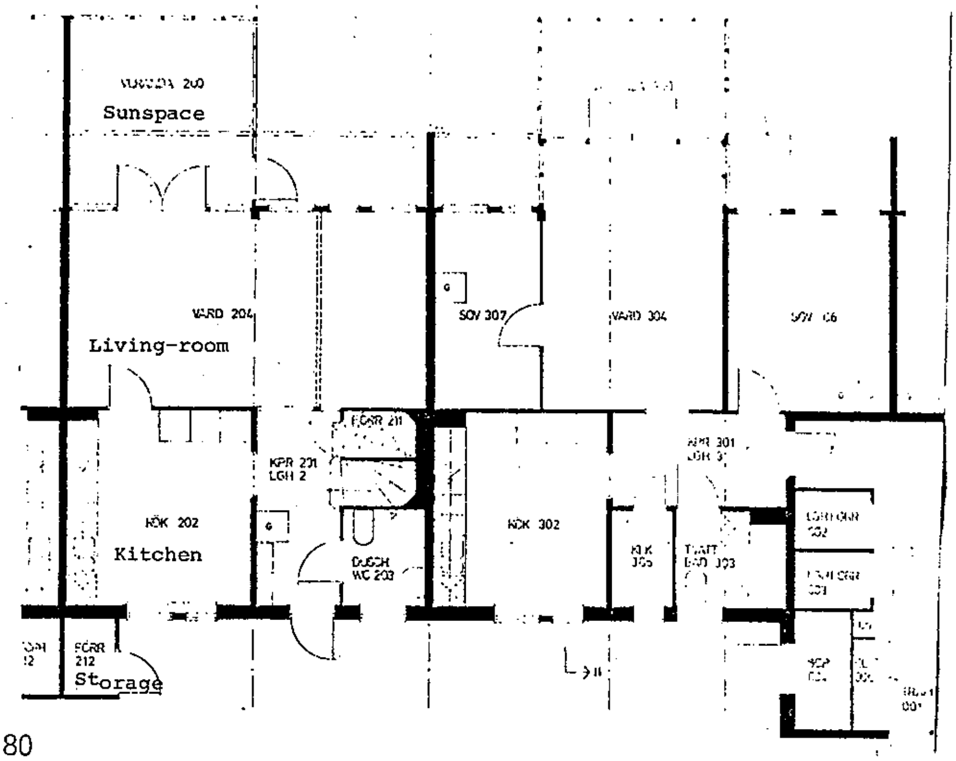
Low energy houses at Smålands Taberg with heat recovery and greenhouses

SW-05

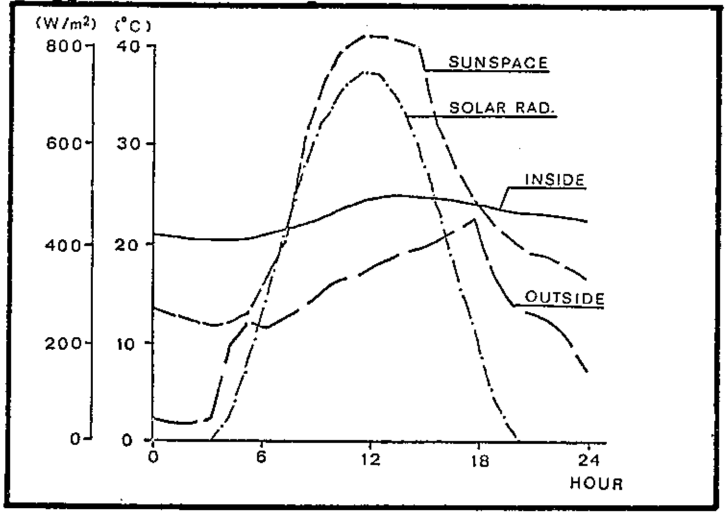
BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

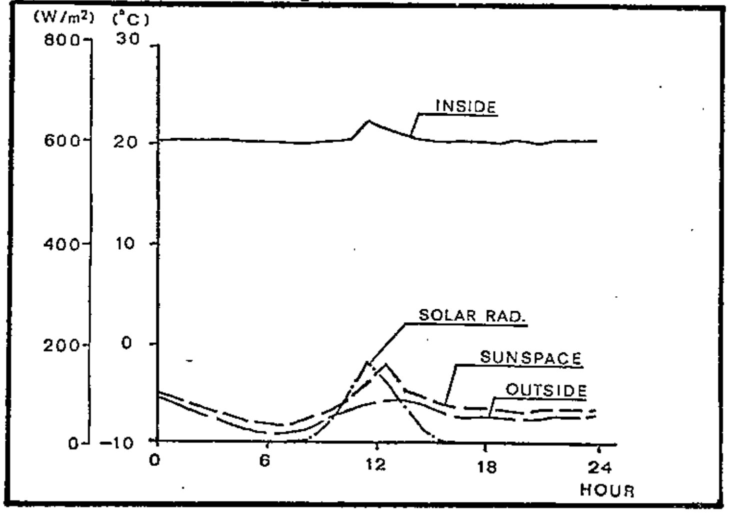




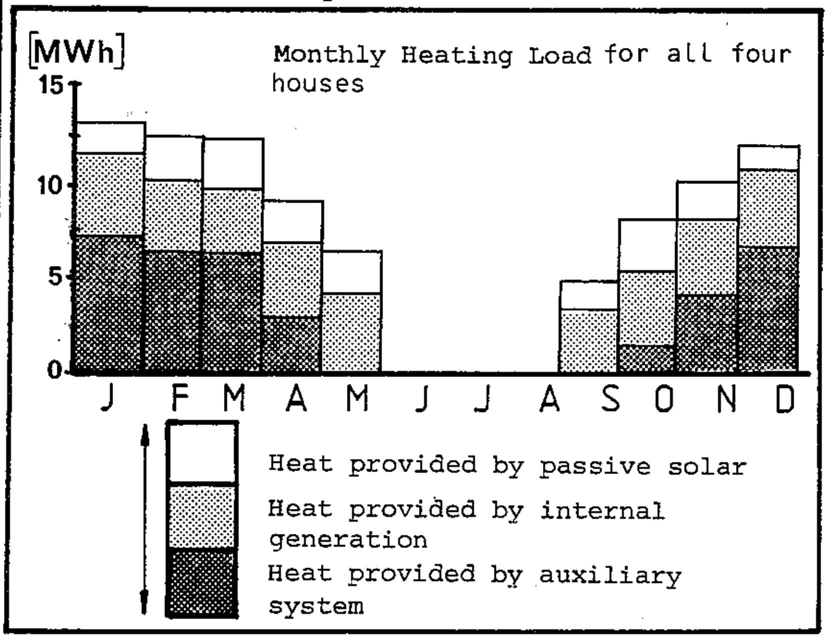
Typical Summer Day



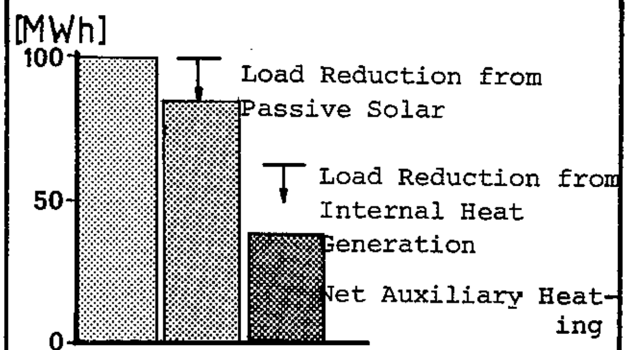
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	16 %
Heating Load Provided by Internal Generation	48 %
Heating Load Provided by Auxiliary Heating	36 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Load reduction from green house is only ~2 %. This gives, with the energy price 0.25 Sw.kr, a saving of ~30 Sw.kr for each greenhouse/year.

Source of Information:

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

PROJECT TITLE

SW-06

Heat from solar energy and air with storage in water and ice

BUILDING AND SYSTEM DESCRIPTION

(plans, sections, system schematics showing energy flows, key components and modes of operation)

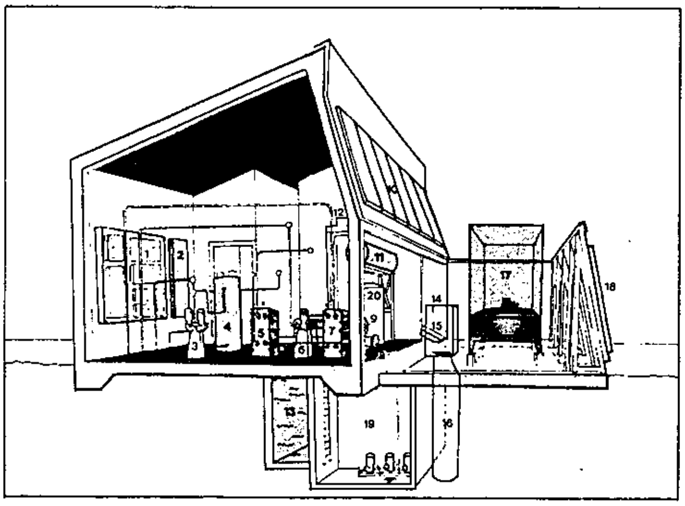


Figure 2.12 Schematic section through the group heating plant building.

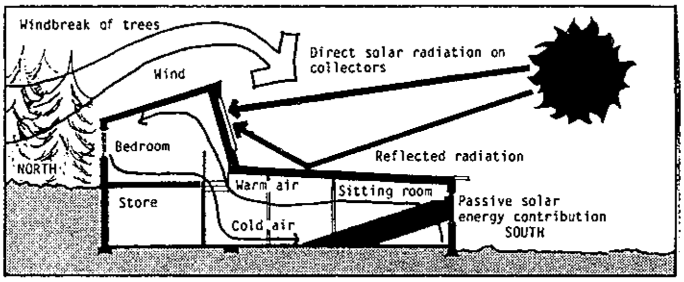


Figure 0.5 Section through one of the houses

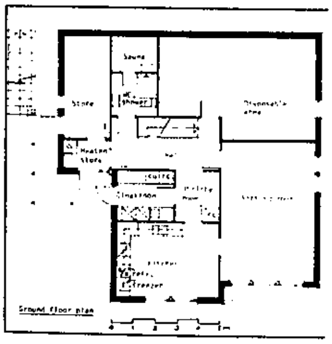


Figure 2.1

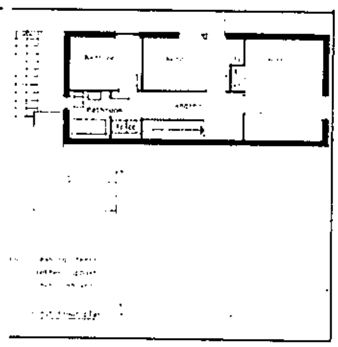


Figure 2.2

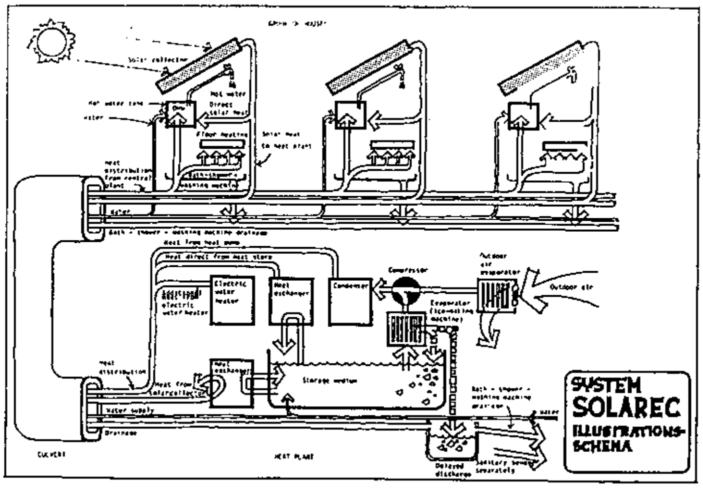


Figure 0.3 A simplified diagram of the heating system

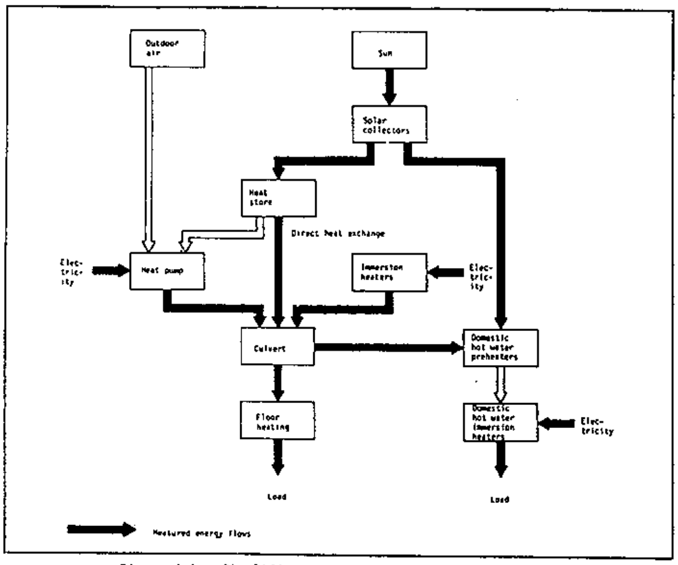
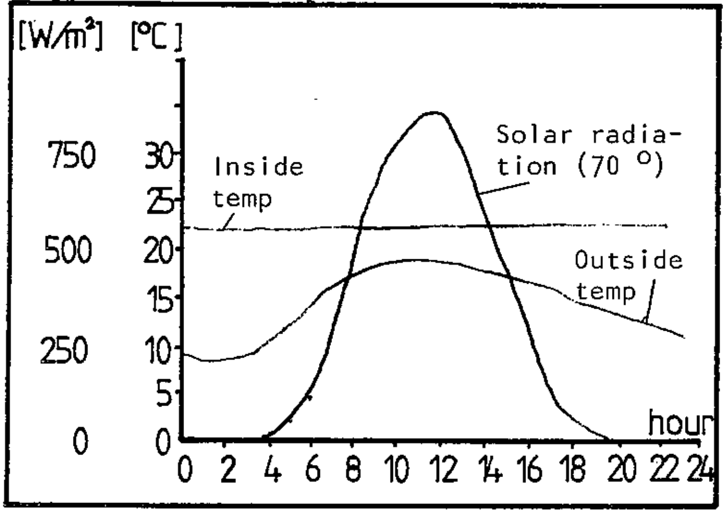
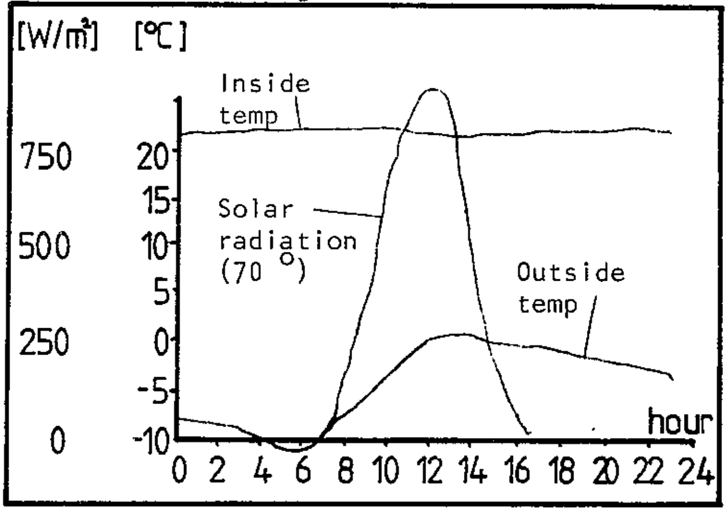


Figure 4.1 Simplified energy flow diagram.

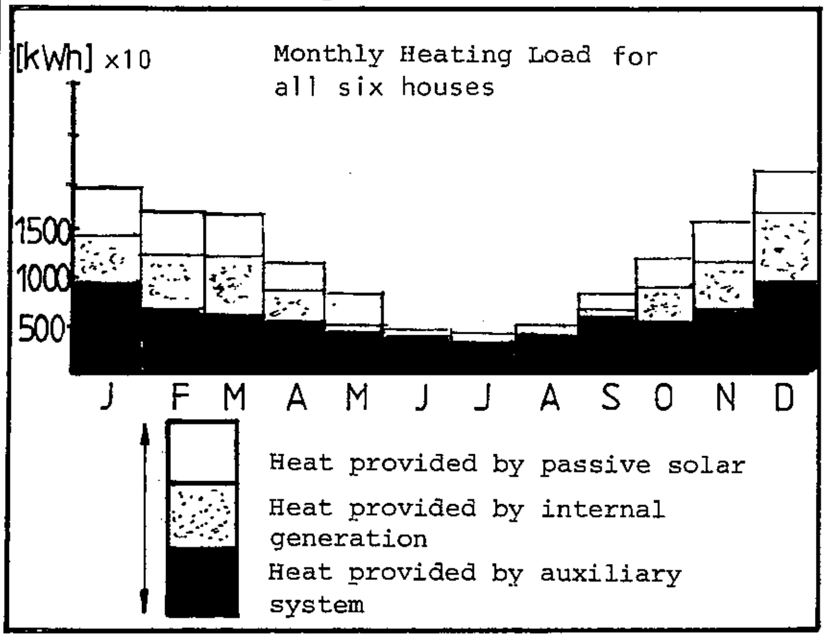
Typical Summer Day



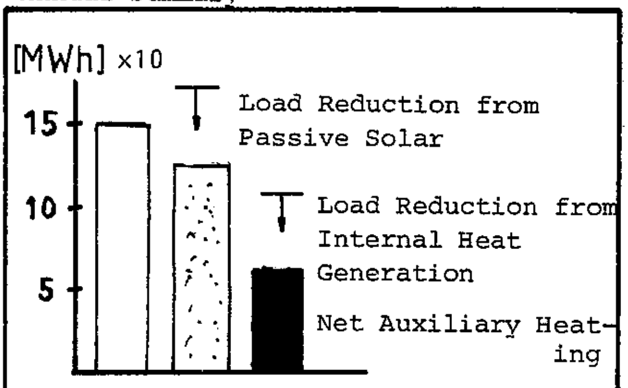
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	27 %
Heating Load Provided by Internal Generation	37 %
Heating Load Provided by Auxiliary Heating	36 %

CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

Future houses should incorporate measures for reducing transmission losses through the building envelope and the ventilation losses due to air infiltration. With the current low price of electricity the houses should ideally have been heated with electric base board heaters. The solar group heating plant in this project is not profitable today, especially on such a small scale being connected only to six houses.

Source of Information:

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

IEA SOLAR R&D

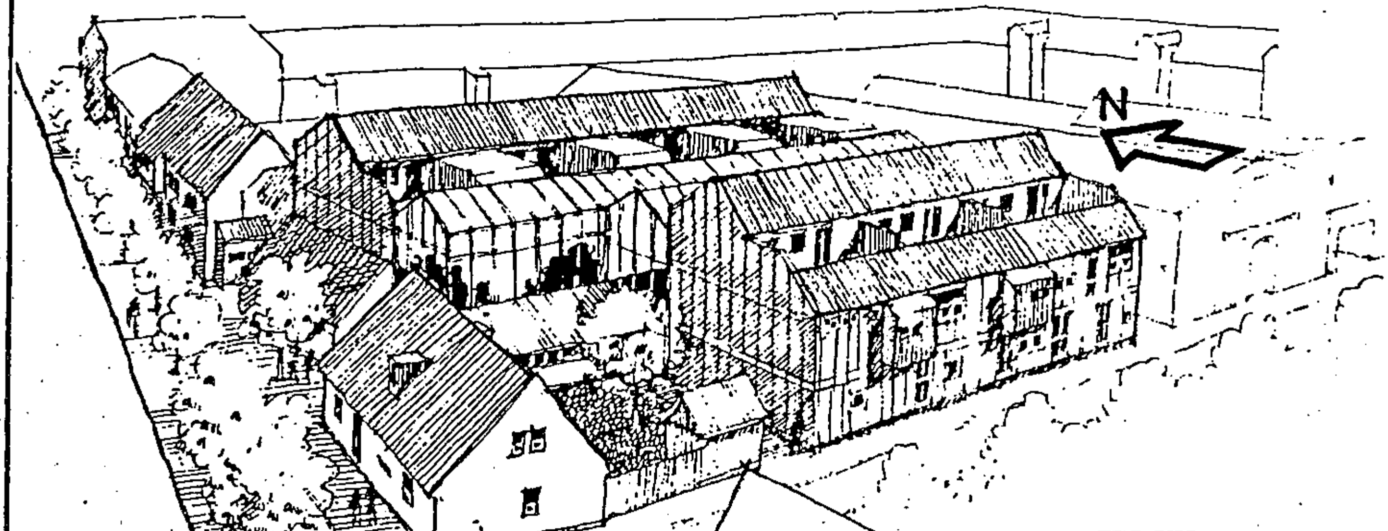
Passive and Hybrid
Solar Low Energy Buildings

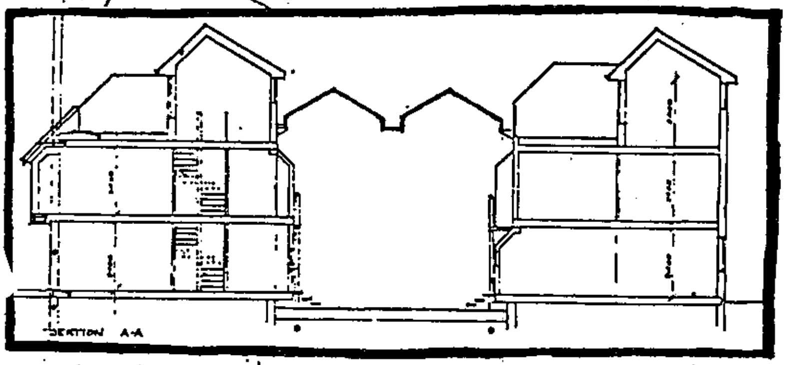
Performance data for systems evaluation

PROJECT TITLE: TÄRNAN - A GLACED COURTYARD.

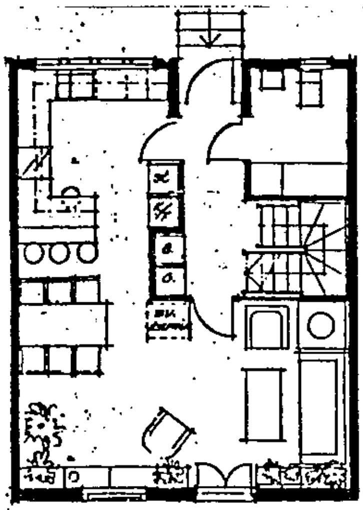
SW-07

BUILDING AND SYSTEM DESCRIPTION

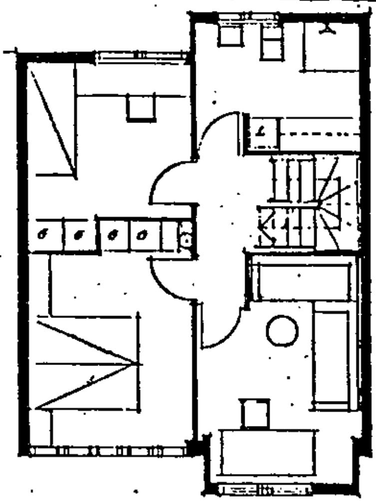




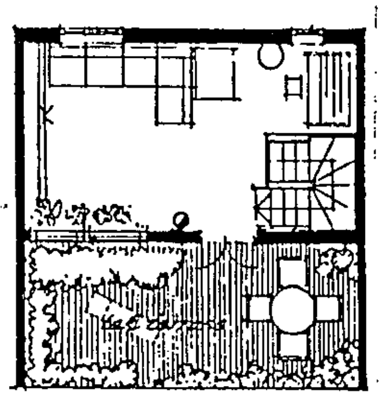
SECTION A-A



GROUND FLOOR

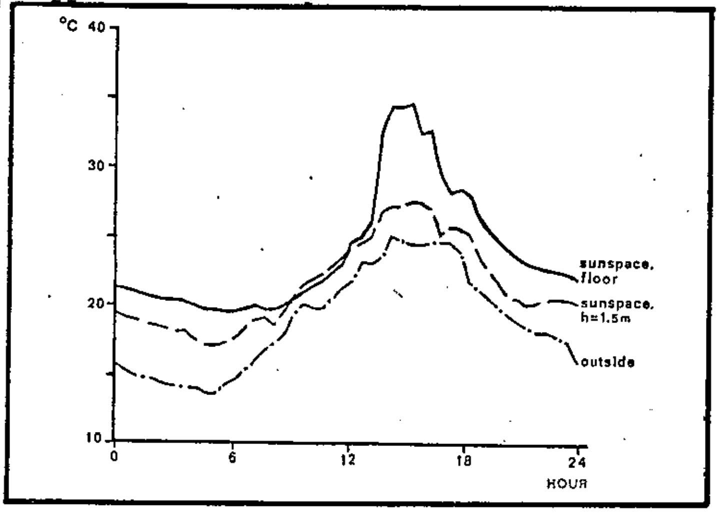


FIRST FLOOR

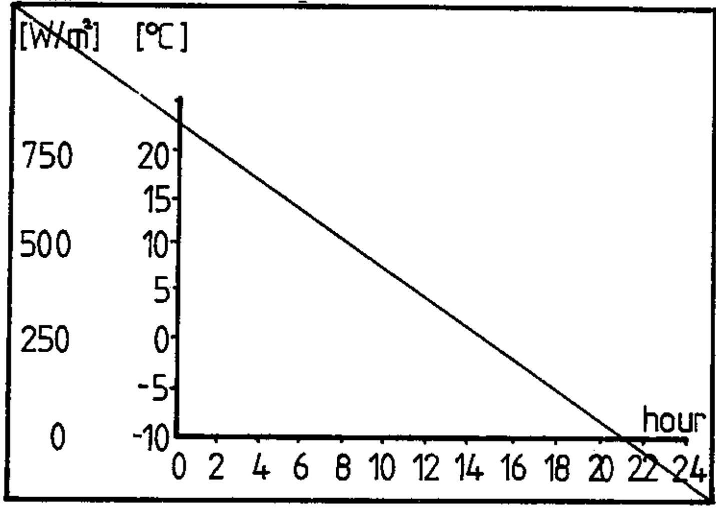


SECOND FLOOR

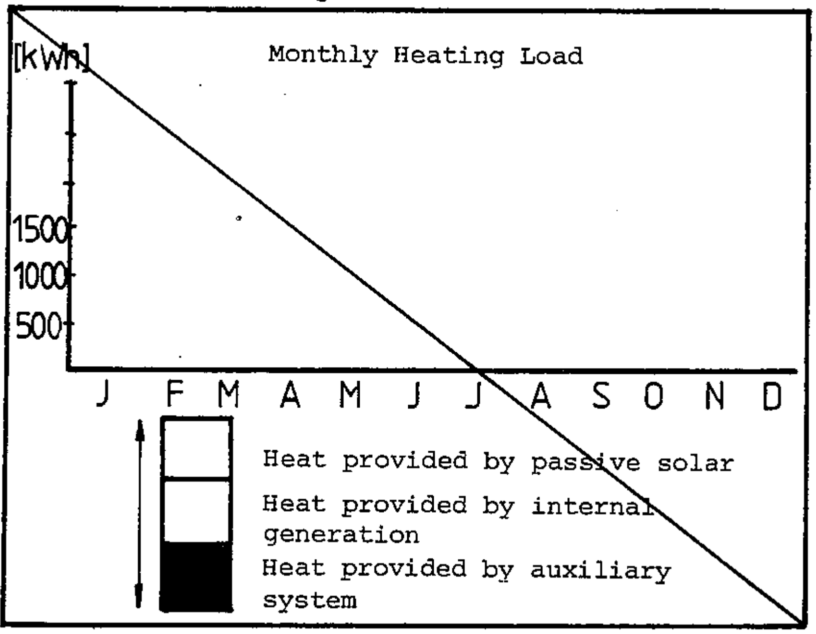
Typical Summer Day



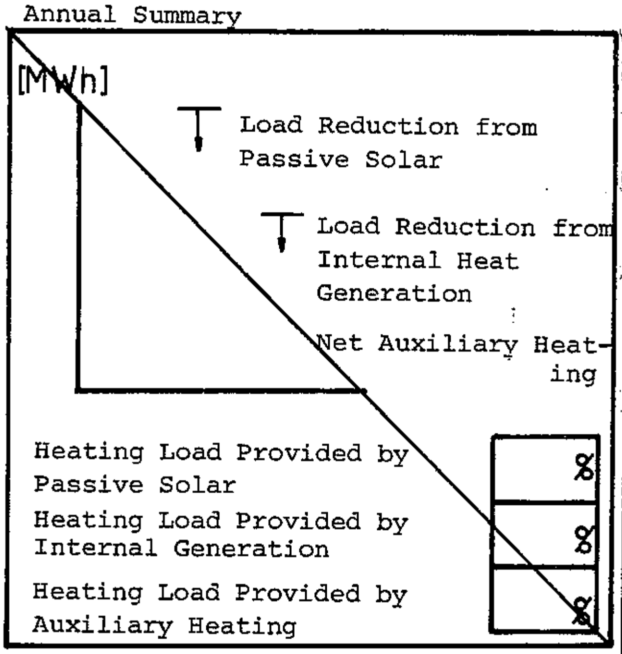
Typical Winter Day



Performance Summary



Annual Summary



CONCLUSIONS/FINDINGS (thermal comfort, user acceptance, costs, etc...)

THEY HAVE SUCCEEDED IN HOLDING THE TEMPERATURE IN THE SUNSPACE DOWN TO 2-3°C ABOVE THE OUTDOOR TEMPERATURE THIS SUMMER. THIS HAS BEEN POSSIBLE BY AN EFFICIENT USE OF THE CURTAINS AND SHUTTERS.

IT WILL BE EVEN MORE INTERESTING TO FOLLOW THE COMING WINTER WHEN WE, AMONG OTHER THINGS, WILL BE ABLE TO SEE WHAT HAPPENS WITH THE TEMPERATURE IN THE SUNSPACE. IF THE TEMPERATURE GOES DOWN BELOW ABOUT 5°C THEN THE PLANTS MAY HAVE DIFFICULTIES OF SURVIVING.

Source of Information:

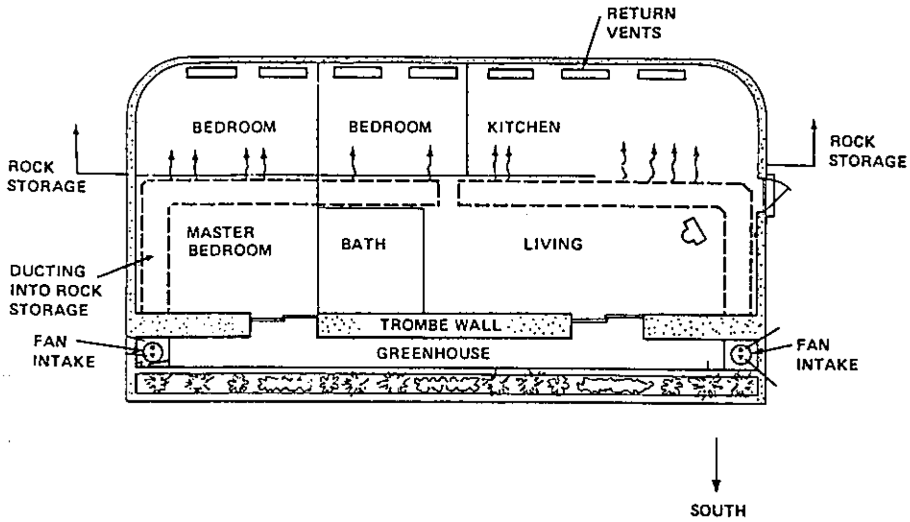
Performance data for systems evaluation

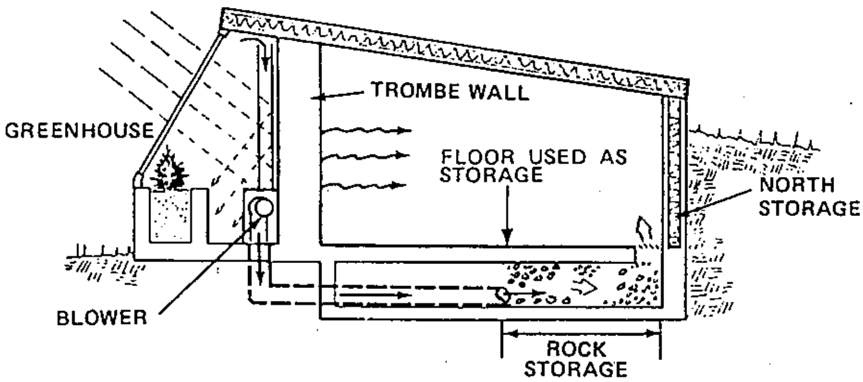
PROJECT TITLE

US/AZ-06

HULLCO CONSTRUCTION
PRESCOTT, ARIZONA

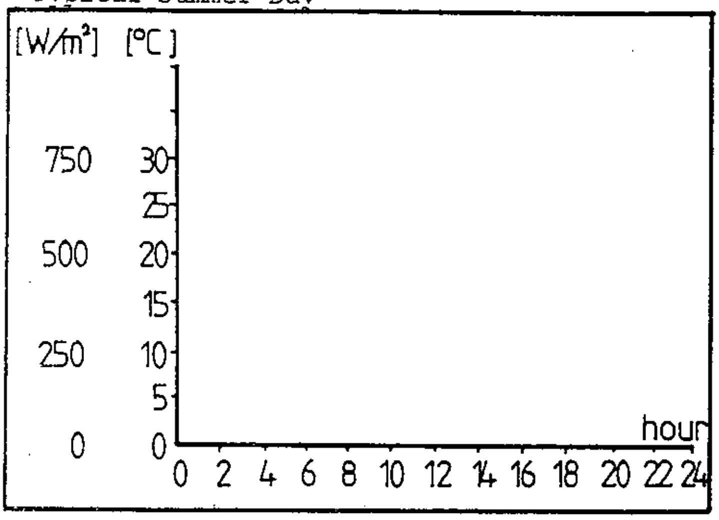
BUILDING AND SYSTEM DESCRIPTION



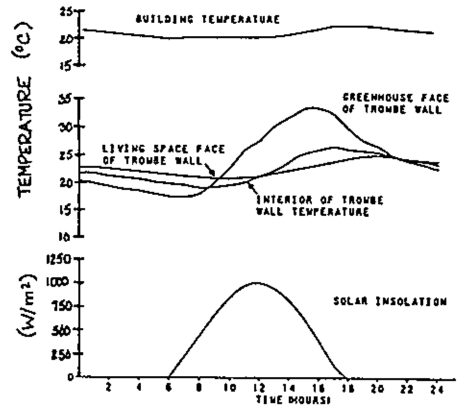


The entire south wall of this small one-floor house in central Arizona is a double-glazed greenhouse. Glass panels in a massive storage wall allow direct gain through the greenhouse to the house interior. Thermal storage is provided by the mass wall, the concrete, brick and tile floor and a forced-air-fed rock storage bin under the north half of the house. Summer cooling is by controlled venting from the top of the greenhouse to prevent daytime overheating and provide night cooling of the storage masses. Exterior roll-down shades provide additional protection against overheating.

Typical Summer Day



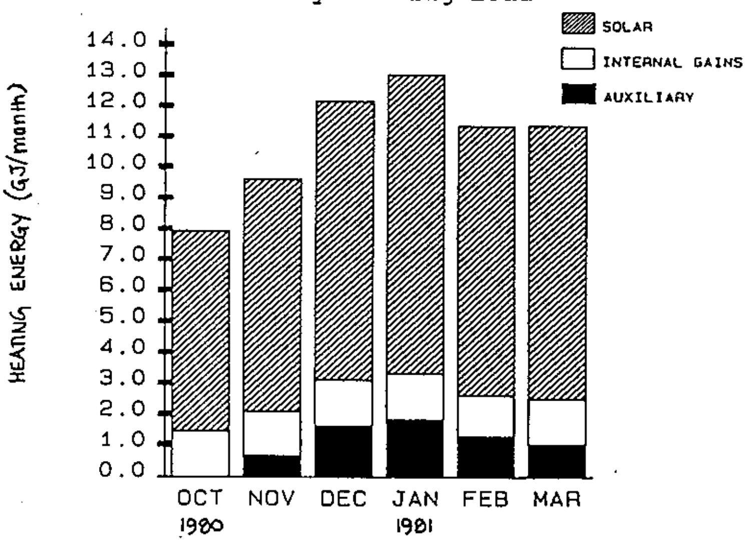
Typical Winter Day



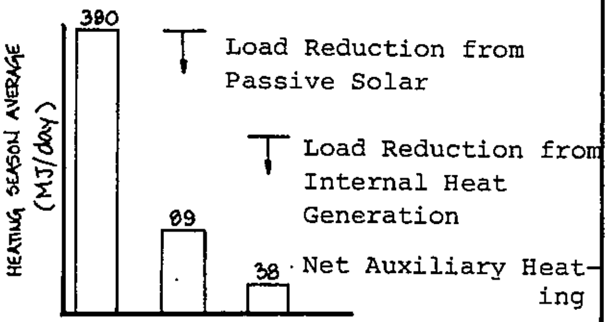
APRIL 3, 1980

Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	77 %
Heating Load Provided by Internal Generation	13 %
Heating Load Provided by Auxiliary Heating	10 %

CONCLUSIONS/FINDINGS

In 1980-81, solar energy supplied 53.02 GJ of the 69.24 GJ building heating load for a solar fraction of 77%. The solar system performed smoothly and efficiently throughout the heating season. Except for 10.54 MJ of electric heat, all of the auxiliary heating energy used was supplied by the wood stove in the living room.

It was found that a pulse of heat took approximately 4.5 hours to travel through the Trombe wall. It was suggested that this relatively long time may be due in part to the fact that the hollow blocks in the wall are filled with loose sand which does not conduct heat as well as the solid concrete.

Source of Information: Solar Energy System Performance Evaluation: Hullco Construction (by Vitro Labs for NSDN)

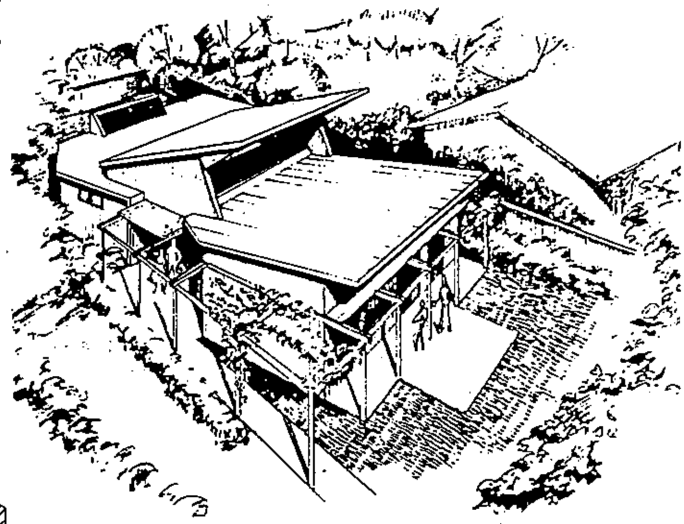
IEA
SOLAR R&D

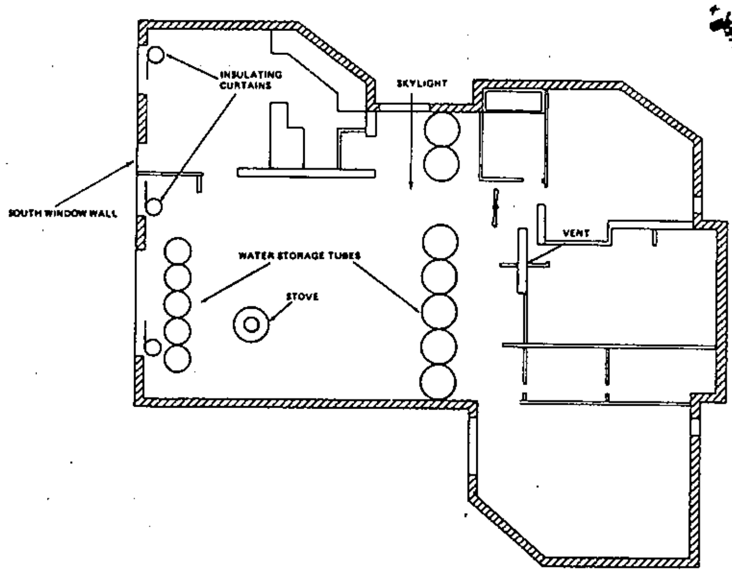
Passive and Hybrid
Solar Low Energy Buildings

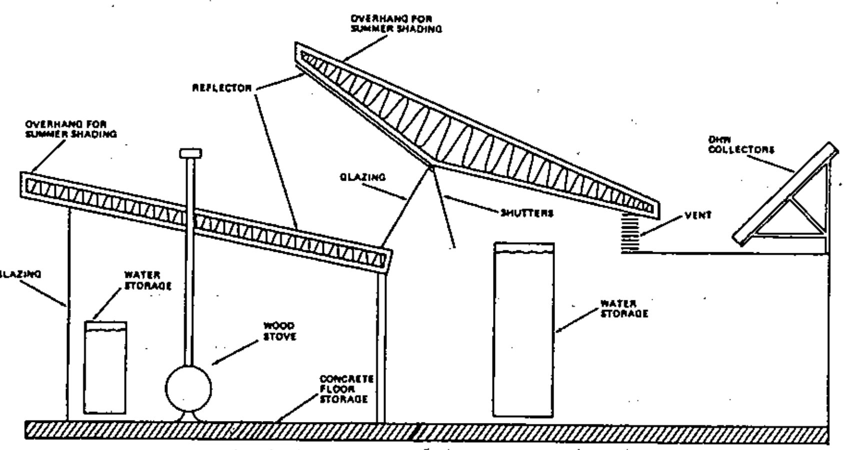
Performance data for systems evaluation

PROJECT TITLE	LIVING SYSTEMS
US/CA-01	DAVIS , CALIFORNIA

BUILDING AND SYSTEM DESCRIPTION

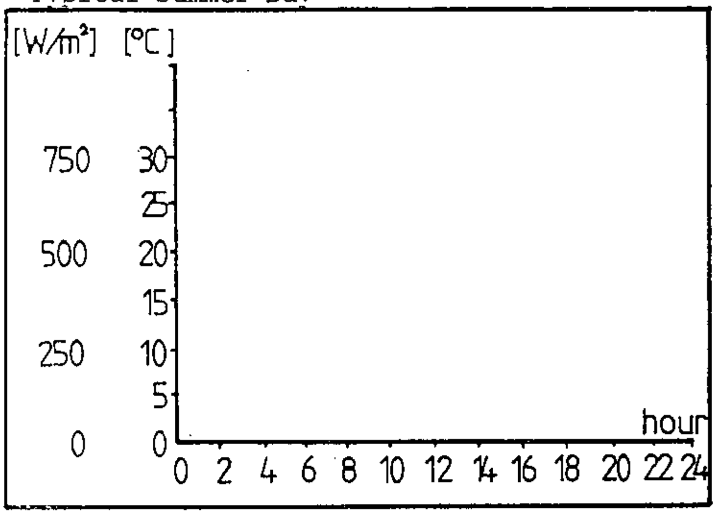




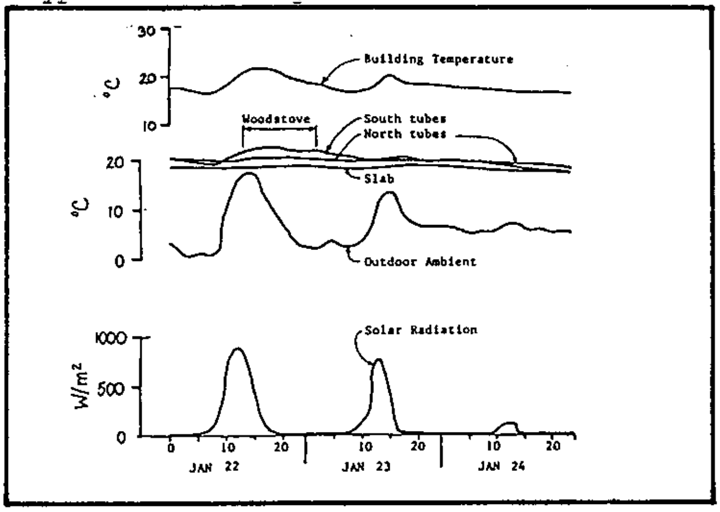


This single detached residence is located in Davis, California. The system uses 25.4 square meters of direct-gain collector, part of which is in a 7.5 square meter clerestory. Solar energy is stored in a series of steel tubes filled with 13,626 liters of water. Additional storage is supplied by the floor slab. Night-time losses are reduced by the use of insulating curtains on the windows and shutters on the clerestory. Auxiliary energy is supplied by a wood stove and a gas-fired wall furnace.

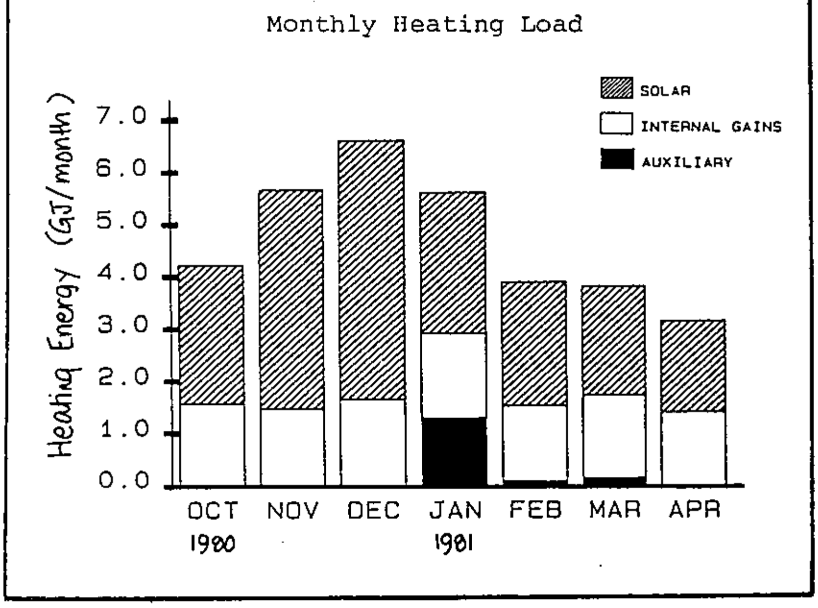
Typical Summer Day



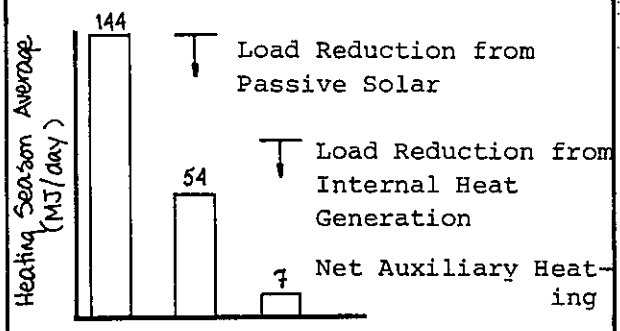
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	62 %
Heating Load Provided by Internal Generation	33 %
Heating Load Provided by Auxiliary Heating	5 %

CONCLUSIONS/FINDINGS

The overall performance of the system was very good with an annual solar fraction of 80%. If the internal gains had been lower for January and February, the system could have used more solar energy and the annual solar fraction would have been higher.

The system was designed with a good collector to storage ratio which prevented large temperature swings inside the building.

The heating season began with an average storage temperature of 24°C. The storage temperature decreased during the winter, and by February the average storage temperature was 20°C. This drop in temperature accounts for the fact that more energy was delivered from storage than was delivered to storage. The additional energy delivered from storage was energy collected during the summer months and released during the heating season.

The overall system performance suffered somewhat due to the manual operation of the movable insulation. The net savings from the use of the movable insulation were 3.56 GJ, but because the shutters and curtains were only open to collect 56% of the available solar energy, 16.27 GJ of solar energy were lost or not collected (based on average collection efficiency of 69%).

Source of Information: Solar Energy System Performance Evaluation: Living Systems (by Vitro Labs for NSDN)

IEA
SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

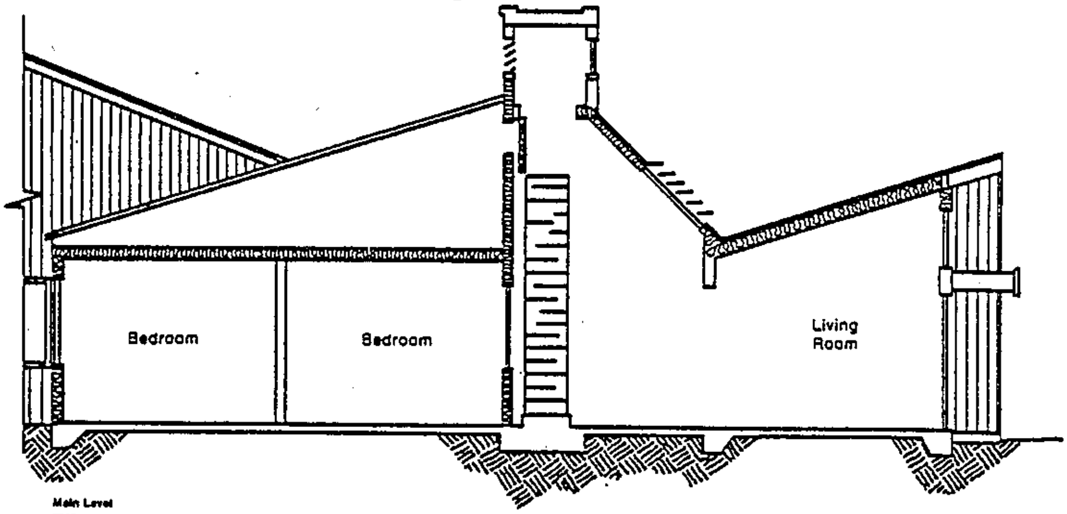
Performance data for systems evaluation

PROJECT TITLE

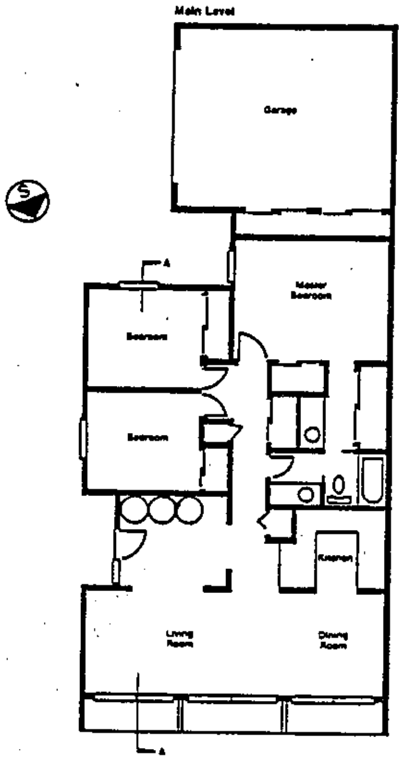
US/CA-07

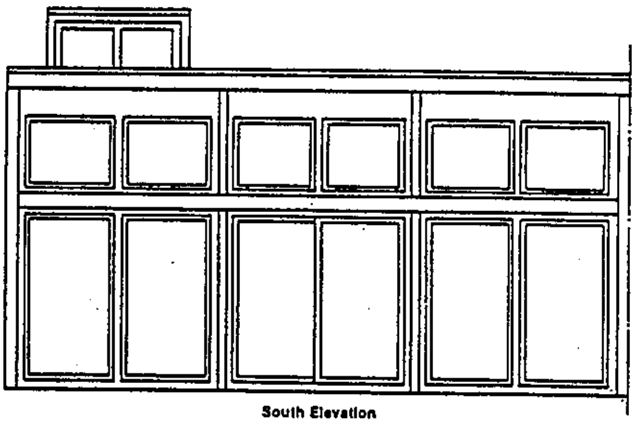
Site WSA
Davis, California

BUILDING AND SYSTEM DESCRIPTION



Section A-A

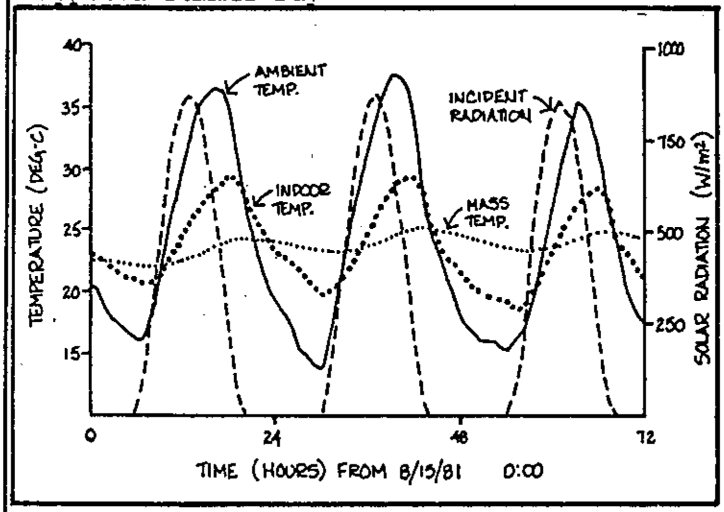




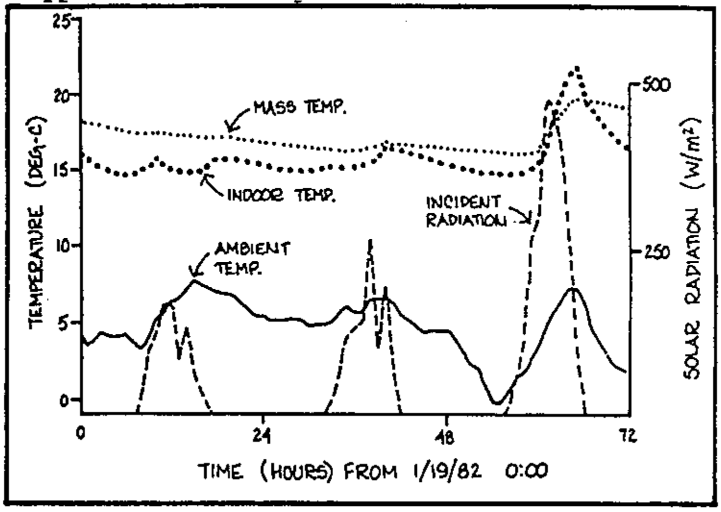
South Elevation

This small single-story slab-on-grade house comprises the western half of a duplex. It receives direct gain through south windows and a 45° tilted clerestory. The clerestory glazing charges 1100 gallons (4169 L) of water contained in four steel cylinders. Warm air from the clerestory is ducted to the north bedrooms. The clerestory also serves as a solar chimney, which can be opened to vent warm air during the summer.

Typical Summer Day

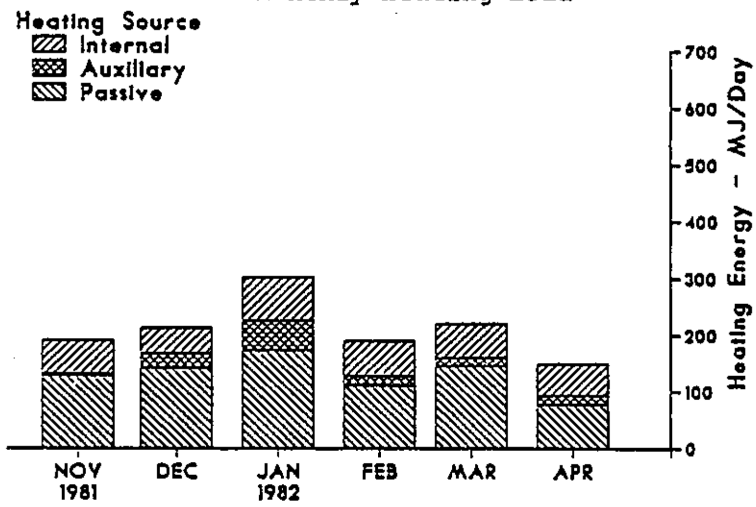


Typical Winter Day

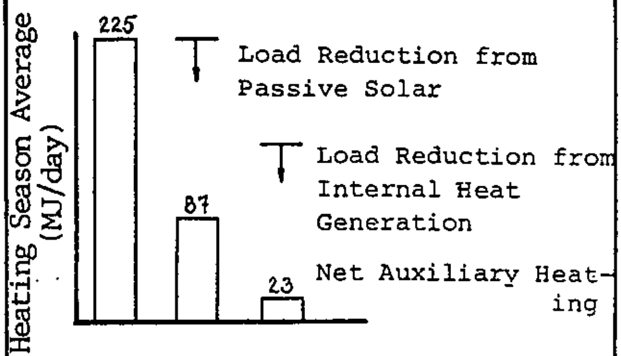


Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	62 %
Heating Load Provided by Internal Generation	28 %
Heating Load Provided by Auxiliary Heating	10 %

CONCLUSIONS/FINDINGS

The solar components met more than 60% of the heating load with little auxiliary heating needed. The interior temperature was allowed to fluctuate a great deal, often falling below 60°F (16°C) during cloudy weather.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

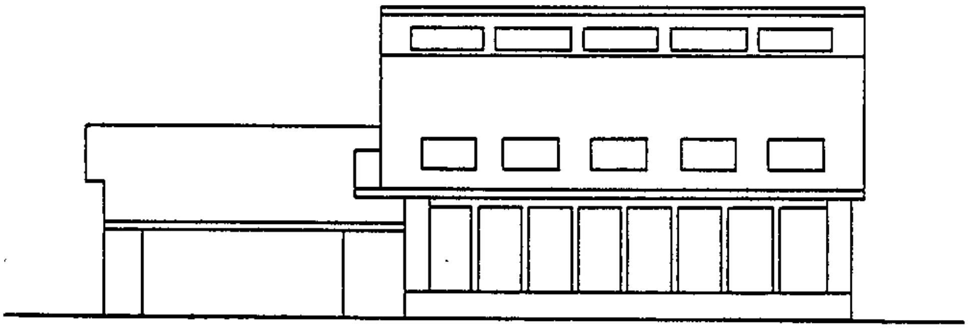
Performance data for systems evaluation

PROJECT TITLE

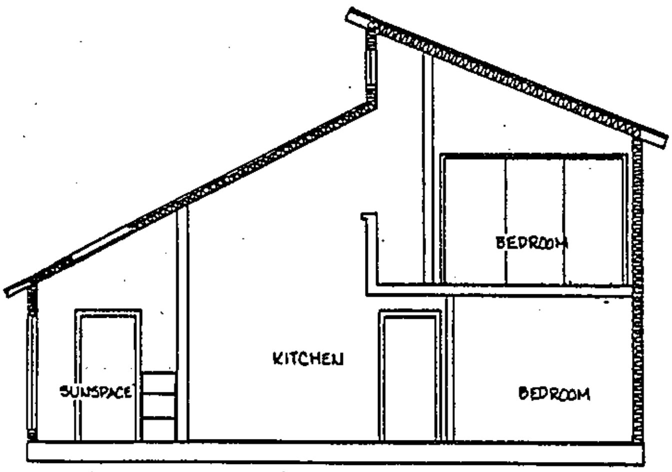
Site WSF
Yreka, California

US/CA-10

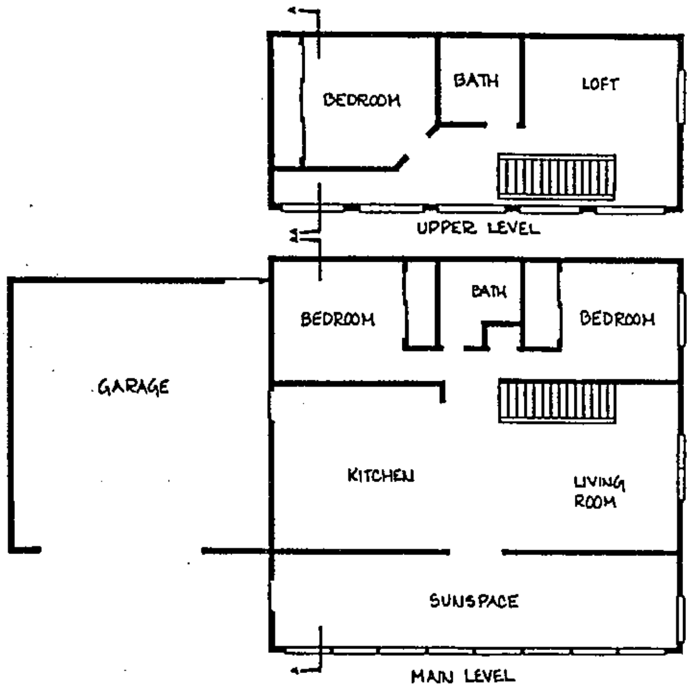
BUILDING AND SYSTEM DESCRIPTION



SOUTH ELEVATION

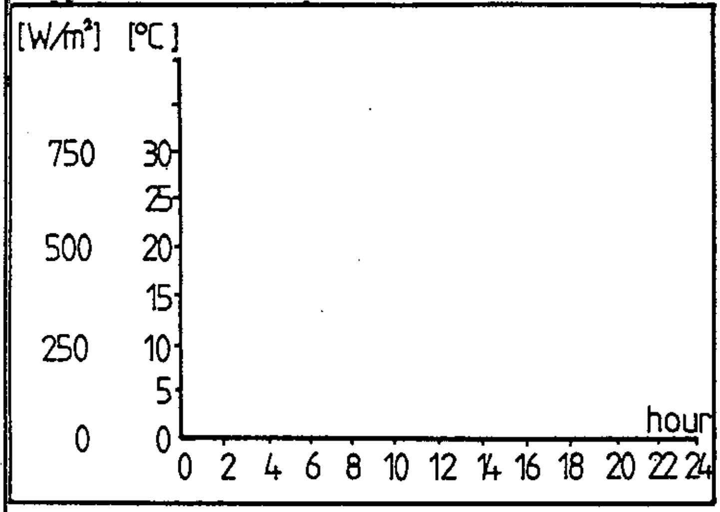


SECTION

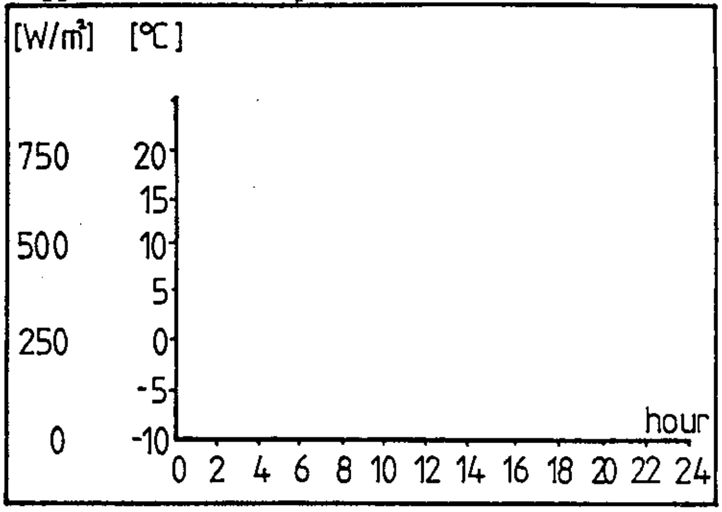


This two-story slab-on-grade house in north-central California has a large attached greenhouse. The greenhouse has both vertical glazing and skylights. There are barrels filled with 385 gallons (1459 L) of water along the north wall of the greenhouse. One-third of this wall is glazed to allow direct solar gain to the living space. Clerestory windows provide direct gain to the second floor and open to allow venting of warm air.

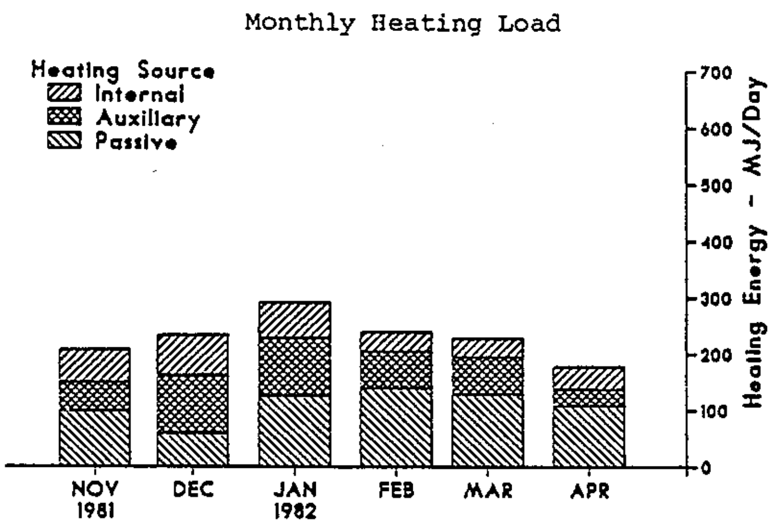
Typical Summer Day



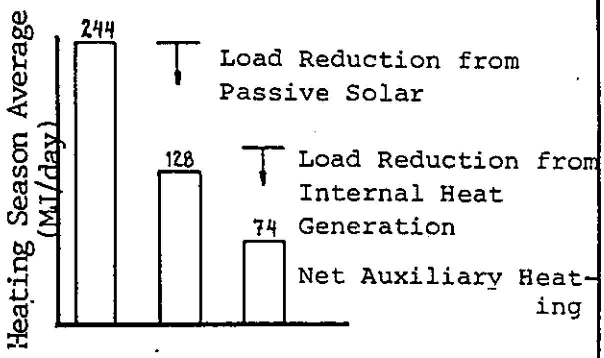
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	48 %
Heating Load Provided by Internal Generation	22 %
Heating Load Provided by Auxiliary Heating	30 %

CONCLUSIONS/FINDINGS

Despite the large glazing areas, the heat loss coefficient was relatively small due to the low infiltration rate of 0.16 air change per hour. The solar components met about half the winter heating load, with decreased performance only during a very cloudy December. The greenhouse was generally not open to the interior living space, resulting in large greenhouse temperature swings. The interior temperature was stable, however, with no tendency to overheat. Wood burning is included in the monthly auxiliary heating figures. It does not appear as auxiliary heating on the hourly data plot, but wood use is obvious from the sudden indoor temperature increases in the evenings.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher & T. Cowing)

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

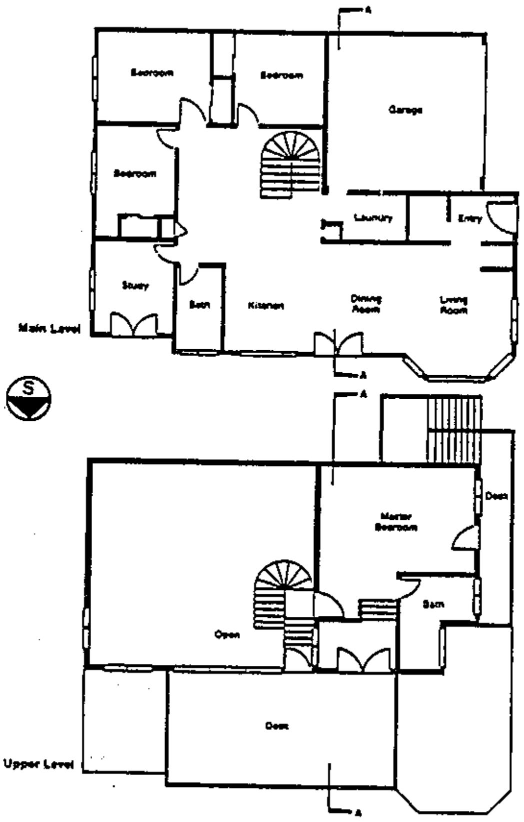
PROJECT TITLE

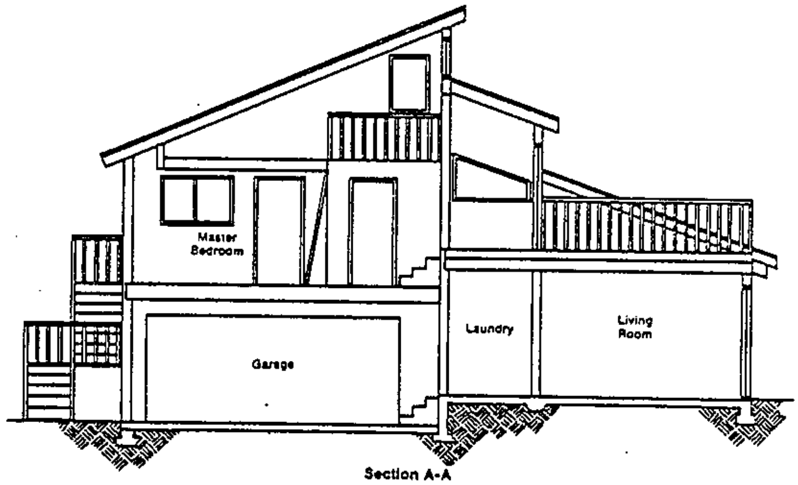
Site WSG

Eureka, California

US/CA-11

BUILDING AND SYSTEM DESCRIPTION



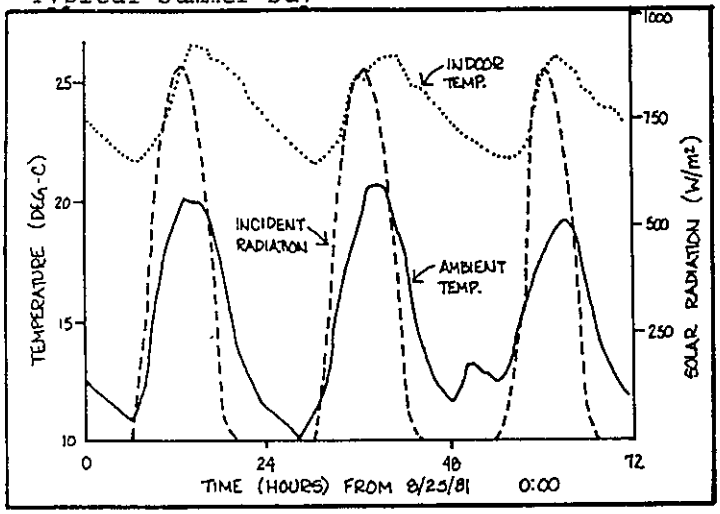


Section A-A

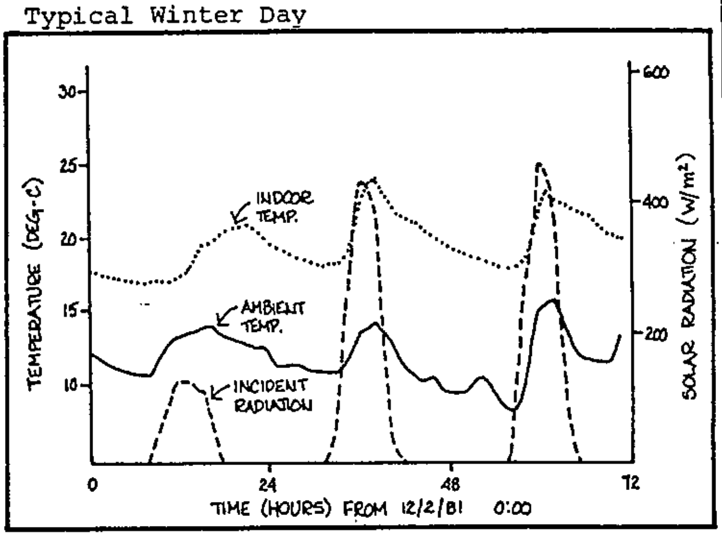

South Elevation

This large two-story frame house is located near the northern California coast. South windows, skylights, and clerestory windows provide 367 ft² (34.1 m²) of direct gain solar aperture. There are also 114 ft² (10.6 m²) of east-facing windows. A rock bed located beneath the west rooms can be charged by warm air that is drawn from near the clerestory by a thermostatically controlled fan. This system was not in operation during the monitoring period.

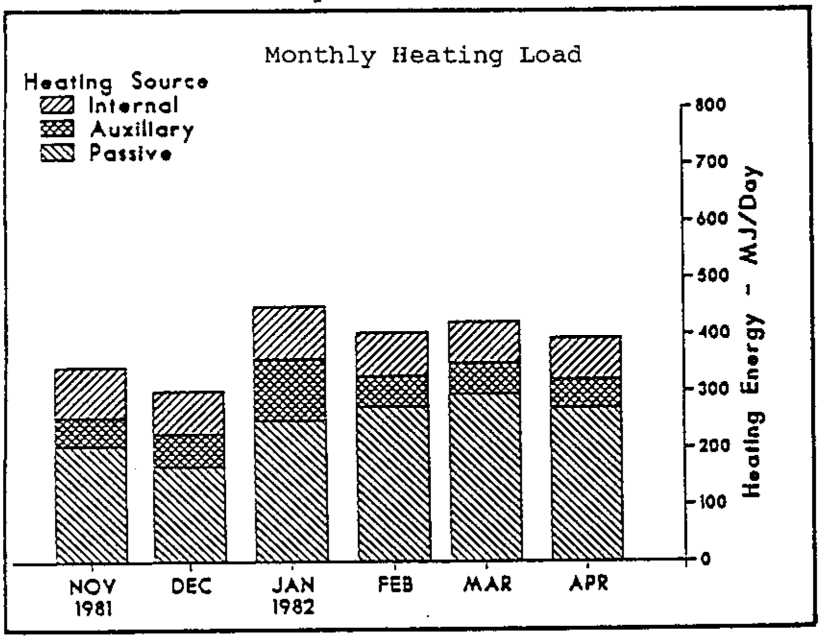
Typical Summer Day



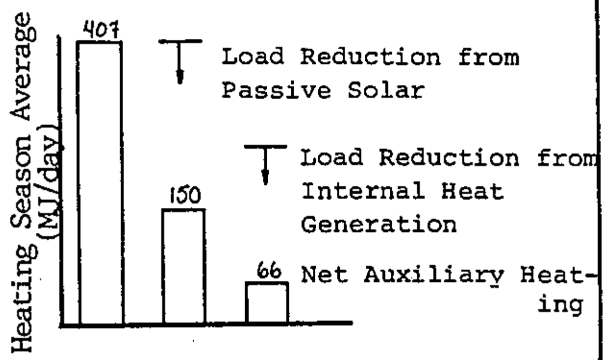
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	63 %
Heating Load Provided by Internal Generation	21 %
Heating Load Provided by Auxiliary Heating	16 %

CONCLUSIONS/FINDINGS

The solar heating contribution was about 60% of the heating load throughout the winter months. In the cool coastal climate, the solar components continue to provide useful heat year-round. There was little overheating. However, the interior temperature swings were large on sunny days, and the temperature dropped below 60° F (16° C) during cloudy winter weather. Wood burning is included in the monthly auxiliary heating figures. It does not appear as auxiliary heating on the hourly data plot, but wood use is obvious from the sudden indoor temperature increases in the evenings.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

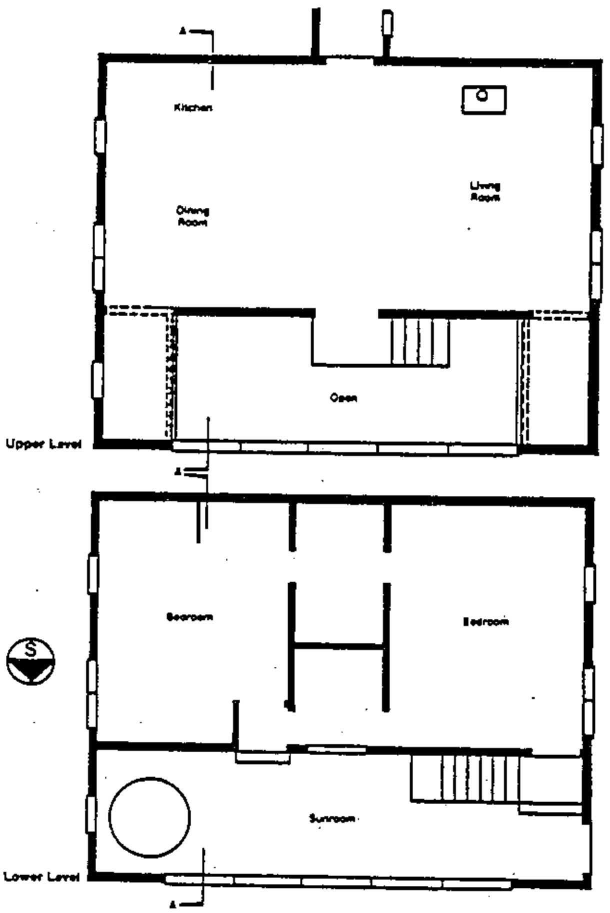
Performance data for systems evaluation

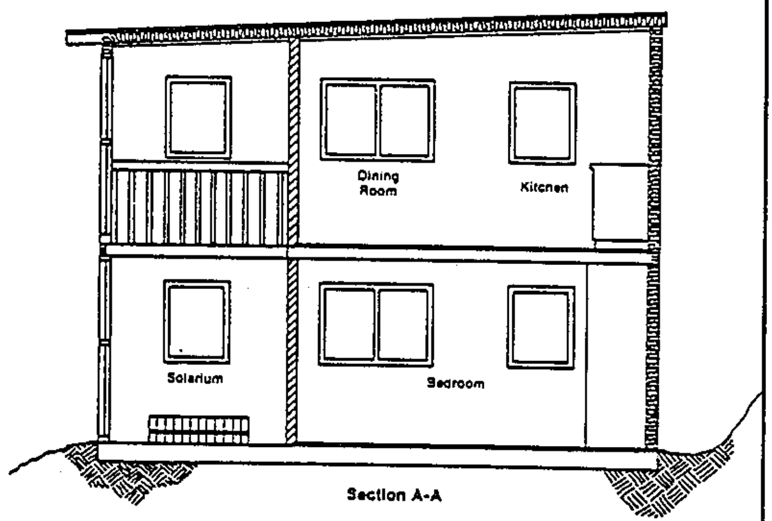
PROJECT TITLE

US/CA - 12

Site WSH
Truckee, California

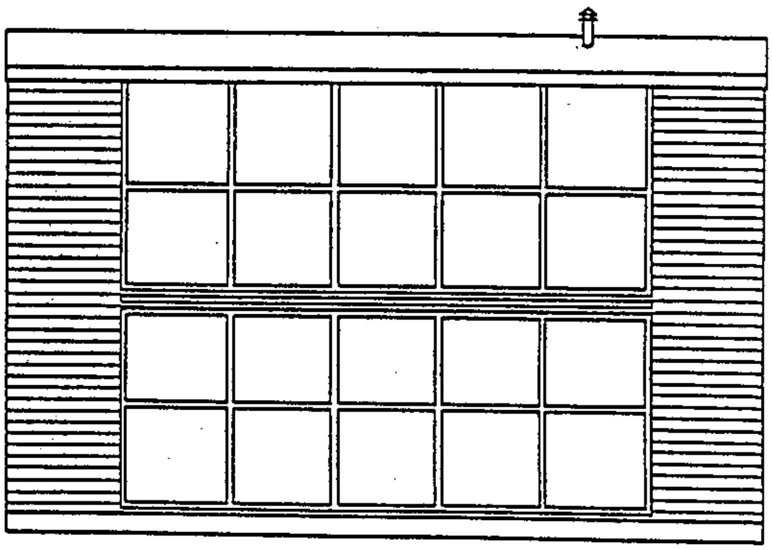
BUILDING AND SYSTEM DESCRIPTION



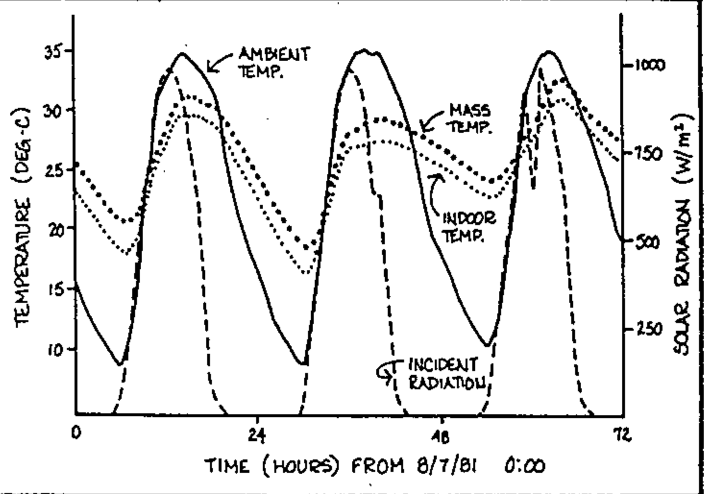


Section A-A

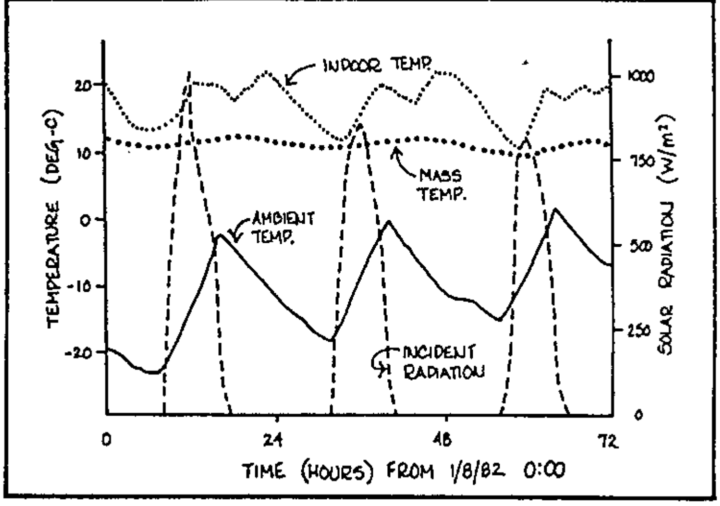
This small house is located in the Sierra Nevada mountains of eastern California. Large direct gain windows charge a two-story solarium which has an exposed slab floor. A 20 cm-thick adobe wall extends from ground level to 1 meter above the second floor level.


South Elevation

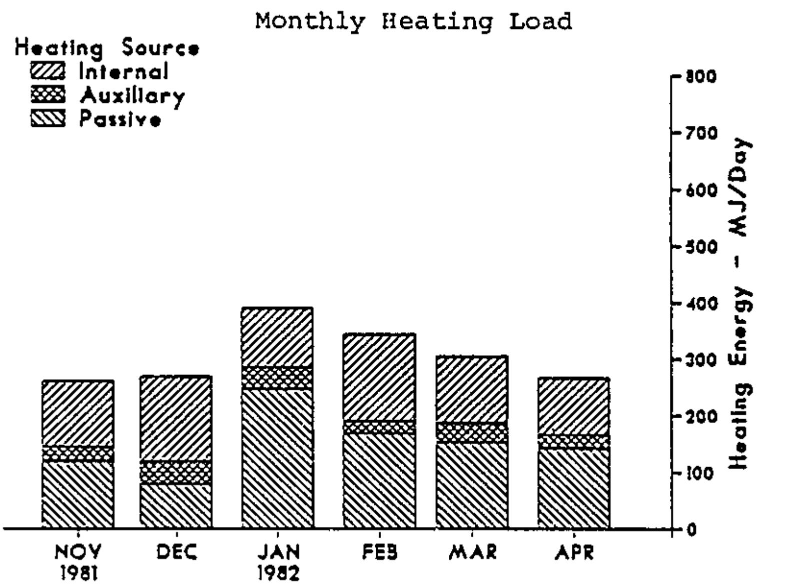
Typical Summer Day



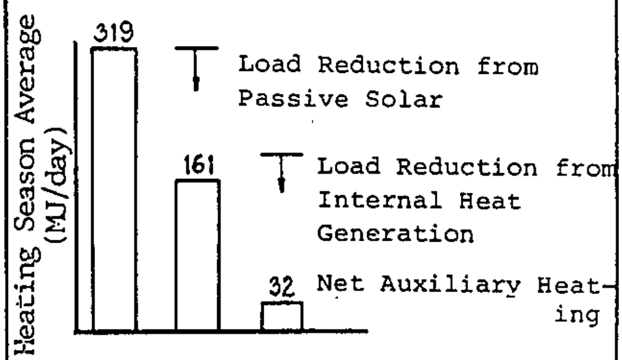
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	50 %
Heating Load Provided by Internal Generation	40 %
Heating Load Provided by Auxiliary Heating	10 %

CONCLUSIONS/FINDINGS

The solar component met about half the winter heating load. Most of the remaining energy requirement was met by internal heating from a hot tub located in the solarium. The average indoor temperature is low because the occupant kept the bedrooms at 50° F (10° C) or below at night, often opening a bedroom window even in mid-winter. Wood burning is included in the monthly auxiliary heating figures. It does not appear as auxiliary heating on the hourly data plot, but wood use is obvious from the sudden indoor temperature increases in the evenings.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

Performance data for systems evaluation

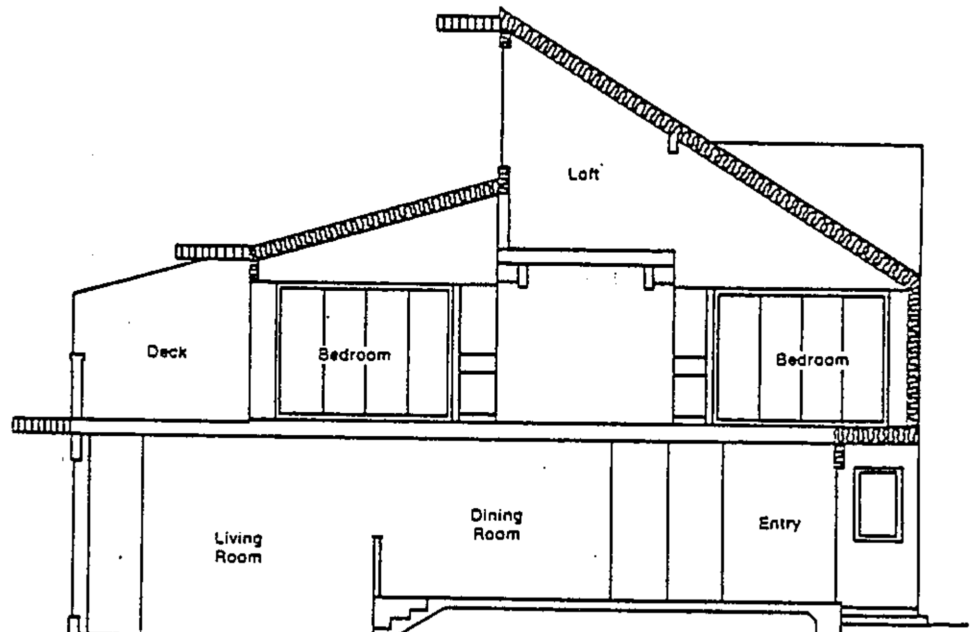
PROJECT TITLE

US/CA-15

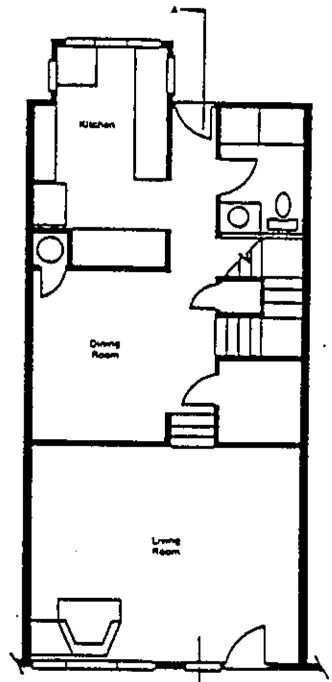
Site WSK

Sacramento, California

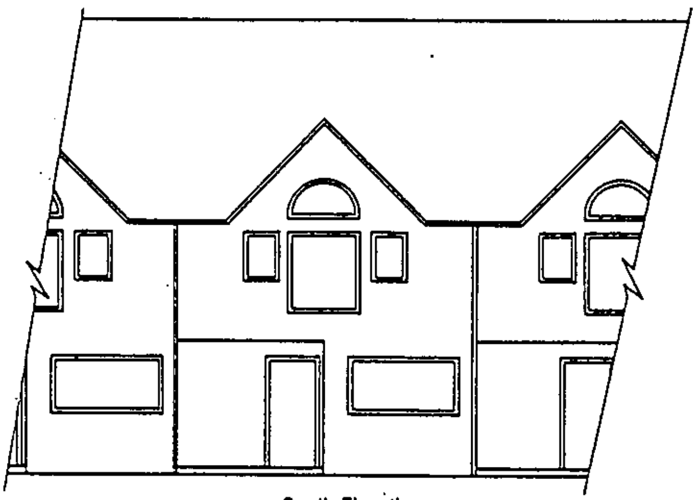
BUILDING AND SYSTEM DESCRIPTION



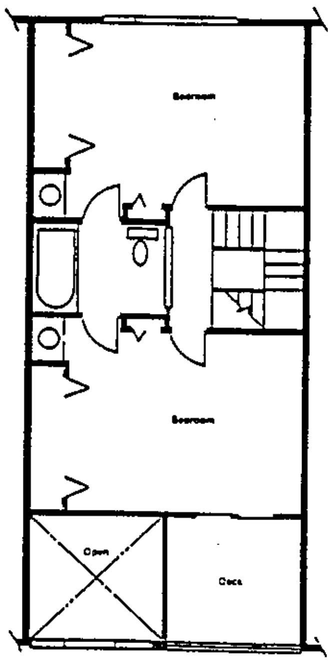
Section A-A



First Floor



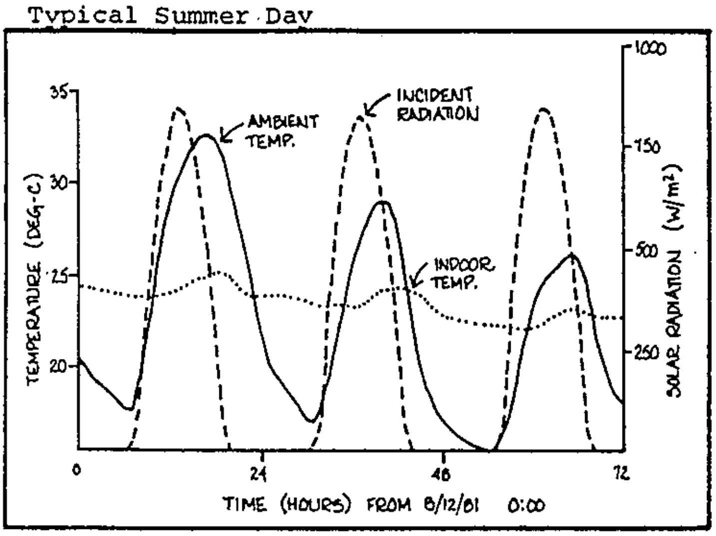
South Elevation



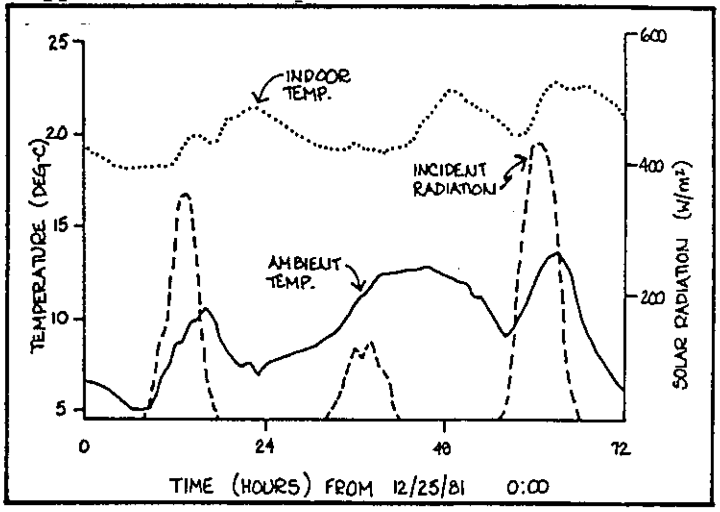
Second Floor

This two-story condominium in downtown Sacramento has common east and west walls. It receives direct solar gain from south windows and a clerestory. The first-floor slab is partly exposed for thermal mass.

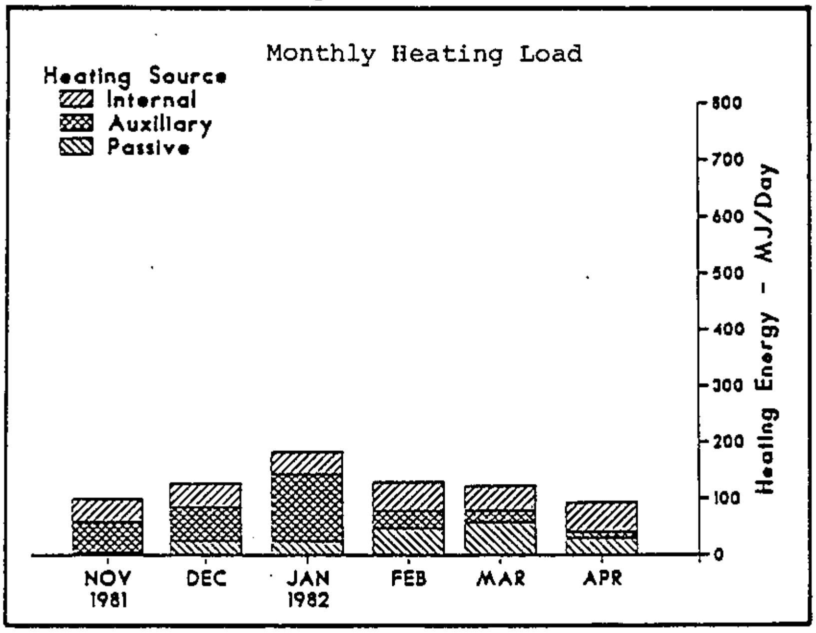
Typical Summer Day



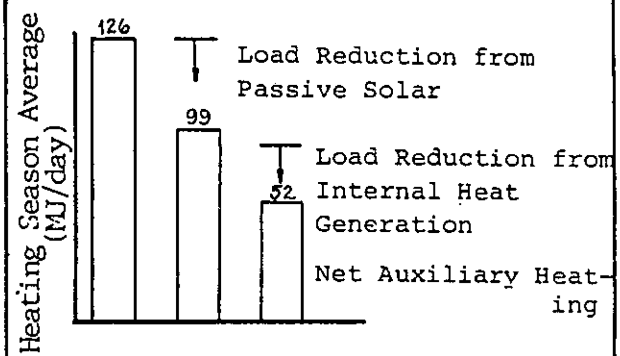
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	25 %
Heating Load Provided by Internal Generation	36 %
Heating Load Provided by Auxiliary Heating	39 %

CONCLUSIONS/FINDINGS

The solar contribution was only 25% of the total heating load due to the shading problem and the cloudy Sacramento winter weather. The relatively low heat loss coefficient helped keep the purchased energy use low. The interior temperature was very stable, staying between 65°F and 70°F (18°-21°C) about 90% of the time.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING - TASK VIII

IEA SOLAR R&D

Passive and Hybrid Solar Low Energy Buildings

Performance data for systems evaluation

PROJECT TITLE

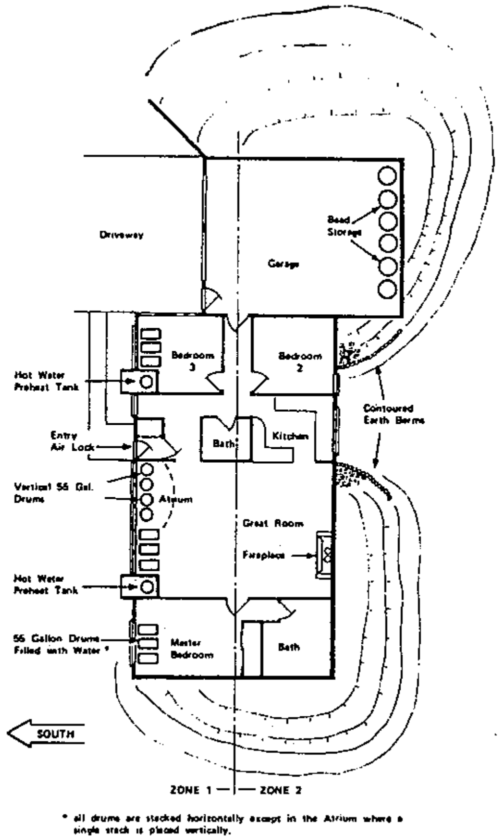
US/CO-01

COLORADO SUNWORKS

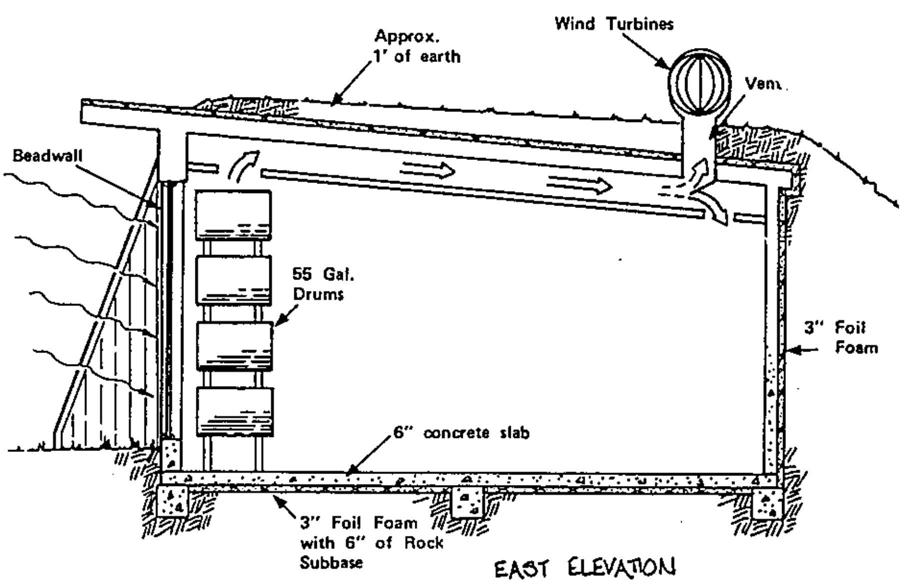
LONGMONT, COLORADO

BUILDING AND SYSTEM DESCRIPTION

This suburban Denver single-story home uses earth-sheltering and direct gain to minimize auxiliary heating needs. The roof and north, east and west walls are covered with earth. Thermal storage is provided by the 10 cm thick floor slab, 20 cm thick externally insulated concrete walls and fifty-two 200-liter water-filled drums located immediately behind the south glazing. Beadwall ® movable insulation reduces night-time heat losses from the 36 square meters of south glazing. Heat distribution is by convection and radiation. A plenum between the roof and the ceilings of the rooms carries warm air rising off of the water drums to the north side of the house.

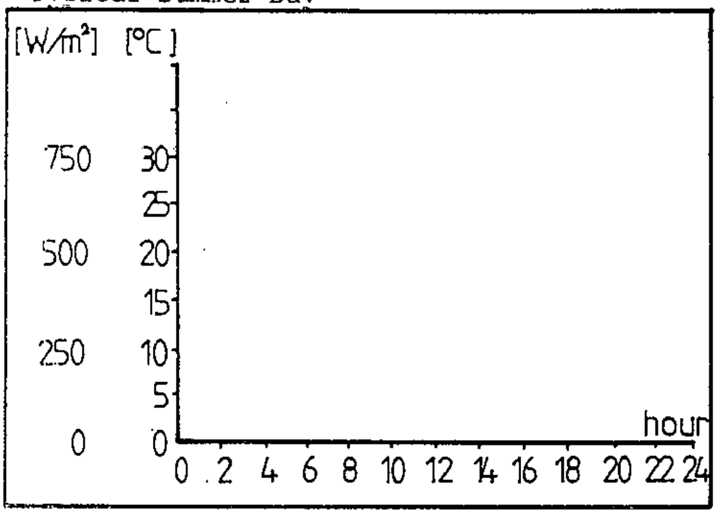


PLAN VIEW

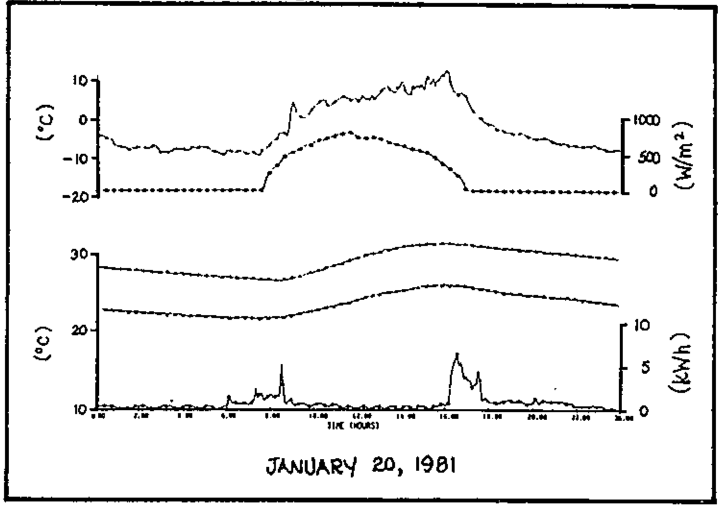


EAST ELEVATION

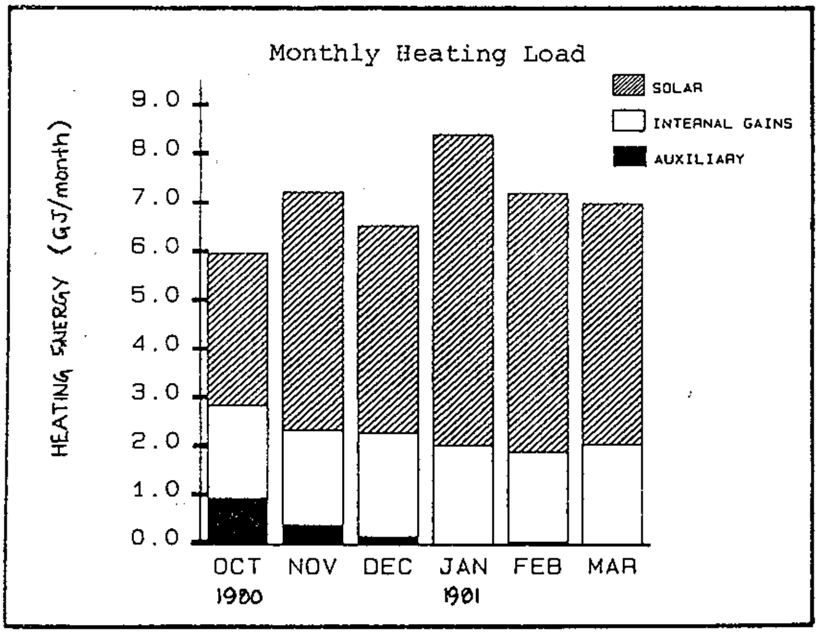
Typical Summer Day



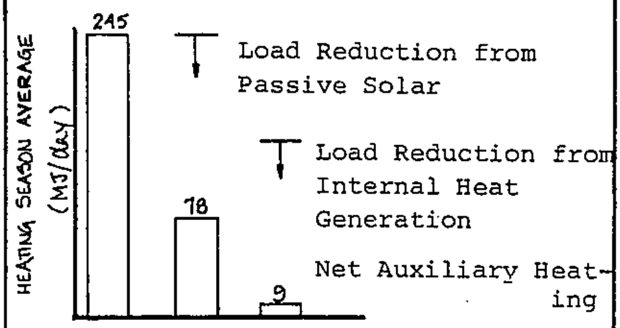
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	68 %
Heating Load Provided by Internal Generation	28 %
Heating Load Provided by Auxiliary Heating	4 %

CONCLUSIONS/FINDINGS

Solar energy supplied 30.45 GJ of the 44.65 GJ building heating load for a solar fraction of 68%. These savings were realized at an expense of 243 kwh of electricity to operate the Beadwall ®. Auxiliary energy was supplied by the fireplace. Temperatures in the building averaged 23°C during this time. The maximum temperature observed during the heating season was 30°C and the minimum was 15 °C. Interestingly, the overheating occurred in mid-November as the result of the use of the fireplace.

Source of Information: Comparative Report: Performance of Passive Solar Space Heating Systems (by Vitro Labs for NSDN)

IEA
SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

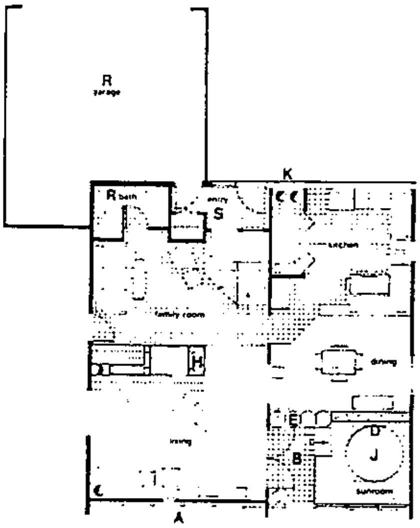
Performance data for systems evaluation

PROJECT TITLE

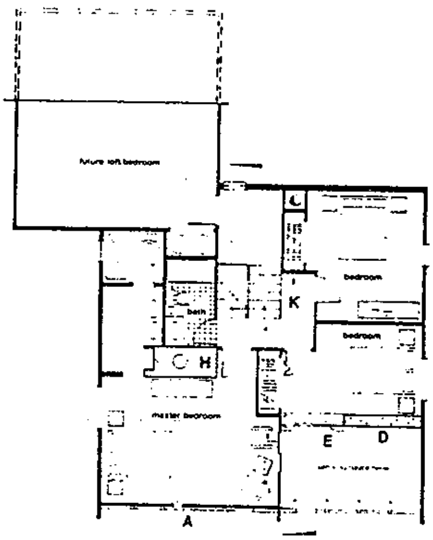
Denver Metro Site DMA
Boulder, Colorado

US/CO-02

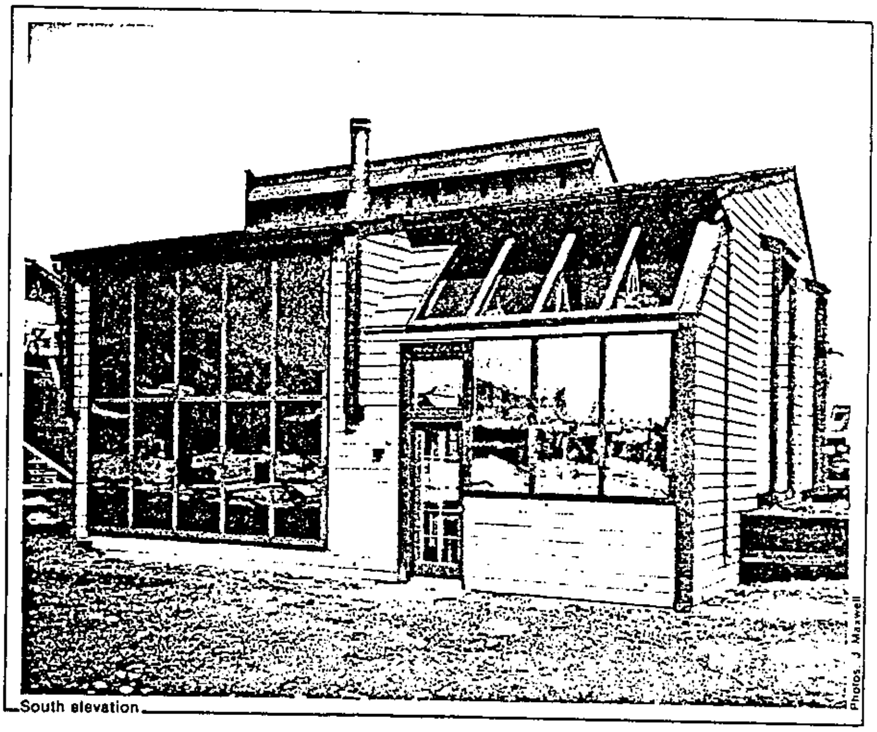
BUILDING AND SYSTEM DESCRIPTION



Main Floor Plan



Upper Floor Plan



South elevation

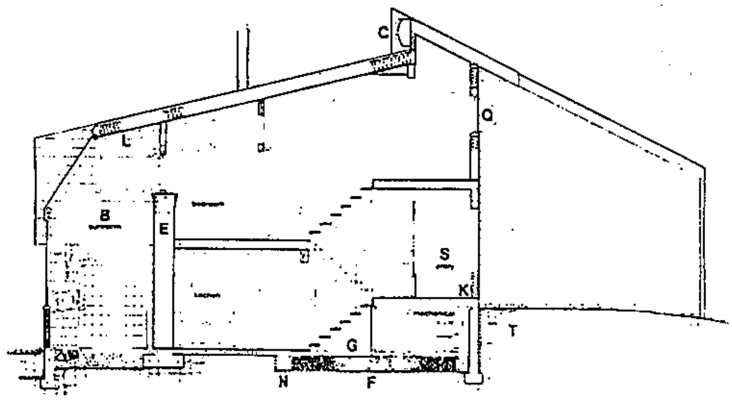
Solar collection:
- A Site-built vertical wall collector (216 ft²)
- B Greenhouse
- C Active domestic hot water system

Thermal storage:
- D Concrete mass wall (poured in place)
- E 450-gallon Kalwal tubes
- F Rock storage bed (300 ft³)
- G Slab floor with tile
- H Fireplace wall
- J Hot tub

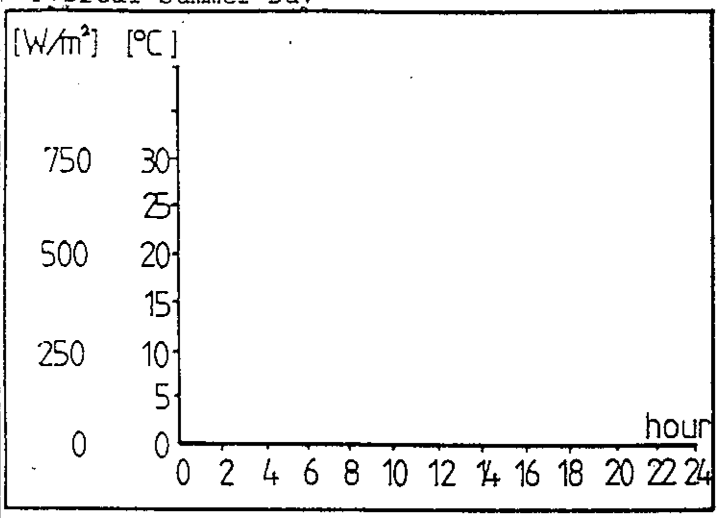
Heat distribution:
- K Warm-air duct from wall collector and greenhouse
- L Fan
- M Air-to-water heat exchanger
- N Return-air duct
- P Warm air to north rooms, motorized damper
- Q Summer cool-air inlet

Auxiliary heat: Electric baseboards; fireplace

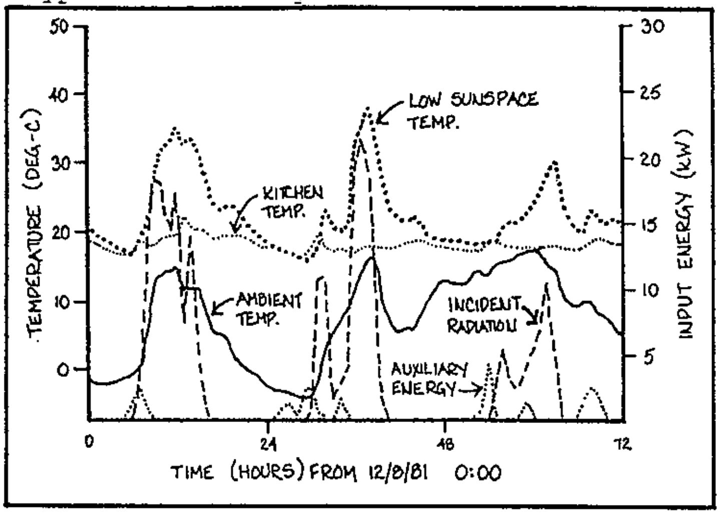
Thermal buffers:
- R Garage, bathrooms
- S Air-lock entryway
- T Earth berm



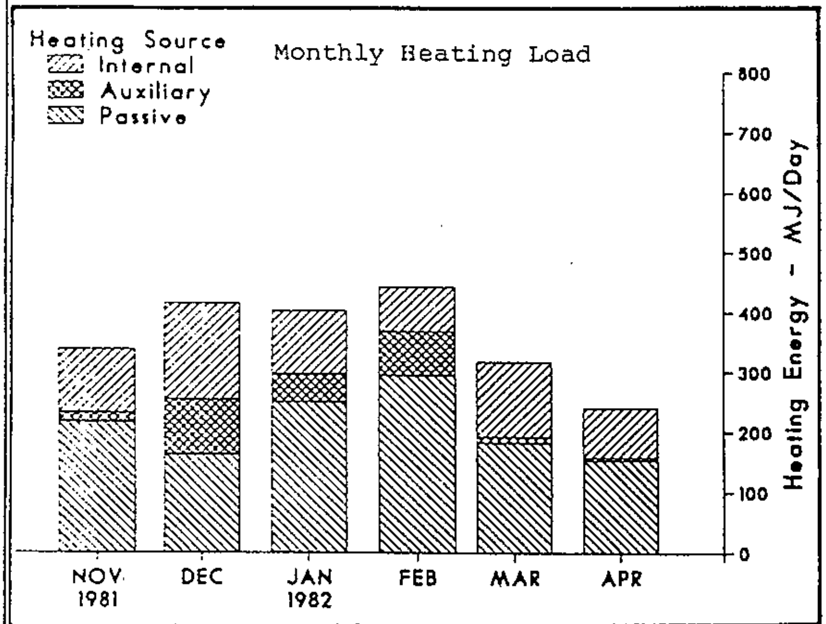
Typical Summer Day



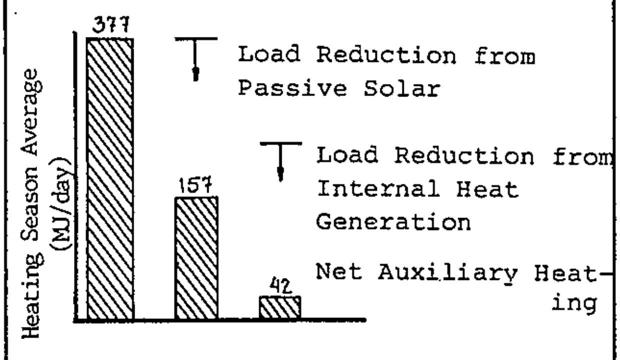
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	58 %
Heating Load Provided by Internal Generation	30 %
Heating Load Provided by Auxiliary Heating	11 %

CONCLUSIONS/FINDINGS

This is a two-story building with a relatively large solar aperture area (15% that of the floor area) divided between an attached sunspace and a site-built, south-wall air heater. The air heater charges a 300-ft³ (8.5-m³) rock bin located under the northern half of the house. The sunspace has both vertical and sloped glazing and a tile floor. It is separated from the living area by a concrete wall and four 450-gal (1700-L) water-filled tubes. The sunspace also contains a hot tub, providing additional mass and, because it's used frequently, a significant internal heating source.

The solar components were effective, contributing about 60% of the heating load during the winter. This high passive heating ratio was partly because of relatively low indoor temperatures, averaging 65°F (18°C). Individually controlled electric room heaters allowed the occupants to heat a small area of the building, resulting in low overall building temperatures and efficient use of solar and electric energy.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

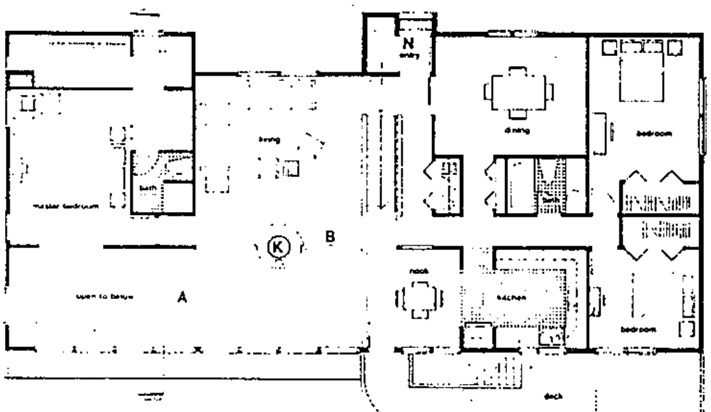
Performance data for systems evaluation

PROJECT TITLE

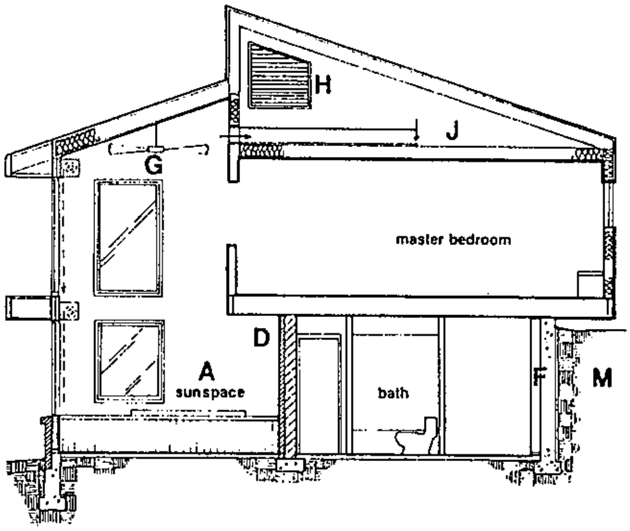
US/CO-04

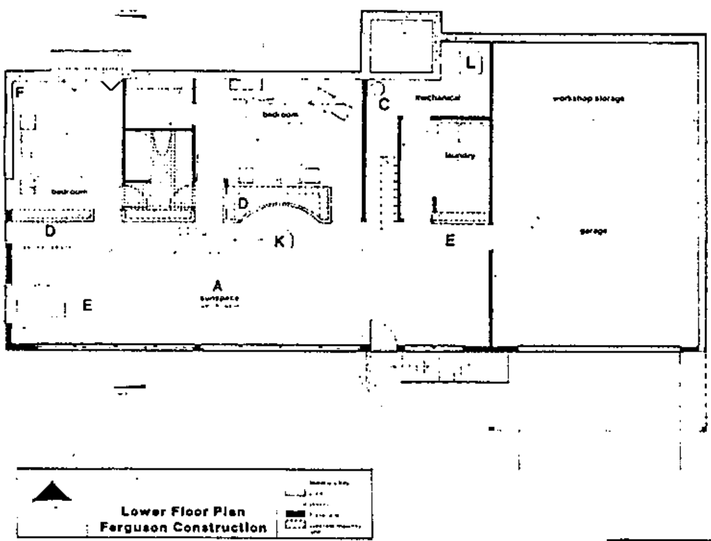
Denver Metro Site DMD
Golden, Colorado

BUILDING AND SYSTEM DESCRIPTION



Upper Floor Plan





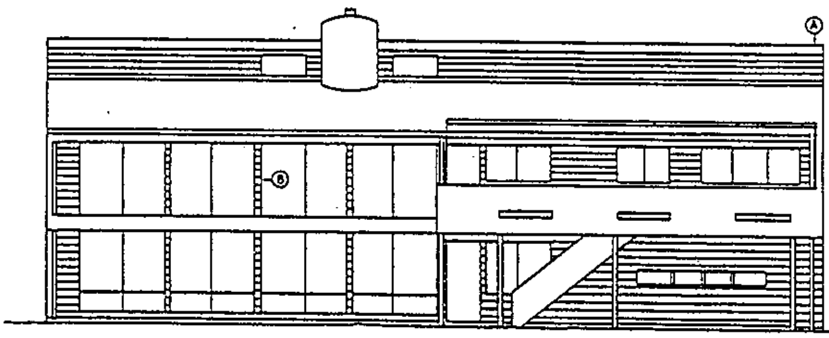
Lower Floor Plan
Ferguson Construction

Solar collection:
- A Solarium (Total south-glazing area: 365 ft²)
- B Clerestory (provides limited direct-gain to living room)
- C Active solar domestic hot-water system

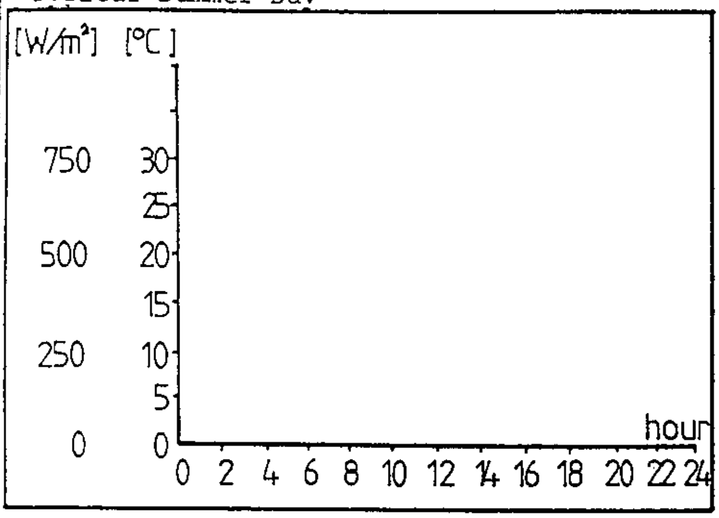
Thermal storage:
- D Mass wall (brick veneer on concrete)
- E Slab floor with tile surface
- F Concrete foundation walls

Heat distribution:
- G Paddle fans
- H Louvered power-exhaust vent
- J Furnace return-air duct from solarium

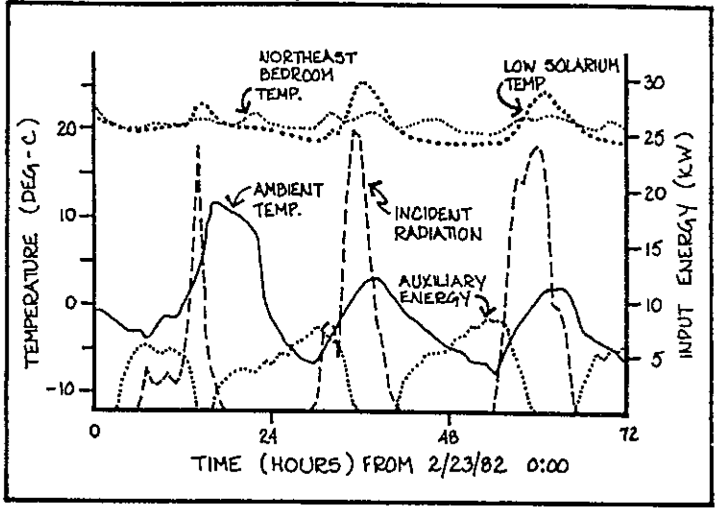
Auxiliary heat:
- K Woodstoves (2)
- L Gas forced-air furnace
- M Partial earth berm
- N Air-lock entryway


South Elevation

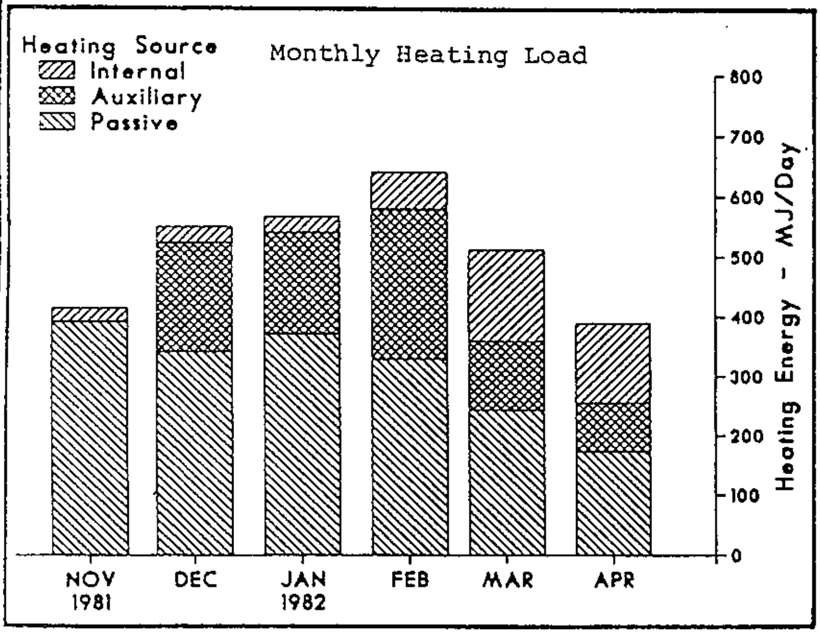
Typical Summer Day



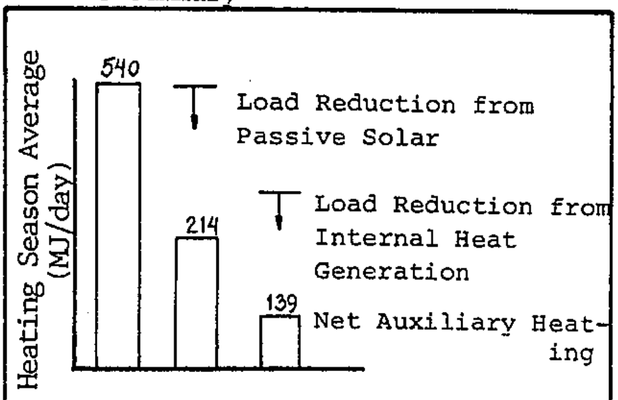
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	61 %
Heating Load Provided by Internal Generation	13 %
Heating Load Provided by Auxiliary Heating	26 %

CONCLUSIONS/FINDINGS

This is a large, two-story house with the north side bermed so that the lower level is below grade. A large direct-gain component charges a two-story solarium, which is open to most interior rooms. The solarium has a tile floor and is backed by an 8-in. (20-cm)-thick concrete wall with brick veneer. Two small ceiling fans in the solarium also help distribute warm air. The south windows are fitted with manually operated insulating shutters; however, the shutters are usually left open.

The building's heat loss coefficient, though relatively high, is low for such a large building. The solar component provided nearly 60% of the winter heating load before the building was occupied, and about 50% thereafter [when the indoor temperature was kept 4°F (2°C) higher]. The excellent interior air circulation heated the building very evenly on sunny days and prevented overheating in the solarium.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

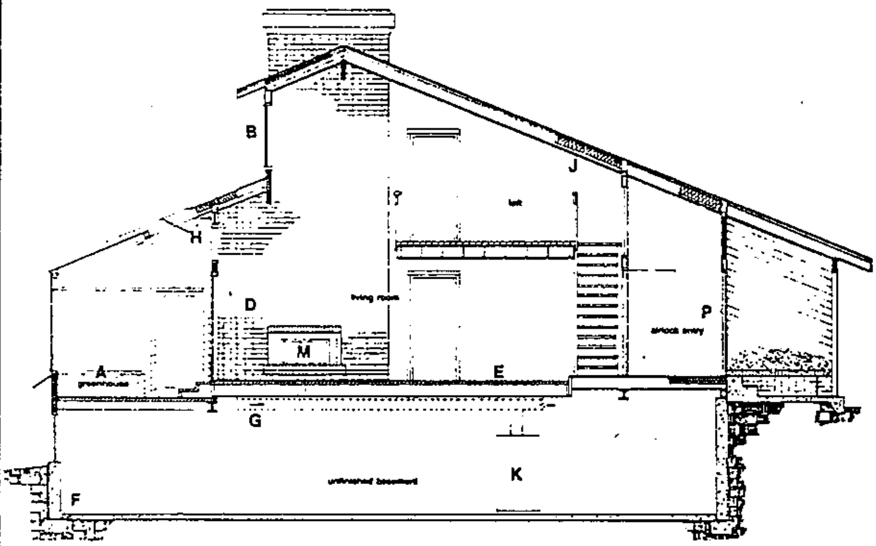
Performance data for systems evaluation

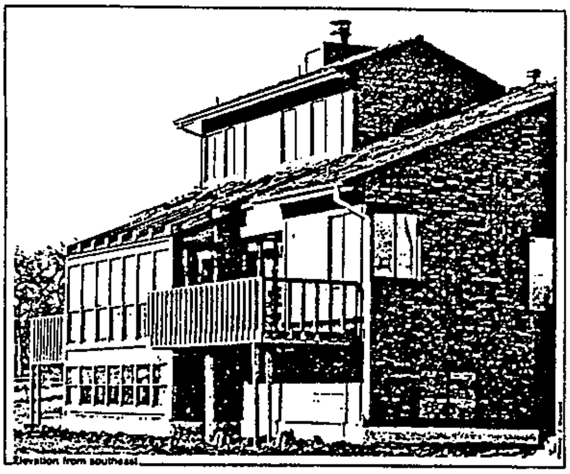
PROJECT TITLE

SITE DME
ARVADA, COLORADO

US/CO-05

BUILDING AND SYSTEM DESCRIPTION




Elevation from southeast

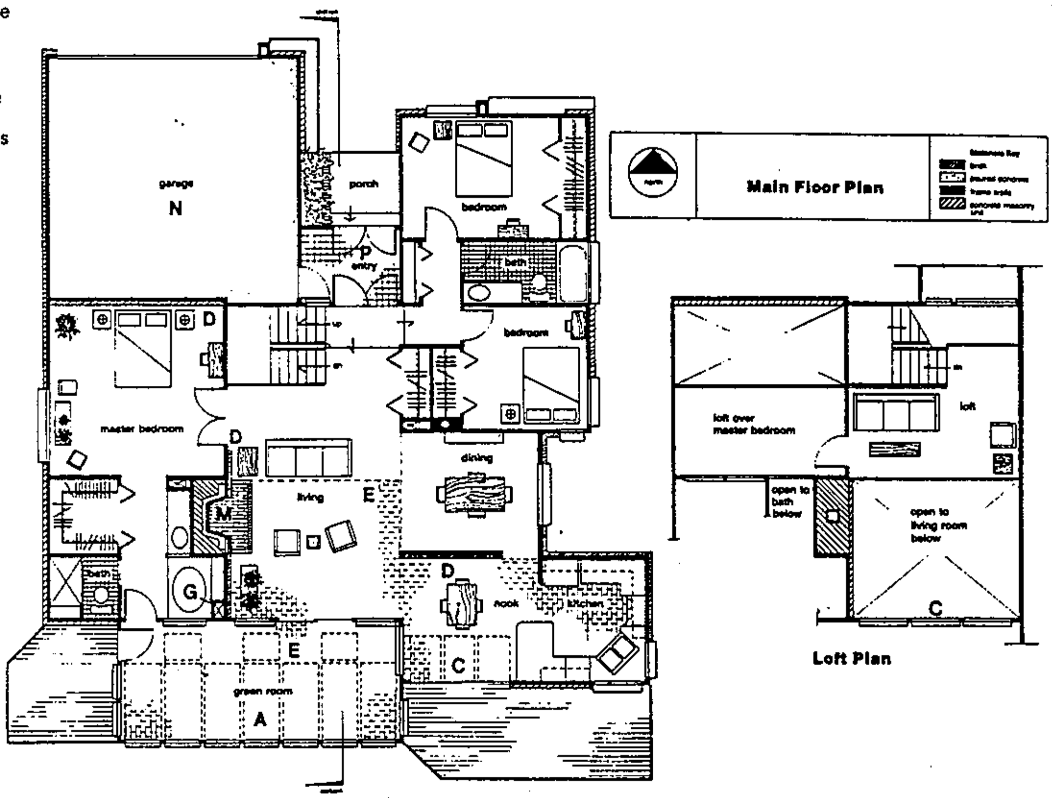
Solar collection:
- **A** Attached greenhouse-style sunspace
- **B** Clerestory glazing
- **C** Additional south-facing glass

Thermal storage:
- **D** Mass walls — brick veneer on frame
- **E** Brick paved flooring
- **F** Basement slab and 9" concrete walls

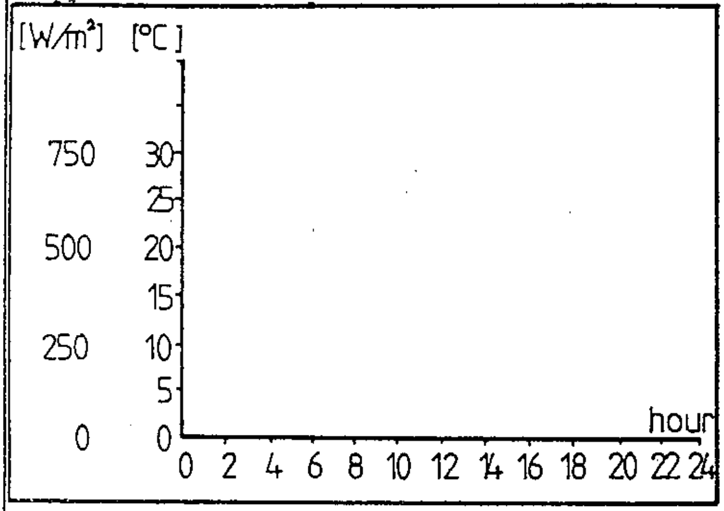
Heat distribution:
- **G** Warm-air duct from sunspace to bedrooms and basement mass
- **H** Thermostatically controlled fan
- **J** Powered destratification units (circulate heat from loft, ceilings)

Auxiliary heat:
- **K** Gas forced-air furnace
- **M** Brickalator fireplace

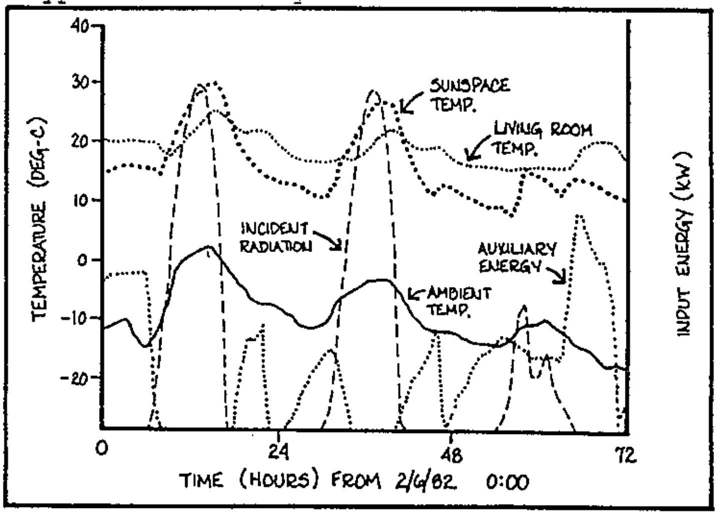
Thermal buffers:
- **N** North-zoned garage, bedrooms
- **P** Air-lock entryway



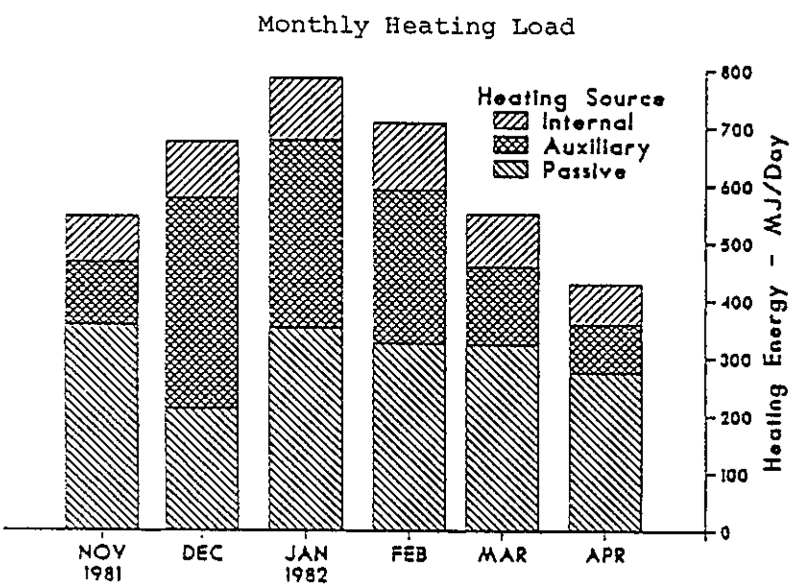
Typical Summer Day



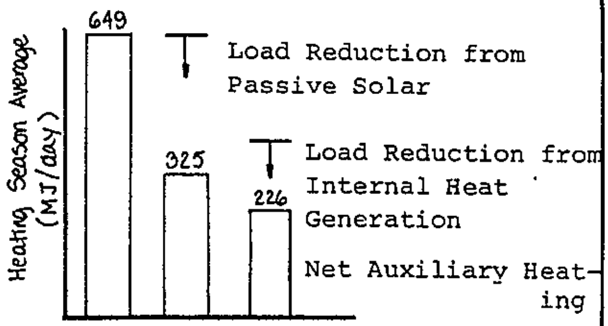
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	50 %
Heating Load Provided by Internal Generation	15 %
Heating Load Provided by Auxiliary Heating	35 %

CONCLUSIONS/FINDINGS

This house is a large two-story design with an attached sunspace and a basement. Most of the main level is an open great room that receives direct gain through the sunspace, from skylights, and from additional south windows. The great room is also open to a loft above. The upper level and the basement also have south windows.

The sunspace has a tile floor and both vertical and sloped glazing. The design includes a thermostatically controlled fan to dump warm sunspace air into the basement. Apparently this fan was not used, however, since the sunspace performance depended on the presence of the homeowners. During the week, the house was usually empty, with the sunspace doors left closed (because the sunspace was quite cold in the morning). On sunny winter days, the sunspace temperature exceeded 90° F (32° C); but with the doors closed, the interior remained cool and the backup furnace was needed in the early evening. On weekends, the homeowners were usually home and opened the sunspace doors on sunny days. This resulted in a cooler sunspace, a warmer interior, and less furnace use in the evening.

The building's heat loss coefficient was extremely large, due to infiltration. It was not possible to pressurize the building adequately for an infiltration test. The builders were informed of this and have had better results with their more recent buildings based on this design. The solar component performed well, meeting about half of the large heating load. Tighter construction and better control of heat distribution could increase this percentage considerably.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher & T. Cowing)

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

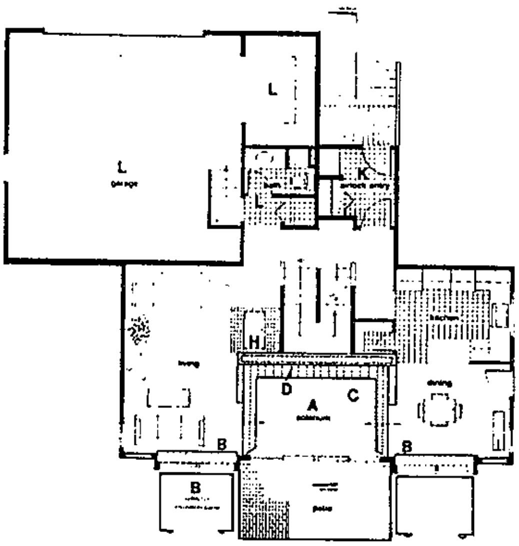
Performance data for systems evaluation

PROJECT TITLE

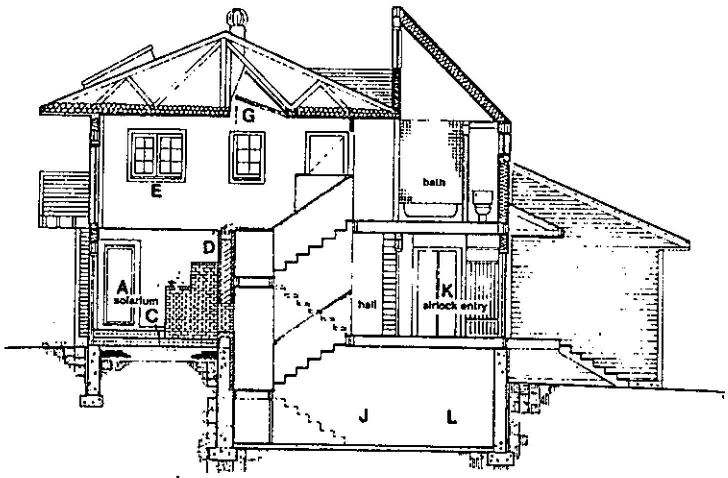
US/CO-07

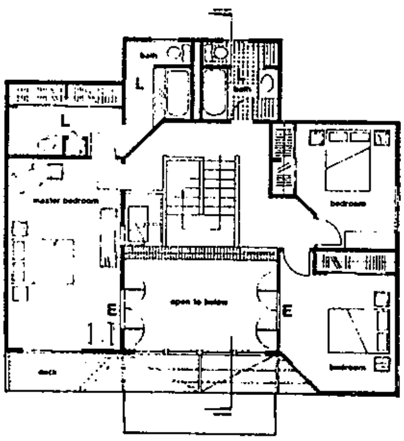
Denver Metro   Site DMG
Northglenn, Colorado

BUILDING AND SYSTEM DESCRIPTION



Main Floor Plan





Second Floor Plan

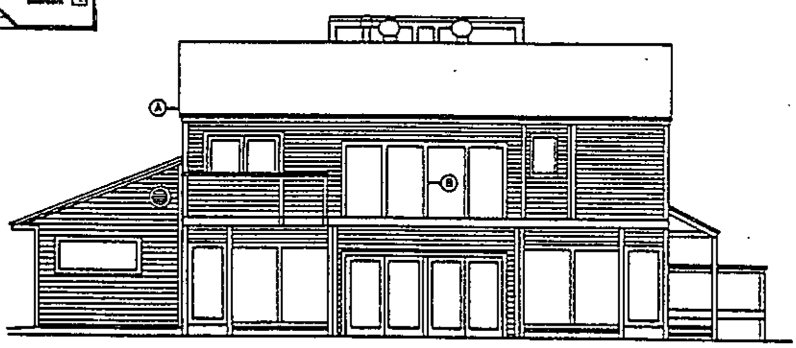
Solar collection:
- A Sun space (total direct-gain glazing area: 210 ft²)
- B Trombe walls with insulating/reflective panels (glazing area: 97 ft²)

Thermal storage:
- C Ceramic tile on 4-inch concrete slab floor
- D Mass wall — brick veneer on solid-grouted concrete masonry units (165 ft²)

Heat distribution:
- E Interior windows between bedrooms and sun space
- F Destratification ductwork tied to return-air plenum for furnace
- G Ceiling vent to rooftop ventilators

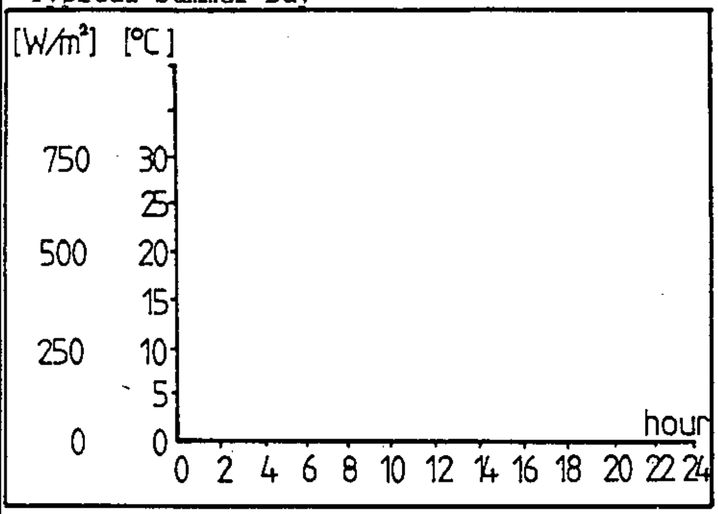
Auxiliary heat:
- H Woodstove
- J Gas forced-air furnace

Thermal buffers:
- K Air-lock vestibule
- L North-zoned garage, storage area, bathroom

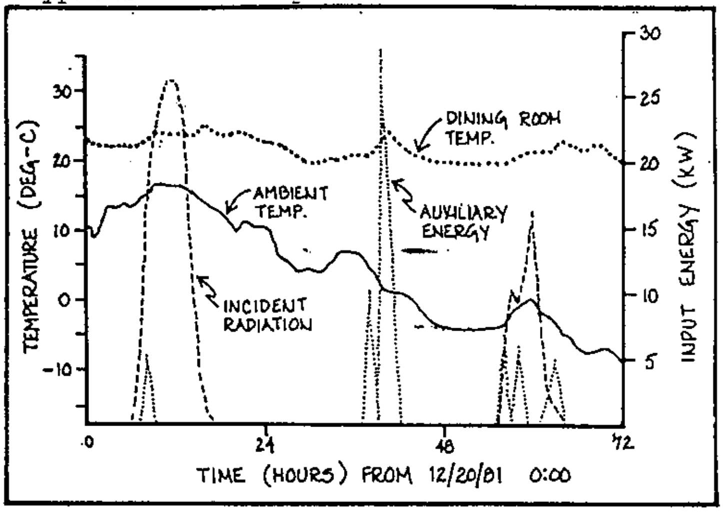


South Elevation

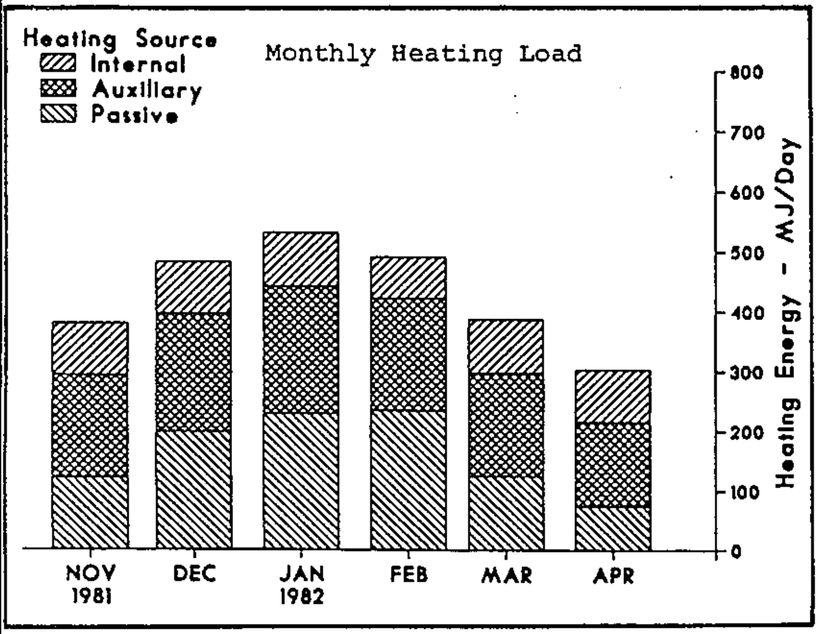
Typical Summer Day



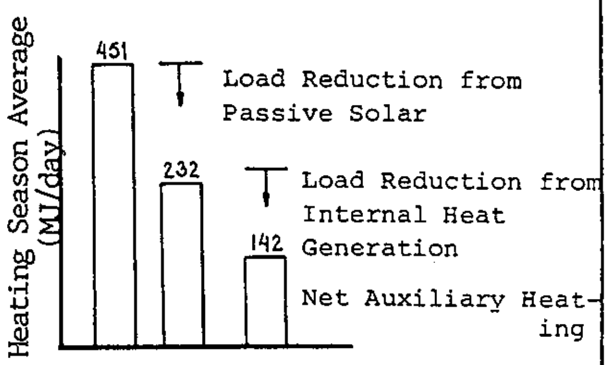
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	49 %
Heating Load Provided by Internal Generation	19 %
Heating Load Provided by Auxiliary Heating	32 %

CONCLUSIONS/FINDINGS

This house is a large two-story design with a basement. One-third of the solar glazing is backed by a brick-veneered concrete wall with hinged exterior insulating panels (which were rarely used). The remaining glazing charges a two-story solarium, which is open to the interior living space. The solarium has a tile floor and is backed by a brick-veneered wall.

The solar component supplied about 50% of the winter heating load. This figure would probably have been higher had the insulating panels been used regularly. Also, the interior temperature was kept high, averaging 71°F (23°C) throughout the heating season.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing) 209

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

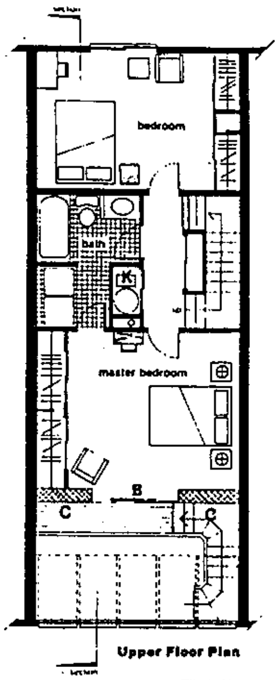
Performance data for systems evaluation

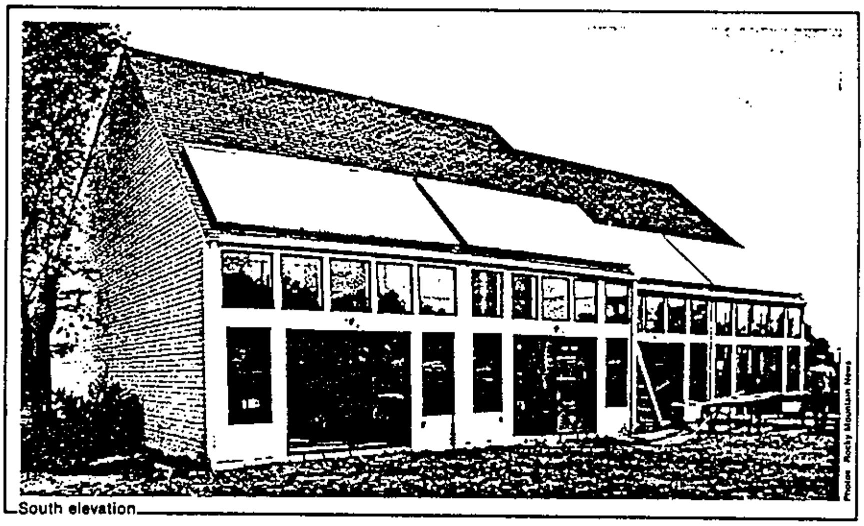
PROJECT TITLE

Denver Metro   Site DMH
Denver, Colorado

US/CO-08

BUILDING AND SYSTEM DESCRIPTION





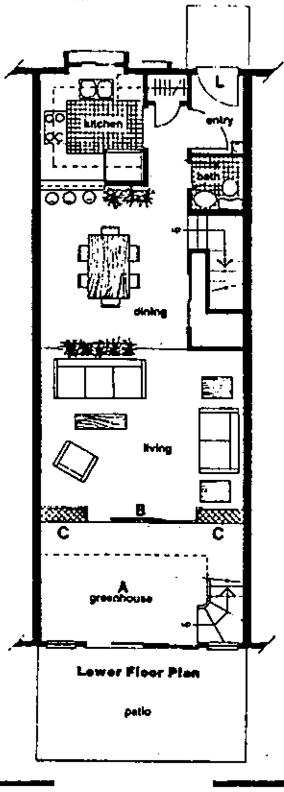
Solar apertures:
- A Attached greenhouse
- B Sliding glass doors

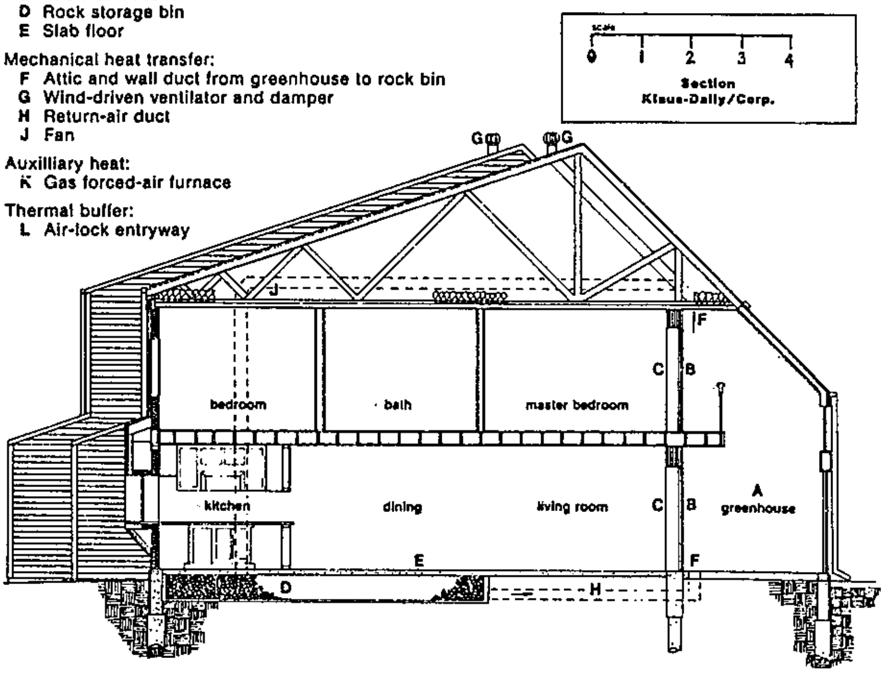
Storage:
- C Thermal mass wall
- D Rock storage bin
- E Slab floor

Mechanical heat transfer:
- F Attic and wall duct from greenhouse to rock bin
- G Wind-driven ventilator and damper
- H Return-air duct
- J Fan

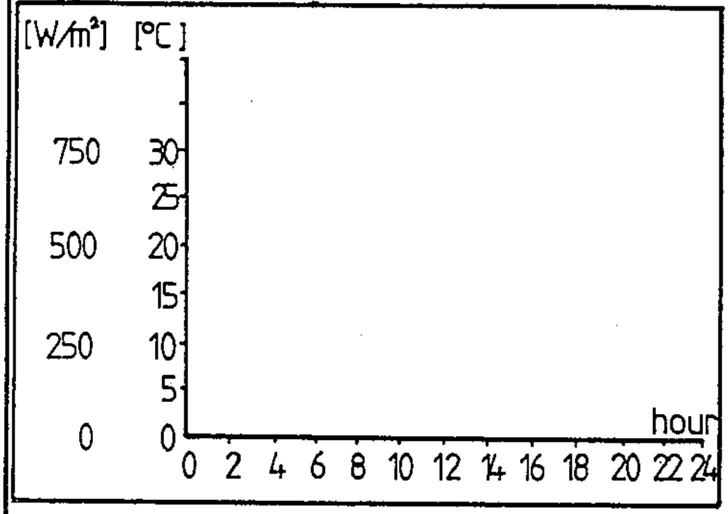
Auxiliary heat:
- K Gas forced-air furnace

Thermal buffer:
- L Air-lock entryway

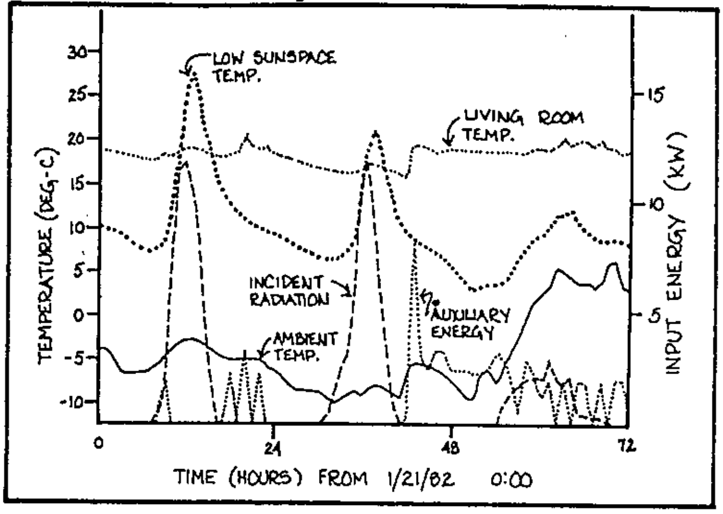




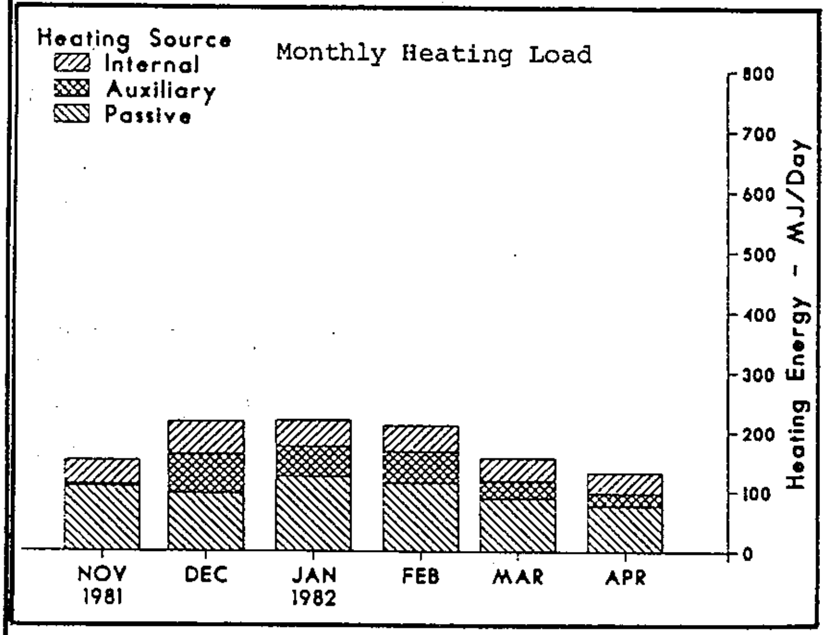
Typical Summer Day



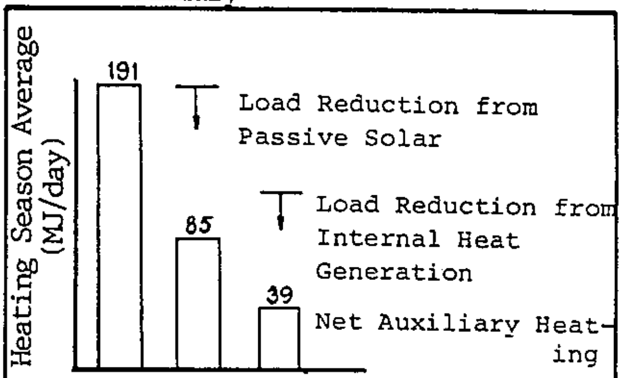
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	56 %
Heating Load Provided by Internal Generation	23 %
Heating Load Provided by Auxiliary Heating	20 %

CONCLUSIONS/FINDINGS

This is a townhouse unit with common east and west walls. A two-story attached sunspace, with both vertical and sloped glazing, forms the south end of the unit. The sunspace is separated from the main living space by a brick wall, which has sliding glass doors to both levels, allowing some direct solar gain. A thermostatically controlled fan draws warm air from the sunspace to charge a rock bin under the north rooms.

With little exposed surface area, the building's heat loss coefficient is quite low, such that internal heat generation supplied more than 20% of the heating load through the winter. The sunspace also performed well, contributing more than 50% of the load each month. Despite large sunspace temperature variations, the interior temperature never exceeded 75°F (24°C) throughout the winter, showing no tendency to overheat.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

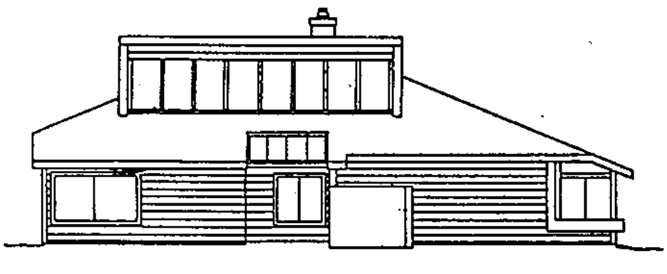
Performance data for systems evaluation

PROJECT TITLE

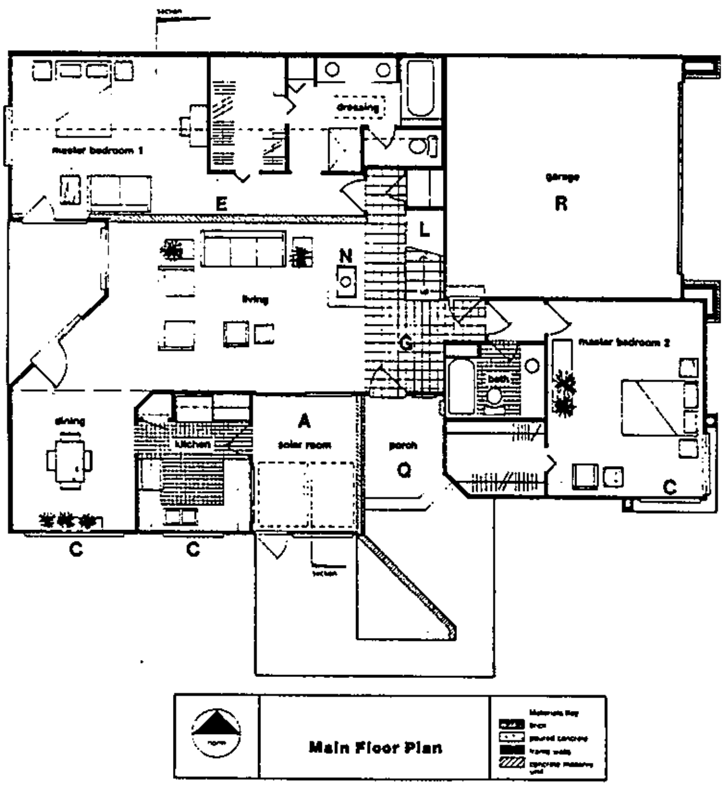
SITE DMI
DENVER, COLORADO

US/CO-09

BUILDING AND SYSTEM DESCRIPTION



South Elevation



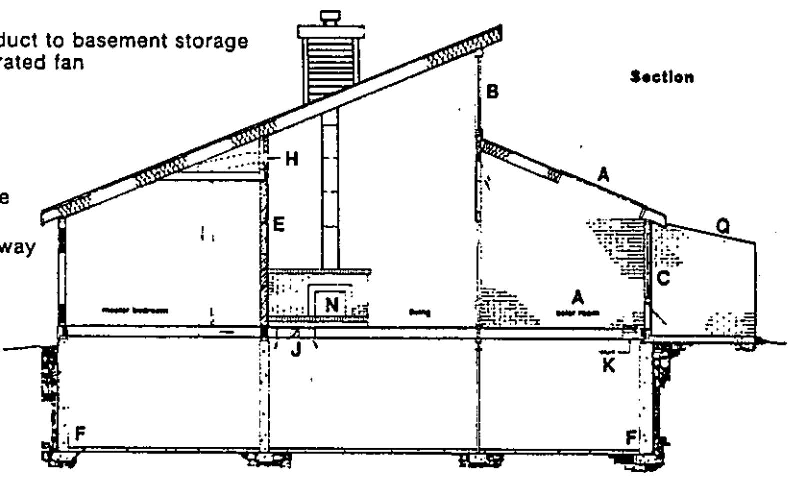
Solar collection:
- A Solar room and skylight
- B Clerestory
- C Other south-facing glass (Total south glazing area: 265 ft²)
- D Solar domestic hot-water system

Thermal storage:
- E 8-inch brick mass wall
- F Basement concrete walls and slab
- G Tiled concrete slab

Heat distribution:
- H Warm-air intake and duct to basement storage
- J Thermostatically-operated fan
- K Return-air duct
- L Open stairwell
- M Roof vents

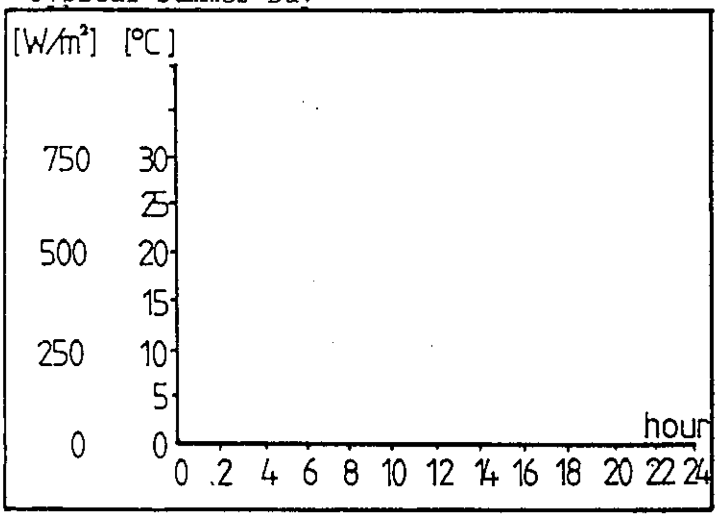
Auxiliary heat:
- N Fireplace
- P Gas forced-air furnace

Thermal buffers:
- Q Wind-protected entryway
- R North-zoned garage

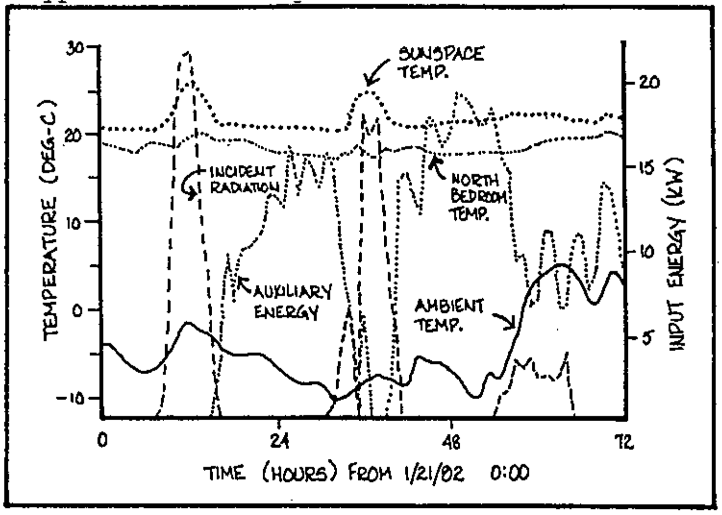


Section

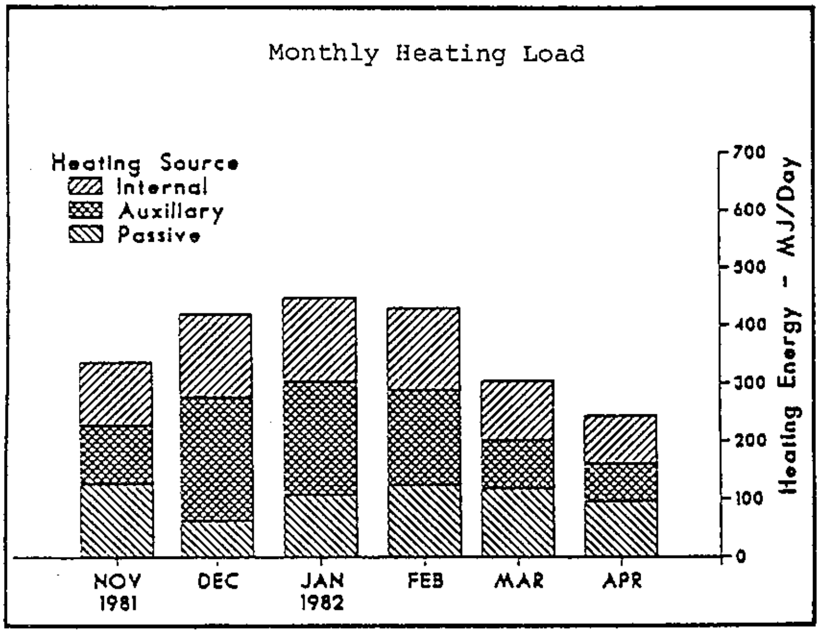
Typical Summer Day



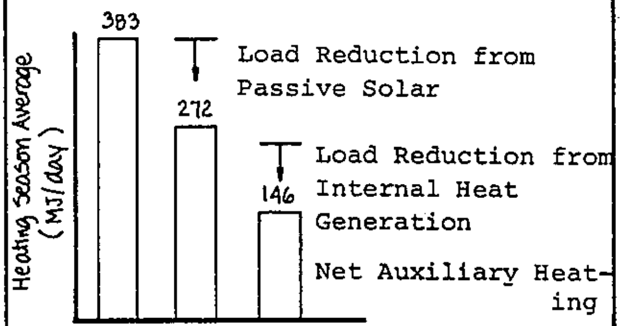
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	29 %
Heating Load Provided by Internal Generation	33 %
Heating Load Provided by Auxiliary Heating	37 %

CONCLUSIONS/FINDINGS

This house receives direct gain from south windows and a clerestory. The central living room has a vaulted ceiling to accommodate the clerestory, which charges an 8-in. (20-cm)-thick brick partition wall. The south glazing includes a small integral sunspace with skylights and a tile floor. Although it is a large house, it is relatively tight, with infiltration at only 0.38 air change per hour under typical winter conditions.

The solar aperture area is only 9% that of the floor area, and, consequently, the passive heating ratio was as low as 15% in December. Because of the efficiency of the building envelope, however, the auxiliary heating energy needs were small for a house of this size. The living room temperature occasionally exceeded 80° F (27° C), due to solar gains from the sunspace and the clerestory.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

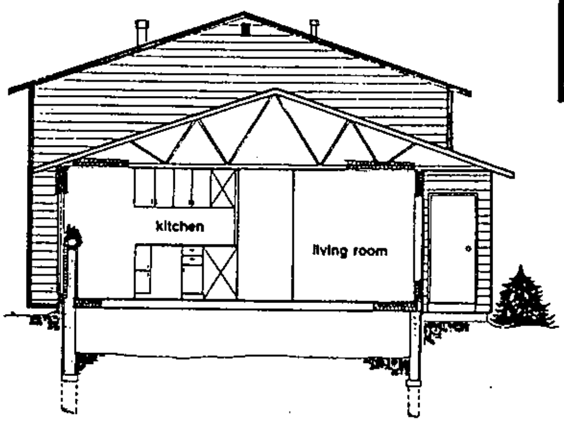
PROJECT TITLE

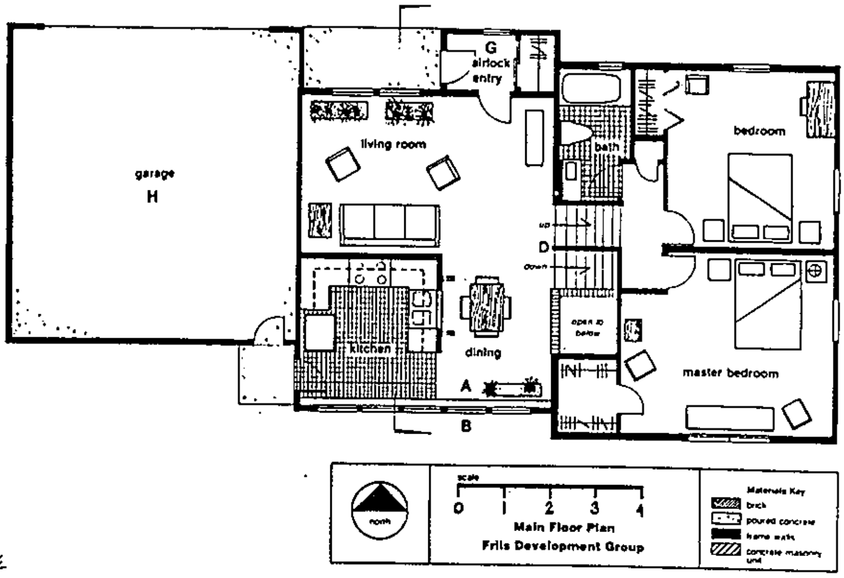
Denver Metro   Site DMJ

Aurora, Colorado

US/CO-10

BUILDING AND SYSTEM DESCRIPTION



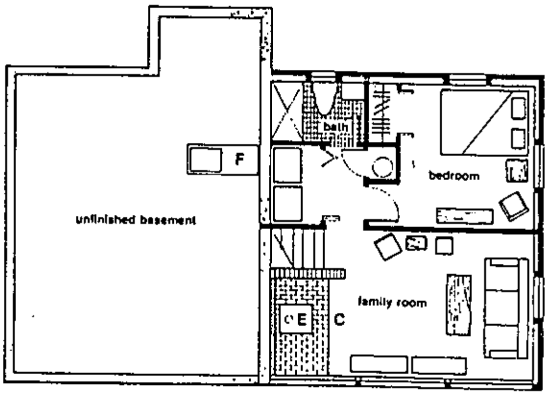


Solar collection and thermal storage:
- A Partial Trombe thermal storage wall
- B Additional direct-gain glazing
- C Brick mass wall and pavers surrounding woodstove and fluepipe

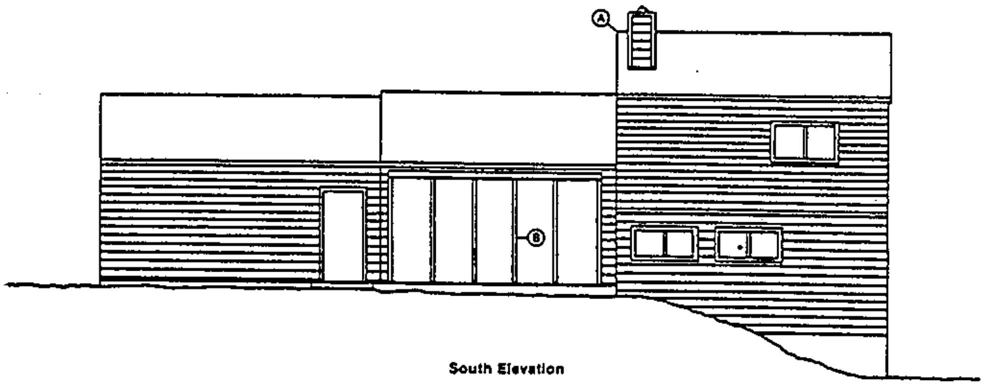
Heat distribution:
- D Stairwell

Auxiliary heat:
- E Woodstove
- F Gas forced-air furnance

Thermal buffers:
- G Air-lock entryway
- H Garage

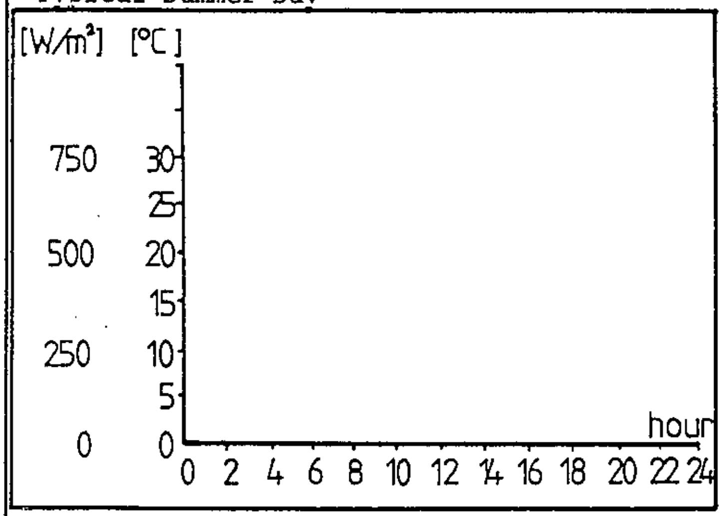


Lower Floor Plan

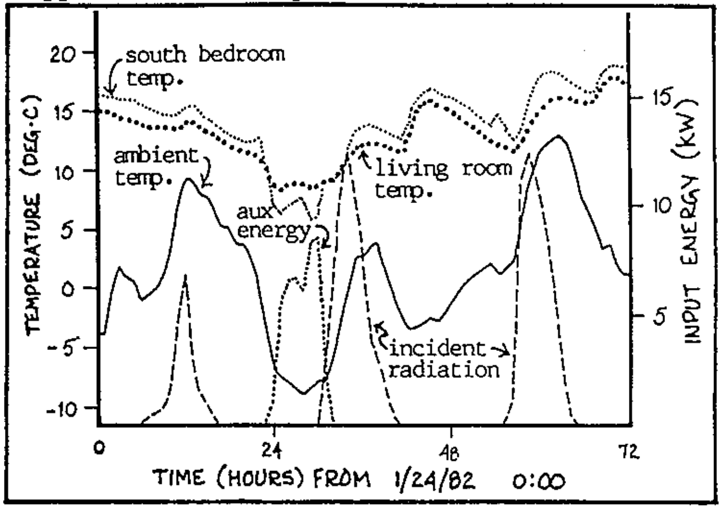


South Elevation

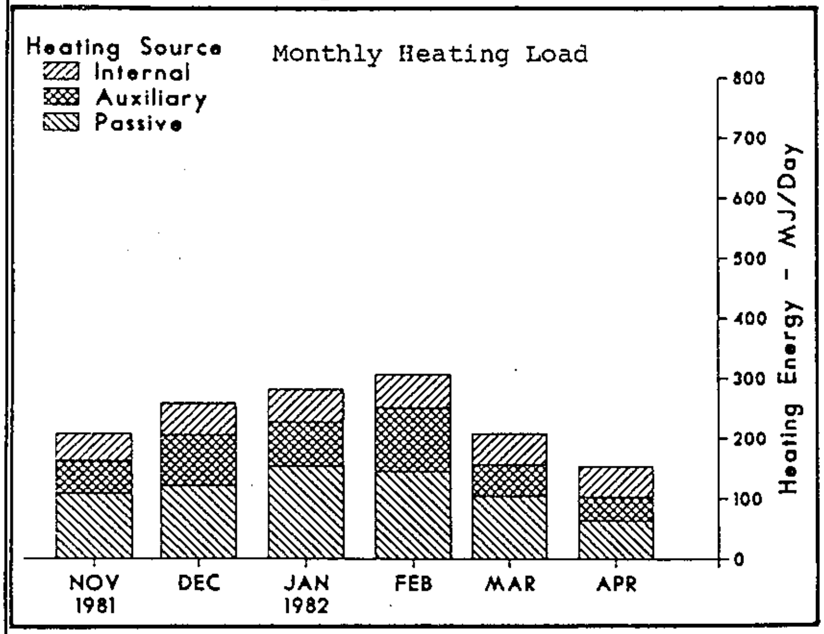
Typical Summer Day



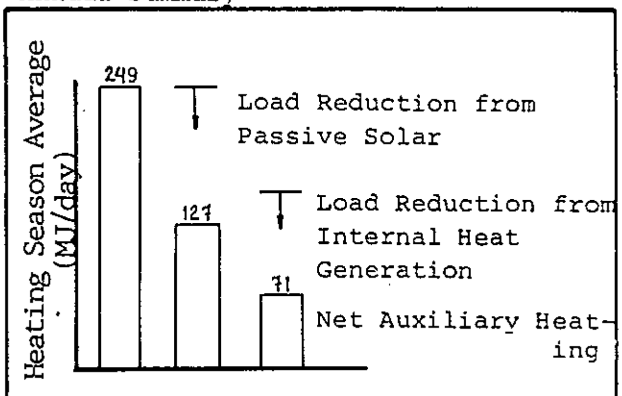
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	50 %
Heating Load Provided by Internal Generation	21 %
Heating Load Provided by Auxiliary Heating	29 %

CONCLUSIONS/FINDINGS

This house is a small split-level design with a partial basement and a crawl space. The south glazing is backed by a 3-ft (1-m)-high brick-veneered concrete wall. The main living area is at grade level, with bedrooms at the half levels above and below.

The auxiliary heating energy is relatively uncertain because the occupants insisted on using their woodstove throughout the heating season. The monthly energy summaries include estimates of wood heat in the auxiliary heating figures. Wood heat is not included in the auxiliary energy plotted on the hourly data graphs, but stove use is obvious from the sudden increases in the indoor temperature at night. The interior temperature was kept relatively cool, averaging 64°F (18°C). This reduced the purchased energy needs and allowed the solar component to meet about half the heating load.

Source of Information: PASSIVE SOLAR PERFORMANCE : SUMMARY OF 1981-82 CLASS B RESULTS (by J. Swisher and T. Cowing)

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

IEA
SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

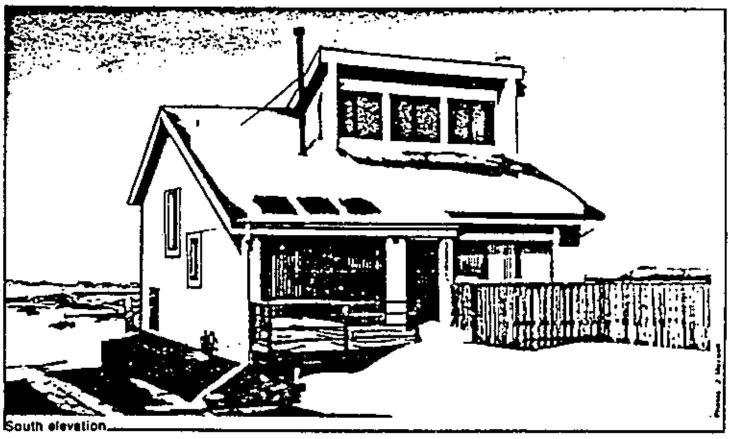
Performance data for systems evaluation

PROJECT TITLE

US/CO-12

SITE DML
AURORA , COLORADO

BUILDING AND SYSTEM DESCRIPTION

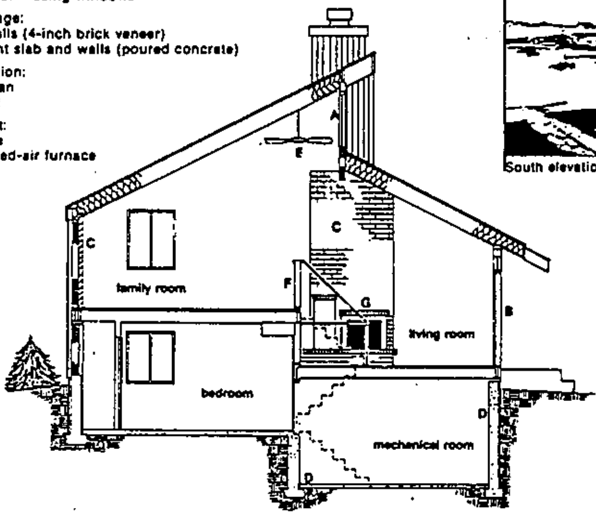


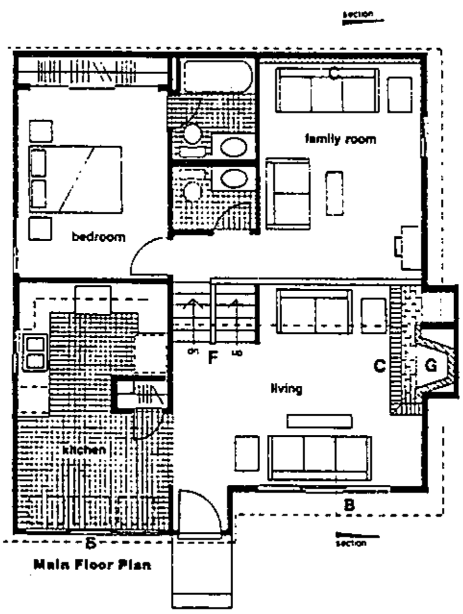
Solar collection:
- A Clerestory
- B Other south-facing windows

Thermal storage:
- C Mass Walls (4-inch brick veneer)
- D Basement slab and walls (poured concrete)

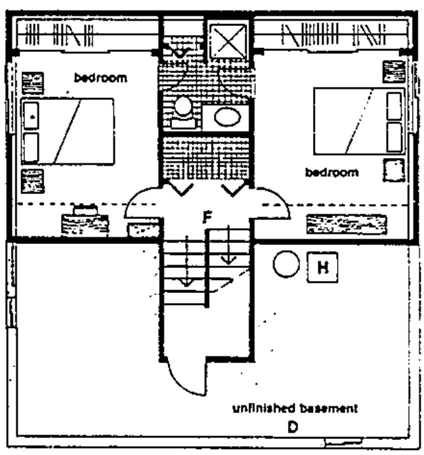
Heat distribution:
- E Paddle fan
- F Stairwell

Auxiliary heat:
- G Fireplace
- H Gas forced-air furnace



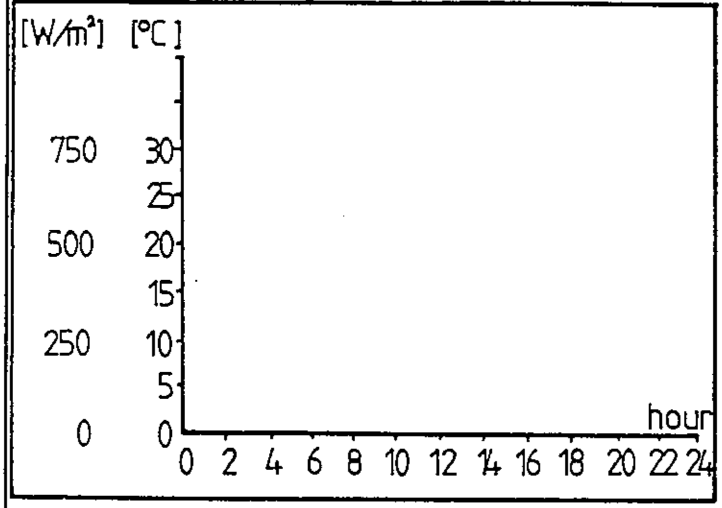


Main Floor Plan

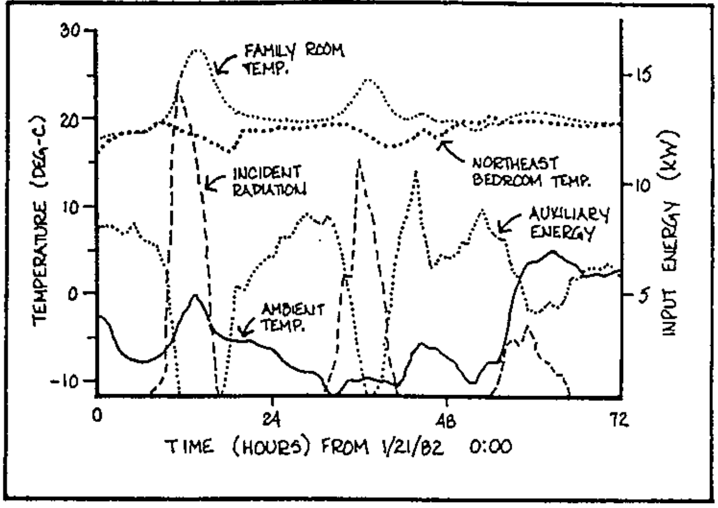


Lower Floor Plan

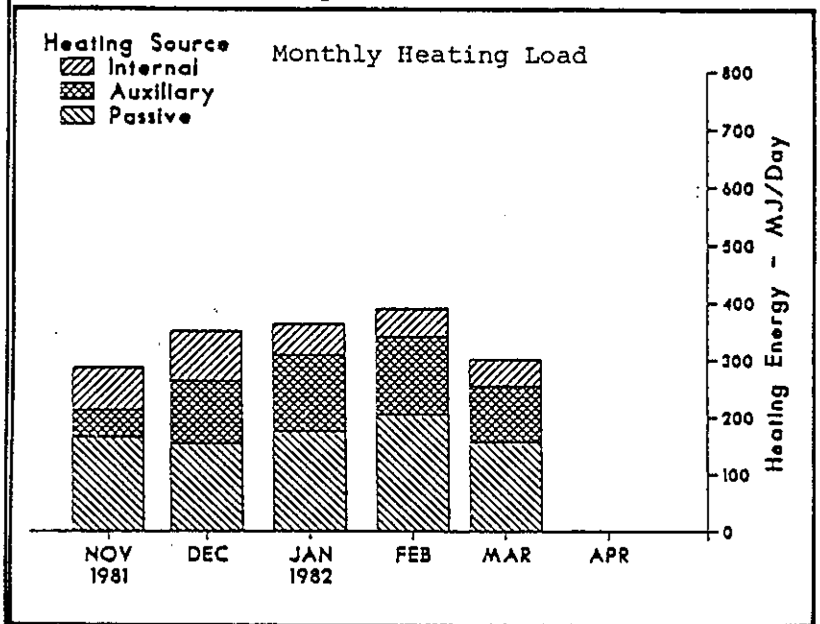
Typical Summer Day



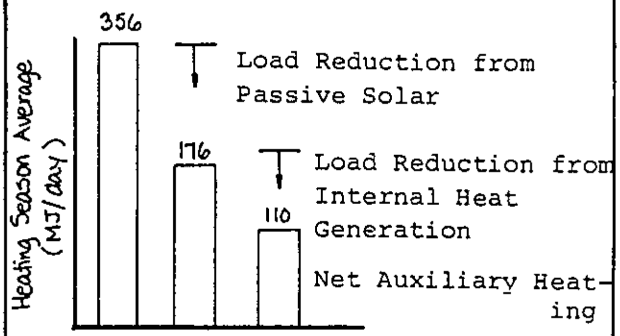
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	51 %
Heating Load Provided by Internal Generation	18 %
Heating Load Provided by Auxiliary Heating	31 %

CONCLUSIONS/FINDINGS

This house is a multilevel design with south windows, skylights, and a clerestory. The top level contains the family room, with a vaulted ceiling for the clerestory and a brick-veneered north wall. The living room and kitchen are at grade level and contain the remaining solar glazing. Two bedrooms on the north side are partially below grade level with a half basement.

Although the solar aperture area is relatively small (only 9% that of the floor area), it was effective in meeting about half the heating load through the winter. The solar gain had little effect on the north bedrooms, which typically remained as much as 20°F (11°C) cooler than the family room on sunny winter days.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
BOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems ,evaluation

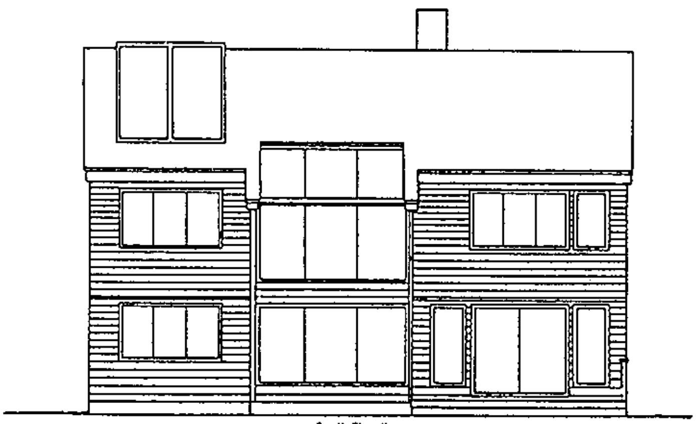
PROJECT TITLE

US/CO-15

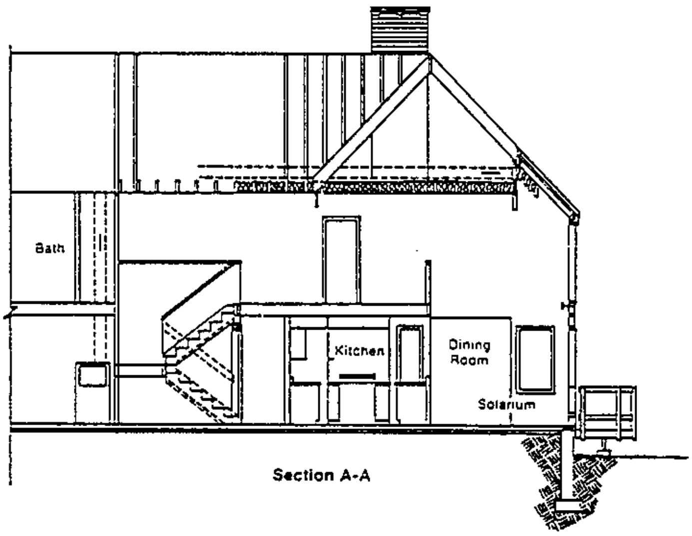
SITE MBA

BOULDER , COLORADO

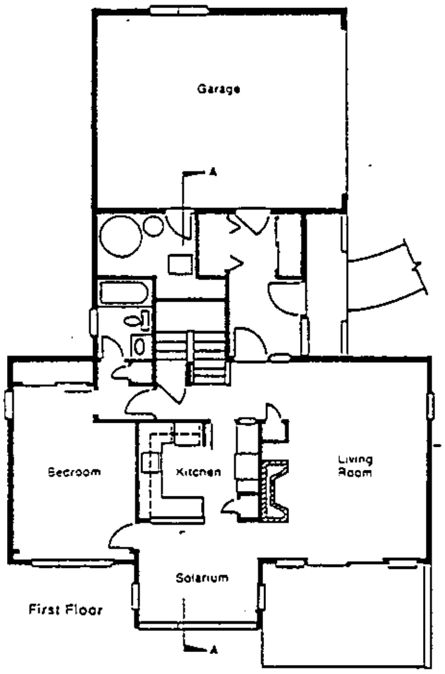
BUILDING AND SYSTEM DESCRIPTION



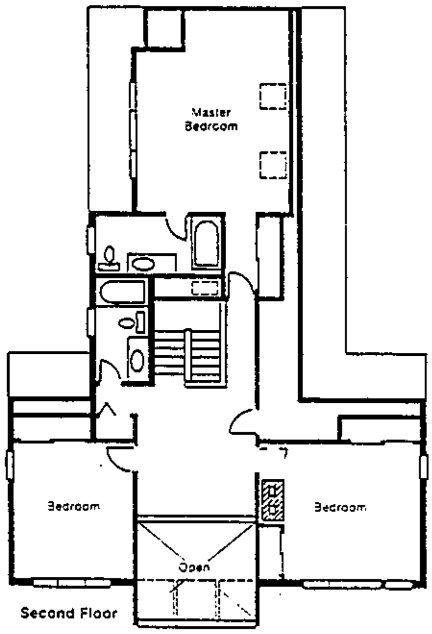
South Elevation



Section A-A



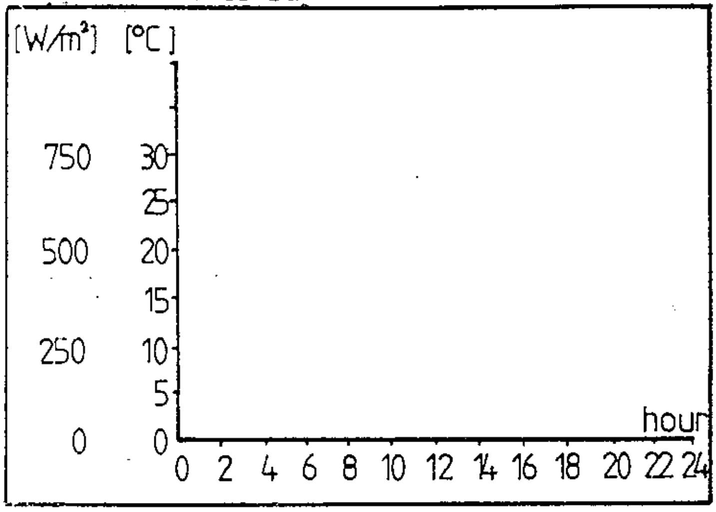
First Floor



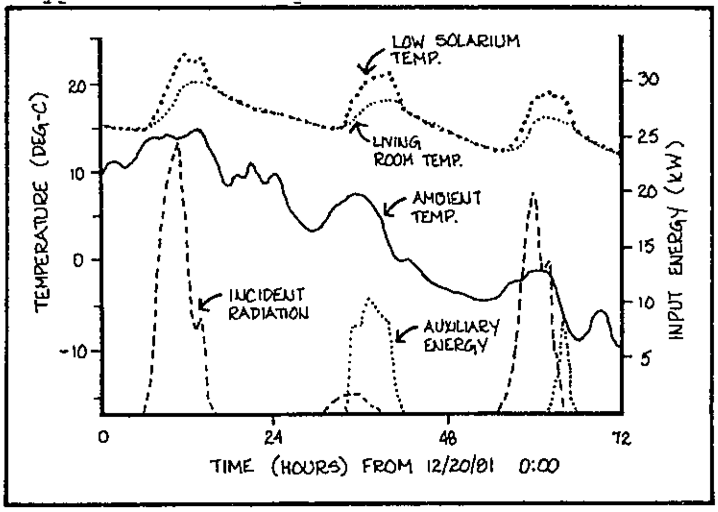
Second Floor

This is a manufactured panelized house with a two-story solarium. The solarium has a tile floor charged by a large direct gain component. Solarium air is open to the interior living space and can be vented into the attic. The solarium glazing is fitted with an R5 insulating curtain that is mechanically drawn at night.

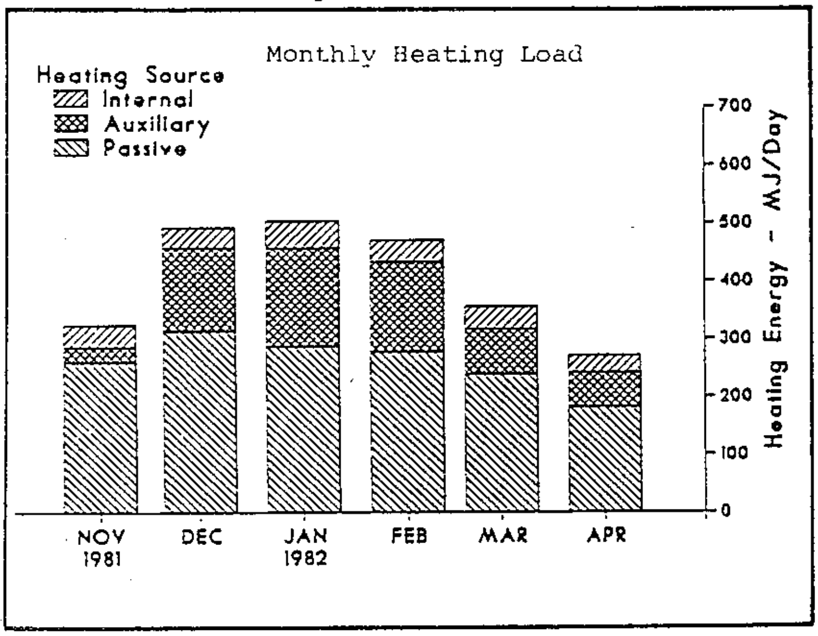
Typical Summer Day



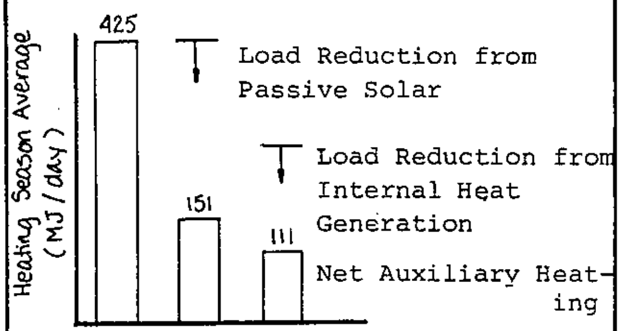
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	65 %
Heating Load Provided by Internal Generation	9 %
Heating Load Provided by Auxiliary Heating	26 %

CONCLUSIONS/FINDINGS

The house was being used as a sales model, so it was occupied only during the day. Because the building was unoccupied at night, the internal gains were small. The night-time thermostat setting was about 13 °C, which resulted in low average indoor temperatures. The solar component supplied about 60% of the mid-winter heating load.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA

BOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

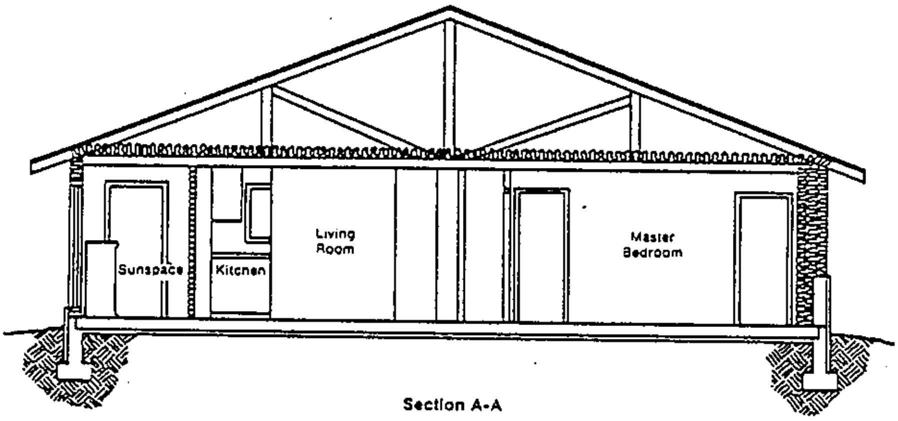
Performance data for systems evaluation

PROJECT TITLE

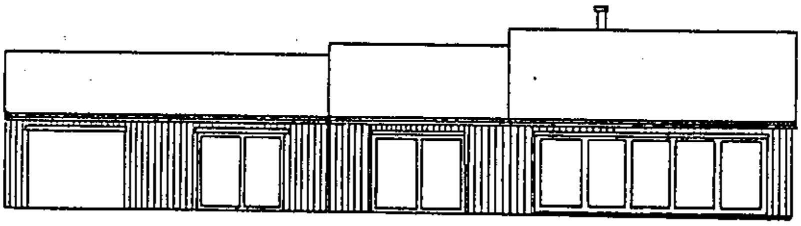
SITE NEC
TOLLAND , CONNECTICUT

US/CT-01

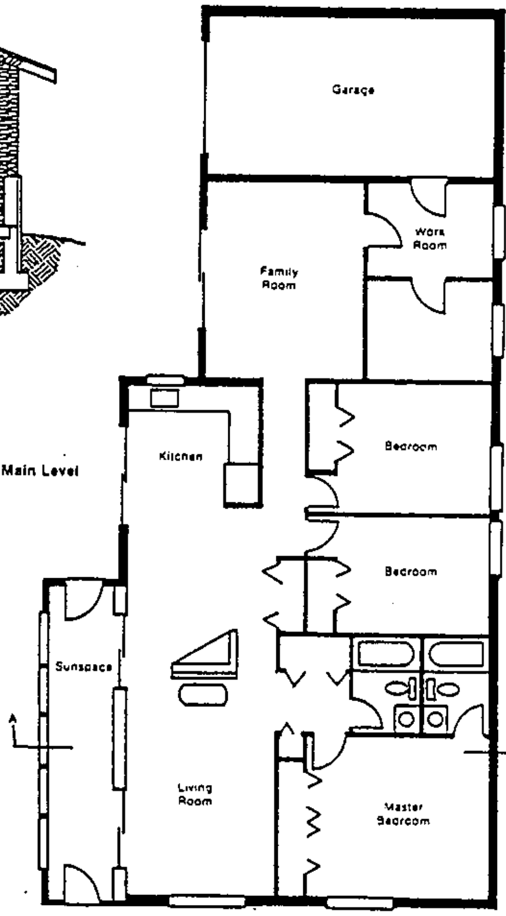
BUILDING AND SYSTEM DESCRIPTION



Section A-A

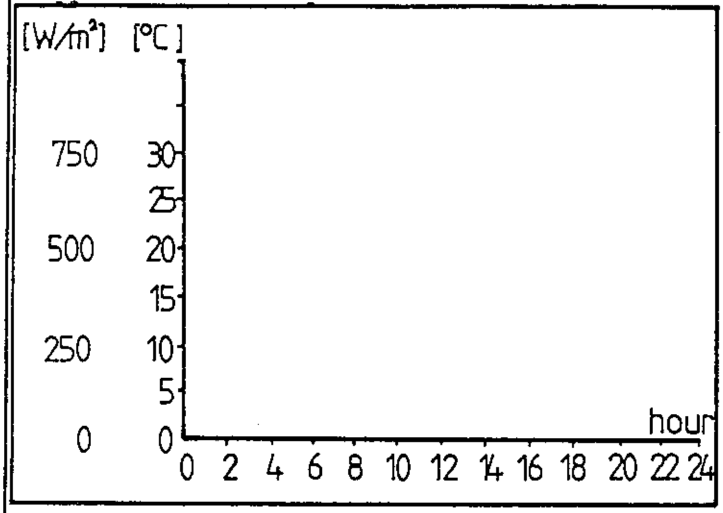


South Elevation

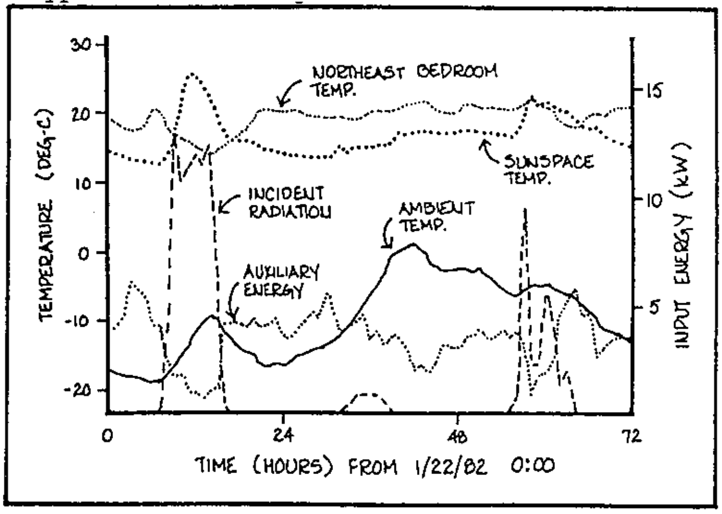


This is a single-story frame house located in central Connecticut. It is constructed on a concrete slab and bermed heavily on the north and west sides, where there are double walls with a 10 in. (25 cm) concrete outer wall and a 4 in. (10 cm) insulated inner wall. The combination of direct gain and a sunspace charges both the slab floor and a brick-faced concrete block wall between the sunspace and the living room. Two sets of sliding glass doors provide some control over heat flows between the sunspace and other zones. Night insulation consists primarily of insulating drapes on the south side. The north and east windows are insulated with sliding panels.

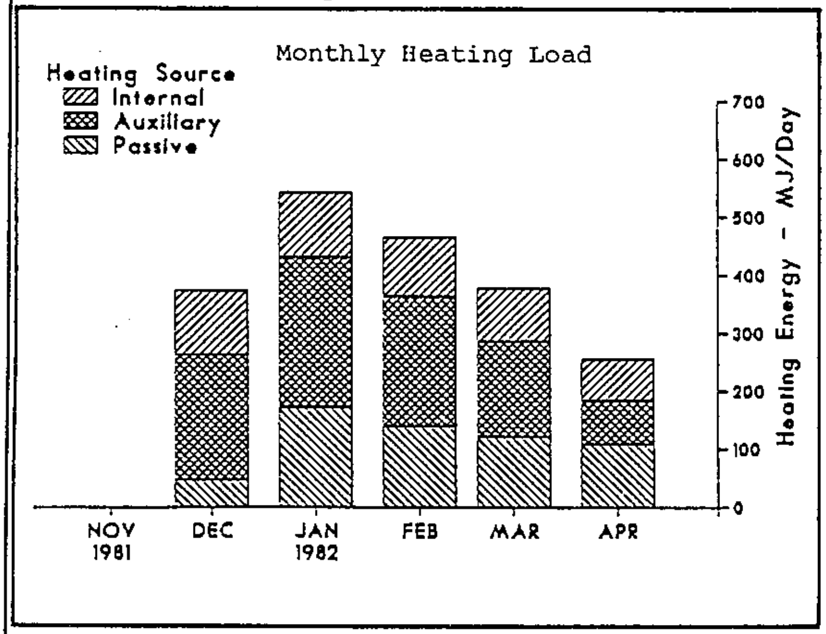
Typical Summer Day



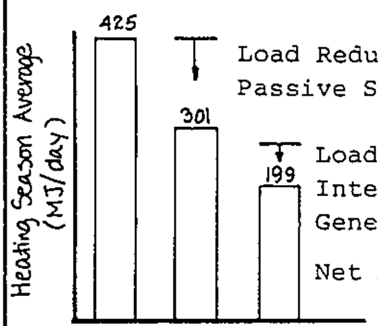
Typical Winter Day



Performance Summary



Annual Summary



Load Reduction from Passive Solar

Load Reduction from Internal Heat Generation

Net Auxiliary Heating

Heating Load Provided by Passive Solar	29 %
Heating Load Provided by Internal Generation	24 %
Heating Load Provided by Auxiliary Heating	46 %

CONCLUSIONS/FINDINGS

The solar components met about 30% of the large heating load, except during a very cloudy December. The occupants kept the doors to the north bedrooms closed. Thus, the solar gain had little effect on these rooms, where the temperature would drop below 60° F (15° C) in the absence of auxiliary heat, even on very sunny winter days.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results by J. Swisher and T. Cowing

IEA SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

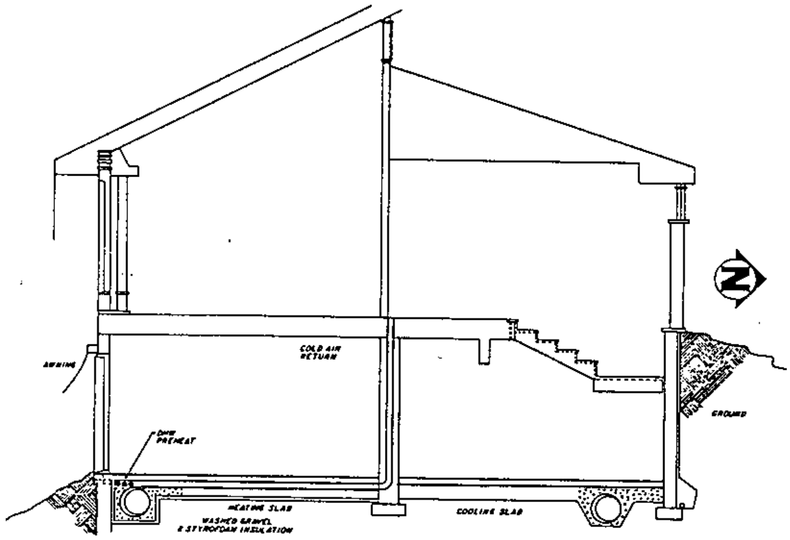
Performance data for systems evaluation

PROJECT TITLE

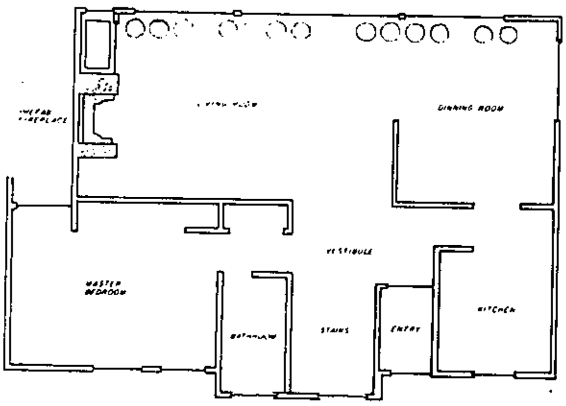
US/IA-03

WEHNER, NOWYSZ AND PATTSCHULL
IOWA CITY, IOWA

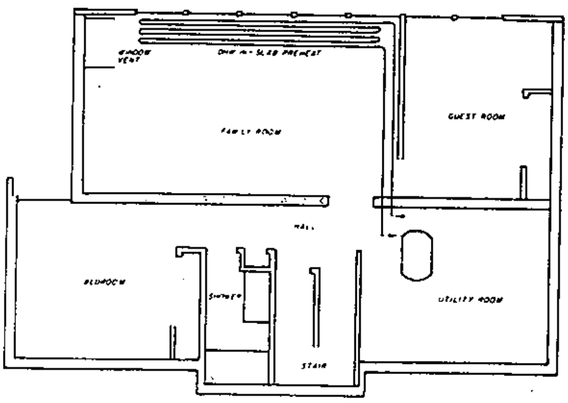
BUILDING AND SYSTEM DESCRIPTION



SECTION



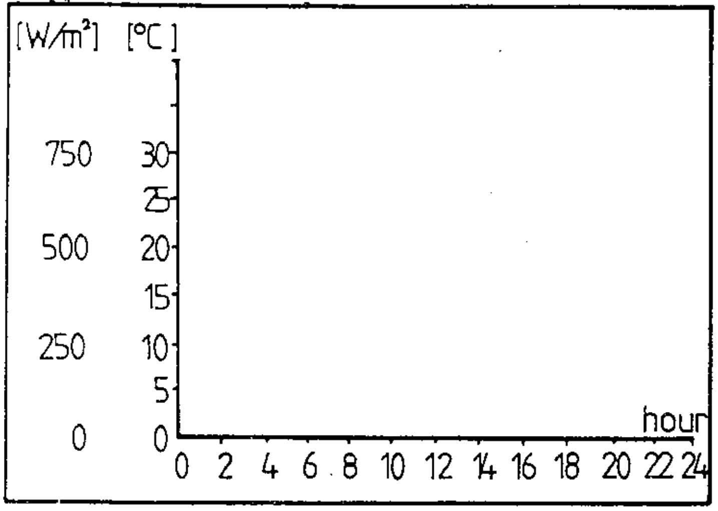
FIRST FLOOR PLAN



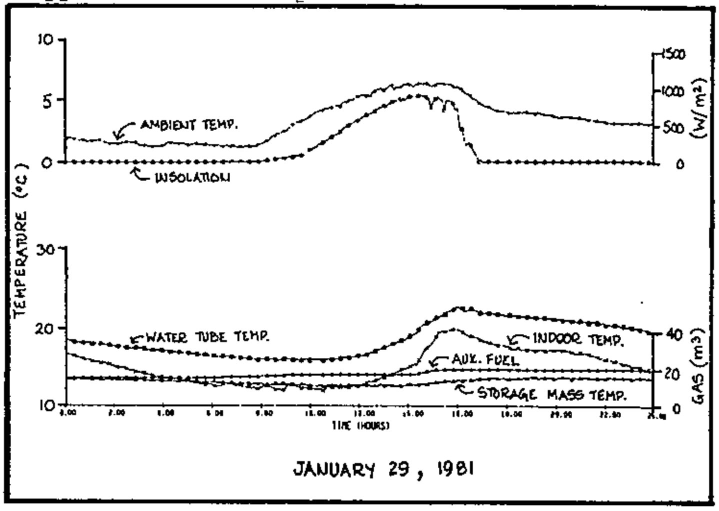
BASEMENT FLOOR PLAN

This two-story house in eastern Iowa receives direct solar gain from 26 square meters of south-facing double-glazed windows. Heat is stored in water tubes directly behind the windows on the second floor. Additional water tubes embedded in the lower-story floor slab convect heat accumulated in the slab up the central dividing wall, to provide heat to the center of the house. Small copper tubes also buried in the south edge of the floor slab provide domestic hot water preheating. The upper floor windows are equipped with RSI-.60 thermal curtains to reduce night-time heat losses.

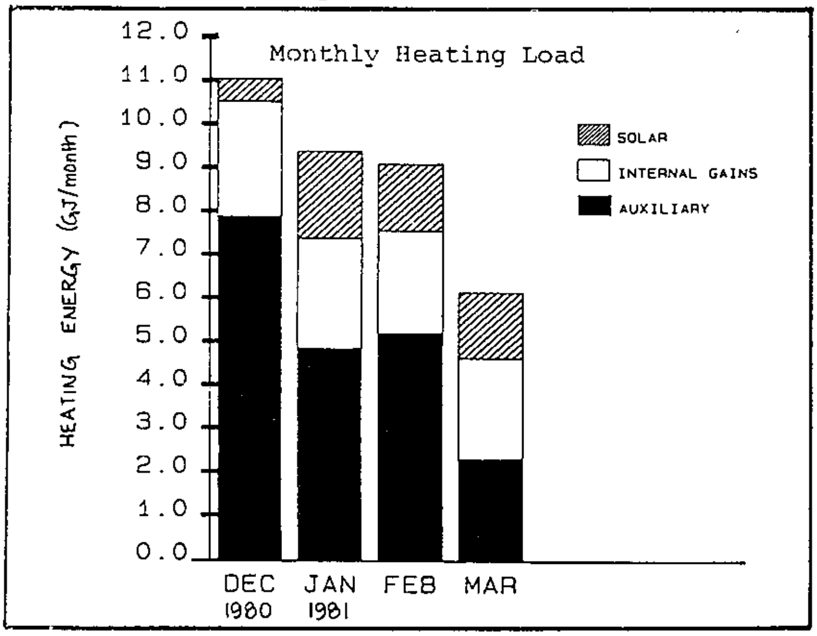
Typical Summer Day



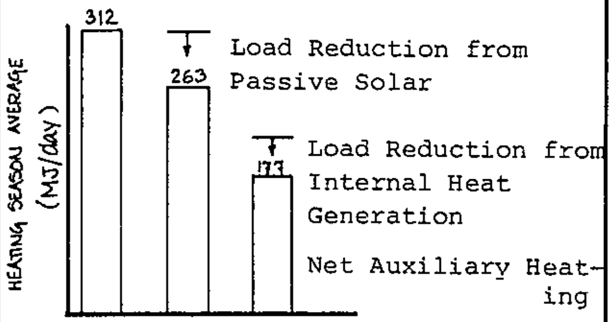
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	16 %
Heating Load Provided by Internal Generation	27 %
Heating Load Provided by Auxiliary Heating	57 %

CONCLUSIONS/FINDINGS

Twenty-two percent of the 27.34 GJ equipment heating load was supplied by the solar system. A solar fraction of 22% was achieved because the occupants were willing to endure very low building temperatures (the temperatures averaged only 15°C for the entire period). There are several reasons for the reduced performance of the system. The house is sited so that it faces 42 degrees west of south, which reduces the available solar energy to, and efficiency of, the collector subsystem. The lack of movable insulation for the lower-level collector glazing is important. Finally, high infiltration levels, which have been calculated as being in excess of 30% of the building heating load, also reduce performance. A large part of the losses appear to be through the uninsulated cooling bed under the floor slab. In spite of above problems, the system did save 5.88 GJ.

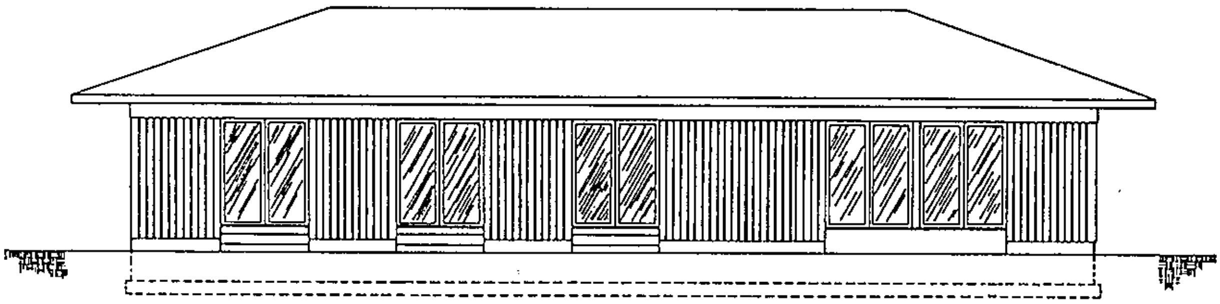
Source of Information: Comparative Report: Performance of Passive Solar Space Heating Systems (by Vitro Labs for NSDN)

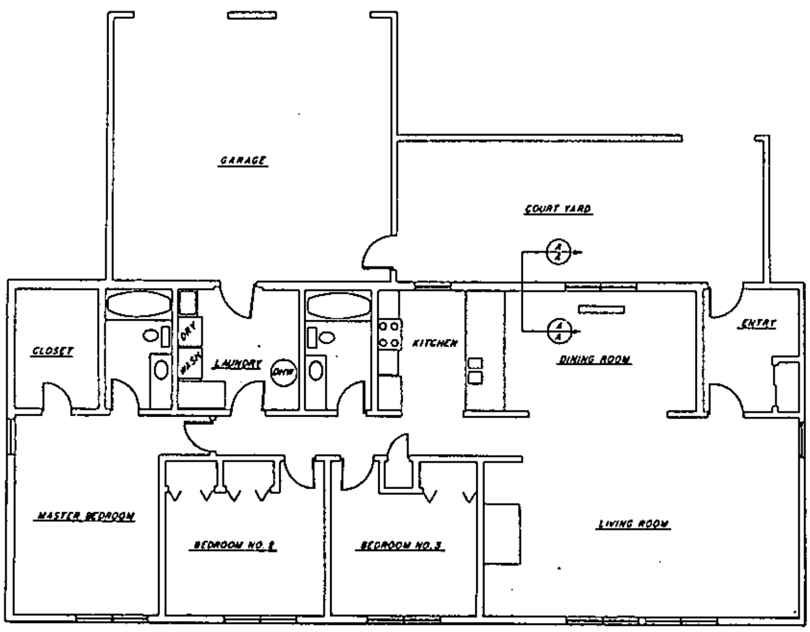
Performance data for systems evaluation

PROJECT TITLE — LO·CAL
CHAMPAIGN, ILLINOIS

US/IL-01

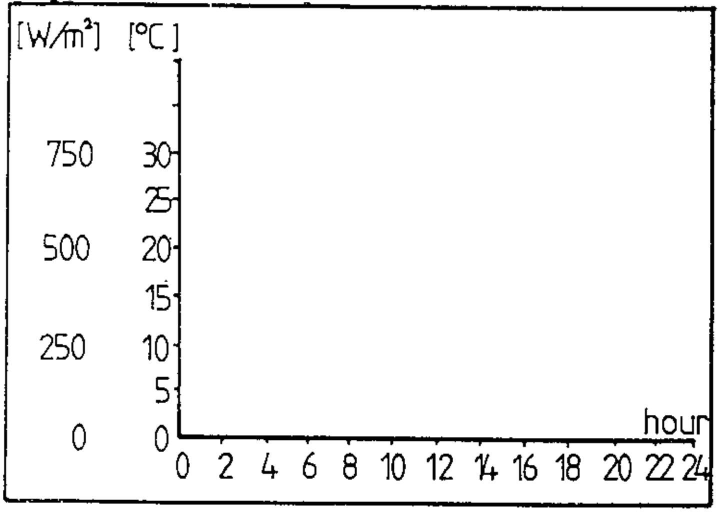
BUILDING AND SYSTEM DESCRIPTION



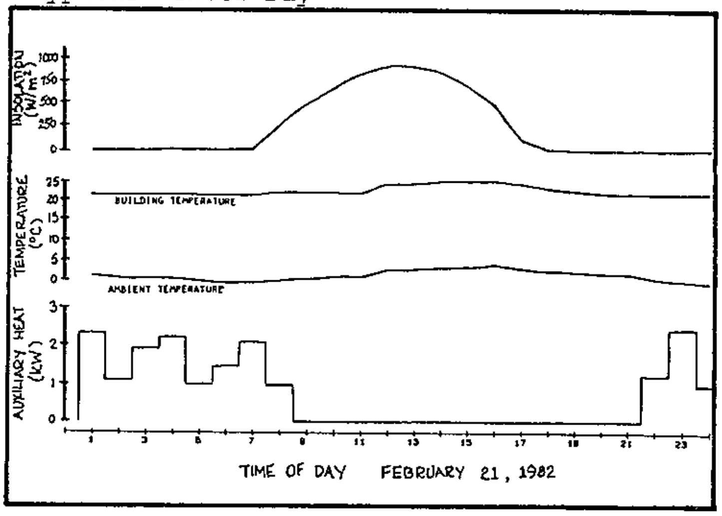


The Lo-Cal site is a single detached residence located in Champaign, Illinois. The building is one story built over a crawl space. The energy-saving features include superinsulation (RSI-4.2 walls, RSI-5.8 ceiling and RSI-3.5 crawl- space walls), an airlock-type entry and triple glazing on all of the windows. The floor of the house over the crawl space is uninsulated and the heat loss from the uninsulated ducts in the crawl space is intended to warm the floor for added comfort. The passive system consists of 18.6 square meters of south-facing triple-glazed windows. There is no storage subsystem other than the mass of typical wood-frame construction materials.

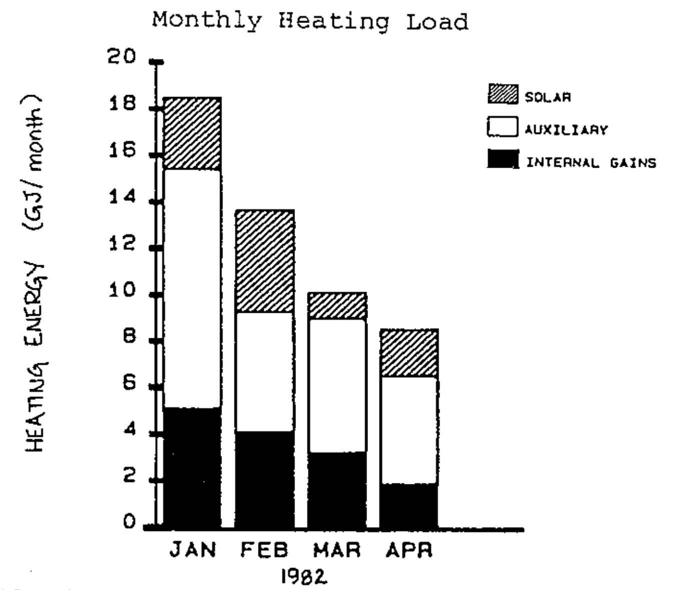
Typical Summer Day



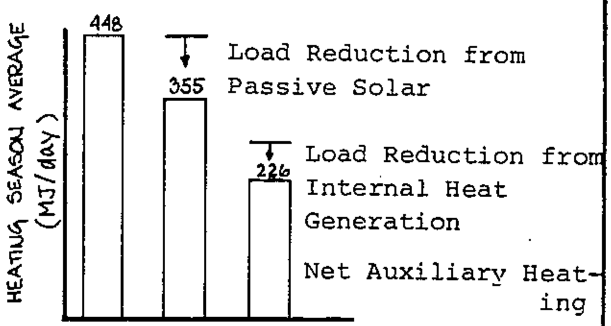
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	21 %
Heating Load Provided by Internal Generation	29 %
Heating Load Provided by Auxiliary Heating	50 %

CONCLUSIONS/FINDINGS

The building performed well during the monitoring period, but a major portion of the heat loss was through the uninsulated floor over the crawl space. This loss rate was measured with a co-heating test. The loss rate of the building with the unheated crawl space was 277 W/°K with the crawl space heated. This results in a difference of 145 W/°K, i.e., 53% of the heat loss of the house is through the floor. During normal operation of the building, the heat loss from the uninsulated heating ducts in the crawl space keeps the crawl space at approximately 16.7°C. The loss from the ducts heating the floor was designed to provide warm floors and improve comfort. The performance of this house could be considerably improved if the floor over the crawl space was better insulated and the ducts relocated within the conditioned space or well-sealed and insulated. This improvement would increase the delivered furnace efficiency and reduce the heat loss of the house.

Source of Information: Solar Energy System Performance Evaluation: Lo-Cal (by Vitro Labs for NSDN)

IEA

SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

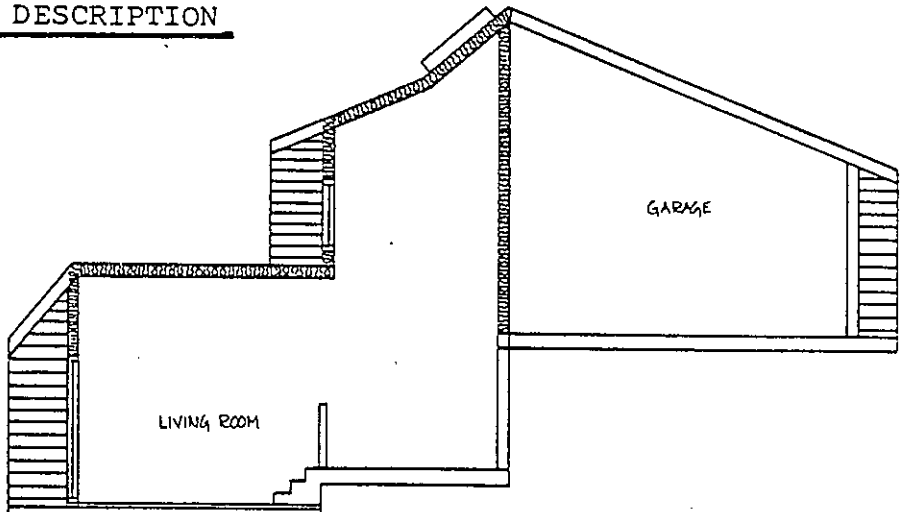
PROJECT TITLE

VS/MA-04

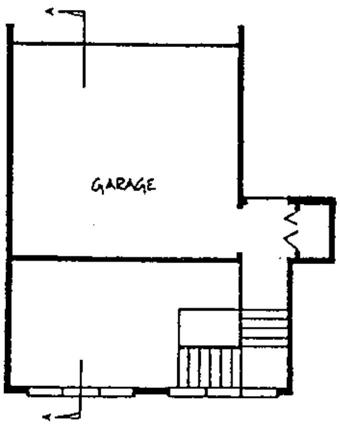
SITE NEA

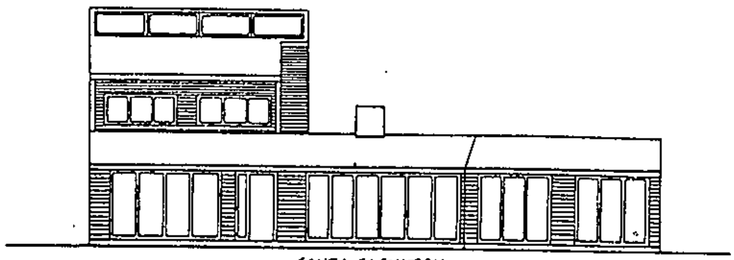
HAMILTON , MASSACHUSETTS

BUILDING AND SYSTEM DESCRIPTION

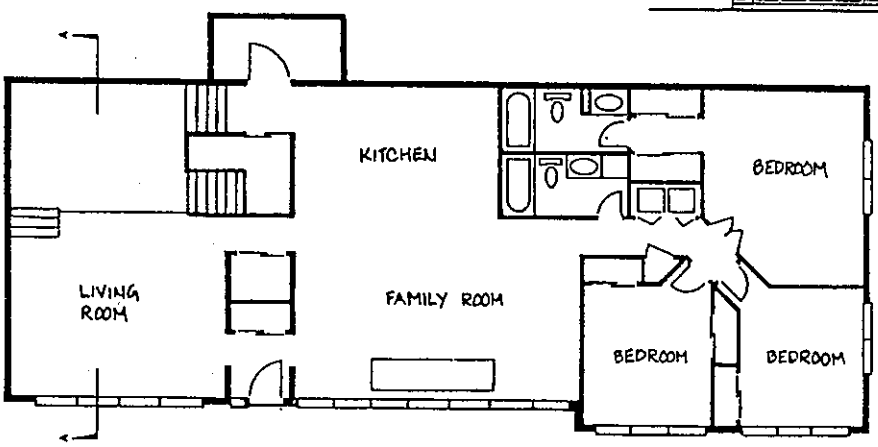


SECTION



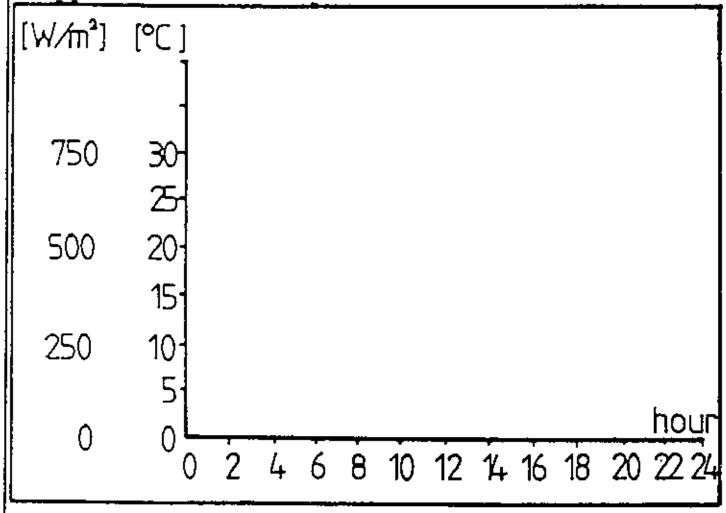


SOUTH ELEVATION

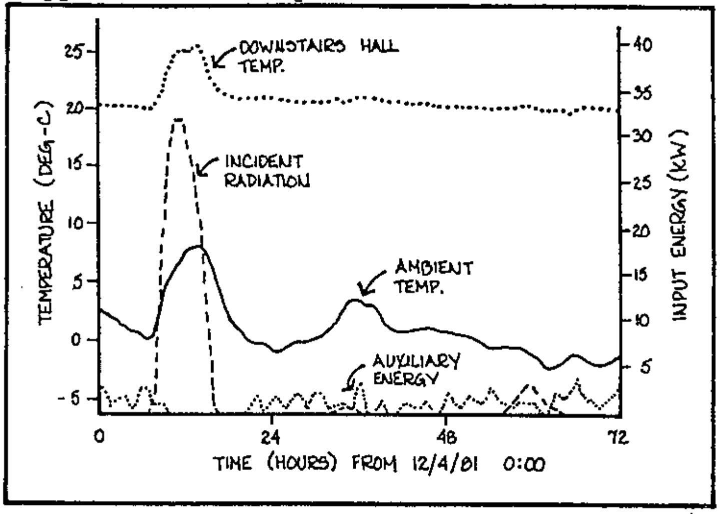


This two-story masonry house is located in northeastern Massachusetts. It is bermed continuously on the north and west sides and over the roof of the first floor. Direct solar gain is received from south windows and a clerestory above the first floor living room. Insulating drapes were installed in the spring of 1982. The air-source heat pump was operated in the resistance mode only during the monitoring period. A heat exchanger system to regulate the makeup air was not operated during the monitoring period.

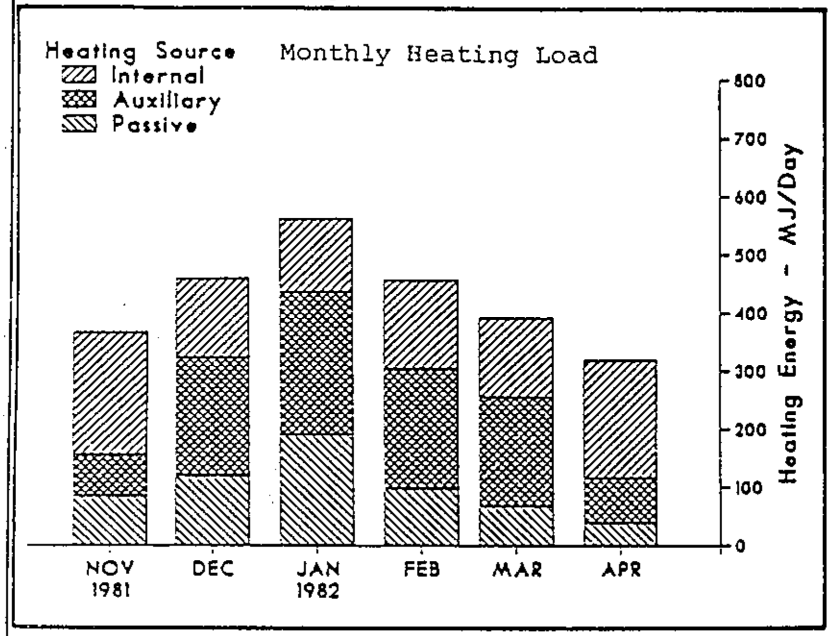
Typical Summer Day



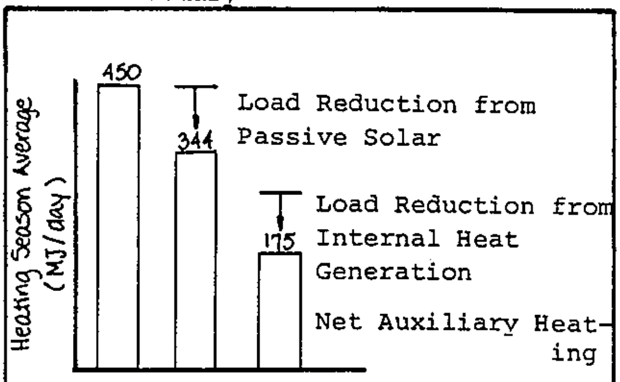
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	24 %
Heating Load Provided by Internal Generation	37 %
Heating Load Provided by Auxiliary Heating	38 %

CONCLUSIONS/FINDINGS

The house has a relatively low infiltration rate, due to the extensive use of earth berming. However, the heat loss coefficient is relatively high because of the large glazing area. The solar contribution was 34% of the heating load in January but decreased in the spring, probably because of the large overhang above the major direct gain component. The building's ability to retain solar heat was disappointing, as the auxiliary heaters activated soon after sundown on sunny winter days. This should improve with the use of night insulation.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

Performance data for systems evaluation

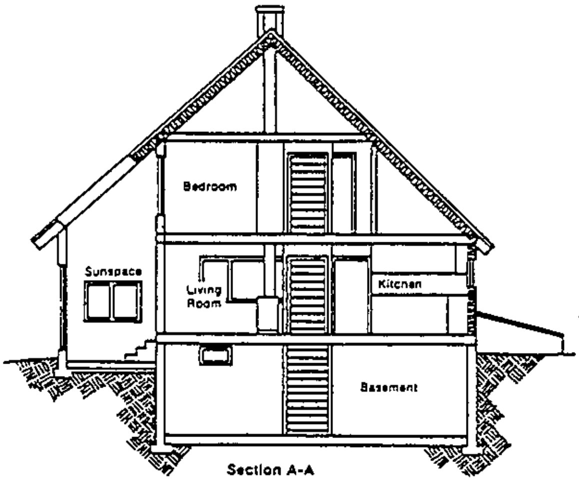
PROJECT TITLE

US/MA-05

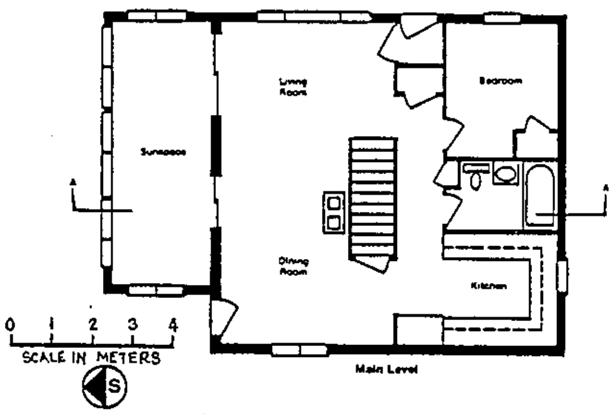
Site NEB

Orange, Massachusetts

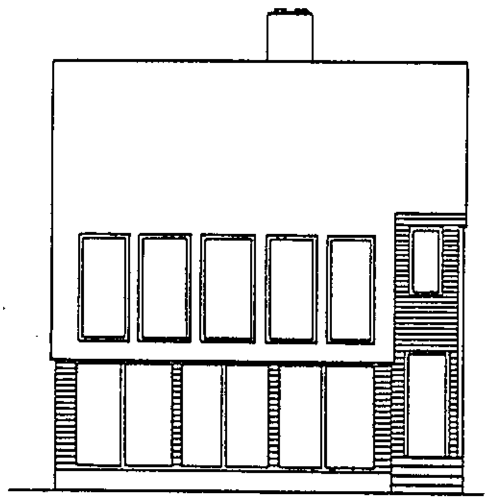
BUILDING AND SYSTEM DESCRIPTION

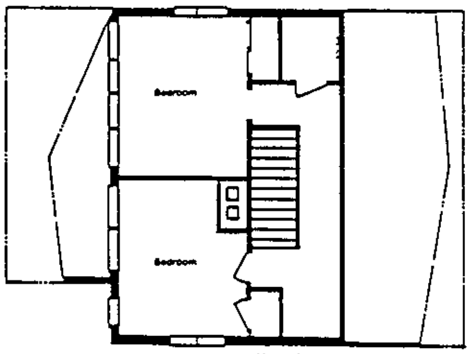


Section A-A



Main Level

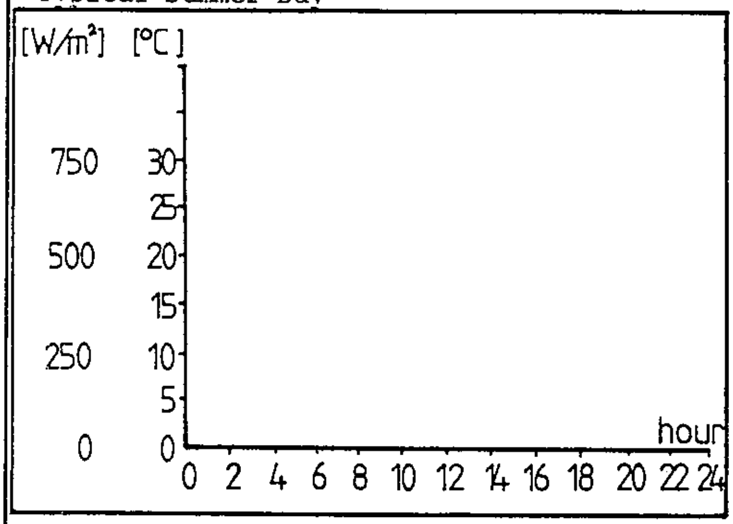

South Elevation



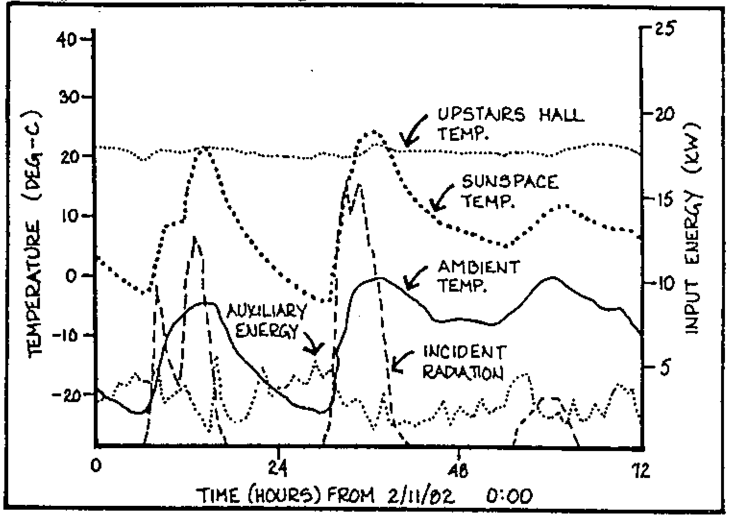
Upper Level

This is a two-story frame house located in north-central Massachusetts. It features a full length sunspace with 208 ft² (19.3 m²) of vertical and sloped glazing. Thermal storage mass is provided by an insulated concrete floor and an 8 in. (20 cm) concrete wall separating the sunspace from the living-dining area. Sliding glass doors and windows in this wall provide the occupants with some control over energy exchanges between interior zones. Also, manually operated windows are located between the sunspace and the second floor bedrooms. Insulating shades are used on the sloped glazing at night.

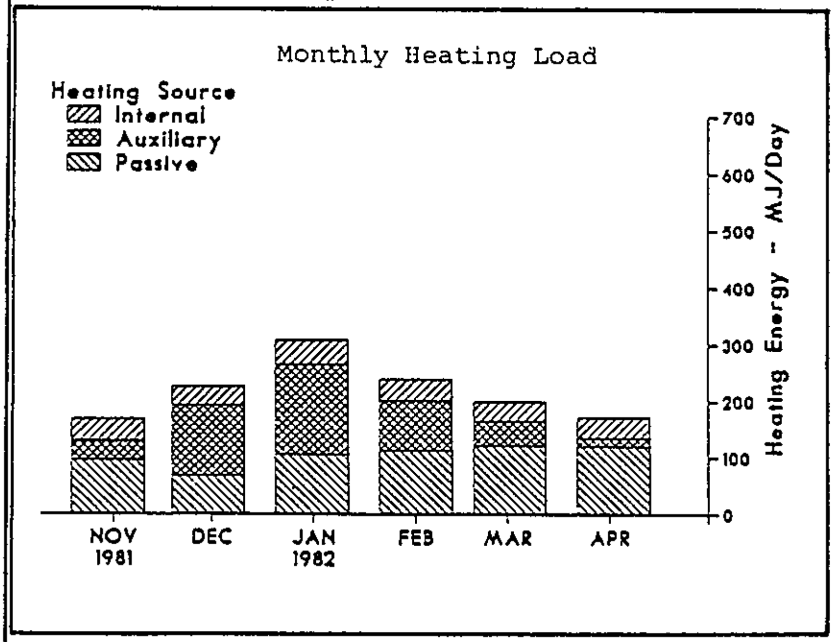
Typical Summer Day



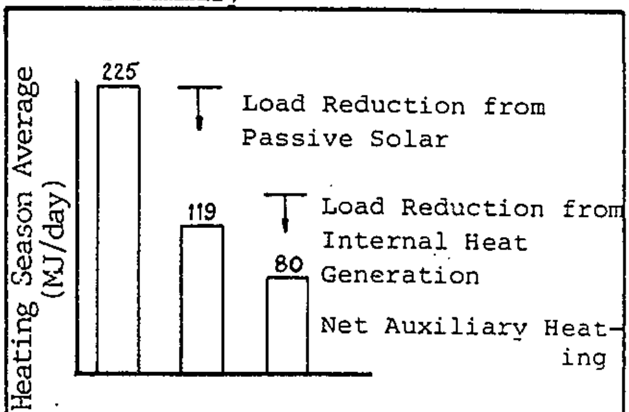
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	47 %
Heating Load Provided by Internal Generation	17 %
Heating Load Provided by Auxiliary Heating	36 %

CONCLUSIONS/FINDINGS

The average interior temperature was maintained at a rather high 70°F (21°C) over the heating season. The living zone temperature was quite stable despite large sunspace temperature swings. The passive solar heating contributions were impressive, providing nearly 50% of the space heating load. Internal energy gains to the living zone appear unusually low for this house. This is due to the location of some major appliances in the unheated basement.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

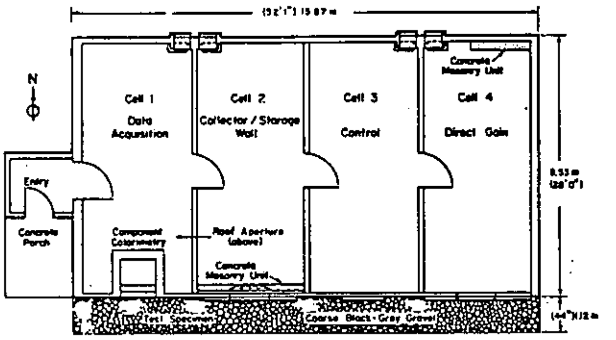
Performance data for systems evaluation

PROJECT TITLE

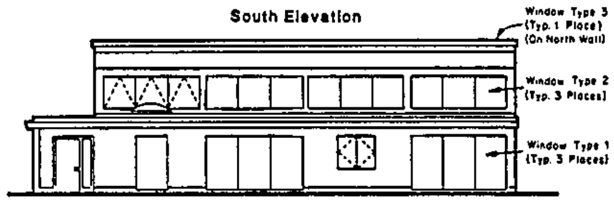
US/MD-08

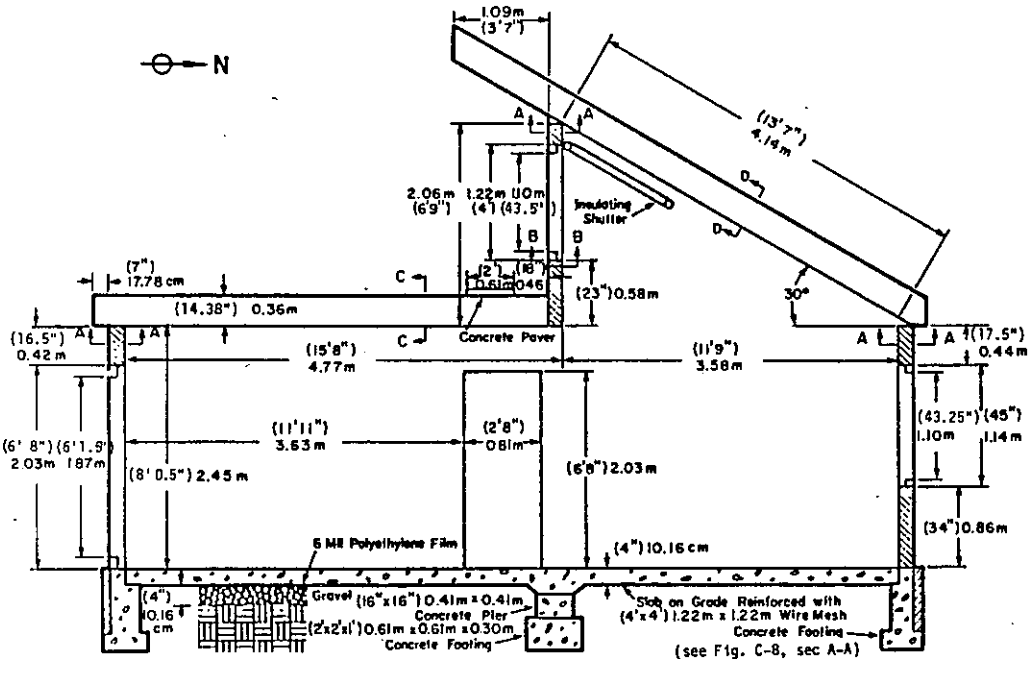
NATIONAL BUREAU OF STANDARDS
PASSIVE SOLAR TEST BUILDING
GAITHERSBURG, MARYLAND

BUILDING AND SYSTEM DESCRIPTION



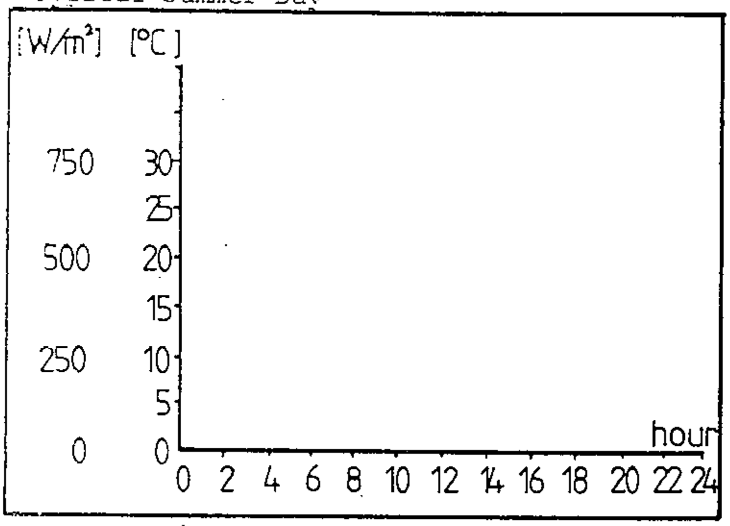
Floor plan



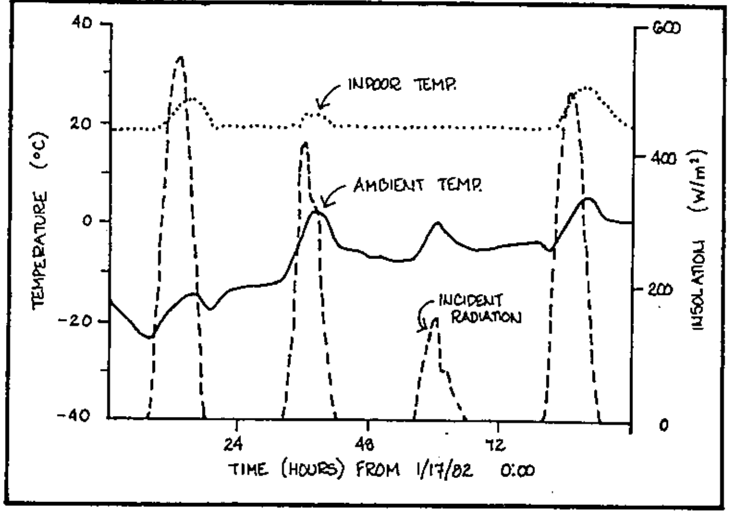


The National Bureau of Standards Passive Solar Test Building was constructed to generate performance data on passive systems and components under highly controlled conditions. The building is divided into four sections by heavily-insulated interior walls. The inside walls, storage mass and glazing can be reconfigured for different test purposes.

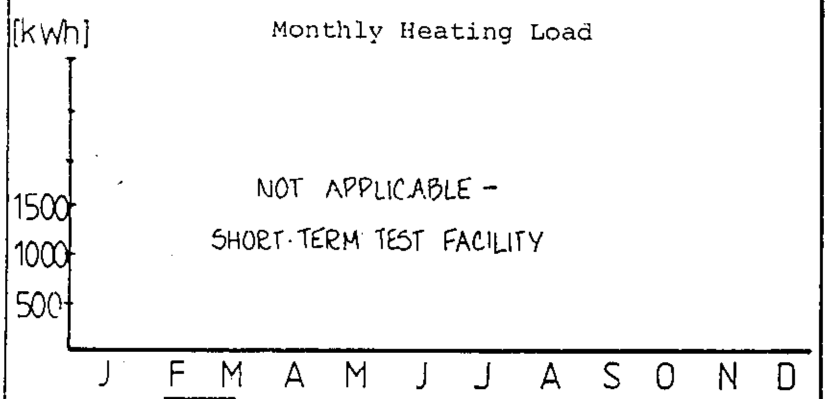
Typical Summer Day



Typical Winter Day



Performance Summary

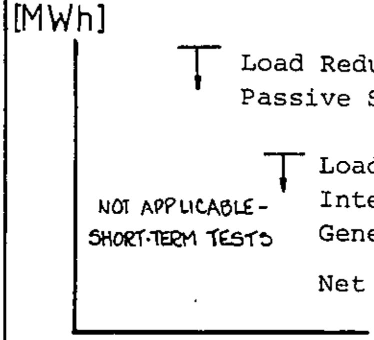


Heat provided by passive solar

Heat provided by internal generation

Heat provided by auxiliary system

Annual Summary



Load Reduction from Passive Solar

Load Reduction from Internal Heat Generation

Net Auxiliary Heating

Heating Load Provided by Passive Solar	%
Heating Load Provided by Internal Generation	%
Heating Load Provided by Auxiliary Heating	%

CONCLUSIONS/FINDINGS

Cell #1 of the facility is used to house the data acquisition system and a special calorimeter used for testing passive solar components. Data have been taken in the storage wall and direct gain cells as part of the DOE Class A Passive Solar Test Program. In this program, data from highly controlled test periods is used for validation of building energy analysis simulations. Five data sets have been generated to date from the direct gain cell and two from the storage wall cell, each under different ambient or indoor control conditions. These data sets are currently being used by Los Alamos National Laboratory and the Solar Energy Research Institute to do validation runs on DOE2.1, BLAST 2.0, SERI-RES and TRYNSYS. These standard data sets are well-documented and available to other researchers.

Source of Information: "Initial Results from the NBS Passive Solar Test Facility" by B. Mahajan & S. Liu Proceedings of the ASME Solar Division Sixth Annual Technical Conference, April 1983.

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

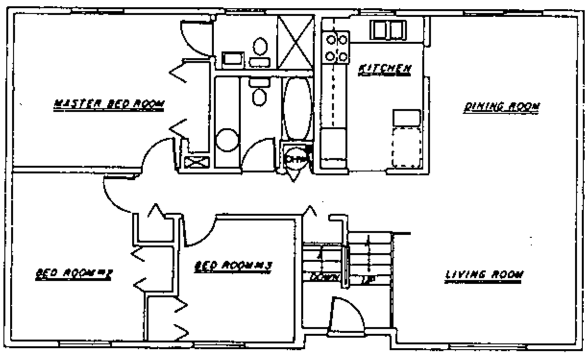
PROJECT TITLE

RYMARK I

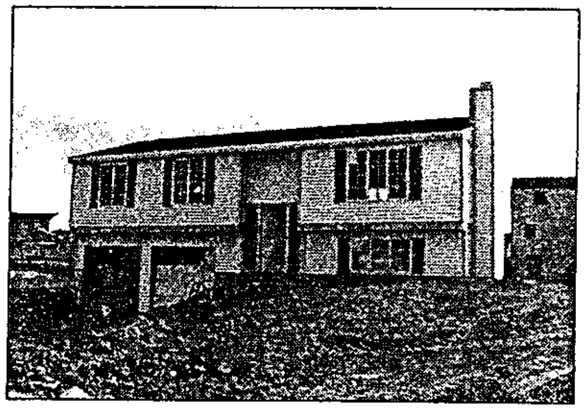
FREDERICK , MARYLAND

US/MD-09

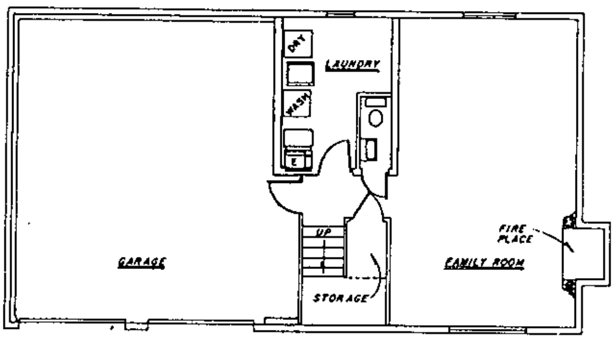
BUILDING AND SYSTEM DESCRIPTION



UPPER FLOOR PLAN

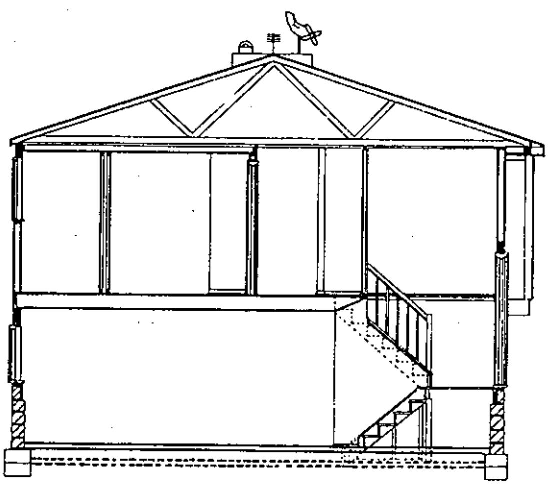


SOUTH ELEVATION



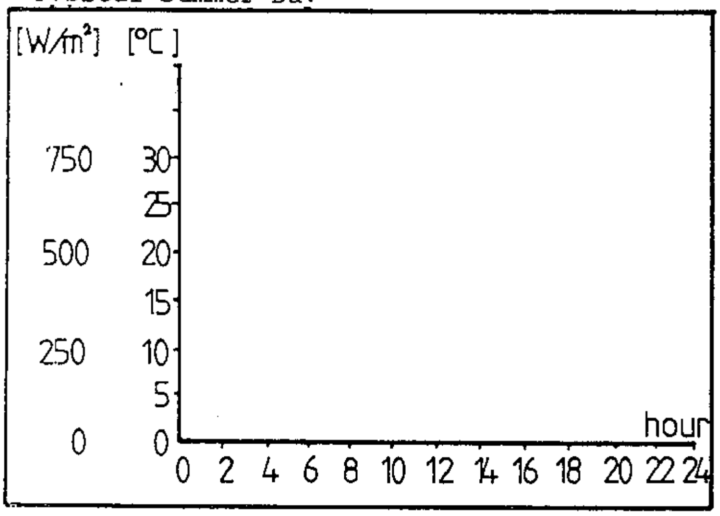
LOWER FLOOR PLAN

Rymark I is a standard bi-level home constructed by Ryan Homes in Frederick, Maryland. It is a 13.4 meter by 11.0 meter rectangular structure fitted with the Ryan standard energy package (RSI-5.3 ceiling, RSI-2.5 wall, double glazing, insulated doors, and foundation perimeter insulation). The rear wall of the house faces south and has 6 square meters of glass. There is no glass on the east or west walls. Rymark I is Ryan's standard building with no modifications other than a southern orientation. This building is used as a "reference" building to compare the performances of Rymark II and Rymark III.

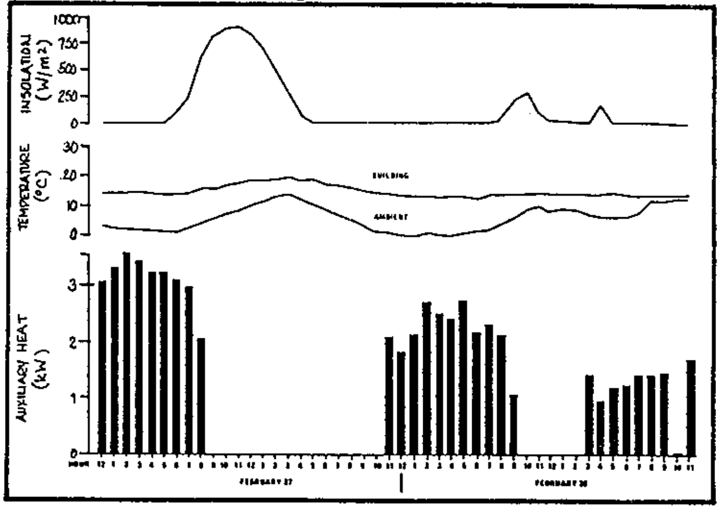


SECTION

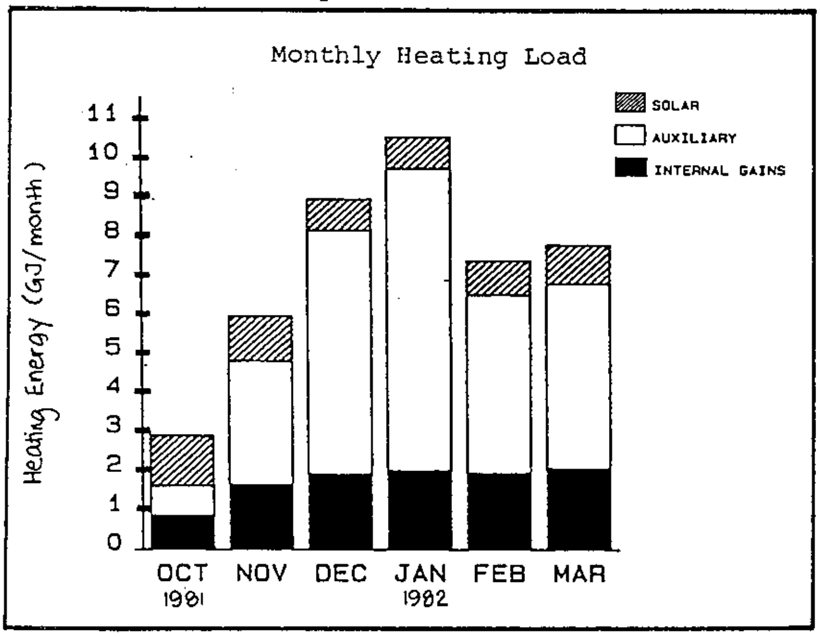
Typical Summer Day



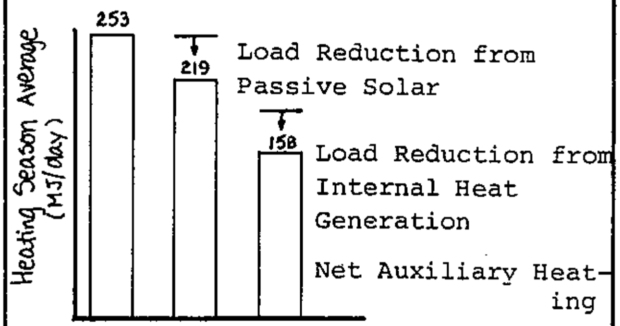
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	14 %
Heating Load Provided by Internal Generation	24 %
Heating Load Provided by Auxiliary Heating	62 %

CONCLUSIONS/FINDINGS

This is a conventional "reference" house monitored for side-by-side comparison with Rymark II and Rymark III. The house has a lower heating load than expected because it was kept at an average of 15 °C for the monitoring period. The net solar gain for the season was 8% of the incident solar energy.

Source of Information: Solar Energy System Performance Evaluation: Rymark I, II, III (by Vitro Labs for NSDN)

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

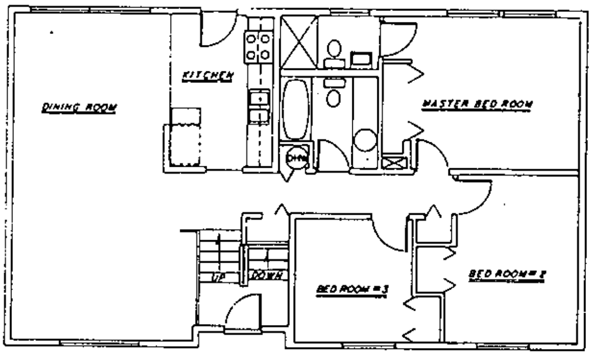
PROJECT TITLE

US/MD-10

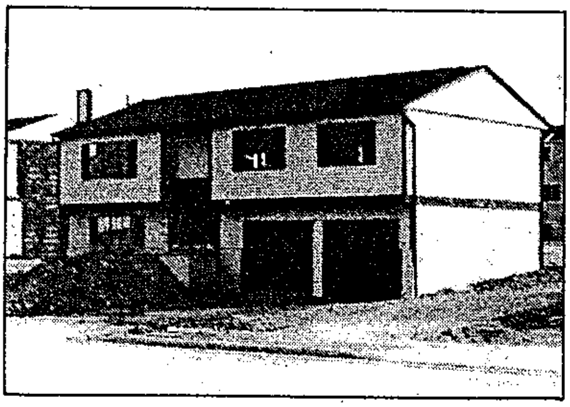
RYMARK II

FREDERICK, MARYLAND

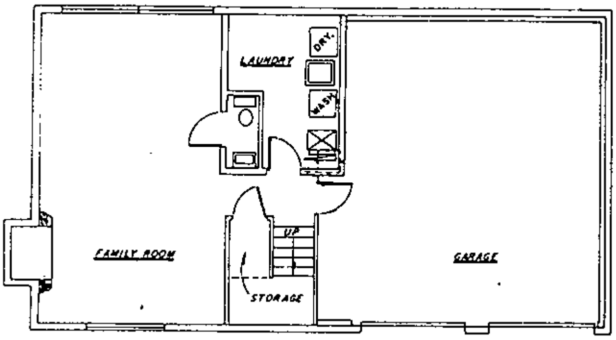
BUILDING AND SYSTEM DESCRIPTION



UPPER FLOOR PLAN

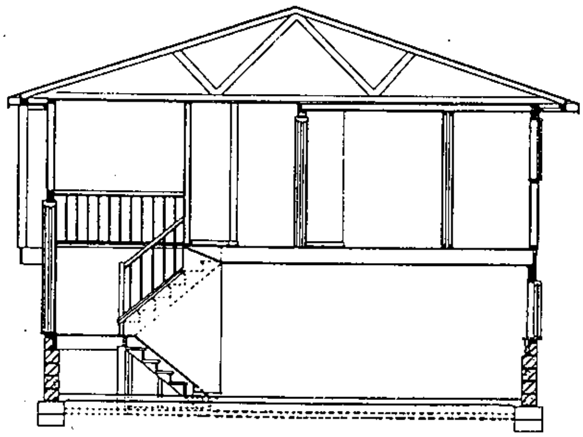


SOUTH ELEVATION



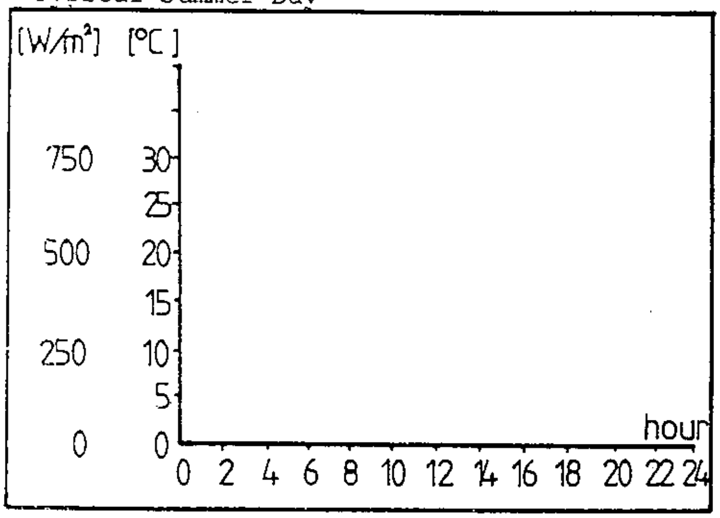
LOWER FLOOR PLAN

Rymark II is the same basic building as Rymark I with some modifications for passive solar. The south- facing window area is almost doubled to approximately 11.5 square meters and the north - facing glass was reduced by 16%. All the windows are triple-glazed and have RSI-.9 "window quilt" movable insulation. A .61 meter overhang is provided on the south side to prevent overheating in the summer.

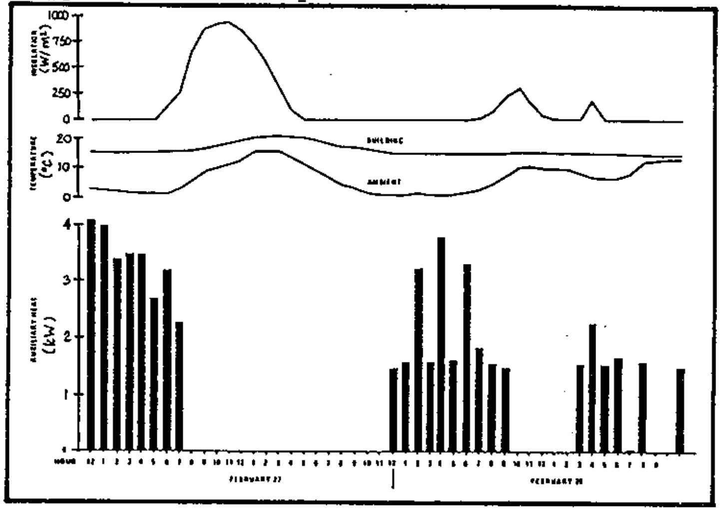


SECTION

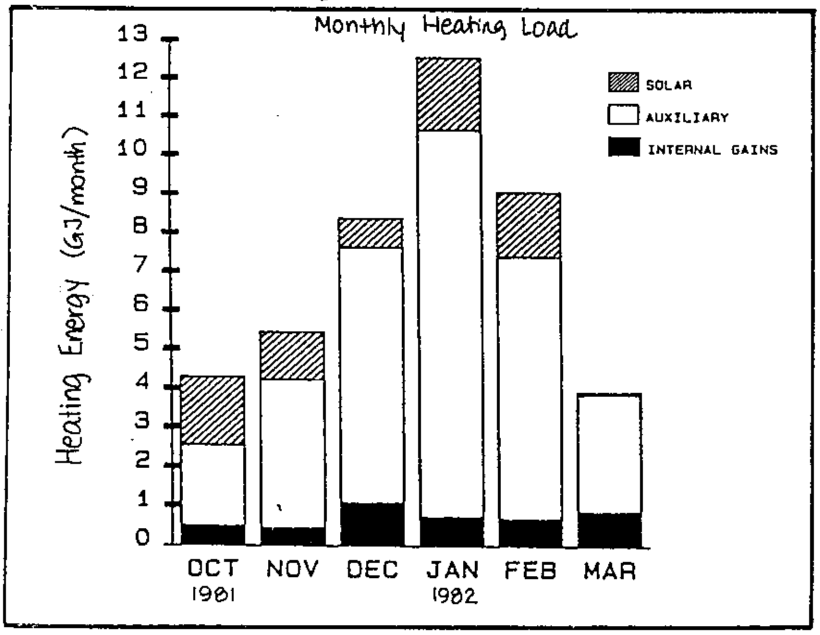
Typical Summer Day



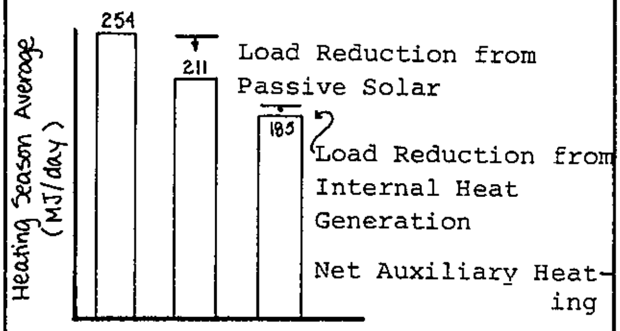
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	17 %
Heating Load Provided by Internal Generation	10 %
Heating Load Provided by Auxiliary Heating	73 %

CONCLUSIONS/FINDINGS

The net solar gain on the south-facing windows was 735 MJ. The glazing system collected 24% of the incident solar energy. The internal gains were very low because the building was unoccupied.

The floor slab is covered by carpet and participated very little in the net energy balance of the building, maintaining an average temperature of 13.9 °C over the monitoring period. The window insulation was not used regularly during the monitoring period because the building was unoccupied.

The overall savings of this house over the Rymark I house due to the "sun-tempering" of the design is estimated to be 20%, at an incremental cost of $1300.

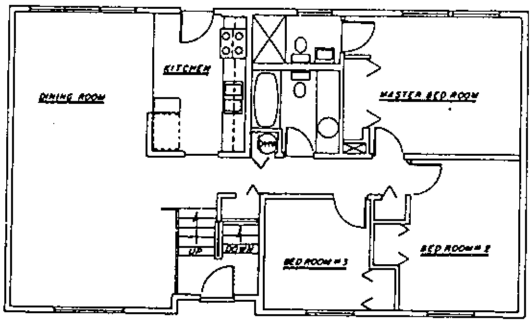
Source of Information: Solar Energy System Performance Evaluation: Rymark I, II, III (by Vitro Labs for NSDN)

Passive and Hybrid
Solar Low Energy Buildings

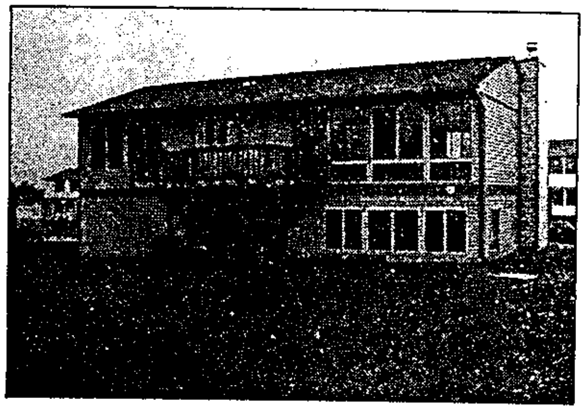
Performance data for systems evaluation

PROJECT TITLE	RYMARK III
US/MD-11	FREDERICK, MARYLAND

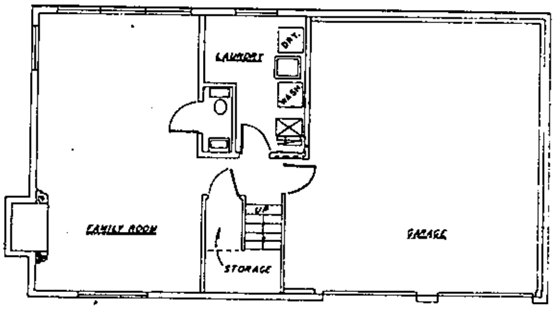
BUILDING AND SYSTEM DESCRIPTION



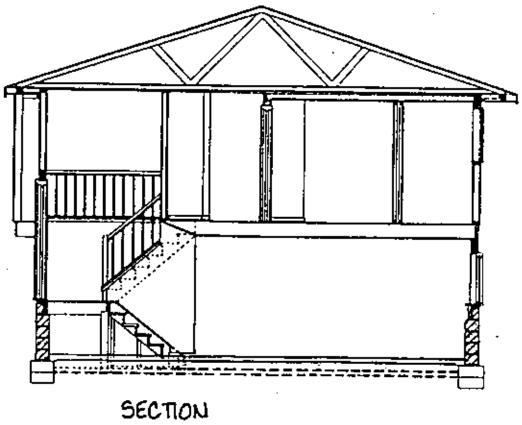
UPPER FLOOR PLAN



SOUTH ELEVATION



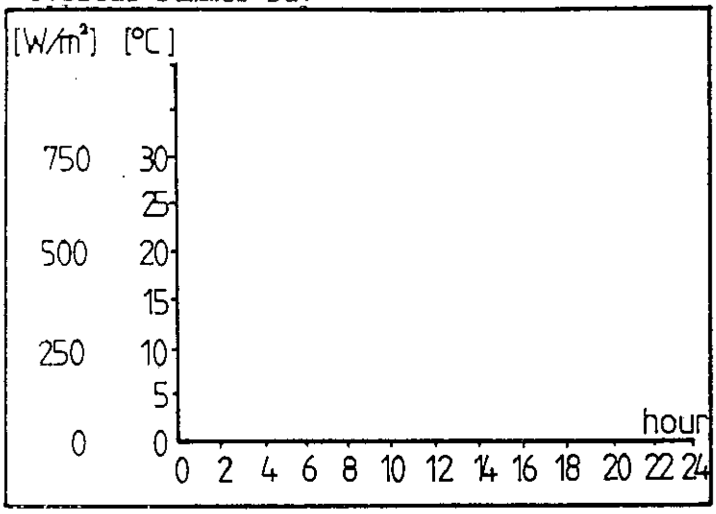
LOWER FLOOR PLAN



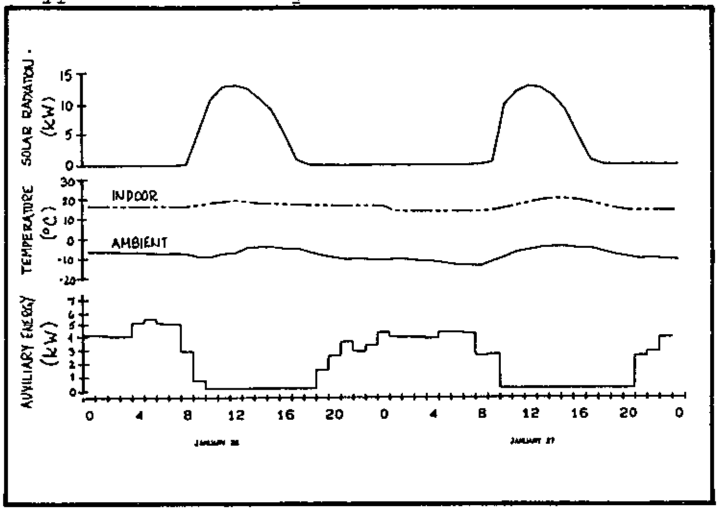
SECTION

Rymark III has 17.7 square meters of south-facing glass. The south-facing windows are triple-glazed with reflective louvers behind the inner glazing. The blinds are designed to reflect sunlight onto the brown ceiling which contains a phase-change heat storage system. This system is based on the principles demonstrated in the MIT SOLAR 5 Project. The phase-change ceiling consists of 52 square meters of eutectic salts (sodium sulphate decahydrate) in bags laid between the ceiling rafters. RSI-7 insulation is placed over the bags in the ceiling. The eutectic salts are designed to change phase at 23 °C. The ceiling storage system is located in the southern half of the ceiling in the dining room, kitchen, master bedroom and the recreation room downstairs.

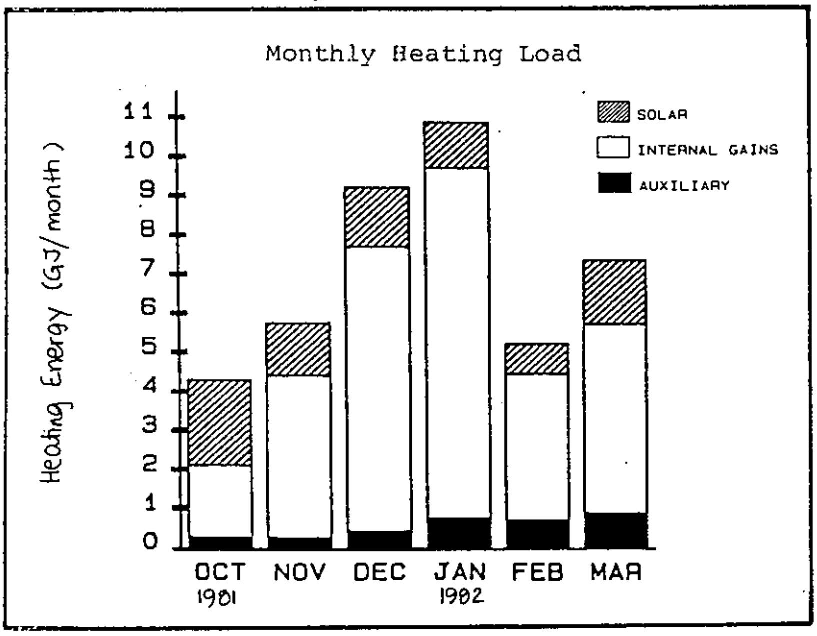
Typical Summer Day



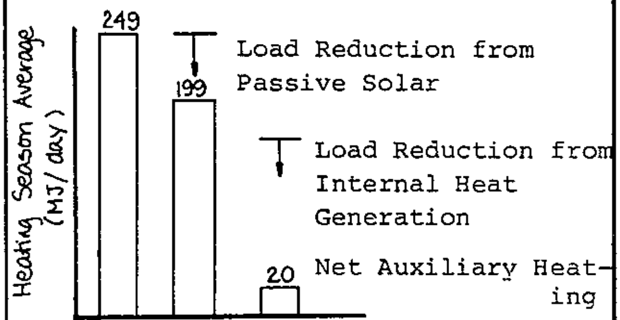
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	20 %
Heating Load Provided by Internal Generation	72 %
Heating Load Provided by Auxiliary Heating	8 %

CONCLUSIONS/FINDINGS

Rymark III was unoccupied for the monitoring period. The non-solar energy consumption represents a 23% savings over Rymark I.

The effect of the thermal mass ceiling caused a shift in the auxiliary energy use profile. Typically, the house warmed up slowly in the morning and the auxiliary heat turned at off at about 10:00 a.m. The storage system carried the load until 9:00 p.m. when the auxiliary heat came back on.

Source of Information: Solar Energy System Performance Evaluation: Rymark I, II, III (by Vitro Labs for NSDN)

IEA
BOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

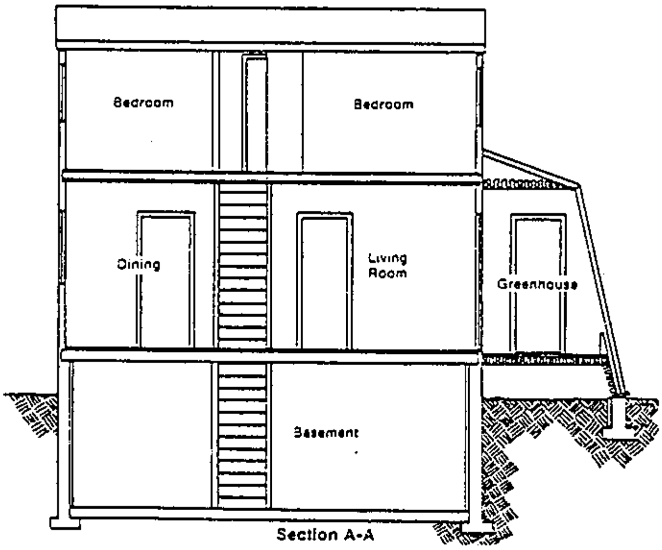
Performance data for systems evaluation

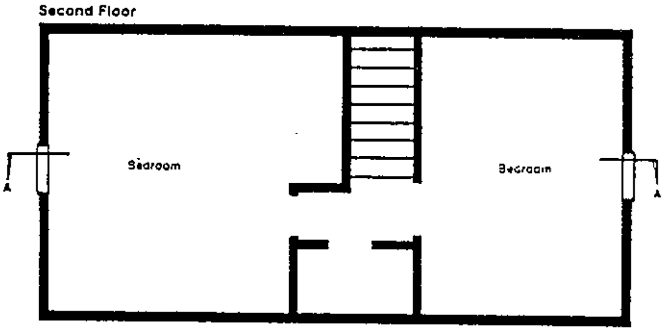
PROJECT TITLE

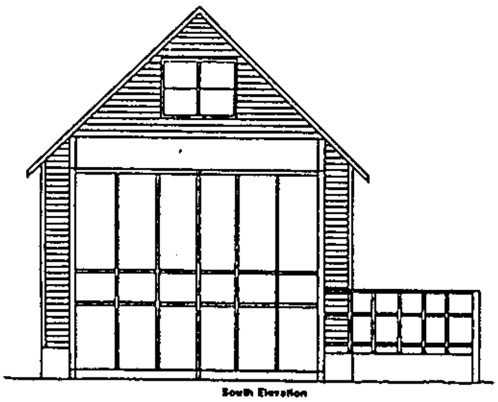
SITE NEH
TOPSHAM , MAINE

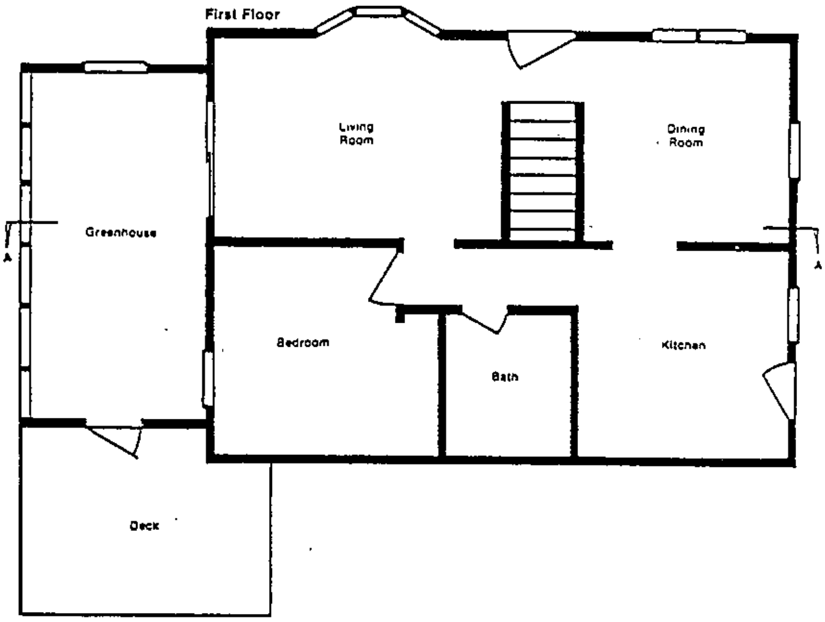
US/ME-01

BUILDING AND SYSTEM DESCRIPTION



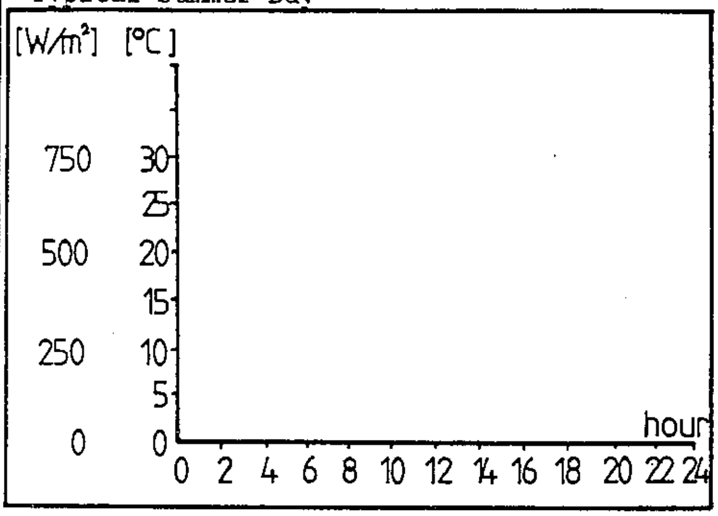




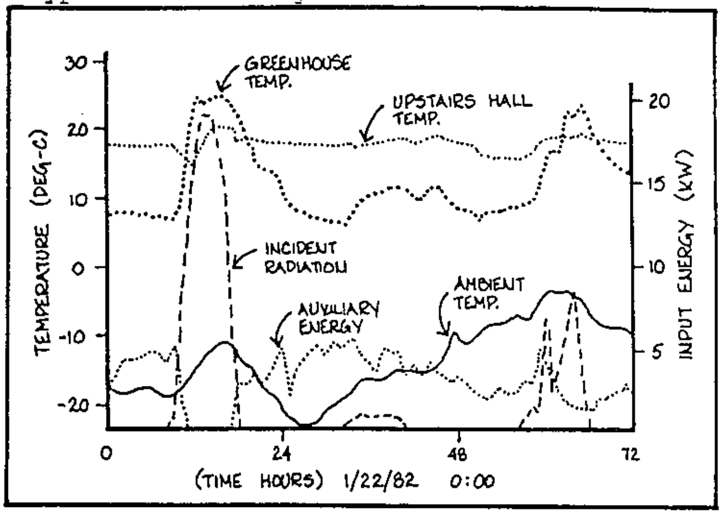


This two-story frame house is located along the lower seacoast of Maine. It is constructed over a full basement and has a retrofit greenhouse built over a crawl space with 161 ft² (15.0 m²) of sloped, south-facing glazing. No significant thermal storage mass is present. A sliding glass door separates the greenhouse from the living room. An electric fan is also used to move heated air from the greenhouse to a first floor bedroom. Insulating shutters are used in the greenhouse only.

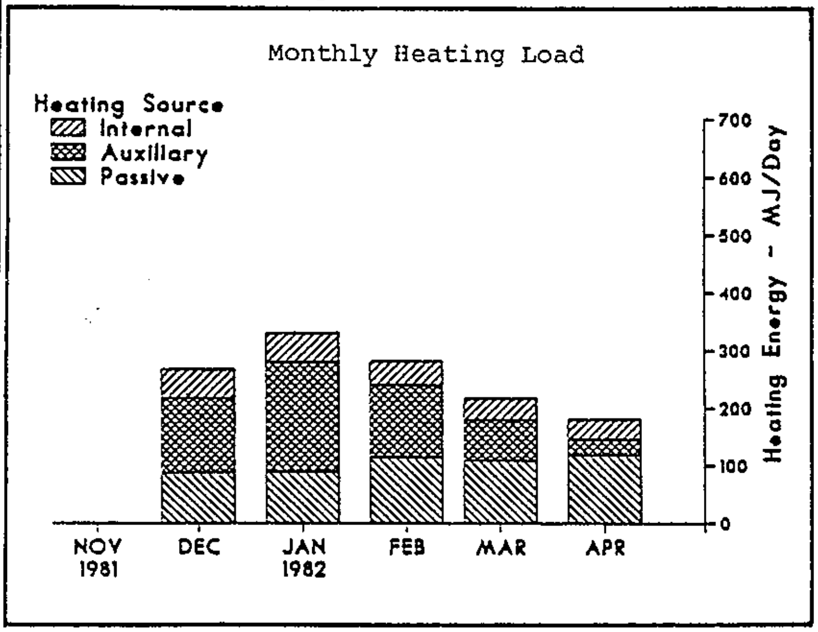
Typical Summer Day



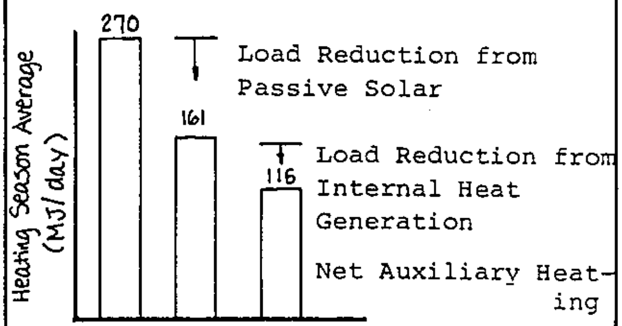
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	40 %
Heating Load Provided by Internal Generation	16 %
Heating Load Provided by Auxiliary Heating	43 %

CONCLUSIONS/FINDINGS

Space heating requirements were kept to a minimum by maintaining the average interior temperature at a moderate 65°F (18°C) and setting the thermostat back several degrees at night. The greenhouse met 40% of the space heating load. With the sliding glass doors open during the day, heat from the greenhouse was convected even to areas on the second floor. The lack of thermal storage mass and the closing of the sliding glass door brought the greenhouse temperature down rapidly in the evening, even with the use of night insulation. The temperature in the greenhouse was not permitted to drop below 45°F (7°C).

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results by J. Swisher and T. Cowing

IEA
SOLAR R&D

Passive and Hybrid Solar Low Energy Buildings

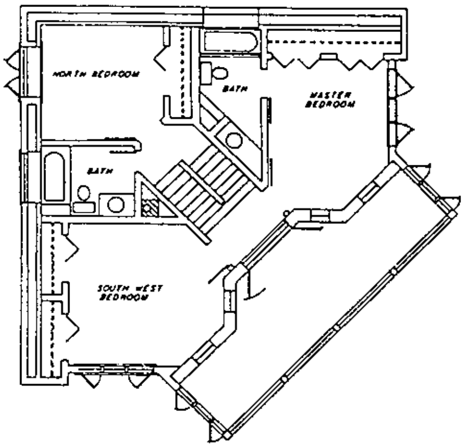
Performance data for systems evaluation

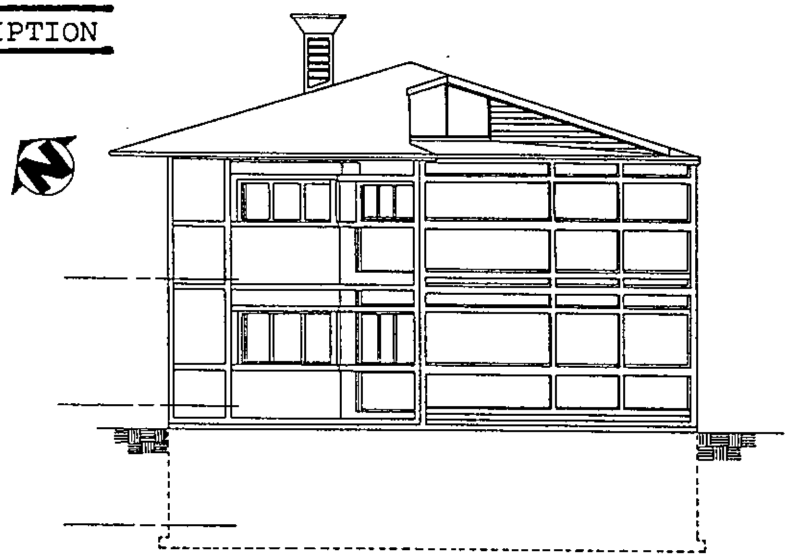
PROJECT TITLE

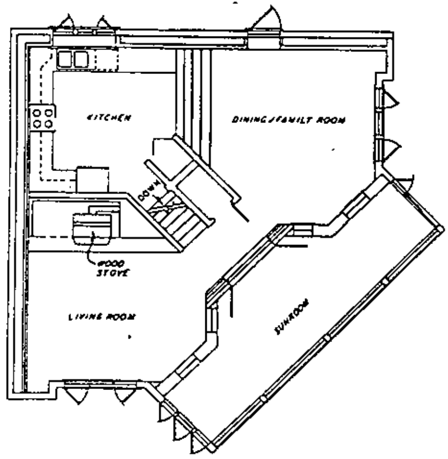
ARNO KAHN
HERMANTOWN, MINNESOTA

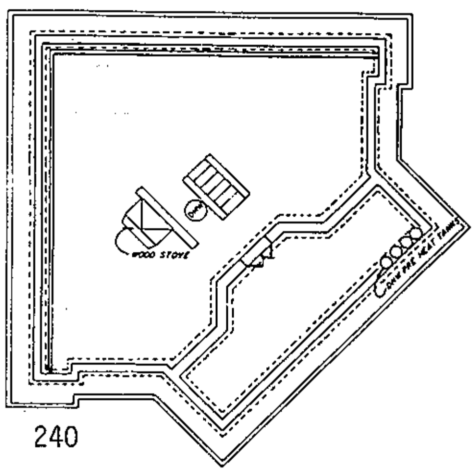
US/MN-01

BUILDING AND SYSTEM DESCRIPTION



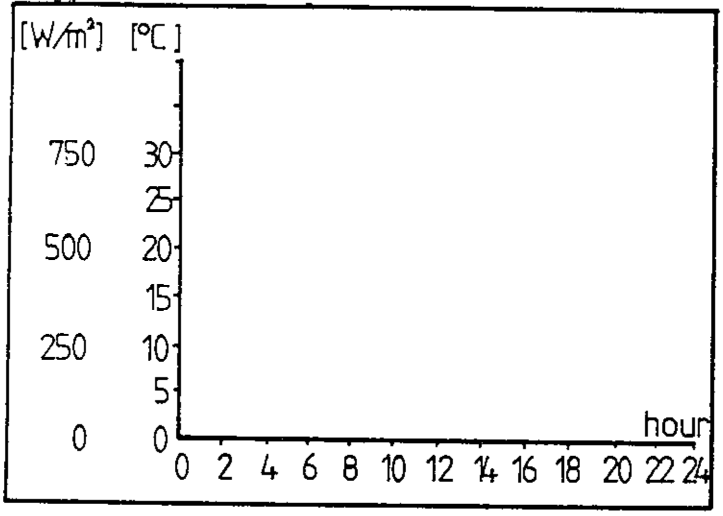




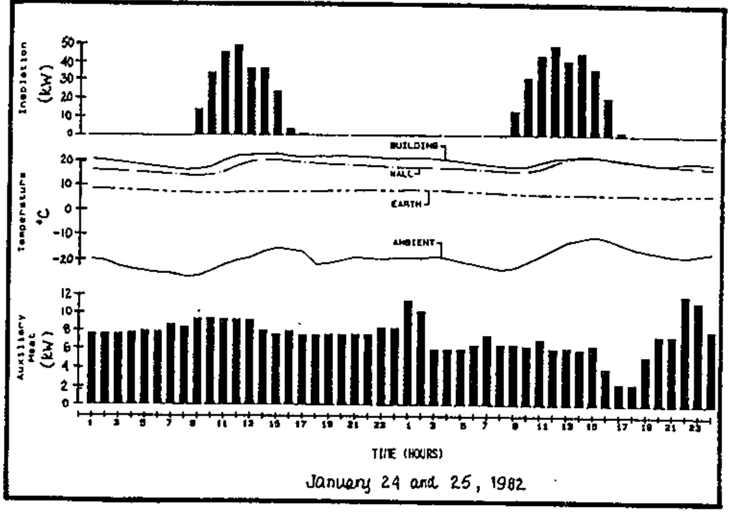


The Arno Kahn site is located in Hermantown, Minnesota, a suburb of Duluth. The house is a modified direct-gain / sunspace sytem integrated with a "thermal envelope". The two-story inner zone has approximately 121 square meters of conditioned living space. The outer zone consists of a three-story solarium, a convection loop along the roof, north walls and basement, and the thermal mass below the living zone. The exterior shell is heavily insulated. A sand-filled concrete block three-story mass wall separates the sunspace from the living space. Manually operated shades originally provided night insulation on the south-facing windows. These were replaced by automatically-controlled RSI-1.8 thermal curtains in the fall of 1981.

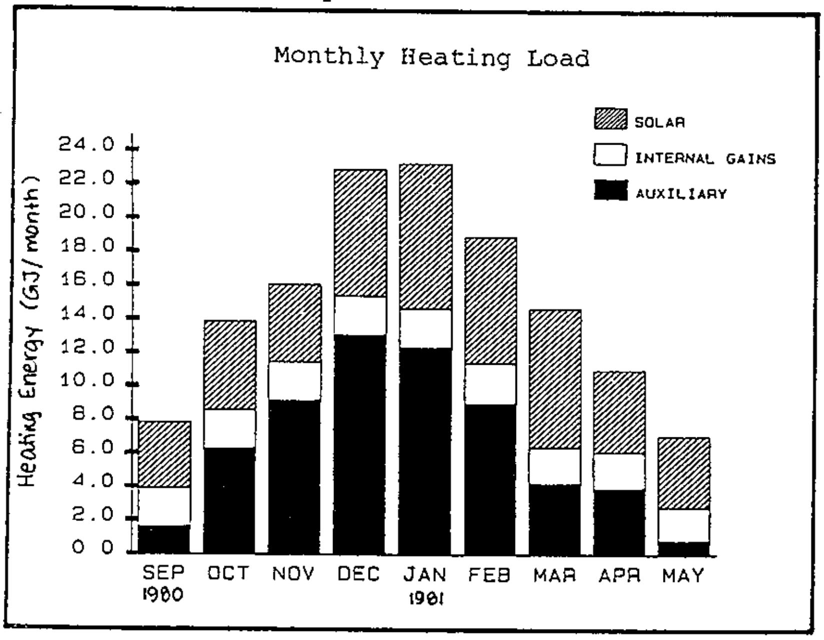
Typical Summer Day



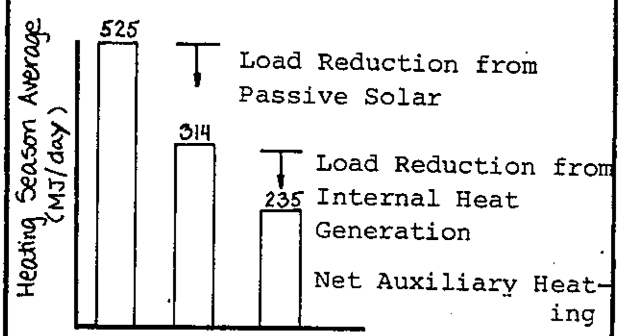
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	40 %
Heating Load Provided by Internal Generation	15 %
Heating Load Provided by Auxiliary Heating	45 %

CONCLUSIONS/FINDINGS

In 1980-81, 27% of the building heat load was lost through the glazing. Subsequently, a complete movable insulation system was installed.

The most notable feature of the house is the "double envelope" design. In theory, air is supposed to flow out the top of the sunspace during the day, across a ceiling chase and down the north walls, dumping the heat into the basement slab and earth below. At night, air is supposed to flow up the north walls, picking up heat from the basement. In practice, this flow was found to be very limited, and the outer envelope temperatures were highly statified.

Source of Information: Solar Energy System Performance Evaluation: Arno Kahn (by Vitro Labs for NSDN)

IEA
BOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

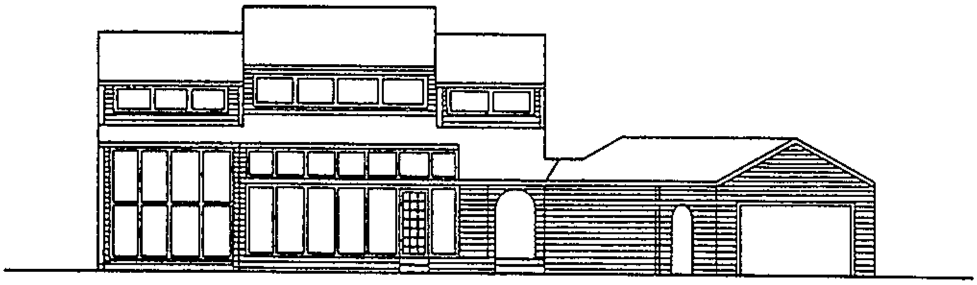
Performance data for systems evaluation

PROJECT TITLE

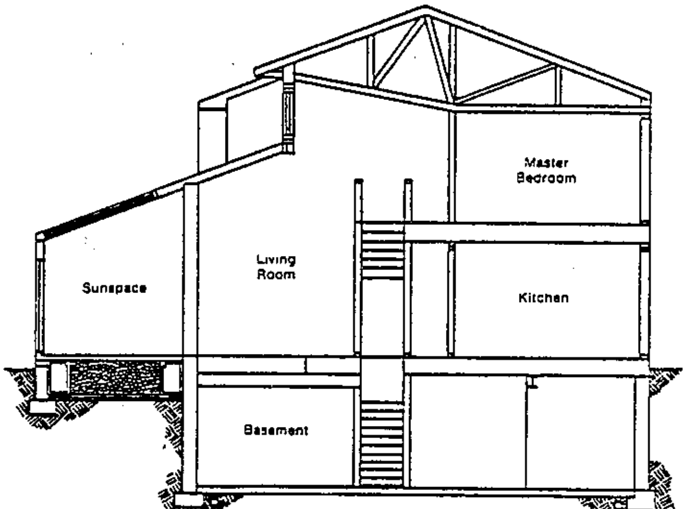
US/NB-01

SITE MAM
LINCOLN , NEBRASKA

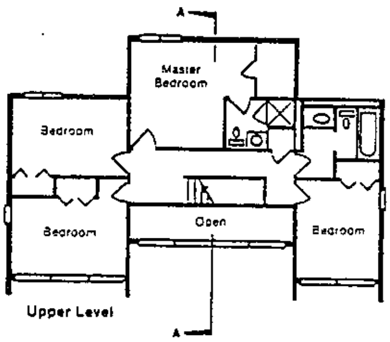
BUILDING AND SYSTEM DESCRIPTION

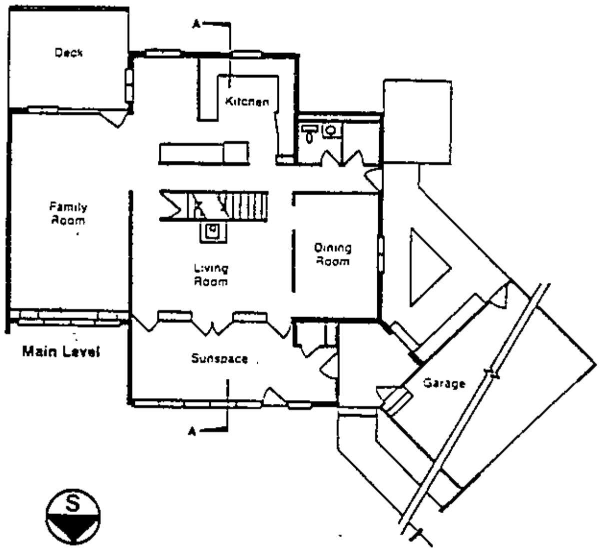


South Elevation



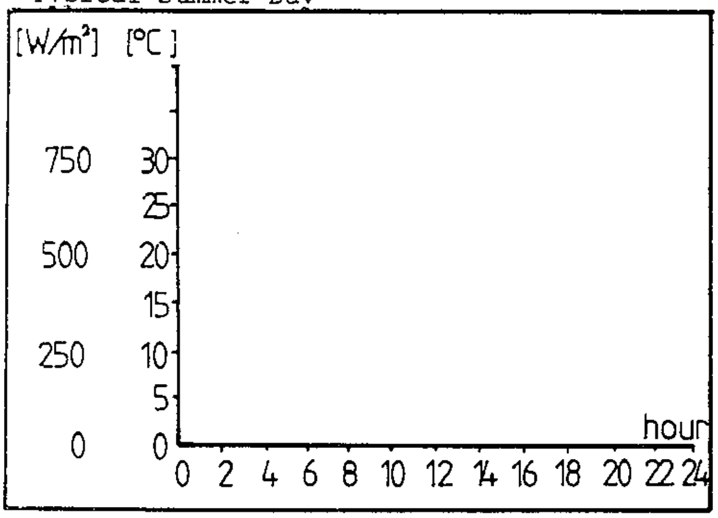
Section



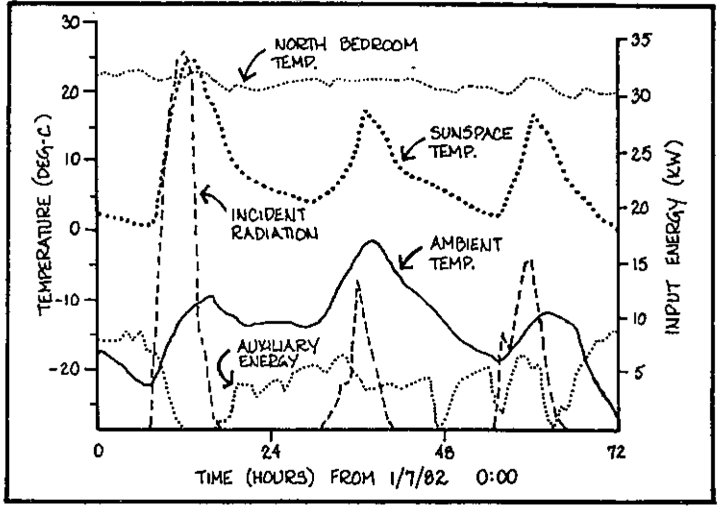


This large two-story house in southeastern Nebraska has a variety of passive solar features. The lower level has a large sunspace with both vertical and sloped glazing. A common wall between the sunspace and the living room is heavily glazed for pass-through direct gain. A thermostatically-controlled sunspace fan charges a rockbed below the brick floor of the sunspace. The upper level receives direct gain through south windows.

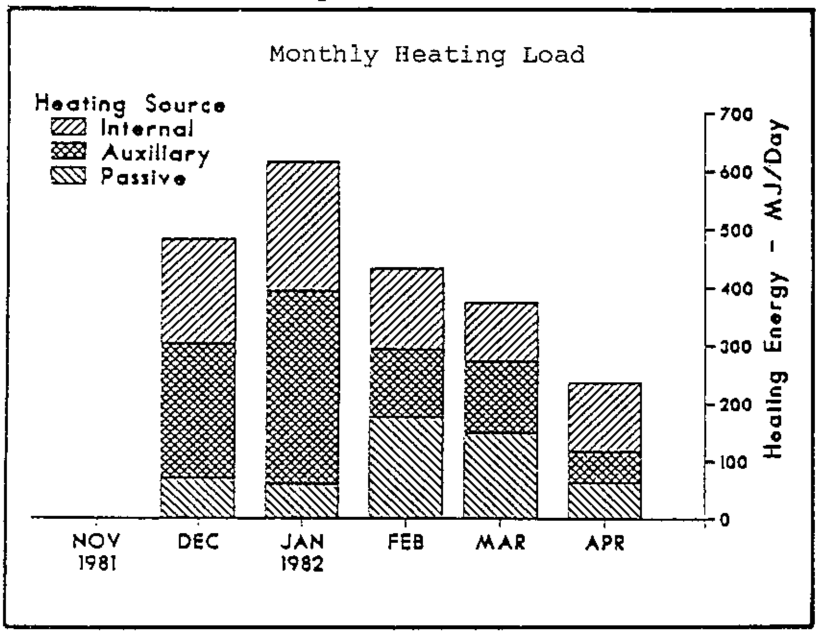
Typical Summer Day



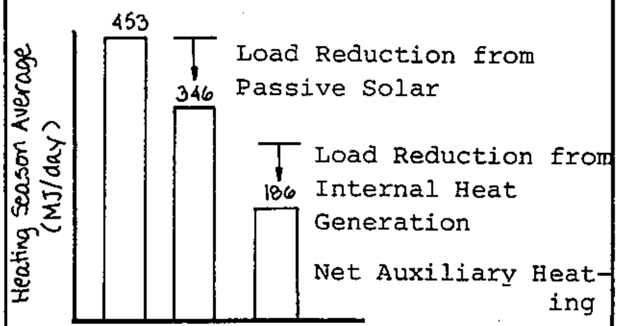
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	24 %
Heating Load Provided by Internal Generation	35 %
Heating Load Provided by Auxiliary Heating	41 %

CONCLUSIONS/FINDINGS

The auxiliary heating needs were quite low for a building of this size. The solar contribution was small during an unusually cold January but increased to 40% during February and March. The poor January performance can be attributed to two factors. First, the mass wall component was shaded during much of the afternoon. The higher sun angles after January alleviated this problem. Second, the cold January temperatures caused excessive heat losses through the sunspace, negating much of its energy collection. Because the rockbed is below the sunspace, not the living space, its energy storage is of little use to the living space when the sunspace is colder than the living space, as was the case throughout January.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results 243 by J. Swisher and T. Cowing

IEA SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

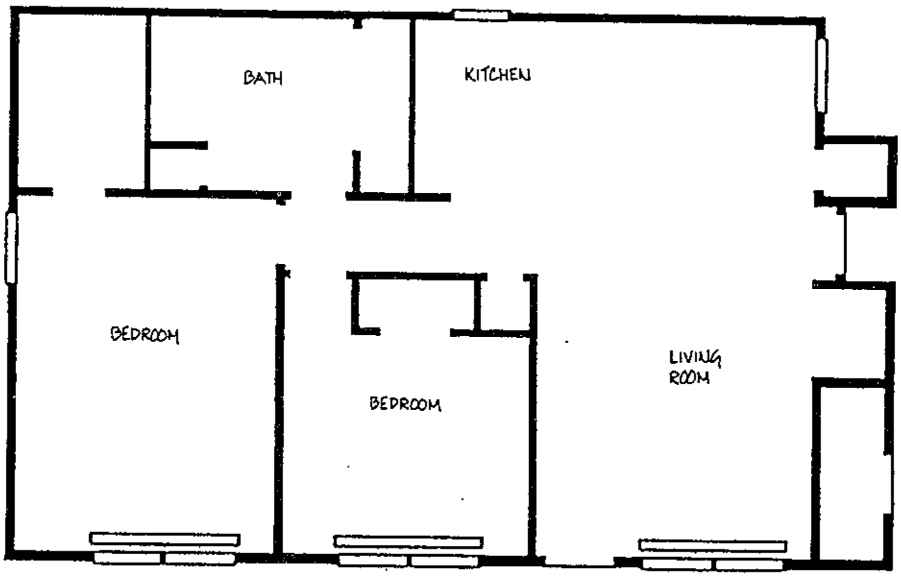
Performance data for systems evaluation

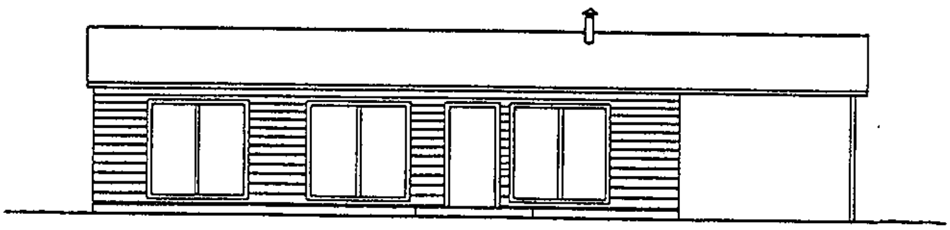
PROJECT TITLE

US/NC-03

Site SSK
Black Mountain, North Carolina

BUILDING AND SYSTEM DESCRIPTION

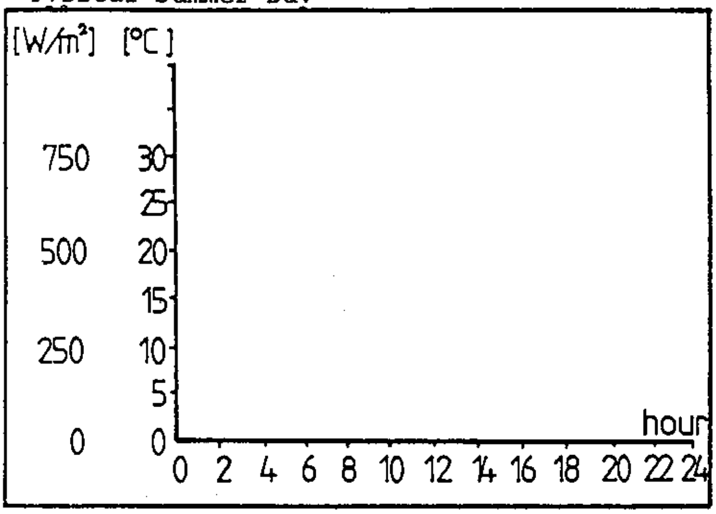




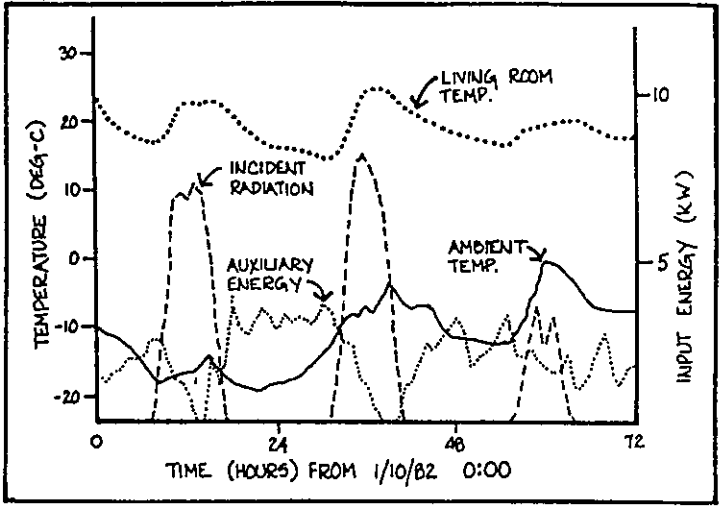
South Elevation

This small slab-on-grade house is located in Black Mountain, in western North Carolina. It has mass walls behind most of the south glazing. These walls are made of 20 cm-thick concrete blocks filled with cement. The south glazing is fitted with insulating shades for reducing both winter night-time heat loss and summer day-time heat gain.

Typical Summer Day

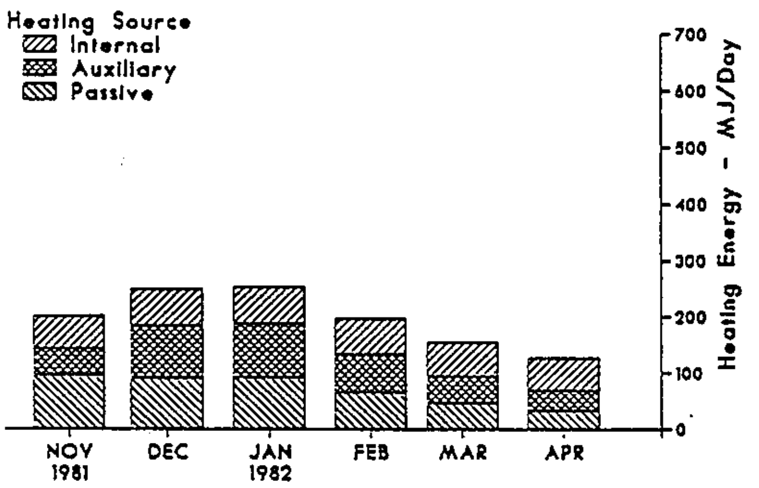


Typical Winter Day

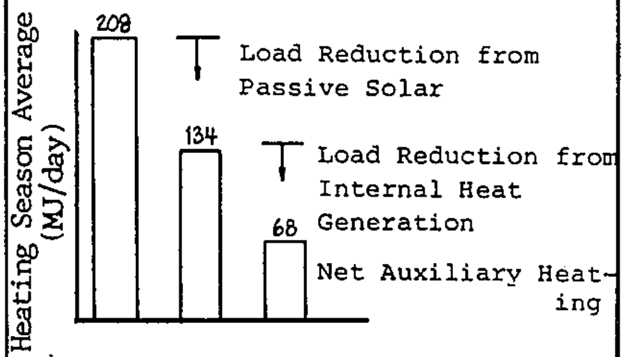


Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	36 %
Heating Load Provided by Internal Generation	31 %
Heating Load Provided by Auxiliary Heating	33 %

CONCLUSIONS/FINDINGS

The amount of south glass is quite small: it is less than 10% of the floor area of the house. Nevertheless, it was effective in meeting 36% of the heating load through the winter. The thermal mass helped maintain relatively stable temperatures in the living space.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

IEA
SOLAR R&D

Passive and Hybrid
Solar Low Energy Buildings

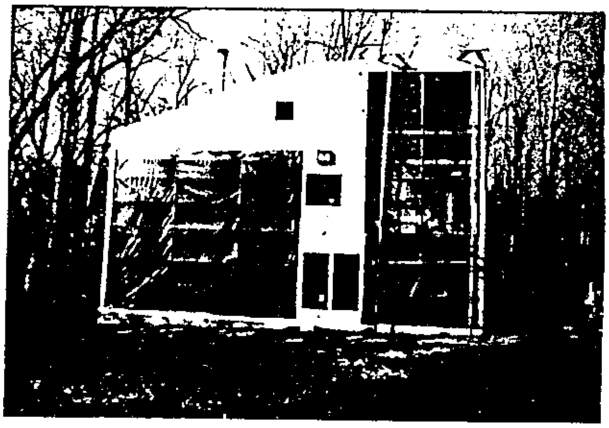
Performance data for systems evaluation

PROJECT TITLE

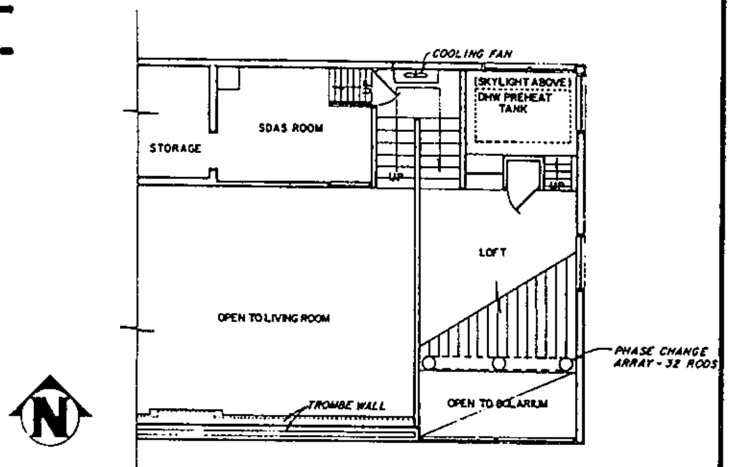
US/NJ-01

ENVIRONMENTAL PARTNERSHIP
CREAM RIDGE , NEW JERSEY

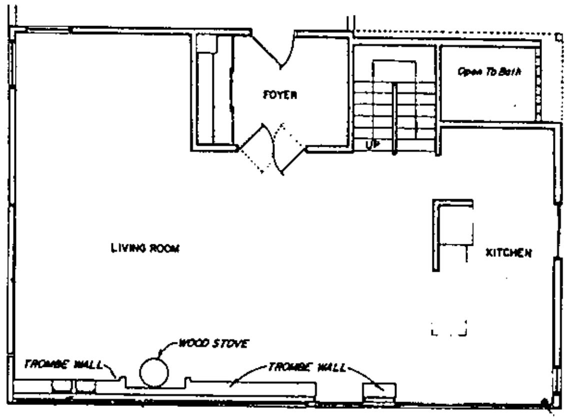
BUILDING AND SYSTEM DESCRIPTION



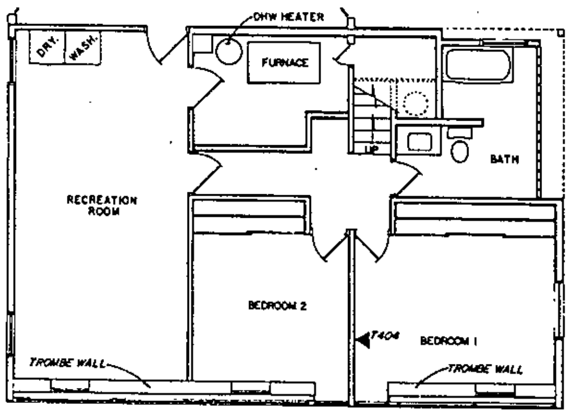
This house is located in a wooded area near Trenton, New Jersey. It incorporates a two-story direct gain sunspace, a three-story Trombe wall and a passive solar water preheat tank. Storage of solar heat is provided in the .30 meter thick Trombe wall and in a series of phase-change rods in the sleeping loft. A small fan redistributes collected heat in the upstairs to the lower floor.



LOFT AREA

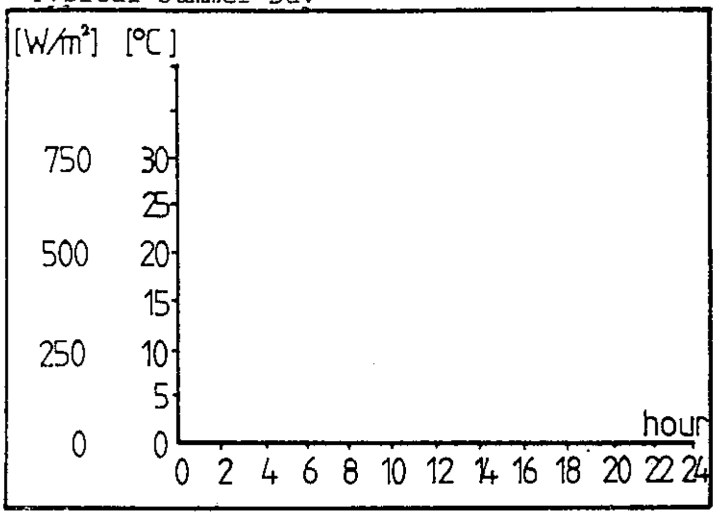


SECOND FLOOR

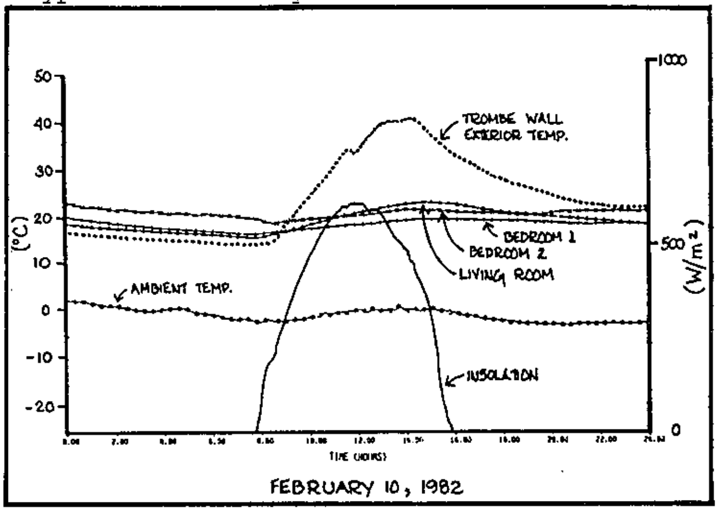


FIRST FLOOR

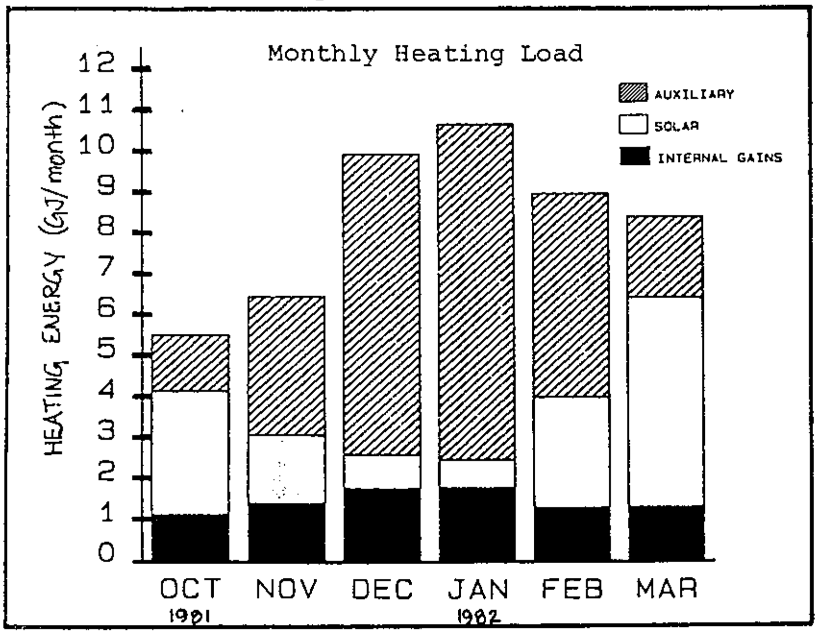
Typical Summer Day



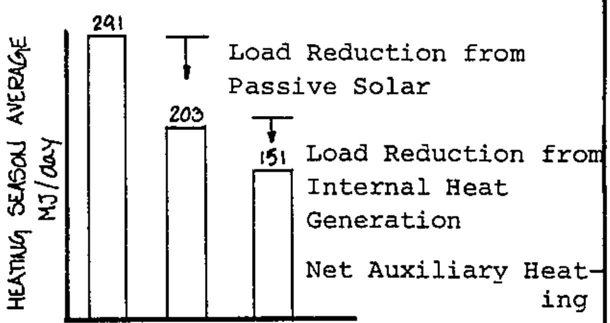
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	30 %
Heating Load Provided by Internal Generation	18 %
Heating Load Provided by Auxiliary Heating	52 %

CONCLUSIONS/FINDINGS

The overall collection efficiency was an estimated 18% of the total incident radiation.

The conduction heat loss from the sunspace was as large as the solar energy collected, at 9.12 GJ lost. This loss was due to the large (15.6 net m^2 glass area. The addition of a movable insulating curtain could reduce the heat loss from the glass area by up to 1/3. This addition would be the single most effective method of increasing the solar heating contribution.

The estimated heat flux from the interior of the Trombe wall was 1.66 GJ over the six-month season, which translates to an estimated overall collection efficiency of 4%. This indicates a fundamental problem at the site - the high exterior losses from the Trombe wall. The site owner operated the wall in a purely conductive mode; that is, the interior wall vents were not opened during the day. Energy was transferred through the wall in a conduction mode only, which may have limited the wall output to some extent.

The Trombe wall had a seasonal variation in temperature as well as a daily temperature swing. The msss wall participates less in the dead of winter (Dec. and Jan.) when the building temperature nearly equals the wall temperature. The wall did provide a net positive effect, since it was essentially adiabatic (i.e., no net heat transfer) during most of the six-month heating season.

Source of Information: Solar Energy System Performance Evaluation: Environmental Partnership (by Vitro Labs for NSDN)

IEA SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid Solar Low Energy Buildings

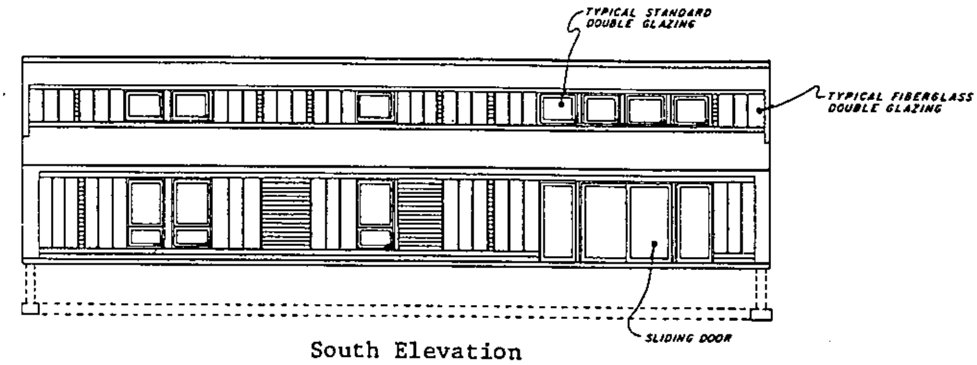
Performance data for systems evaluation

PROJECT TITLE — GILL HARROP

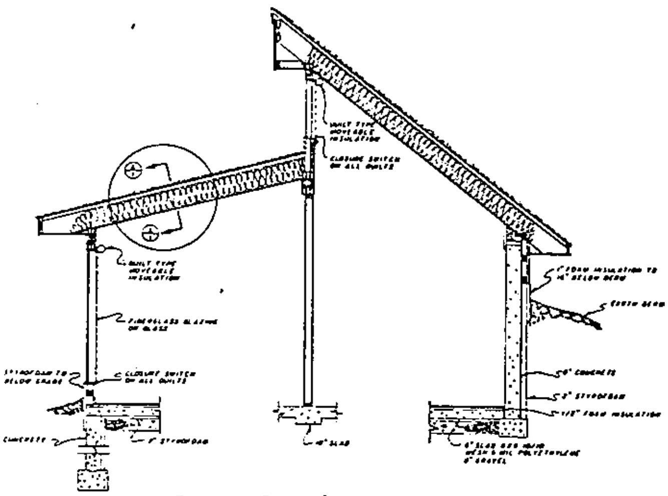
BIG FLATS, NEW YORK

US/NY-01

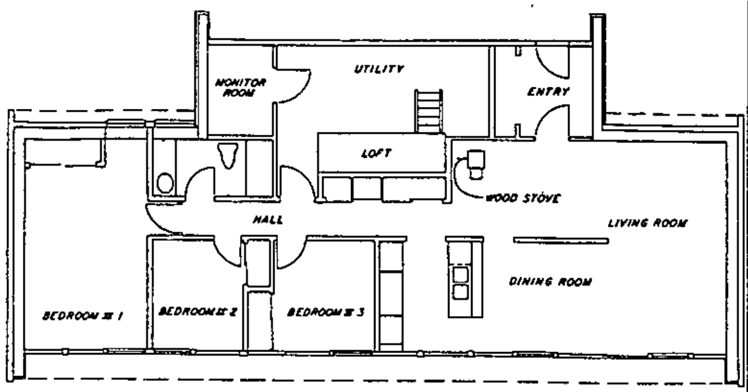
BUILDING AND SYSTEM DESCRIPTION



South Elevation



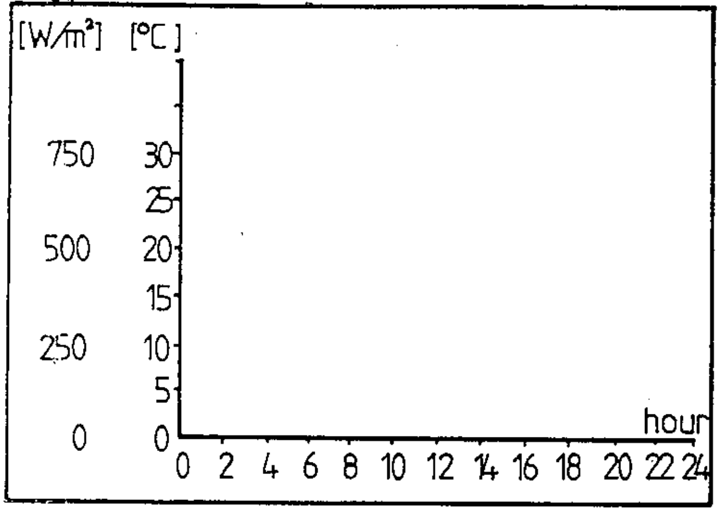
Cross Section



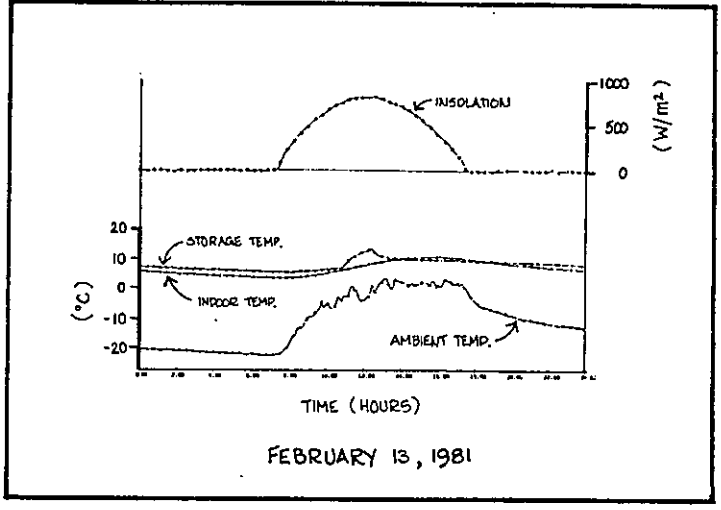
Floor Plan

The collection aperture on this single-story residence in central New York State consists of vertical glazing on most of the south wall and a clerestory which admits solar radiation into the north rooms. The glazing is fixed double-walled fiberglass with operable glass windows to permit venting. All south-facing glazing has movable quilt-type insulated curtains. Both the south wall and the clerestory have overhangs to prevent summer overheating. Heat storage is in the concrete floor slab and exterior insulated concrete walls.

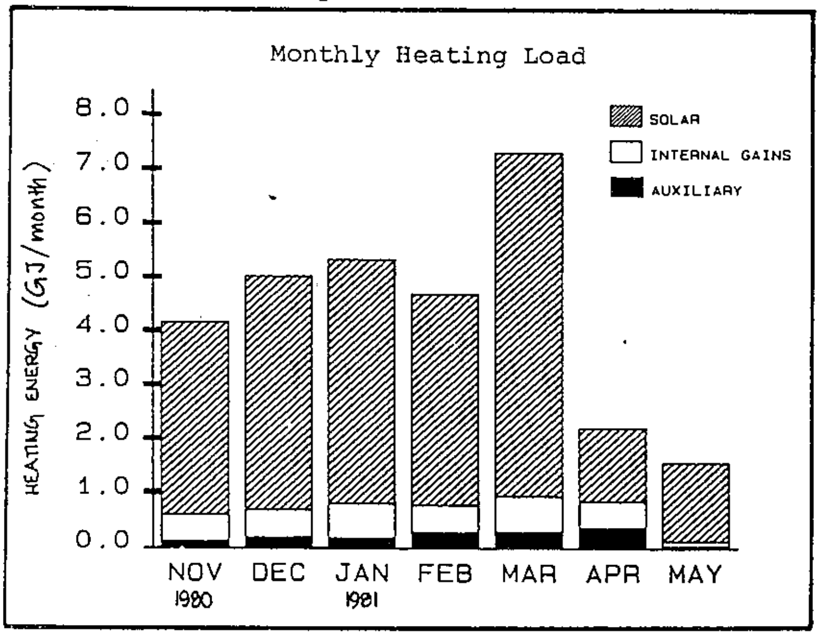
Typical Summer Day



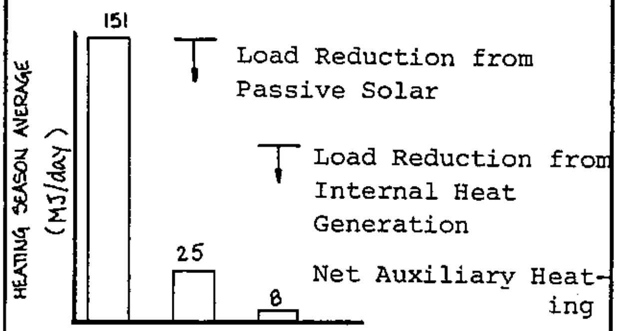
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	84 %
Heating Load Provided by Internal Generation	11 %
Heating Load Provided by Auxiliary Heating	5 %

CONCLUSIONS/FINDINGS

The system was operational throughout the 1980-81 heating season and performed very well. The house was unoccupied for the entire period. During this period, the auxiliary heating thermostats were set back. This allowed the solar system to supply most of the space heating requirements of the building. Since the house was unoccupied, there was no one there to operate the movable insulation. It is anticipated that when the house is occupied the increased heating load resulting from the higher thermostat setting will be partially offset by the use of the insulating curtains.

Source of Information: Solar Energy System Performance Evaluation: Gill Harrop (by Vitro Labs for NSDN)

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

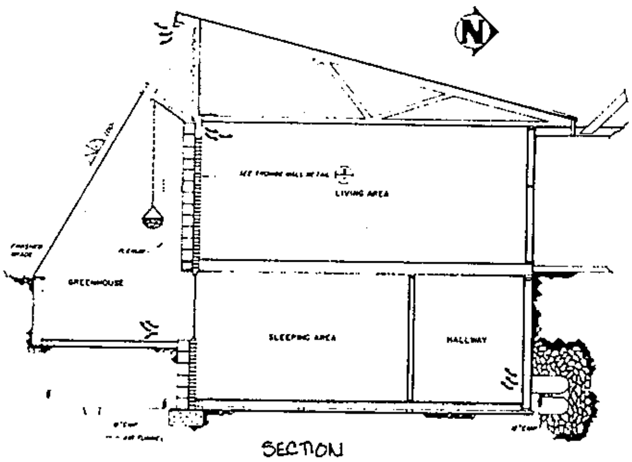
PROJECT TITLE

BAKER CONSTRUCTION

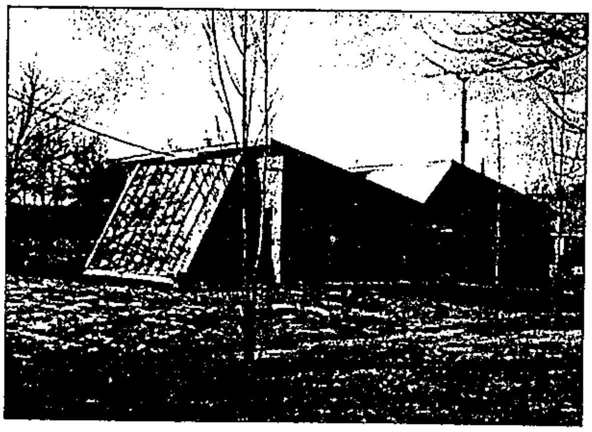
CINCINNATI, OHIO

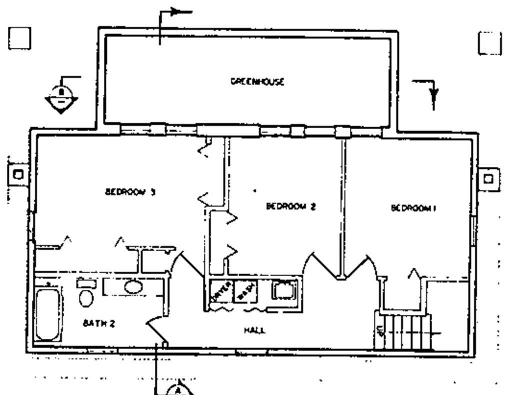
US/OH-01

BUILDING AND SYSTEM DESCRIPTION



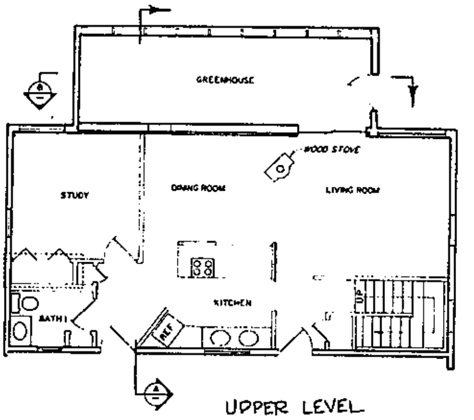
SECTION





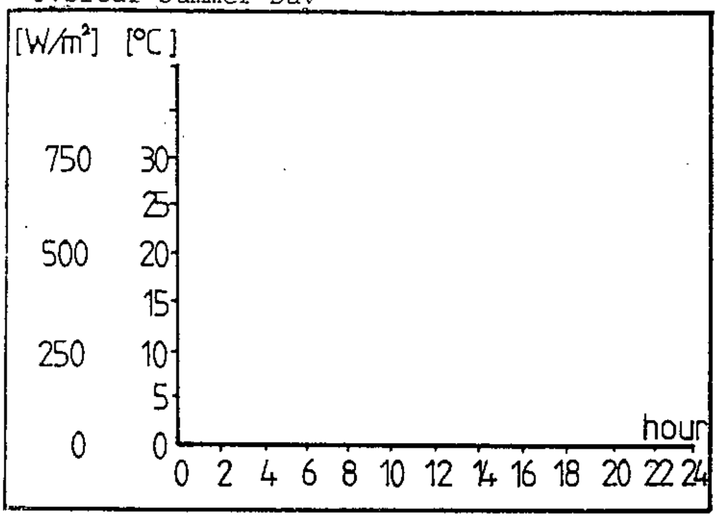
LOWER LEVEL

The lower floor of this 149 square meter, two-level house in Cincinnati, Ohio is below grade. The greenhouse has 37 square meters of double glazing and is constructed so that solar energy can be admitted to both floors. The upper 8 square meter portion of the greenhouse is a site-built active solar collector, from which solar heated air is fan-forced into the living space. Insulating shades (RSI-.6) reduce greenhouse heat losses at night. Additional solar energy is collected by two windows located in the sections of the south wall which extend to the sides of the greenhouse. Thermal storage is provided by a 30 centimeter concrete and brick mass wall, located between the greenhouse and living area, the floor slab of the greenhouse and a phase-change module mounted on the south face of the mass wall. Extra heat, when required, is provided by a wood-burning stove and electric baseboard heaters.

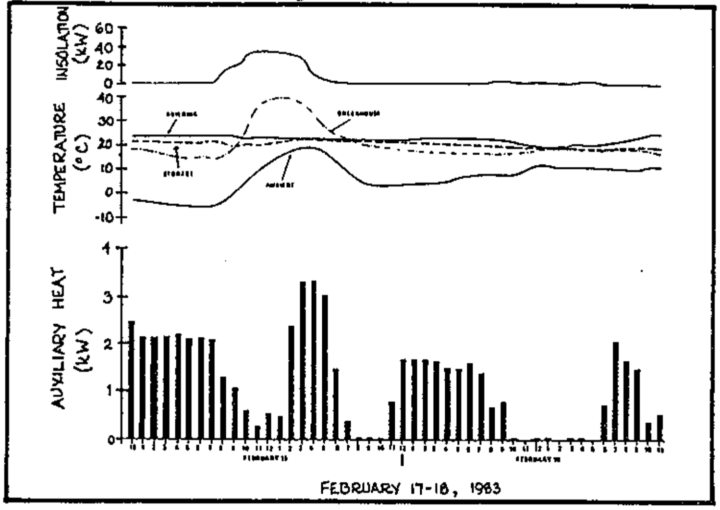


UPPER LEVEL

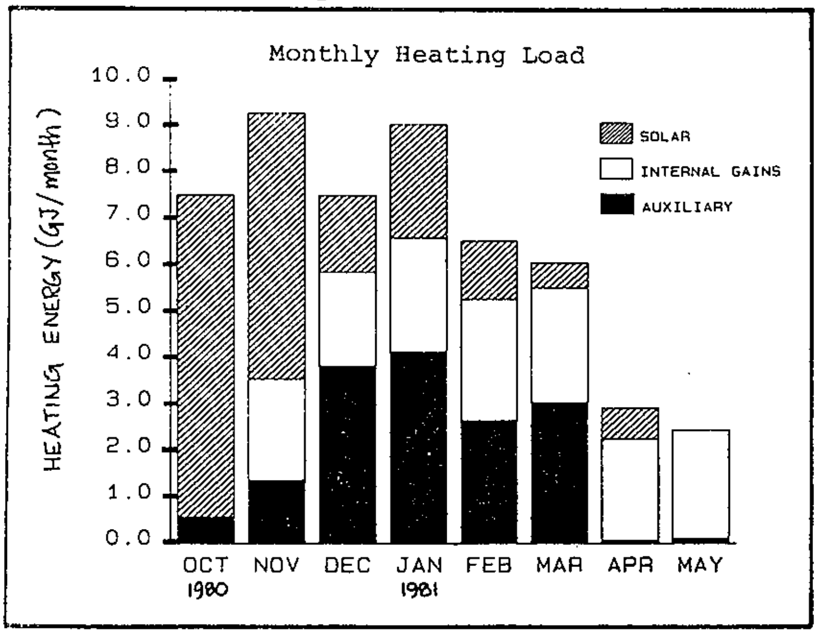
Typical Summer Day



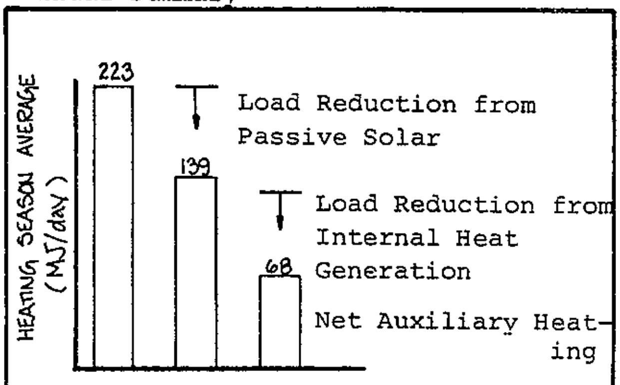
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	38 %
Heating Load Provided by Internal Generation	31 %
Heating Load Provided by Auxiliary Heating	31 %

CONCLUSIONS/FINDINGS

The infiltration loss was 36% of the building heat load. The internal gains were high. This is due to the frequent use of the electric clothes dryer which was vented indoors during the heating season. The electric baseboard heaters provided 21% of the heat load. The electric baseboard heaters were mainly used in the bedrooms on the lower level. Because of stratification of heat in the building, the upstairs is always warmer than the downstairs. A ceiling fan is used over the stairwell to try to destratify the air, but its effectiveness is limited. At times, when the greenhouse was hot, the upstairs overheated and the downstairs was cool and required auxiliary heating.

The movable insulation in the greenhouse was used when possible on cold nights and to prevent overheating during warm days. The operation of the "window quilt" was limited for much of the season due to problems with the curtain pulling loose from the track. The weight of the curtain on a 60° slope tends to pull it out of the track.

The storage wall absorbed 19.15 GJ and gave off 19.03 GJ. Ninety-five percent of the solar energy used went through storage before going to the load. The phase-change system responded very quickly to incoming solar radiation. The phase-change storage tubes in the vertical position seem to stratify severely.

Source of Information: Solar Energy System Performance Evaluation: Baker Construction (by Vitro Labs for NSDN)

IEA
SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

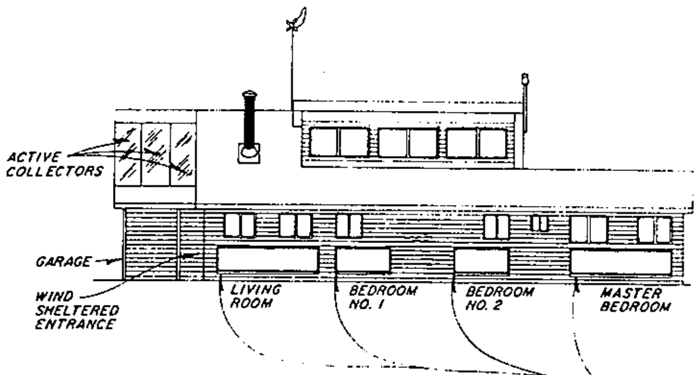
Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

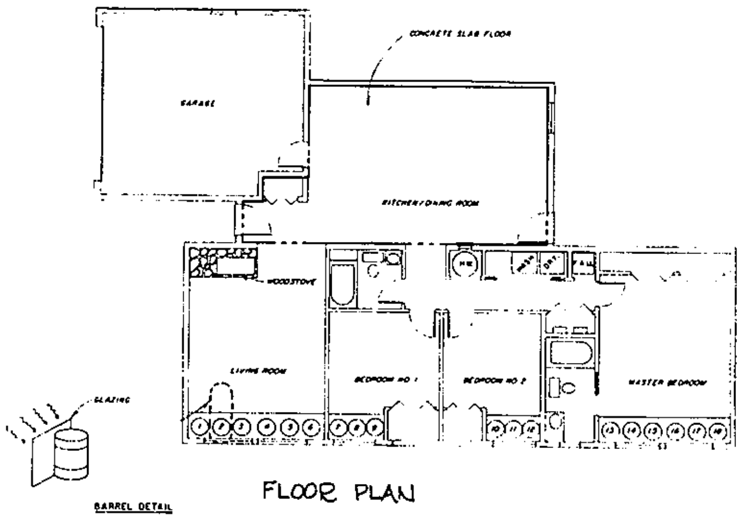
PROJECT TITLE — MODENA HOMES

US/OR-08 — EUGENE, OREGON

BUILDING AND SYSTEM DESCRIPTION



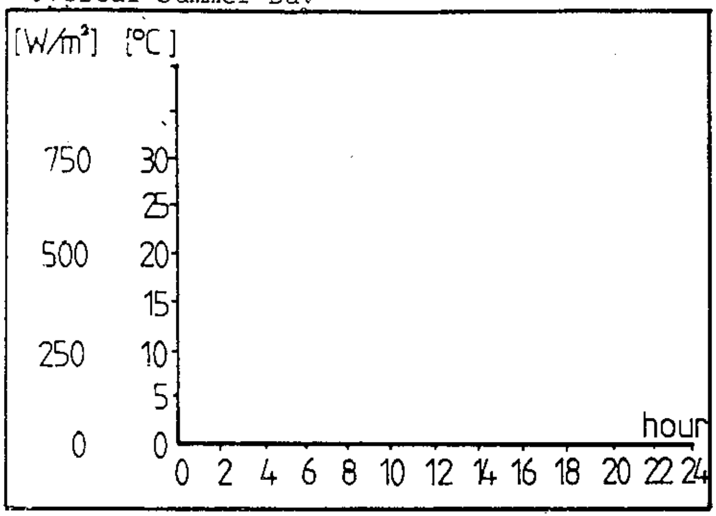
SOUTH ELEVATION



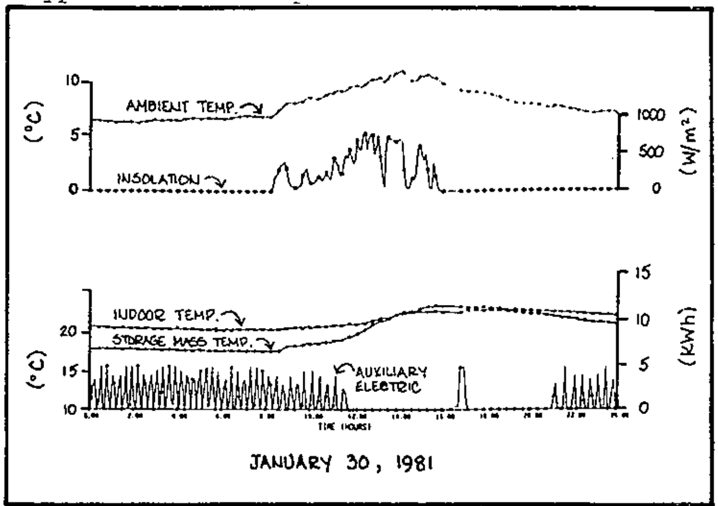
FLOOR PLAN

This single-story home, located in Eugene, Oregon, has a direct gain system with 16.1 square meters of south wall glazing area and 2.9 square meters of clerestory windows. Eighteen 210-litre drums located directly behind the south wall windows provide thermal storage. Auxiliary storage is provided by the 10 cm floor slab. Night heat losses from the clerestory and the windows directly in front of the water drums are reduced by insulating shutters which have an RSI-2.5 value. Auxiliary space heating is provided by a wood stove and an electric furnace unit.

Typical Summer Day

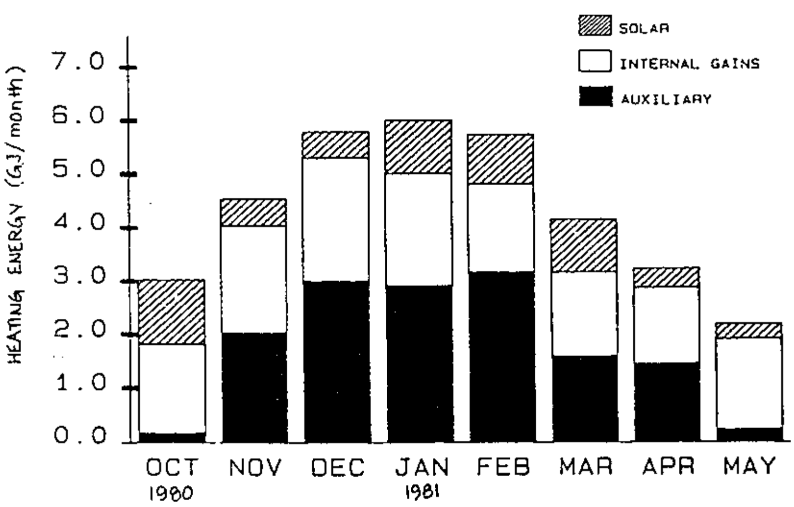


Typical Winter Day

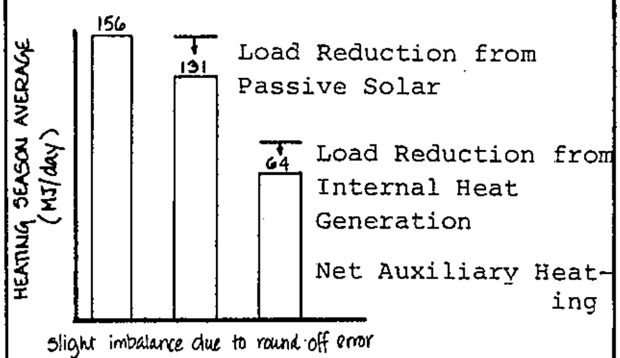


Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	16 %
Heating Load Provided by Internal Generation	39 %
Heating Load Provided by Auxiliary Heating	41 %

CONCLUSIONS/FINDINGS

The number of heating degree-days for the monitored period, 4,129, was 8% lower than the long-term average of 4,503 heating degree-days. The amount of measured insolation available to the south glazing was significantly lower (50%) than the long-term expected average. The lower insolation values are partially due to local obstructions, consisting of a house located not too far to the south and a picket fence. In addition, the weather cover on the winch for the shutters shades the lower collectors and pyranometer part of the time. The low available insolation levels in part explain the rather poor performance demonstrated by the passive solar system. Also influential were the elevated interior temperatures which required additional auxiliary energy to maintain.

The house was occupied during the entire monitored period. The owners did experience some difficulties operating the movable insulation. The shutters jammed in the partially-open position, which prevented calculation of the operational incident solar energy or night-time R-values of the windows. Losses from the collector are based on estimated times of operation.

Source of Information: Comparative Report: Performance of Passive Solar Solar Space Heating Systems (by Vitro Labs for NSDN)

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

Performance data for systems evaluation

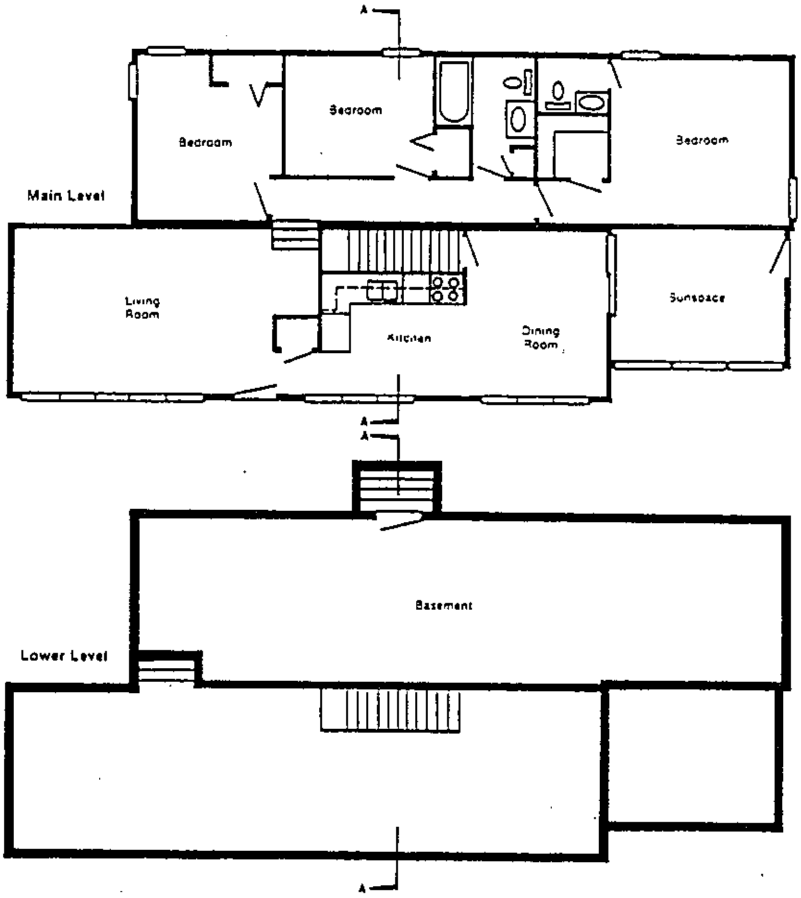
PROJECT TITLE

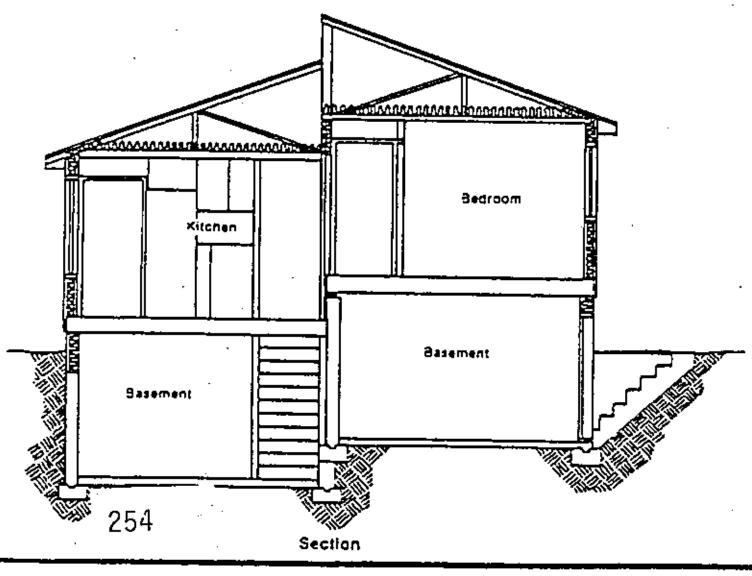
US/RI-02

SITE NEL
JAMESTOWN, RHODE ISLAND

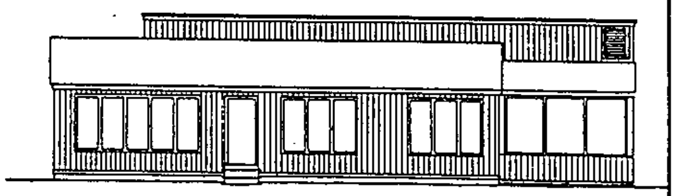
BUILDING AND SYSTEM DESCRIPTION

This single-story house is located near the Atlantic seacost in Rhode Island. It was manufactured in sections and assembled on a full-basement concrete foundation. It has a sunspace with 6.5 square meters of sloped glazing and a concrete floor for thermal mass. The house also receives direct solar gain through 9.7 square meters of south glazing. Heated air from the sunspace can be blown to the bedrooms in the rear of the house through insulated plenums in the basement, although the fan did not operate during the monitoring period.

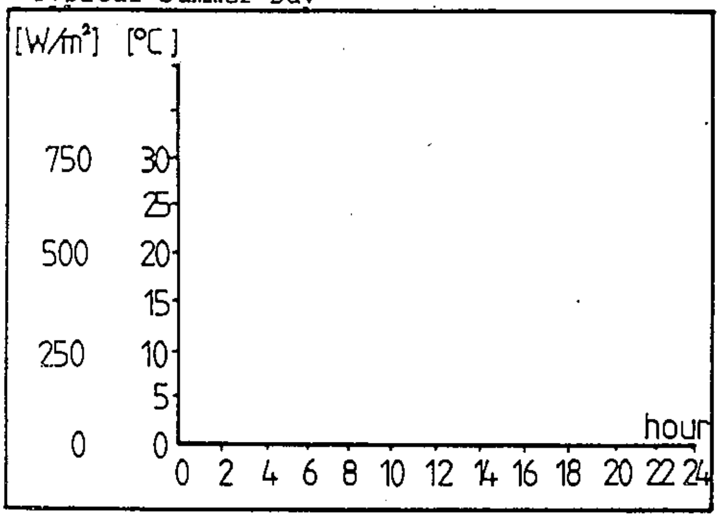




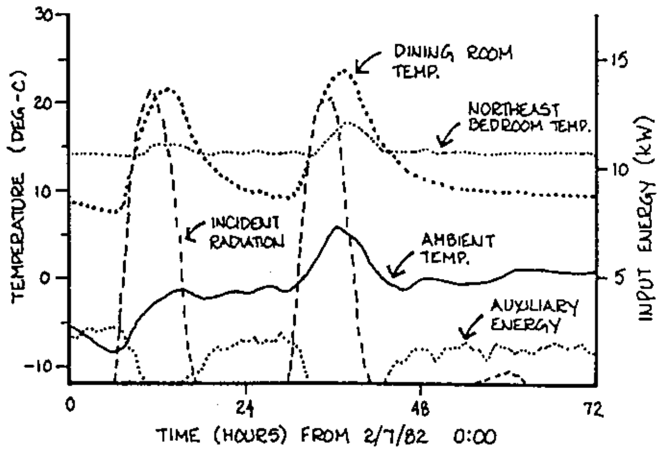
Section


South Elevation

Typical Summer Day

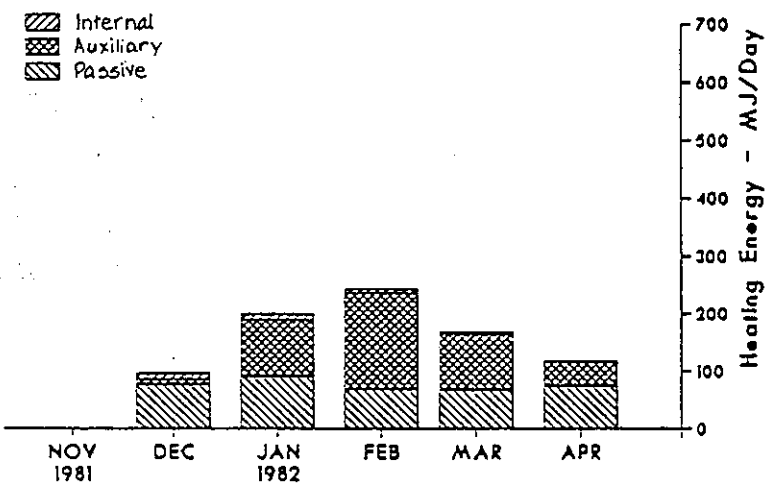


Typical Winter Day

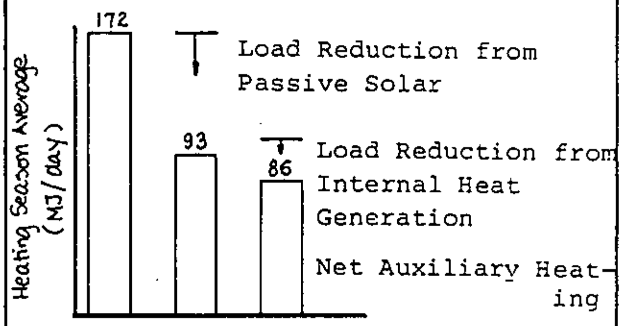


Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	46 %
Heating Load Provided by Internal Generation	3 %
Heating Load Provided by Auxiliary Heating	50 %

CONCLUSIONS/FINDINGS

This house remained unoccupied through the heating season so there was very little internal heating. Also, the interior temperatures were allowed to float during December and January and at times fell below 50° F (10° C). Thus, the measured solar contribution to the space heating load of 46% does not reflect the system's performance under normal conditions.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results; by J. Swisher and T. Cowing

IEA
SOLAR R&D

·INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

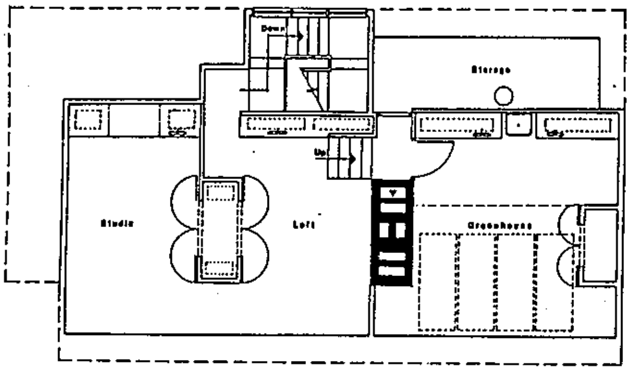
Performance data for systems evaluation

PROJECT TITLE

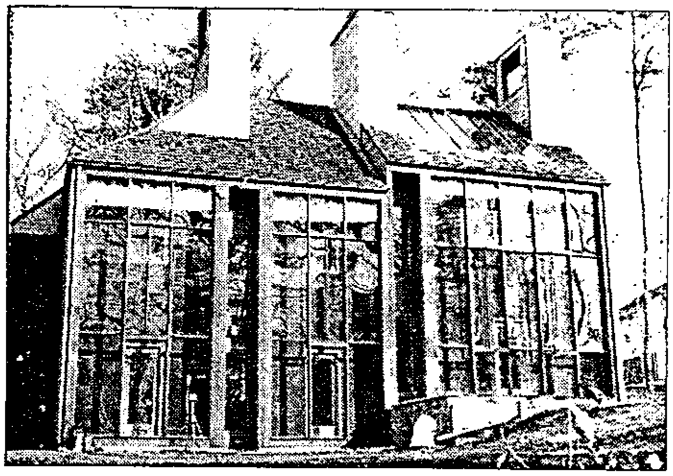
ROBERTS HOME
RESTON, VIRGINIA

US/VA-01

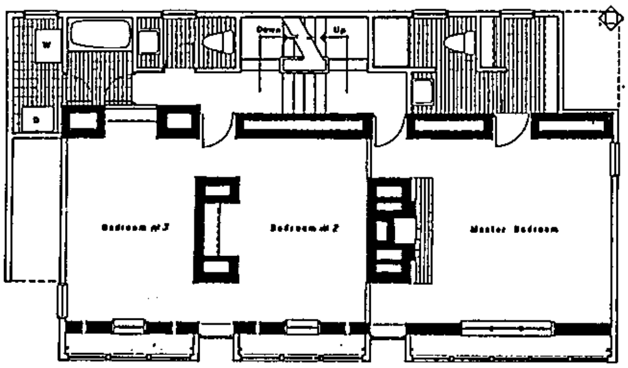
BUILDING AND SYSTEM DESCRIPTION



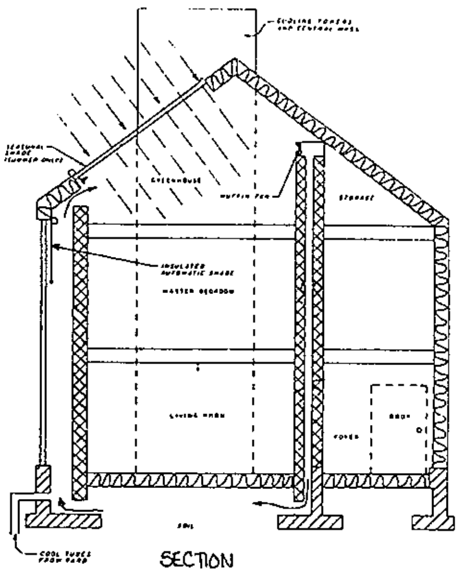
THIRD LEVEL



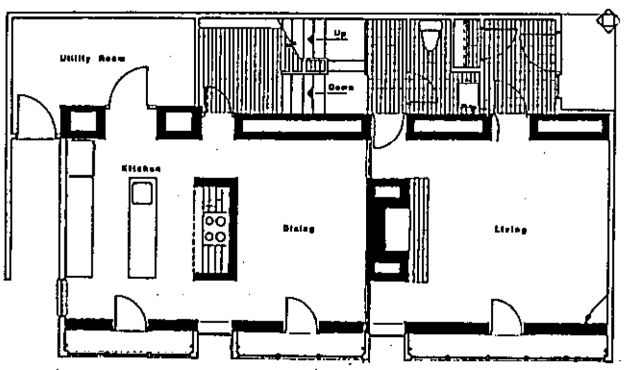
SOUTH ELEVATION



SECOND LEVEL



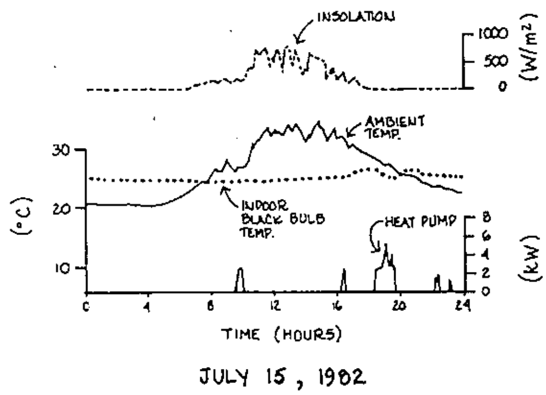
SECTION



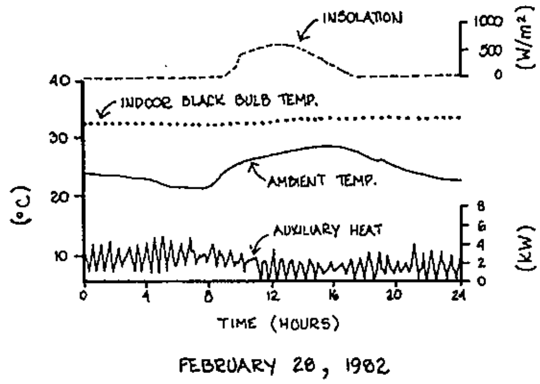
FIRST LEVEL

Space heating for this house is supplied by three sections of two - story Trombe wall, and a sunspace located on the third floor. Thermal storage is provided by the .30 meter Trombe wall, a hollow-core north wall and two centrally located fireplaces. RSI-2.1 thermal curtains reduce night-time heat losses from the Trombe wall.

Typical Summer Day

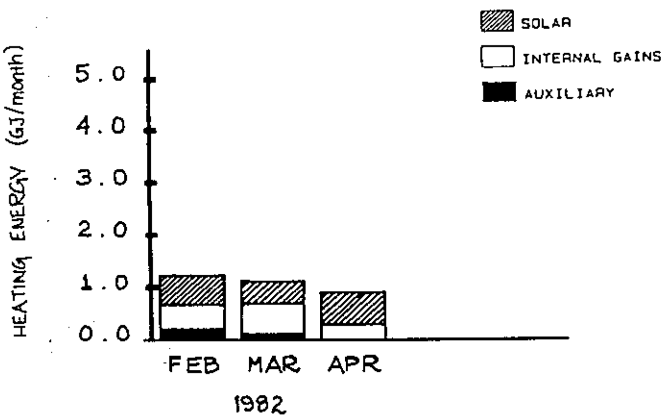


Typical Winter Day

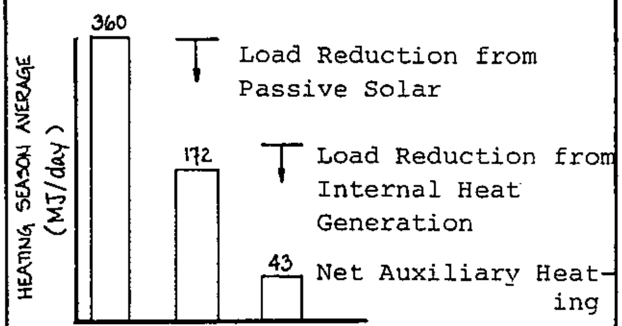


Performance Summary

Monthly Heating Load



Annual Summary



Heating Load Provided by Passive Solar	52 %
Heating Load Provided by Internal Generation	36 %
Heating Load Provided by Auxiliary Heating	12 %

CONCLUSIONS/FINDINGS

The Trombe wall collection efficiency was 32%, while the sunspace collection efficiency was 33%. The movable insulation subsystem required 0.53 GJ to operate. Thus, the solar collection Coefficient of Performance (COP) was 38.0. Ninety-eight percent of the solar energy to the load was delivered via storage. Direct gains were small with the sunspace contributing about 6.94 GJ of the collected solar energy. Most of the sunspace solar energy heated the upper level of the home, while 1.99 GJ were transferred by fans into the rear mass air-core wall. The automated movable insulation system reduced heat losses through the single-glazed Trombe wall.

The performance of the passive solar cooling subsystem was excellent. Auxiliary cooling energy was small, 0.07 GJ, and was used only at the end of July. The storage mass worked very well, reducing temperature swings during the cooling season. A total of 22.30 GJ of thermal energy was removed from the home by a combination of the building's resistance to net radiant gains and through night venting via windows, cool tubes, and the twin thermal chimneys. The thermal chimneys have been shown to remove approximately 24.6 MJ per hour at a 4.4 °C difference in temperature from inside to the outdoors.

Source of Information: Solar Energy System Performance Evaluation: Roberts Home (by Vitro Labs for NSDN)

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid
Solar Low Energy Buildings

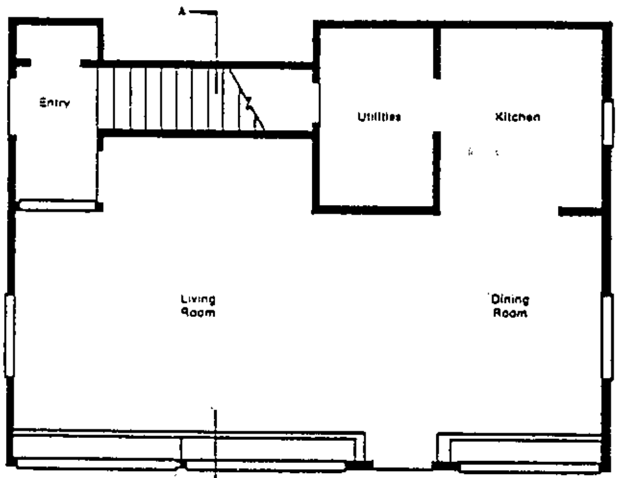
Performance data for systems evaluation

PROJECT TITLE

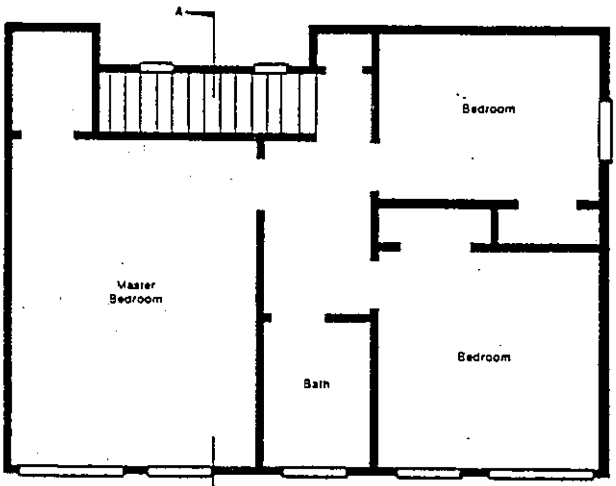
US/VA-05

Site SSN
Richmond, Virginia

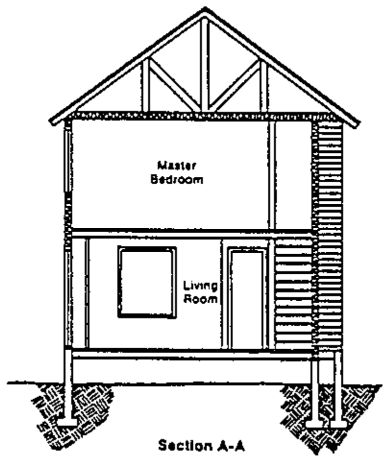
BUILDING AND SYSTEM DESCRIPTION



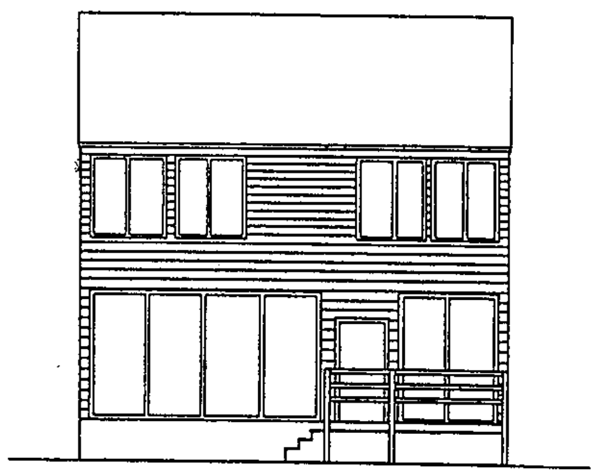
First Floor



Second Floor



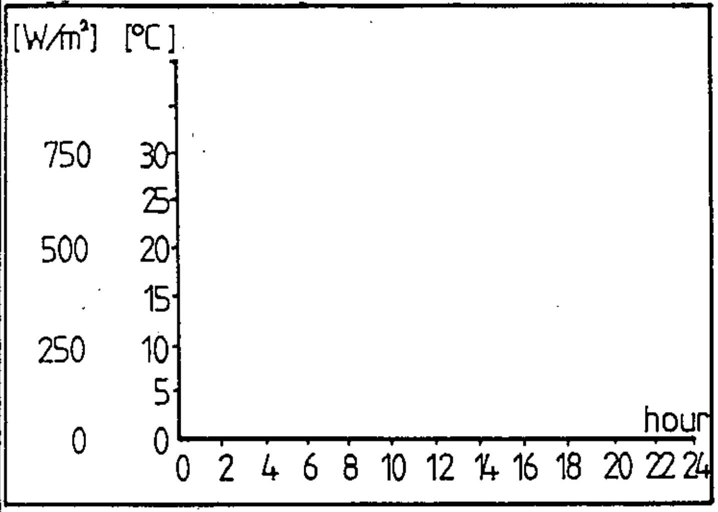
Section A-A



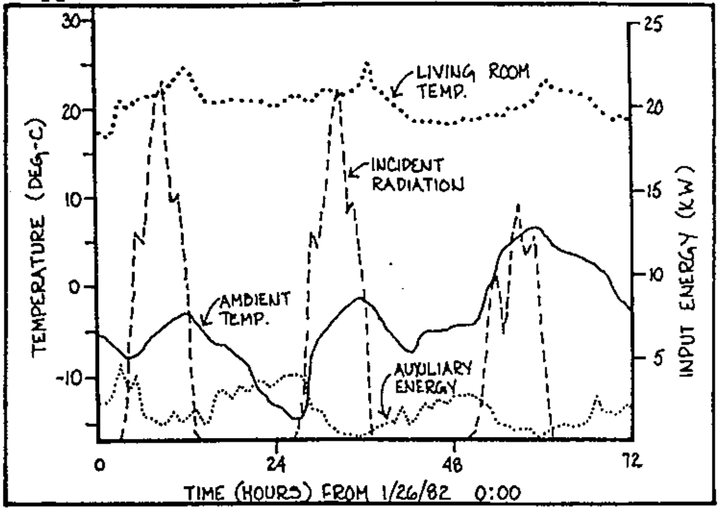
South Elevation

This small slab-on-grade house in northern Virginia has a water wall in the south-facing great room on the lower level. The upper level receives some direct gain. The water wall consists of sixteen 94-gal (355-L) modules made of black fiberglass-reinforced polyester.

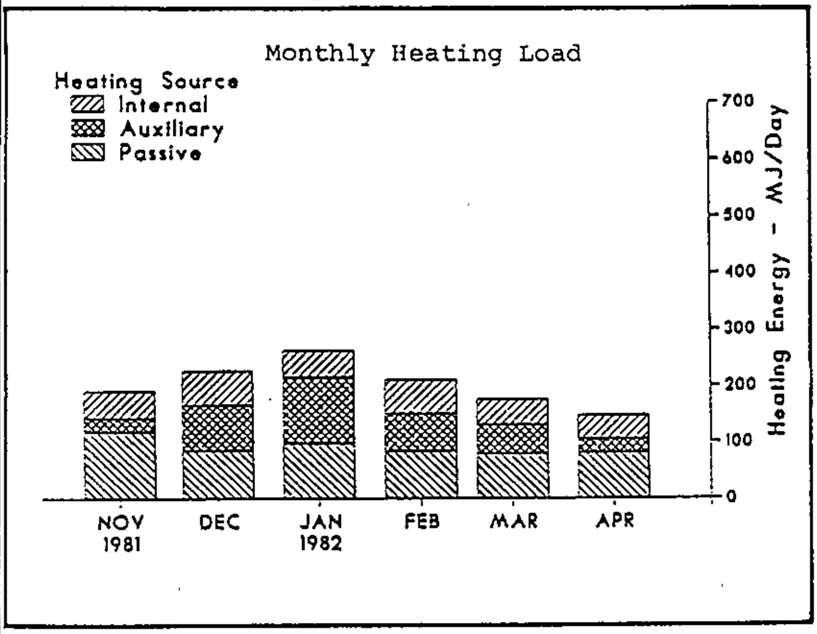
Typical Summer Day



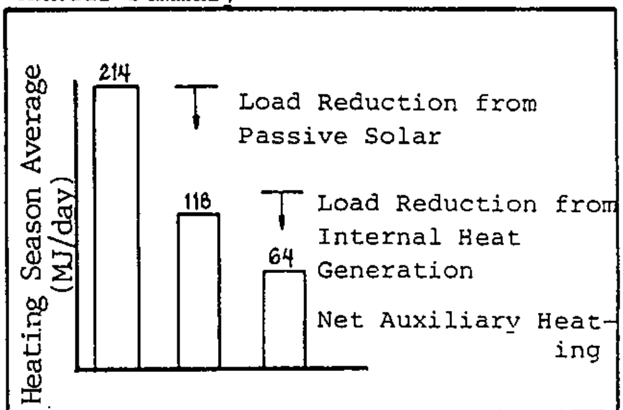
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	45 %
Heating Load Provided by Internal Generation	24 %
Heating Load Provided by Auxiliary Heating	30 %

CONCLUSIONS/FINDINGS

The solar components performed well, meeting almost half of the heating load. The large thermal mass maintained comfortable temperatures in the great room, with no overheating. The auxiliary heating control used a nighttime setback of the great room temperature and a daytime setback of the bedroom temperatures. Thus, the temperature in the bedrooms often dropped below 60° F (16° C) during cloudy winter days.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J.Swisher and T. Cowing)

Passive and Hybrid
Solar Low Energy Buildings

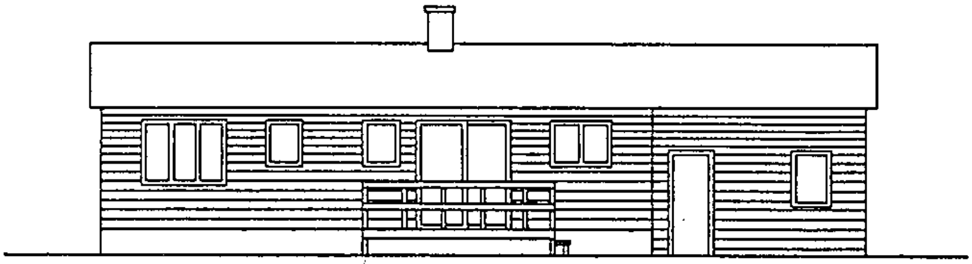
Performance data for systems evaluation

PROJECT TITLE

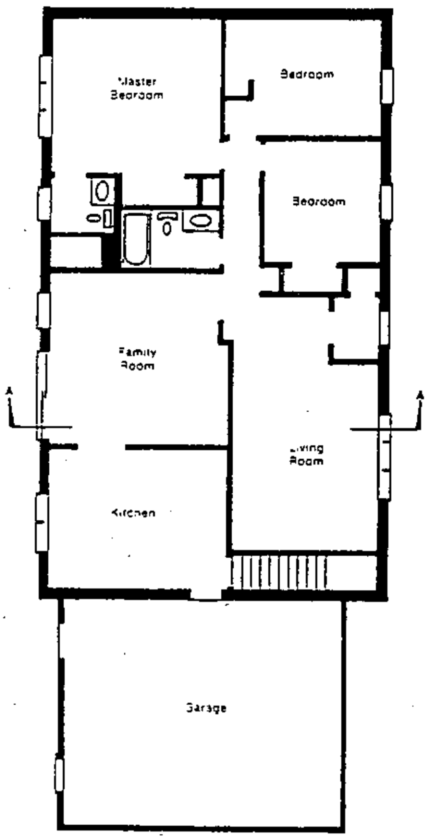
SITE NED
NEWPORT, VERMONT

US/VT-02

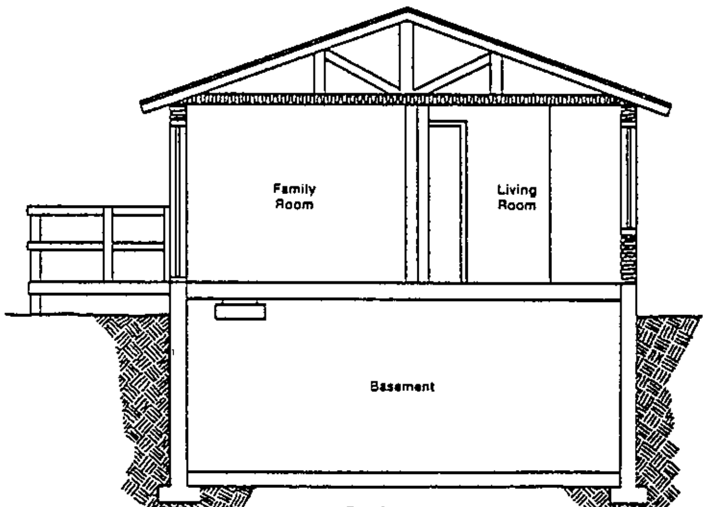
BUILDING AND SYSTEM DESCRIPTION



South Elevation



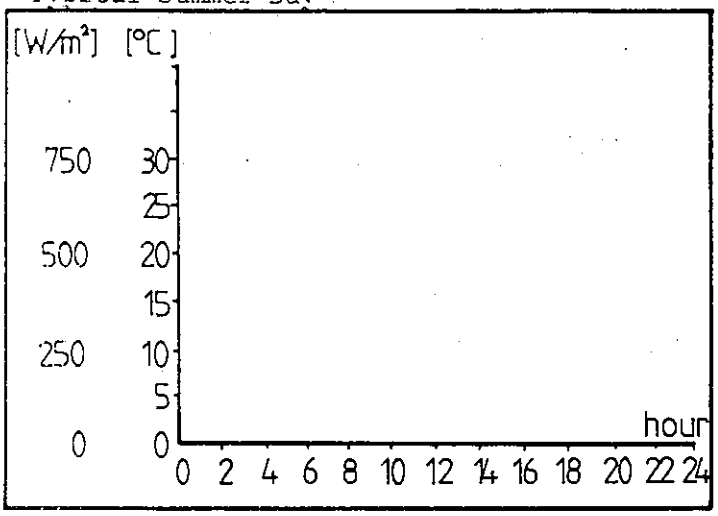
First Floor



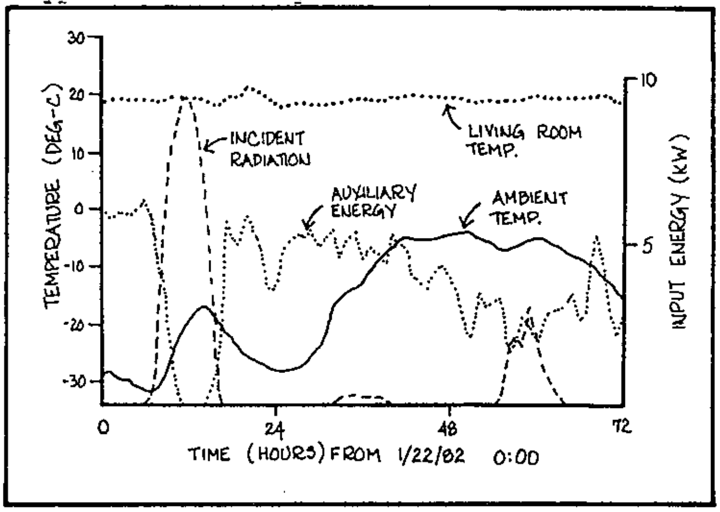
Section

This single-story frame house is located in northern Vermont. It is a simple redesign of a standard "tract" home, with significant energy conservation features such as double-wall construction and triple-glazed windows. No thermal storage mass is provided other than that attributable to the interior structure and furnishings. Ventilation air for the living zone is tempered by an air-to-air heat exchanger.

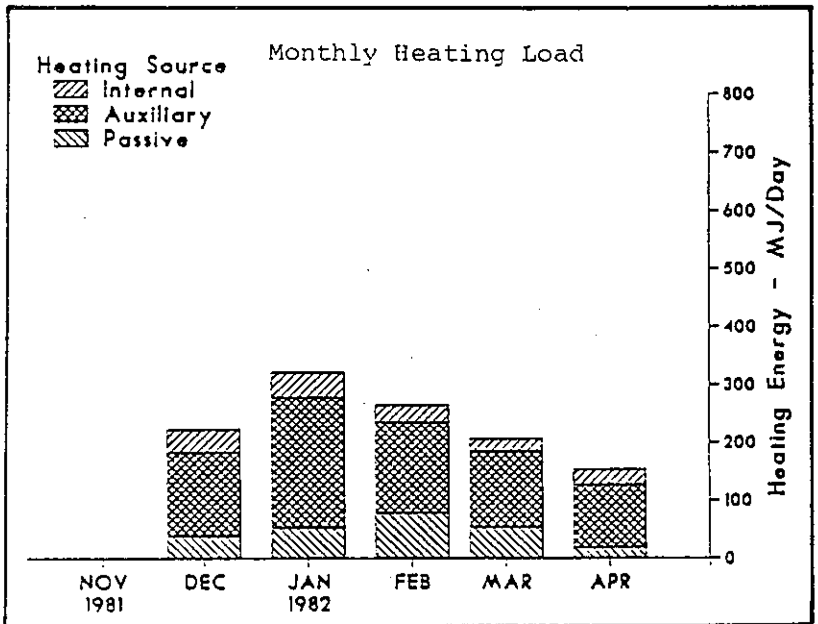
Typical Summer Day



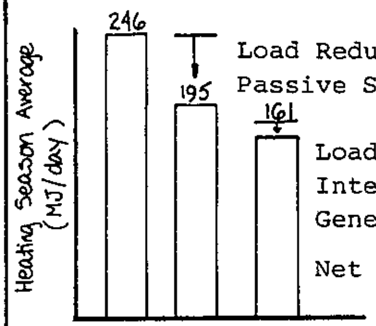
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	21 %
Heating Load Provided by Internal Generation	13 %
Heating Load Provided by Auxiliary Heating	66 %

CONCLUSIONS/FINDINGS

An effective vapor barrier and extensive insulation contributed to a relatively low building heat loss coefficient of 221 Btu/hr-°F (117 W/°C) and typical infiltration rate of 0.20 air change per hour. The relatively small south glazing area supplied 20% of the space heating load. The solar effects occurred primarily during the daytime with little carryover to nighttime periods. The thermal mass was sufficient for the small glazing area, as the interior temperature was between 65° and 70°F (18°-21°C) about 80% of the time. Interior partitions apparently prevented solar heating in the northern rooms.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher & T. Cowing)

IEA SOLAR R&D

INTERNATIONAL ENERGY AGENCY: SOLAR HEATING AND COOLING · TASK VIII

Passive and Hybrid Solar Low Energy Buildings

Performance data for systems evaluation

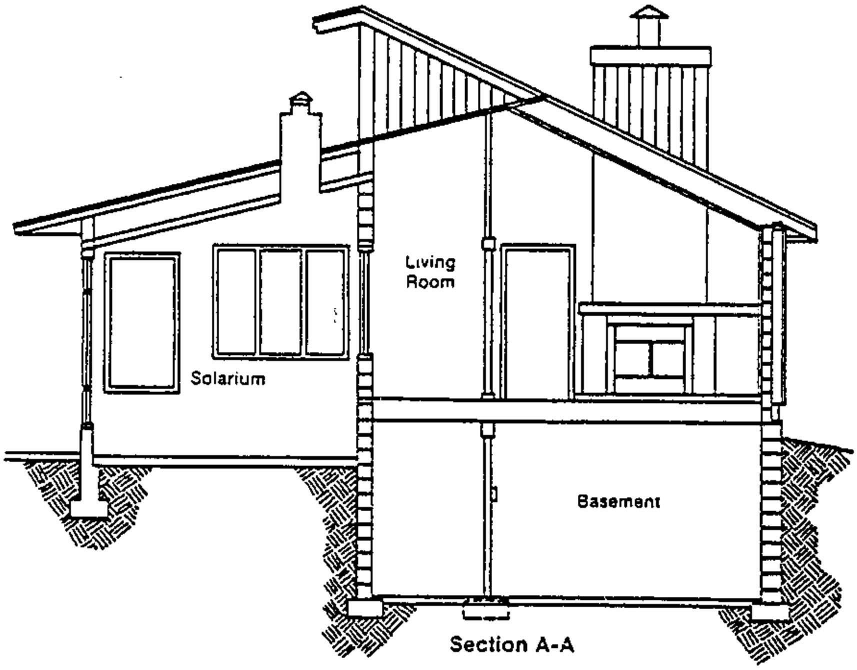
PROJECT TITLE

Clairemont House Site MAC

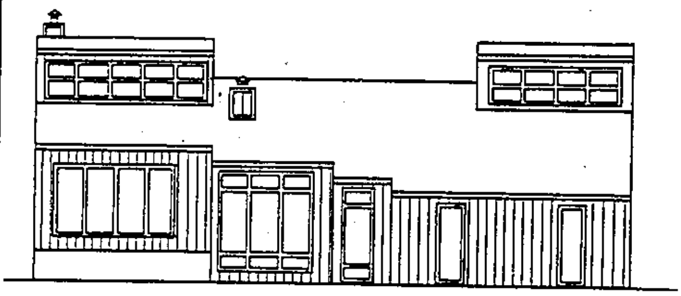
Eau Claire, Wisconsin

US/WI-01

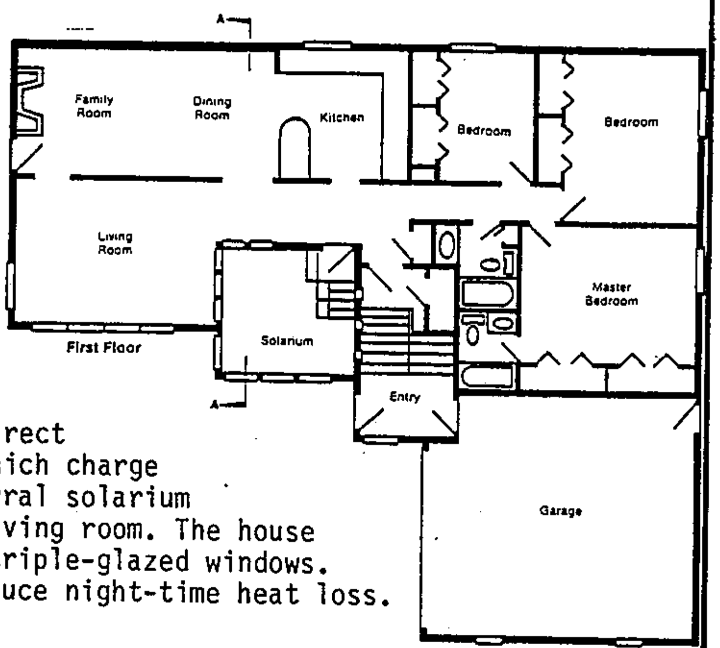
BUILDING AND SYSTEM DESCRIPTION



Section A-A

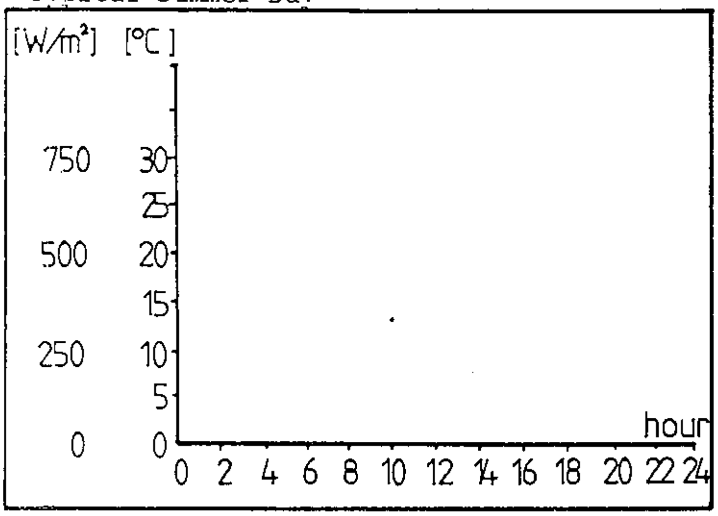


South Elevation

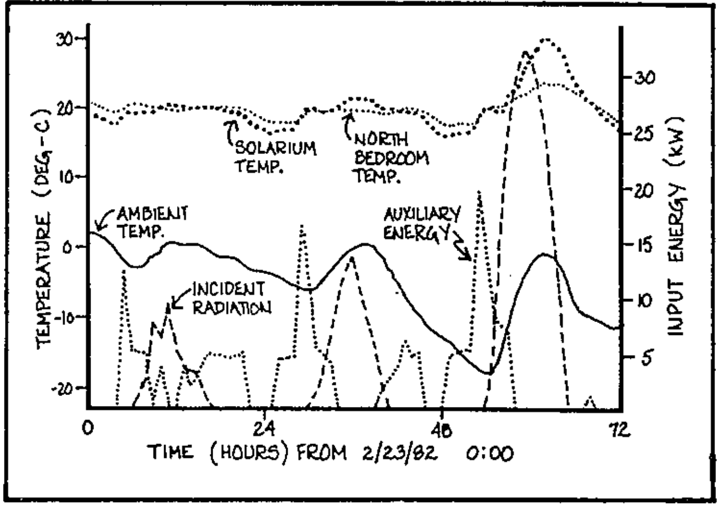


This house in western Wisconsin receives direct gain from south windows and clerestories which charge interior brick storage walls. A small integral solarium with a concrete floor is adjacent to the living room. The house is well-insulated, with RSI-5.8 walls and triple-glazed windows. South windows have insulating drapes to reduce night-time heat loss.

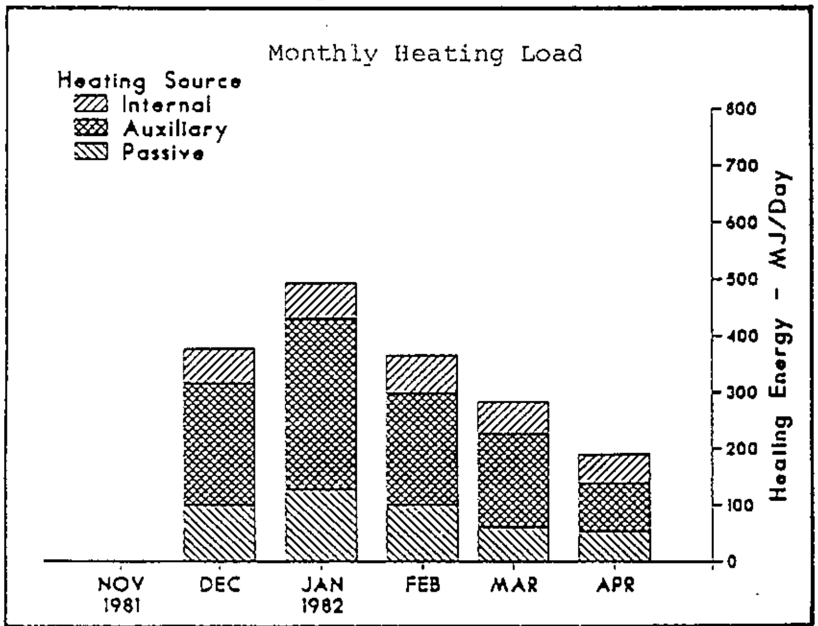
Typical Summer Day



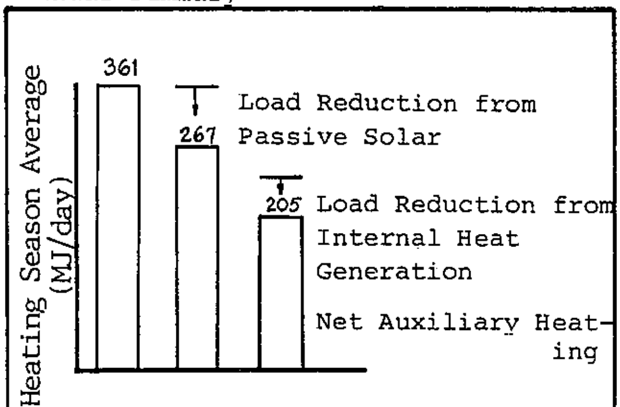
Typical Winter Day



Performance Summary



Annual Summary



Heating Load Provided by Passive Solar	26 %
Heating Load Provided by Internal Generation	17 %
Heating Load Provided by Auxiliary Heating	56 %

CONCLUSIONS/FINDINGS

Due to the efficiency of the building envelope, the auxiliary heating needs were low for such a cold climate. The solar component contributed 26% of the winter heating load. Although the solarium temperature fluctuated a great deal, the temperature in the rest of the house was more stable and comfortable.

Source of Information: Passive Solar Performance: Summary of 1981-82 Class B Results (by J. Swisher and T. Cowing)

APPENDIX A

LIST OF TASK VIII, SUBTASK A REPRESENTATIVES

IEA SOLAR PROGRAMME, TASK VIII

Passive and Hybrid Solar Low Energy Buildings

Subtask A Contact Persons

CANADA	Sherif Barakat Division of Building Research Thermal Performance Section National Research Council of Canada Ottawa, Ontario K1A OR6	Phone (613) 993 9538 Telex 053-3145 NRC ADMIN OTT
DENMARK	Ove Mørck Thermal Insulation Lab. Technical University of Denmark Building 118 DK-2800 Lyngby	Phone (02) 88 35 11/5234 Telex 37529 DTH DIR
HOLLAND	Bart Poel BOUWCENTRUM Weena 700 NL - Rotterdam	Phone (10)11 61 81 Telex
ITALY	Sergio Los Synergia Via B. Ferracina 36 I-36061 Bassano Del Grappa (VI)	Phone (424) 212343 Telex 22843
NEW ZEALAND	Dr. T. Haskell Physics & Engineering Lab. Dept. of Scientific & Ind. Research Lower Hutt	Phone Telex Physics N23814
NORWAY	Terje Jacobsen SINTEF Energy and Fluid Dynamics/HVAX-Section N-7034 Trondheim-NTH	Phone (7) 593871 Telex 55620 sntf n
SPAIN	Jaime Lopez de Asian Seminario de Arquitectura Bioclimatica Excuela Superior de Arquitectura Arda Reina Mercedes SN 41012 Sevilla	Phone (954) 61 01 13
SWEDEN	Åke Blomsterberg Building Physics National Testing Institute P.O. Box 857 S-501 15 Borås	Phone 33-16 50 00/5174 Telex
SWITZERLAND	S. Robert Hastings EMPA - Bauphysik CH-8600 Dubendorf	Phone (1) 823 4795 Telex
USA	Michael J. Holtz Architectural Energy Corp. 8753 Yates Drive, Suite 105 Westminster, CO 80030	Phone (303) 428-8228 Telex 3720504-AEC