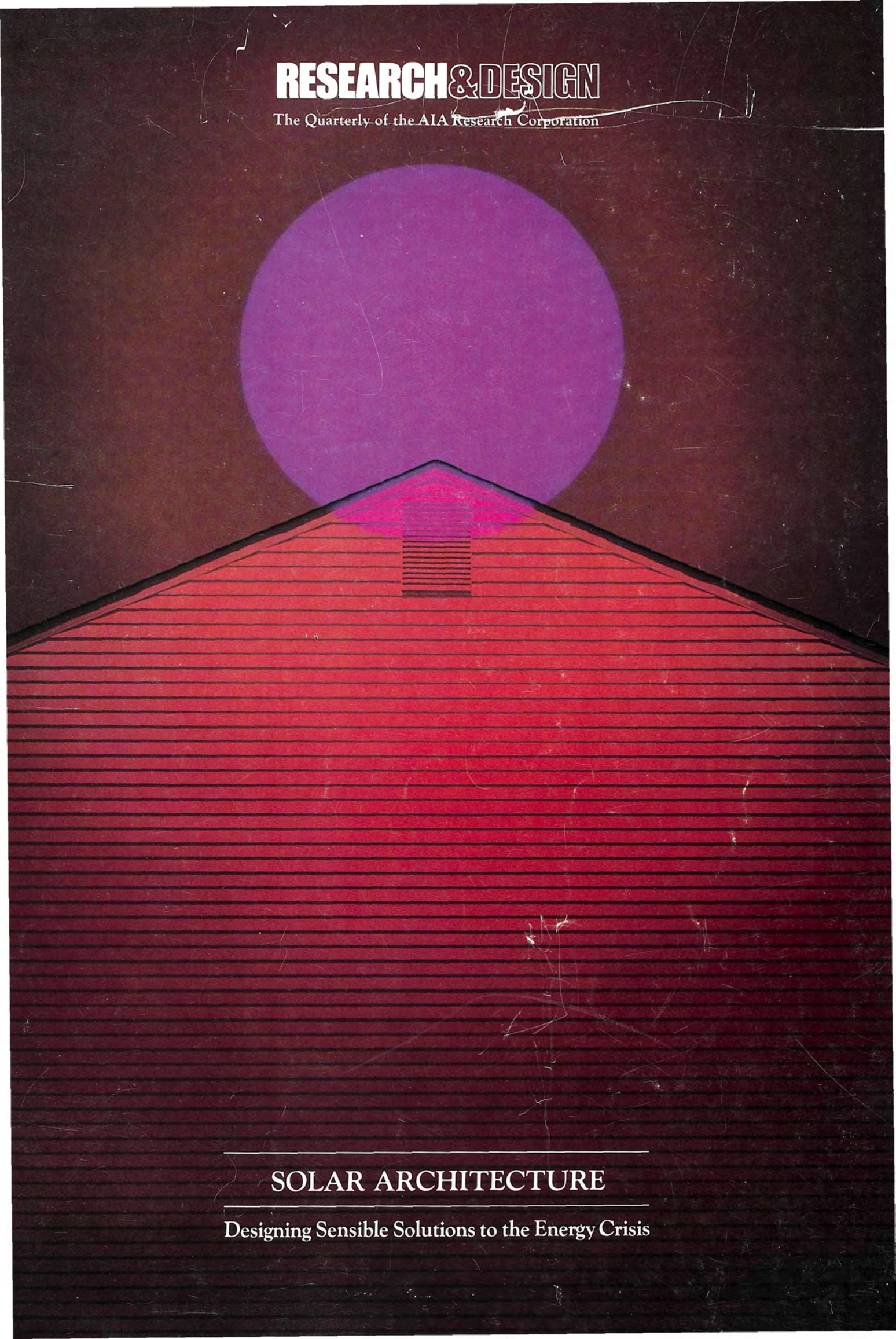
RESEARCH&DESIGN
The Quarterly of the AIA Research Corporation



SOLAR ARCHITECTURE

Designing Sensible Solutions to the Energy Crisis

A word of welcome . . .

Welcome to *Research & Design!* This is the first issue of the AIA Research Corporation's new quarterly review of architectural research, something we've designed for you. We hope other professionals and other people will be interested in seeing this and future issues, but it's intended primarily for the architects who are out on design's front line—in practice. In it, we've tried to demystify research for you. We've covered some of the research being accomplished at AIA/RC and some being accomplished elsewhere in the research community. We've even included some lighthearted and humorous statements about what's going on in research and design. In the same spirit, you'll find this quarterly more graphics-oriented than the serious research reports you may have seen in the past. We want *Research & Design* to be interesting for you to read, informative on subjects you may not hear about otherwise. And we hope it will offer some suggestions on how and where *you* might get involved in architectural research.

Research used to be considered an activity for PhDs in white coats, but that's changing. Many architects are getting involved in research and development these days and, as we'll tell you in the Grantsmanship section of this issue, there is room for many more. It's big business. The amount of money spent on research and development by government, industry, and philanthropic organizations in the United States amounts to more than $35 billion every year. To help give you a feeling for just how much money that really is, the nation's professional design firms generate less than $2.5 billion in architectural fees every year, according to AIA surveys. The architectural community could *double* that income by tapping into just a fraction of the nation's research and development spending—and as we intend to show you in *Research & Design,* the potential there is clearly no small fraction.

The AIA Research Corporation has been active for about five years now in getting architects involved in research and representing an architectural viewpoint in the formulation of the nation's research policies. One field of research that best demonstrates the range of our involvement is solar energy, and the central articles of this issue will give you a comprehensive report on this subject and on our work there. I think we can honestly say that our involvement has had an impact on national policy in solar energy. We've been able to represent an architectural perspective in all the federal programs that support solar applications, and we've managed to utilize the consulting services of hundreds of architects and engineers on our own projects.

This quarterly is our attempt to share with you some of the things we are learning. We hope you like it. Let us hear from you with your comments and suggestions.

Sincerely,

John P. Eberhard, FAIA
President

P.S. We're sending *Research & Design* out free to more than 9,000 design firms and 100 schools of architecture. If you aren't on that list, we'll be glad to send you *R&D* at our cost of $15 a year.

RESEARCH&DESIGN

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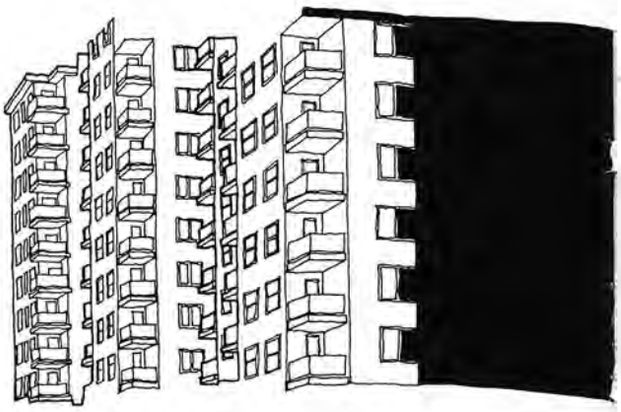
NOTEBOOK



If anyone ever asked you about a place called **The Village** in California, you'd probably assume that it's just another free-spirited commune whose members feast on organic bean sprouts and drive around in pick-up trucks. Well, not quite. The Village is a new 70-acre solar subdivision in Davis, Calif., designed for conservation of energy and natural resources. Construction began in the fall of 1975, and 60 homes and 10 apartment units are now complete. In about five years the development is expected to triple in size. John Hofacre is the principal architect, and Michael and Judy Corbett are the planners.

What makes this development different? The north-south orientation allows maximum advantage of solar radiation. Creeks are actually part of an above ground, natural drainage system. Narrow roads minimize the amount of heat absorbed and re-radiated to the environment. The planting of food-producing plants in gardens and open areas will eventually yield 25% of the residents' total food requirements.

Windows are used for passive solar heating. Overhangs shade the windows during the summer and expose them during the winter. Rooftoop solar collectors heat domestic water and windows supply additional passive solar heating. The homes are very well insulated. North-facing windows are also numerous because they permit summer breezes for cooling.

Consumption of natural gas for heating has been reduced 25 to 80 percent through the use of solar water heating, passive solar techniques, good insulation, double-paned windows, and efficient, wood burning Franklin-type fireplaces.

If this sort of design turns you on (and we think it should!), you can contact the Corbetts for more information at 2417 Bucklebury Rd., Davis, CA 95616.

The Village, a 70-acre solar community in energy conscious Davis, Calif.

We may never design the perfect house or apartment building—but that doesn't give us an excuse to stop trying. And as long as groups like the Ford Foundation deliver needed funding, post-occupancy studies will, thankfully, go on. The Housing Research and Development Program at the University of Illinois has received funds for a six-year study dealing with **Residents' Satisfaction In Housing for Low and Moderate Incomes.** This study of 37 multi-family housing developments for people of low and moderate income in 10 states will identify and reliably measure design, management, and residents' characteristics contributing to residents' satisfaction with their housing environment.

The project is scheduled for completion in March. Information can be obtained from the Housing Research and Development Program, University of Illinois, 1204 W. Nevada, Urbana, Illinois 61801.

When your office gets so noisy you wish you'd been born at least partially deaf, you are sharing an experience with lots of other people. Well, the National Bureau of Standards is trying to help us all get a little more peace and quiet.

Dr. Simone Yaniv, research psychologist at the NBS Center for Building Technology, is leading a research effort that has already produced a manual for the U.S. Army dealing with the control of noise in architectural spaces. Soon to be released is a state-of-the-art review of acoustical measurement scales in building regulations; projected is another study to be conducted under the sponsorship of the Department of Transportation on the effect of interstate highway noise on the occupants of nearby houses.

Gary Winkel and Geoffrey Hayward have completed a study of **Pedestrian Movement In Subway Stations** that should be of interest to designers. The study was begun at the request of the Urban Design Group and the New York City Planning Commission. The concerns voiced at the outset were directed to specific elements and specific configurations of subway stations. The following topics explain the content of the report:

—A study of the width of stairways from platform to mezzanine and from mezzanine to

street. Is there a minimum stairway width?
—A study of seating on platforms . . . what effects do benches have on circulation (especially on side platforms)?
—A study of the effects of multiple entries and exits to platforms. How can that be compared with nonmultiple entries and exits?
—A study of side and center platforms . . . Is one type of platform a better solution in any or all situations?

Anyone interested in the report should contact Gary H. Winkel at the Environmental Psychology Program, City University of New York, 33 West 42nd Street, New York, N.Y. 10036. Please include a check for $2.50 (made payable to Center for Human Environments) to cover copying costs.

No, **Airport Siting, Planning and Management** isn't another disaster movie where the pilot sites, plans, and manages an emergency landing in the Alps near St. Moritz. It is, however, a research project at the Environic Foundation International, under the direction of Patrick Horsburgh.

The Environic Foundation is concerned with the seeming absence of any educational program devoted to the specialized subject of airports and their management. It is exploring the feasibility of establishing an advanced, academic airport design program. The prospect of promoting an international journal devoted to this subject is also being explored in the project. Those interested should contact Horsbrugh at the Environic Foundation International, Inc., P.O. Box 88, Notre Dame, Indiana 46556.

What makes a library successful? Maybe it's the handsome design of the reading room, or perhaps it's the 6,000 volume rare book collection on the second floor.

Community Responsive Branch Library Program was a study of four neighborhood libraries in the city of Los Angeles in order to determine why some neighborhood branch libraries were so successful while others were little used. Findings and recommendations are contained in the project report, and the recommendations are now being tested in a pilot project at the Lincoln Heights Branch Library in Los Angeles. Interested persons should contact Dr. Thomas Lasswell, Professor of Sociology, University of Southern California, Los Angeles, California 90007.

Are you one of those people who like to get lots of mail at the office? Well, here's a chance to add to that pile on your desk.

Reflecting the Carter Administration's interest in increasing government responsiveness to public needs, the Center for Building Technology at the National Bureau of Standards has recently set up a computerized mailing list of persons and organizations wishing notification of research activities. Inclusion on the mailing list is available for the asking. Those listed will receive the CBT newsletter, an annual yearbook of selected publications, and special mailings as they occur. Write to the Office of Program Planning and Liaison, Center for Building Technology, National Bureau of Standards, Washington, D.C. 20234.

Metro Center, the central terminus of Washington, D.C.'s new rapid transit system.

What good are those nicely designed city parks if they never get used? The National Institute of Mental Health granted the Baltimore City of Planning and Johns Hopkins University funds to study this question in a recently completed project call **Metropolitan Open Space On Community Life.**

Open spaces were studied in several inner city neighborhoods in Baltimore to derive guidelines for the location and design of future open spaces. The approach was socio-ecological, and the findings showed that parks were seldom used by the people and for the purposes for which they had been designed. Recommendations were made about city policy, about decisions and actions at the neighborhood level, and about the role of design professionals. For more information, contact Roger Stough, Center for Metropolitan Planning and Research, Johns Hopkins University, Charles and 33rd Streets, Baltimore, MD.

EDRA strikes again. **The Ninth Annual Conference of the Environmental Design Research Association** (EDRA) will be held at the University of Arizona, Tucson, on April 8-11.

The purpose of the annual conference is to provide a meeting ground for the interchange and development of ideas and practices relevant to environmental design research and its application. The theme of this conference is "New Directions in Environmental Design Research." EDRA 9 is jointly sponsored by the University of Arizona's College of Architecture, Program in Landscape Architecture, and Department of Psychology.

Address general correspondence and inquiries to EDRA 9, Department of Psychology, University of Arizona, Tucson, Ariz. 85721.

Research supported under a previous NSF grant to architectural educator Neil Hawkins at the University of Washington will be continued this year for studies of **Bond Deterioration In Reinforced Concrete Structures Subjected To Earthquake Loadings.** Hawkins' immediate objectives are to conduct calibration experiments to collate bar stress-slip relationships with the development of internal cracking

and acoustic emissions. He'll use these results for a variety of experiments simulating practical connection details. In the first phase of the study, eight specimens will be tested to various levels of failure and examined, using a variety of methods, to determine the degree of bond deterioration. Both straight and hooked bars will be studied. In the second phase of the project analytical studies will be undertaken and additional tests will be run under progressively increasing reversed cycle loading, using both conventional and lightweight concretes. All of these studies have one long-range goal: The development of practical techniques to assess the degree of bond deterioration in a structure surviving an earthquake, and the development of improved design methods and regulations for new reinforced concrete structures.

For more information on this project ask for proposal number 76-15366 at the Research Applications Directorate, National Science Foundation, 1800 G Street, NW, Washington, D.C. 20550.

If you haven't been to an energy conference yet, here's a tip to get in on one of the biggest. The nation's largest annual energy technology conference and exposition will soon examine "challenges to technology" in light of an emerging national energy policy. **The 5th Energy Technology Conference & Exposition** is scheduled for Feb. 27-March 1 in Washington, D.C. The meeting is held each year to provide a forum for examination of all aspects of energy technology, including research and development, production, transportation, and consumer use, as well as economic, environmental, and regulatory considerations. All sources of energy—coal, oil, gas, nuclear, solar, and other alternative sources—will be considered.

Sponsors are ERDA (now part of the Department of Energy), the Electric Power Research Institute, and the American Gas Association, with the support and cooperation of other key energy organizations.

To reserve a copy of the program or to obtain further information about the exposition, write or call: 5th Energy Technology Conference & Exposition, 4733 Bethesda Avenue, N.W., Washington, D.C. 20014 (301/657-2922).

A final note: If you are tired of attending energy conferences, just order AIA's **Energy Notebook** by writing to Joe Demkin at AIA Headquarters. Updated four times every year, the Notebook offers more design-oriented energy information than you'll gain at a host of plenary sessions.

The Department of Psychology at the University of Kansas has completed a project entitled **An Investigation of Open Plan Schools In Action.** Researchers Paul Gump and Rhonda Ross visited twenty-one elementary schools of "open space" design to answer the following questions: How can the original degree of openness of a building be measured? Has modification of openness occurred over time? What kind of educational programs are operating in these buildings? What factors press schools for or against maintaining open spaces and/or open programs?

The data indicated that all schools moved in the direction of *decreasing* their original openness, with some of the schools approximating the openness of traditional "eggcrate" buildings. No significant relationship was found between architectural openness and program openness. Generally, teachers who were free to modify their environment to achieve compatability between the environment and program were the most satisfied.

Additional information is available from either Gump or Ross at the Department of Psychology, University of Kansas, Lawrence, Kansas 66044.

Architects and Earthquakes may be the answer if you're looking for an introduction to earthquake design. It's a primer intended to start architects thinking about the subject of earthquakes as a problem of design. The primer won't tell you how to make complex calculations, but it will show you how our engineering colleagues view the structural design issues of earthquake resistance. AIA/RC produced this report based upon research supported by the National Science Foundation. If you'd like a copy of the primer, it can be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price is $2.00 and ask for stock No. 038-00-003313.

If you frequent the environment and behavior scene, then the names of Gary Moore and Uriel Cohen should be as familiar to you now as Santa Claus. They have just finished an applied research, programming, and design project conducted for the **St. Francis Children's Activity and Achievement Center** in Milwaukee. The Center is a special education facility for children with cognitive physical disabilities which exclude them from the mainstream of public education. The conceptual approach to the project was derived from an integrative model of research-and-design being developed by Moore and Cohen. The program was structured to respond to major child developmental goals. Information was collected on physical cues as a stimulus to motor, cognitive, and social-emotional development, and on handicapped access. The publication on this project, *Outdoor Environments for Exceptional Education: Behaviorally-Based Programming and*

An open plan classroom at the TAC-designed Josiah Quincy School in Boston.

Design, is available from the School of Architecture and Urban Planning, University of Wisconsin, Milwaukee, WI 53201.

Speaking of Gary Moore, what would the University of Wisconsin do without him? A well known researcher in environment-behavior studies, Moore has just completed an **Evaluation of Children's Outdoor Recreation Environments.**

The purpose of Moore's research was to evaluate current outdoor recreation environments in Milwaukee's inner city, focusing on

the effectiveness of a new, experimental adventure playground relative to both existing school playgrounds and other nonformal play spaces in the city (such as lanes, porches, streets, etc.). The data is presently being analyzed and will be available soon. Those interested in the report should contact Moore at the School of Architecture and Urban Planning, University of Wisconsin, Milwaukee, WI 53201.

Everyone is getting in on the act according to a low-key research study on housing in Canada. **Tenant Participation In Housing Design** is a report on two experiments with tenant participation in the planning and design of public housing projects in Winnipeg and Brandon, Manitoba. The general purpose of the experiments was to provide information on the feasibility and advisability of tenant participation in the design process.

The scope of the experiment was to complete a preliminary design with the tenants. It was not originally intended that the tenant involvement continue into the final design and working drawing stages. As the projects developed, though, the tenants expressed a desire to have some input during these phases.

Architects interested in reading the report should contact the author, Eric J. Barker, at Barker and Guslits Associates, 26 Edmonton Street, Winnipeg, Manitoba, Canada, R3C 1P7.

Barrier Free Design is a popular field of study these days, and rightly so. Another BFD project is being done by the Maryland State Department of Education under a grant from HEW. The primary objectives of the study are identification of planning and design criteria for educational facilities for the handicapped, and passage of legislation proposed by MSDE to the Maryland Legislature mandating criteria for these facilities. Information on the project can be obtained from Allen Abend or William Coviello, MSDE, 6510 Elkridge Landing Road, Linthicum, Maryland 21090.

Fire research doesn't necessarily mean standing in the flames checking temperatures readings every 5 seconds. At least not at the Center for Fire Research at the National Bureau of Standards. Among other things, the center has been investigating the technical research underlying OSHA's emergency egress standards. A recently-released report on this project identifies and reviews the technical literature on which current egress regulations are based, and identifies those areas for which there are either insufficient or contradictory research findings. The investigation included the literature on egress requirements (from which came the 22-inch "module" on which current stair and exitway design is based); signage, lighting and visibility through smoke, and "after-the-fact" studies of occupant behavior in fires. The report, **Buildings and People in Fires,** is available from the Center for Fire Research, Institute for Applied Technology, National Bureau of Standards, Washington, D.C. 20234.

While not actually conducting research, a group at North Carolina State University has devised a method with which non-architects can self-evaluate their own facilities. The project, called **A Model Program for Health Departments in North Carolina,** ran from May to November last year under the direction of Henry Sanoff. In explaining the project, Sanoff notes that the last decade has seen a rapid increase in the support of health programs, but a stalemate in the facilities that house these programs. Many of the new programs require revised or additional facilities to work properly. The scope of this problem is tremendous, Sanoff says, and there aren't enough architects to do the necessary programming work. The aim of the Sanoff group was to devise a method for these health departments to self-evaluate their facilities. Through the development of a systematic procedure, recording sheets, and interaction sessions, a communicable model was developed to inventory and project space needs. The project report is available from Sanoff at the School of Design, North Carolina State University, Raleigh, N.C. 27607.

There may be more to taking care of babies than your mother ever suspected. The National Institute of Mental Health is supporting a project to study **Environments for Infants** by the Mental Health Study Center in Adelphi, Mary-

land. The designed environment can have a significant effect on development during the first few months of a human's life. NIMH is trying to identify those parts of the environment that can be manipulated to meet specific biological needs. The data collected will identify the effects sound and lighting have on psychobiological and psychosocial behavior. The project, which began last May, has established findings on the noise conditions that may affect auditory capacities, and on lighting conditions that produce very high risk dehydration. Final results should be out by November. For more information, contact Coryl La Rue Jones, NIMH Mental Health Study Center, 2340 University Blvd. E., Adelphi, Maryland 20783.

Earthquake design isn't just for engineers anymore. Even planners are going after a piece of the action.

Land Use Planning As A Principle of Earthquake Mitigation was a recent subject of study at the Rice Center for Community Design and Research in Houston. Supported by the American Institute of Planners and the National Science Foundation, the project explored the state-of-the-art of land use planning to mitigate earthquake damage and life loss. Three case study cities were examined to discover potential opportunities and problems with using land management as a hazard mitigation tool. Cities studied included San Jose, Calif.; Salt Lake City, and Boston.

Niigata, Japan, 1964

Natural hazards could make good bedtime reading material. For those interested, these research findings are published in the form of a book, *Earthquakes and Planners* which is now available from AIP, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036.

A new building system, using plastic modules which can be produced and assembled on site with local labor and materials, was demonstrated in April by the United Nations Industrial Development Organization (UNIDO). Developed jointly by UNIDO and the Government of Cyprus, the new technology's parts are known as **Patfoort Housing Modules** after Belgian architect and educator Georges Patfoort, who headed up the three-year development effort.

The system makes use of extruded filaments composed of plastic resin, glass and natural fibers, local minerals and agricultural wastes. Once a construction site has been selected, a simple wood or metal frame is erected, around which the filaments are wound. The winding machine costs only around $2,400 to build, and runs without electricity or fossil fuels. Human or animal effort can provide all the energy needed, and almost all of the construction work can be done by hand.

Once the filament compound has set, modifications (windows, doors, and recesses in the walls) can easily be carved out by hand. Although the buildings are sturdy enough to withstand strong winds and even earthquake tremors, they are light enough to be easily transported, and can be anchored to the ground without foundations. Single units can be combined in any desired configuration to form larger residences or such community facilities as schools or meeting halls.

The technique has been demonstrated in Nicosia, Cyprus before an international group of town planners, architects and engineers as a method for saving time and cost in housing construction, as well as for use as temporary emergency shelter for victims of earthquakes and other natural disasters.

Additional information on this new construction system is available on request from the Editor, UNIDO Newsletter, P.O. Box 707, A-1011, Vienna, Austria.

If you've ever seen a movie about Alaska (how about *The Gold Rush* with Charlie Chaplin?) you know it's cold there, and that anyone in his right mind hibernates through the long winter nights. If you were to be stationed there in a military community you might easily be bored to death with the monotony of it all. Well, there's help on the way. **Cold Regions Habitability** is the subject of investigation by the U.S. Army Cold Regions Research Engineering Laboratory. The study, which began in 1972, takes an in-depth look at military and civilian communities in remote and isolated locations of both cold (like Alaska) and hot arid regions. The investigation is to identify design management and operations guidelines that improve the physical and emotional well-being of the inhabitants, which in turn influences their performance in conducting their assigned and assumed tasks. With minor modification, the findings are applicable to most environmental and geographic locations.

The findings show that architectural design significantly influences user behavior. This influence is so significant in some instances that immediate application of the habitability guidelines would improve environmental conditions now contributing to unsatisfactory home life, boredom, inefficient industrial operations, unsatisfactory customer service, limited

use of recreational facilities, and poor command leadership in very cold climates.

Reports have been published demonstrating design and operations guidelines, architectural-psychology research methods, dynamics of architect and behavioral scientist collaboration, methods of architectural programming to be utilized by architect and layperson, etc. These are available from C. Burgess Ledbetter, U.S. Army Cold Regions Research and Engineer Lab, Hanover, N.H. 03755.

Would you like to know more about how your buildings are used once occupants take over? In a future issue of *Research & Design* we will be discussing post occupancy evaluation, but in the meantime . . . A HUD project on **Post Occupancy Assessments** will be completed soon by the Environmental Research and Development Foundation (ERDF) in Tucson. The project will develop resources as well as a model delivery system for POEs. Robert Bechtel and Rajendra Shivastava are conducting the study (results should be ready in February). They can be contacted at ERDF, 2030 E. Speedway, Suite 116, Tucson, Ariz. 85719.

If you've ever been a statistic for the crime rate in your city because your house was robbed, then this project should be of interest. The Justice Department's National Institute of Law Enforcement and Criminal Justice has issued a voluntary standard intended to reduce the number of burglaries in which entry is through a forced window or door. The standard calls for strengthened construction for both the total door assembly and individual components, to resist forces measured in simulated "typical" break-ins. Basic research for this standard was conducted at the Center for Building Technology of the National Bureau of Standards.

The standard has recently been adopted into the Uniform Building Code (UBC) and is expected to be added to the BOCA and other standard codes in the very near future. More information is available from the National Bureau of Standards, Center for Building Technology, Washington, D.C. 20234.

The days of the jailbird behind steel bars may be gone. Researchers at the School of Criminology at Florida State University will begin a project this month using **Tent and Mobile Structures As Housing for Correctional Institutions.** The purpose of the project is to explore the legal, psychological, architectural, and rehabilitational aspects of using tents, mobile homes, and other temporary structures for incarcerated people.

The FSU project team believes that stress from enclosure in tents is far less, for both inmates and staff, than in traditional steel or concrete cells. Are the softer forms of housing adequate for inmates legal rights, protection from the elements, and protection from other inmates? An experimental design will be set up to test prison environments to find out what is suitable for both medium and maximum classified inmates. Maximum security cells will still be single occupancy.

Information on the project's findings should be ready in September when the project is scheduled for completion. Randy Atlas is the principal investigator, and he can be contacted at the FSU School of Criminology in Tallahassee, Fla. 32306.

Some people look at the world through rose-colored glasses, while others look at it through an enthescoop.

The Agricultural University in Wageningen, The Netherlands, is working on a project dealing with the problem of "image-forming" of a future situation within the building process. For this purpose the enthescoop, an environmental simulator, was developed. This research project compares the reactions of dwellers, architects, administrators, and housing ecologists to several kinds of environmental simulation, based on the information included in the design. It is also concerned with their reactions to the actual situation when the realization is just finished. For a close look at this project, and at the enthescoop, contact Marc J. A. Bouwman, Department of Housing, Ritzema Bosweg 32 A, Wageningen, the Netherlands.

Basis for Seismic Resistant Design of Mechanical and Electrical Service Systems is a report presenting the results of the dynamic interaction of building components during earthquakes, with emphasis on mechanical and electrical service systems. Current codes and practices are examined, and the nature of earthquake motions within buildings—from both historical and analytical viewpoints—are investigated. Principal analysis and design approaches allowing for either the prediction of these motions or direct specification of design forces are examined and compared. In light of these studies, the various possible strategies to mitigate earthquake damage to service systems are studied and the most promising alternatives detailed. The report is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. Ask for the report on grant No. AEN 74-23196 by Thomas R. Simonson, the project's principal investigator.

Architectural research is popular in Houston. The city's Chamber of Commerce recently funded **Why Downtown?,** an urban study by the Rice Center for Community Design and Research. Downtown Houston was compared to other U.S. cities and other Houston business centers to identify the quantifiable characteristics of a healthy downtown. The Rice Center looked at economic data for a number of large U.S. cities, comparing Houston's growth and development patterns and developing a relationship between these patterns and the overall viability of the city's CBD. Information on the analysis, which lasted from May until September of 1977, can be obtained by writing to

Downtown Houston

David Glunt at the Rice Center, 1929 Allen Parkway, Houston, Texas 77019.

Houston also allocated funds last September for a one-year project entitled **Growth Options for Houston, 1975/1995.** The Rice Center is conducting this study, too, and its objective is to describe future development patterns in the Houston region for the next 20 years. Key city policies which can affect development patterns are being identified, alternative growth options studied, and the roles city policies have in implementing those options described. Detailed projections of population and households for each growth option have been prepared. This information can be quite useful to architects involved in (or thinking about) construction or planning in Houston and environs. Charles Savino is the project director, and he can be contacted at the Rice Center in Houston.

Flooding and Drainage aren't always wishy-washy subjects. On the contrary, they were topics of serious discussion at a symposium held late last year at the University of Tulsa in Oklahoma. The proceedings are now published and available upon request. The publication includes four papers on the natural environment and flood-plain planning, covering such topics as geography, ecology, geology, and planning. Ian McGarg's lecture on "Planning and the Impact of Urbanization on Drainage" is included, as well as case studies of floodwater management. Architects who can use this information should contact Anthony J. Filipovitch, Urban Studies Program, University of Tulsa, Oklahoma 74104.

Those of you who remember **Don Conway** as Director of Research Programs for AIA (he left in 1975) will be interested in knowing that he is hard at work in Paris, but not painting or writing poetry. Conway is putting together an assessment of the "total information environment of the global architectural community." The aim of the year-long feasibility study is to assess and recommend ways to improve worldwide information-sharing among architects, construction policy-makers, researchers, and architectural educators. This modest effort, currently known as **Arkisyst,** is being done for UNESCO and the International Union of Architects, and the Spanish Ministry of Housing is footing the bill.

Those who design for the handicapped should be interested in this project. The Alberta Housing and Public Works Department contracted the research team of James S. Jones and Harold Hanen to produce a **Source File for Planning Vocation Services for Developmentally Handicapped.** They developed this manual for planning community-based, integrated vocation services for developmental handicapped persons. The file contains five sections: Overview Concepts; Systems Concepts; Implementation Concepts; Program Planning Concepts; and Patterns for Facility Design Concepts. Interested? Contact Jones or Hanen at the Department of Housing and Public Works, Room 207, Legislative Building, Edmonton, Alberta, Canada, T5K 2B6.

In panic situations, it's hard to appreciate the design quality of your surroundings—especially if you happen to be in a hospital emergency waiting room. Still, these areas merit careful design consideration.

The Department of Psychology at the University of Utah has recently completed a study on **Behavorial Design Criteria for A Hospital Emergency Department Waiting Room.** The data were analyzed and used to develop a set of design criteria congruent to the evaluation of user needs. Specific recommendations regarding position of furniture, activities, etc., should be helpful to architects involved in hospital design. Contact the author, Ronald W. Peterson, at the Department of Psychology, University of Utah, Salt Lake City, UT 84112.

Some notes on recent developments in solar energy: Economists from the University of New Mexico, the University of Southern California, and the Los Alamos Science Laboratories announced last month that President Carter's goal of 2.5 million American homes heated with solar energy by 1985 is attainable under current conditions, but that solar energy will be much more economically attractive if federal price controls on oil and gas are lifted.

One of the crucial—and least controversial—elements of Mr. Carter's plan is a system of subsidies for the installation of solar equipment by homeowners. Federal tax credits of up to $2,000 would be available for solar systems costing up to $6,000.

According to the economists, whose study results were announced to 1,000 energy experts from 40 countries attending the International Conference on Alternative Energy Sources in Miami last month, the proposed incentive structure "covers sufficiently the cost of domestic solar hot water systems so that economic feasibility is achieved in a number of states." If federal price controls on oil and gas are lifted and the prices for those fuels and the electricity

produced from them rises as expected, the economists said, economic parity for solar water heating is achieved today in all states except Washington, where inexpensive hydroelectric power is plentiful. Solar space heating, however, will still cost more than oil or gas in 1985, even if prices are deregulated.

Another report issued at the Miami conference said most Americans using solar devices today earn more than $30,000 a year. The report also quoted solar homeowners as saying that the only major problem encountered with their solar systems is the initial high cost of installation.

Solar Action's Sun Day logo

And finally: According to The Washington Post, the creators of 1970's Earth Day—the highly successful if short-lived raising of America's environmental consciousness—have announced plans for a nationwide celebration of solar energy to be held this spring, called Sun Day. Denis Hayes, the highly regarded energy/environmental expert who coordinated Earth Day, is chairman of Solar Action, the organizing body behind Sun Day. A fund-raising letter has gone out from Solar Action describing the May 3 event as "a day of celebration for solar energy." Earth Day "marked the beginning of a new national commitment to environmental quality," the letter says. "A similar level of public sentiment now exists for a safe, nonpolluting, decentralized power system. . . . We need to dispel the myth that solar energy is an 'exotic' technology." Solar Action, which lists Los Angeles Mayor Thomas Bradley and Sierra Club Executive Director Michael McCloskey among its board members, says it hopes to see local fairs, teach-ins, conferences, rallies, and other related actions around the country reminiscent of those that involved several million people on Earth Day eight years ago.

Improvement of Residential Street Environments is the title of a grant to the San Francisco office of planners DeLeuw-Cather from the U.S. Federal Highway Administration. The three year research project (which began in August, 1977) will create an information base and engage in experimental programs to improve the quality of residential street environments in existing neighborhoods. Some of the experimental methods will include traffic control, resident protection, and a system for actually paying residents to keep their neighborhood clean. The project began with an international survey of current activity in the street improvement field, resulting in a state-of-the-art report. Development of technical assistance packages and street improvement guidelines for communities, community involvement processes, community analysis and evaluation methods was phase two. A number of selected cities and neighborhoods engaging in street improvement programs are being contacted for evaluation and a few will be selected for in-depth experiment and evaluation. Those interested in the project report should contact Daniel Smith at DeLeuw-Cather, 120 Howard Street, San Francisco, CA.

Are recommended illumination levels for design much higher than necessary? The National Bureau of Standards thinks that they may be. Assuming the impact this could have on energy consumption, NBS is expected to produce a new set of "energy efficient illumination standards" soon. Work is also underway to develop, from the same research, software for programmable calculators to compute the illumination levels required for most occupancies. The results should be out this summer.

Coming Up:

4-8 Feb.: Phoenix, Ariz. Solar Energy Industries Association Winter Meeting. Contact: SEIA, 1001 Connecticut Ave., N.W., Suite 632, Washington, D.C. 20036 (202/293-1000).

16-18 March: Second National Passive Solar Heating and Cooling Conference will be held in Philadelphia. Write to Mid-Atlantic Solar Energy Association, Dept. of Architecture, University of Pennsylvania, Philadelphia, PA 19104.

20-24 March: Tempe, Ariz. Advanced Energy Conversion Short Course. Contact: C. E. Backus, Prof. of Engineering, College of Engineering and Applied Sciences, Arizona State University, Tempe, Ariz. 85281, (602/965-3857/7298).

24-26 March: Portland, Ore. Whole Earth Environmental Expo Portland '78. Contact: Whole Earth Environmental Expo Inc., P.O. Box 4047, Portland, OR 97208, (503/234-9141).

26-30 March: Riyadh, Saudi Arabia. First World Conference on Resource Depletions, Energy Alternatives, and the Quality of Life in the Year 2000. Contact: Congress Organizer, Department of Geography and Environmental Studies, Northeastern Illinois University, Bryn Mawr at St. Louis Ave., Chicago, IL 60625.

24-27 April: Bahrain. Middle East Solar Technology Exhibition and Conference. Contact: Hugh Johnson, Soltech '78, Arabian Exhibition Management, 11 Manchester Square, London, WIM 5AB, England.

Solar Architecture

With the avid interest and financial support of the federal government, the AIA Research Corporation is exploring the complex matrix of energy and design and discovering that the problems of an energy crisis in the built environment can best be solved by the problem-solvers themselves—architects.

Last October, two of the world's most important illuminated manuscripts, Ireland's ancient Books of Kells and Durrow, journeyed from Dublin to New York City's Metropolitan Museum of Art for an exhibition called "The Treasures of Early Irish Art." According to The New York Times, the journey bothered many scholars who believe the fragile and unique eighth-century manuscripts should never have left what the Times called "their cozy digs" in the library of Trinity College, Dublin, for "the perils" of a two-year, five-museum tour of the United States.

The Met, of course, had an answer for the doubting scholars; it arranged to bring the key to the manuscripts' remarkably well-preserved condition—Dublin's foggy climate—along with the sacred Irish books.

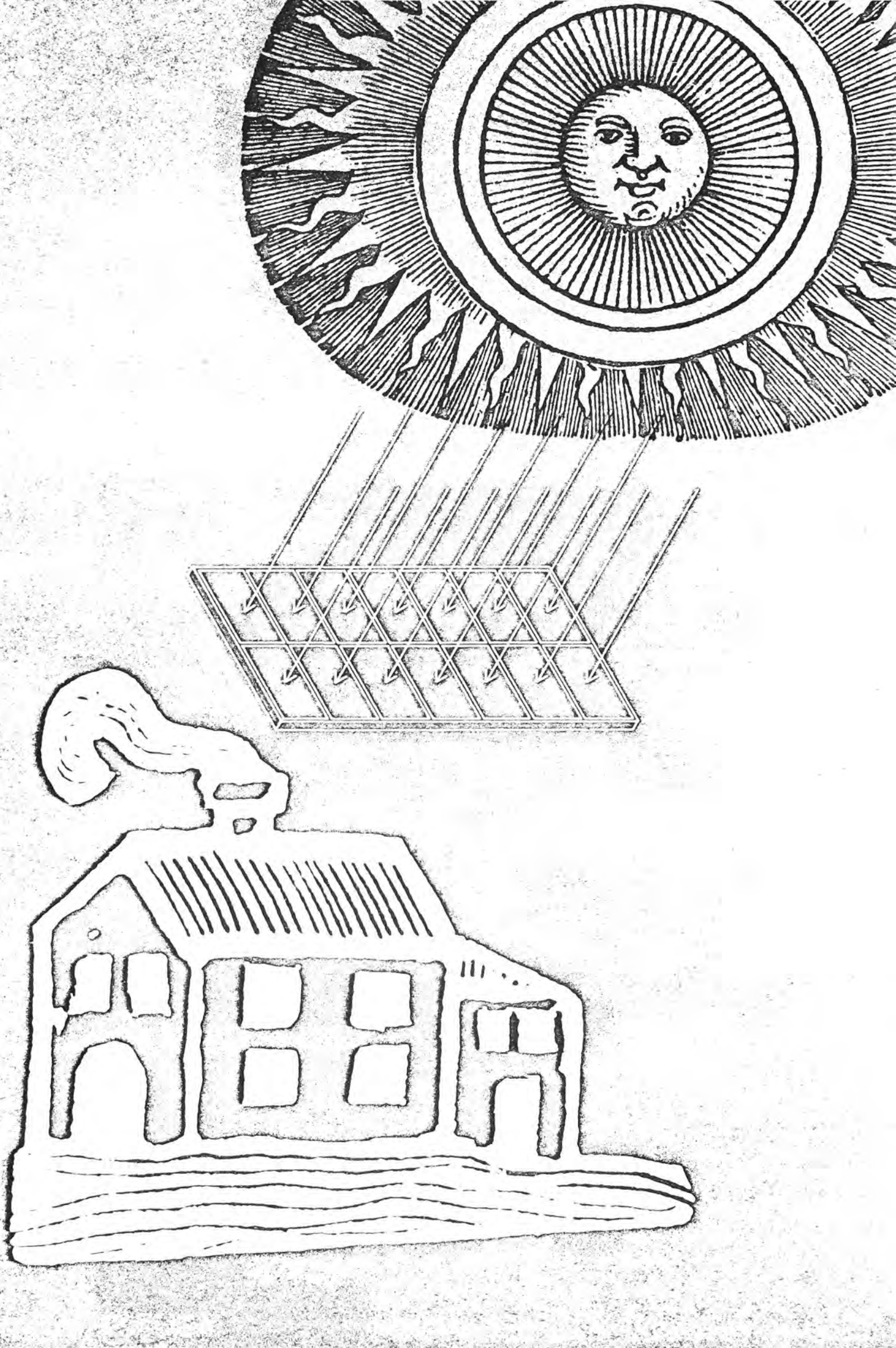
The exhibit's designers have created a hermetically sealed display chamber for the tour, a portable room in which both the light and moist climate of Ireland's capital are duplicated. There the ancient manuscripts, which lay buried for centuries prior to their discovery several feet beneath the Irish sod, will be viewed through impervious double-pane glass walls. The environment inside the room-size glass case will remain at a constant 70-degree temperature and 60 percent humidity through summer and winter, night and day, as the exhibit travels to San Francisco, Pittsburgh, Boston, and Philadelphia during the next two years. And at the close of the tour, the first-of-its-kind chamber may itself be moved to the National Archives in Washington, D.C. to serve as a model for future portable, controlled-climate environments.

What makes the Met's novel exercise in climate control worth a special story in The New York Times and a place in the National Archives is its new application in moving and preserving fragile works of art; the idea could have a profound effect on the way museums will shelter and show the delicate relics of our heritage. But its basic technology, the technology involved in maintaining a specified climate in a hermetically sealed environment, is certainly nothing new, especially to architects. In fact, the designers who created the Met's exhibit system dealt with their problem in substantially the same way architects approach their design decisions. And the result—a space with a climate controlled to fit within a specifically defined zone—isn't at all unlike a building conditioned to keep its users comfortable.

That similarity is what makes the exercise worthy of a mention here. The Met's new exhibit is an apt metaphor for modern design, and it doesn't take a long look at the architecture of recent history to make the connection. Architects are using the same processes and the same design tools to shape the built environment as the Met's designers have used to preserve the fragile Irish manuscripts. With the evolution of high technology, and with the assumption that the energy required to support that technology will always be cheap and abundant, we have evolved a very complex architecture based on very complex systems, not the least of which are the systems contrived to control climate for human comfort. And we've come to approach the use and development of those systems in terms of the same hermetically-sealed framework.

Now, of course, we're learning that our "cheap and abundant energy" assumption was wrong, and that much of our technology is quickly becoming outdated because of it. We use a full third of the nation's energy heating and cooling the built environment—a fraction we have already been called on to reduce. One of the casualties of this new low-energy era is going to be the across-the-board hermetic approach, because even though a sealed building can be energy efficient in some circumstances, it's an approach that can often be improved on, in ways most architects haven't given a lot of thought to. Only now is the profession beginning to look in new directions. And only now are we discovering that the end of the abundant energy paradigm may not be so much a cataclysm as an opportunity. Thanks to the rude impetus of an energy crisis, a great many architects are learning that there are better ways to design, better both for an energy-hungry nation and a profession skilled in solving problems.

Illustration by J. Beveridge



Late in 1974, Congress passed and President Ford signed into law the National Solar Heating and Cooling Demonstration Act, the nation's first modern commitment to a significant (non-nuclear) energy alternative. Congress had become convinced that we seriously endanger our environment by polluting the atmosphere, the ground, and the water with the by-products of our technological society. With a big push from the OPEC nations, Congress had also become convinced that we were finally beginning to run short of the conventional fuels that enabled us to achieve this high standard of technological development. So Congress directed a sizeable portion of the nation's fiscal resources toward developing and demonstrating new solar technologies for heating and cooling the built environment.

Responsibility for the new solar program went to the Energy Research and Development Administration (ERDA), at that time the newly-created agency established to coordinate federal energy initiatives. Broadly, ERDA was charged with overcoming the technical, social, and economic problems perceived to be standing in the way of a major change in our existing patterns of energy use. More specifically, ERDA was directed to demonstrate the viability of using existing solar technology to heat and cool both residential and commercial buildings, to develop advanced technologies in the field, and to disseminate the information generated by its work.

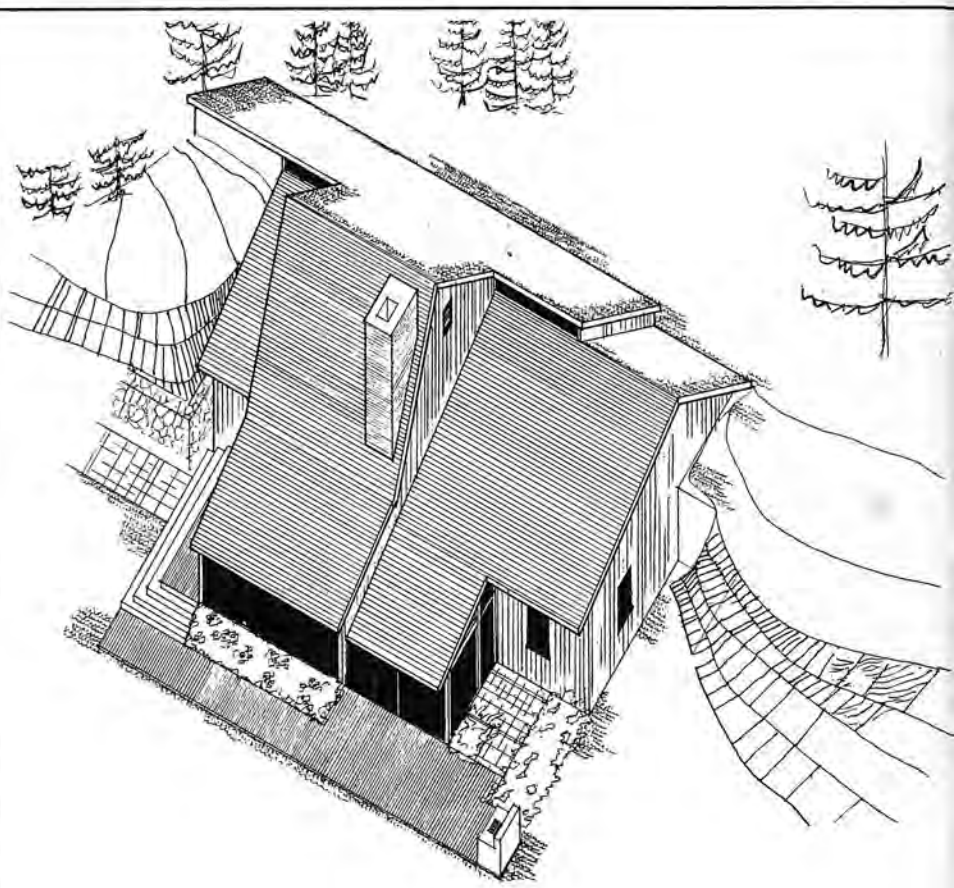
ERDA decided to delegate much of the work on the massive program to other agencies, keeping the commercial demonstration program and asking the Department of Housing and Urban Development (HUD) to handle residential demonstrations. The Department of Defense and the General Services Administration were commissioned to work with the federal building inventory, NASA assumed responsibility for advanced systems development, and the National Bureau of Standards would establish solar codes and standards.

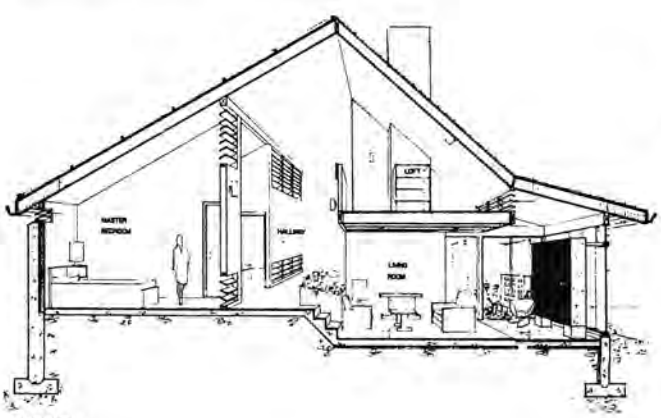
Today, four years after the program's inception, it's

Designing for extremes: One student's solutions

In the fall of 1976, AIA/RC sponsored and administered a Solar Dwelling Design competition, funded by the Exxon Corporation, for architectural students in the U.S. and Canada. Of the more than 2,000 students who participated in the competition, ten were finally selected by an interdisciplinary jury to receive awards for their designs. All of the winning designs were innovative, but two in particular deserve special attention. Submitted as a single entry, both are the work of Mike Marsh, a Canadian architectural student at Nova Scotia Technical College in Halifax.

Marsh's two passive solar dwellings, designed for two climatic extremes, bear little resemblance to each other. Nor should they. Each is designed in response to its particular climate—one to keep warm in cold weather, the other to keep cool in warm weather. The two sites are Nova Scotia and Jamaica.





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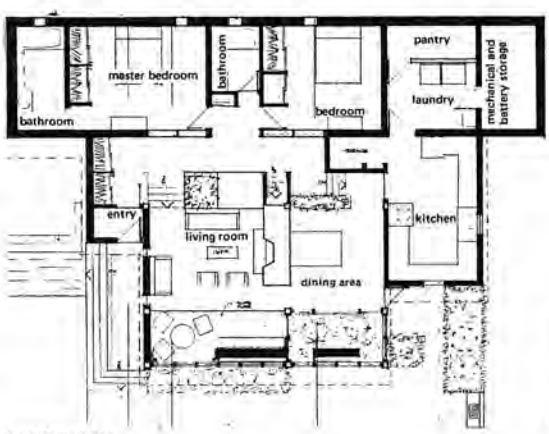
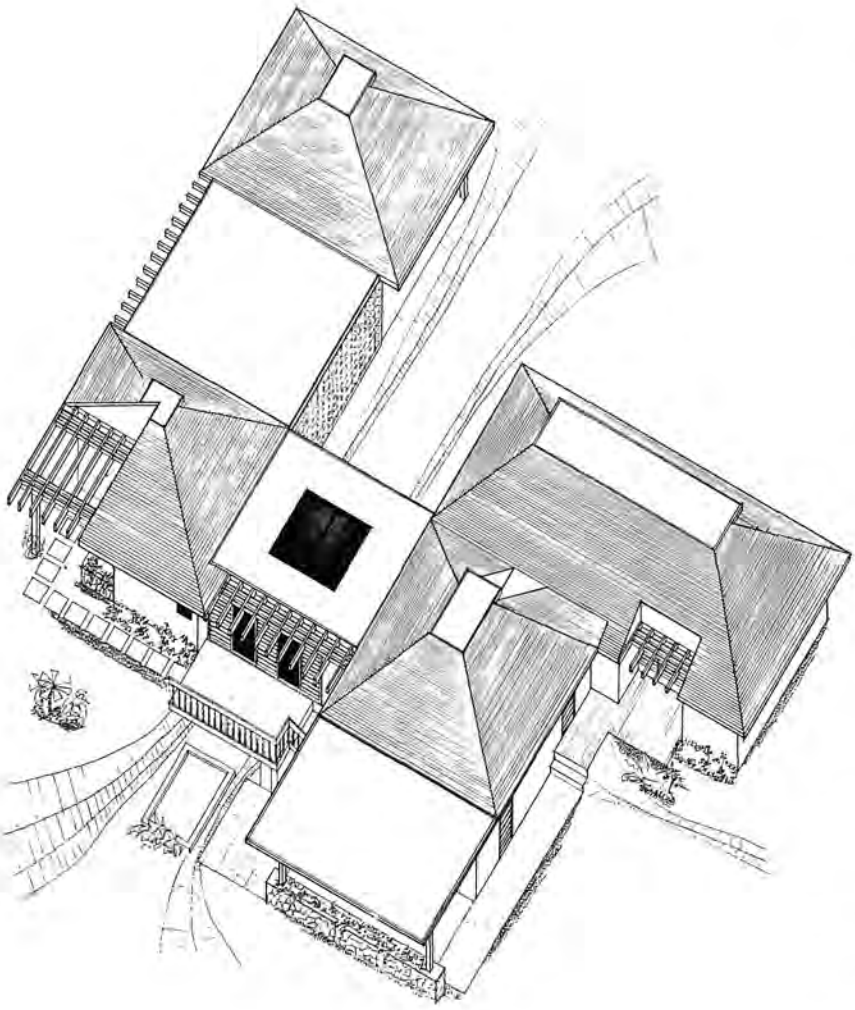


FLOOR PLAN

LOFT PLAN



Cold winters determined the compact plan for the house in Nova Scotia, shown on page 12. The design takes advantage of the earth's insulating qualities in helping to reduce temperature fluctuation in the house. Setting the north side of the building into the slope of a hill cuts heat loss by reducing the amount of exposed area. Sod covers the north slope of the roof.

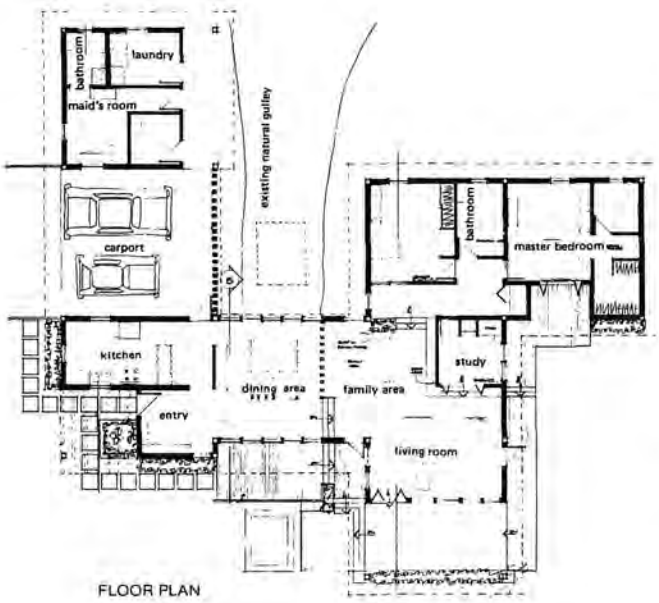
The site is used to advantage with coniferous trees located to the north to block the winter winds. Deciduous trees to the south shade the house in summer, but allow the sun to warm the house when they lose their leaves in winter.

Large glazed areas on the south serve as passive solar collectors. The sun radiates through the glass onto a large, dark-colored thermal (mass trombe) wall. The wall stores the heat, then slowly reradiates it later into the living spaces. Heated air between the trombe wall and the glass heats the larger living space by convection.

The windows are triple-glazed with thermal drapery to reduce nocturnal heat loss, and there are few operable windows because cold infiltration is a major contributor to heating load.

A Heatilator fireplace provides the house with auxiliary heat. Heat radiates directly from the fireplace, while air ducts through the chimney capture heat that usually escapes through the flue. The house also has a supplementary electric baseboard heating system which derives some power from a wind-driven generator.

SECTION



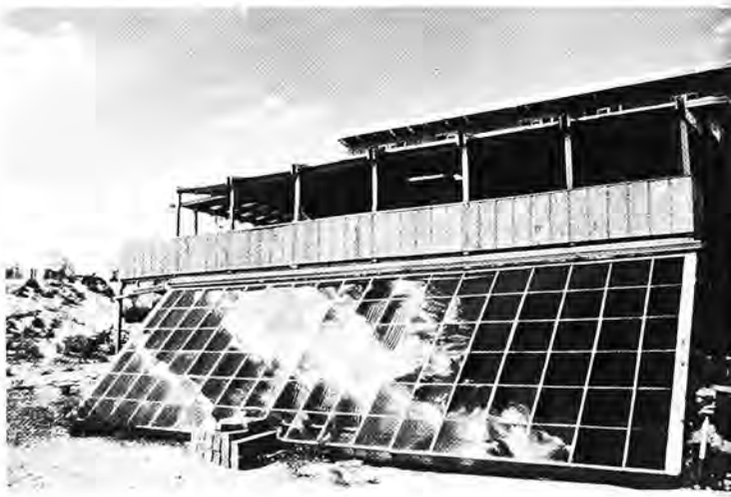
FLOOR PLAN

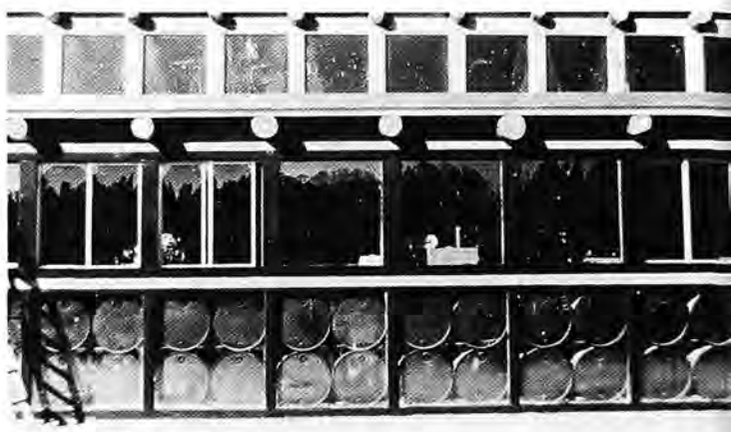
Marsh's Jamaica house deals with an entirely different climate. It is concerned not with heating, but with cooling loads and ventilation, so Marsh sought to control the effects of solar radiation with louvers in glazed areas, overhangs, and high ceilings that will allow heat to rise. Openings are located to catch prevailing southern breezes and so provide an evaporative cooling effect inside.

The large overhangs are complemented by careful landscaping to shade walls and the surrounding ground from the sun. Self-shading concrete block is used similarly and adds thermal mass to the building, thereby minimizing interior temperature fluctuation.

Flat plate solar collectors linked to a cistern for rainwater are used to supply domestic hot water.

Above, Paul Davis's passive solar residence in Albuquerque, heated with a thermosiphon solar system. Below, the south wall of Steve Baer's water trombe wall passive solar heating system for a Pecos, N.M. Benedictine monastery. Baer also designed the thermosiphon system for Davis's house.





safe to say that none of those federal agencies had any firm notions then about how they would pursue their new tasks. Operational frameworks were erected, points of departure established, but the course followed in the intervening years has been less a well-mapped route than it has an evolution. The national solar program has given the building industry a chance to learn, at federal expense, how solar systems work and how they influence building design and construction. For the federal agencies, that has meant evolving new ways to bring the industry in touch with a totally new field. But for the industry, and especially for the architectural community, it has been a conceptual evolution, one that is still going on. Under federal aegis, the groundwork is being laid for a new architectural paradigm that embraces much more than the new solar technology, more than heat pumps and collectors, more than purely solar energy altogether.

The AIA Research Corporation has been involved with the national solar program from the latter's beginning. With a small staff and an even smaller office in the AIA Headquarters Building in Washington, D.C., the Research Corporation has worked on federally-funded projects in solar energy from HUD, the National Science Foundation, the Federal Energy Administration, and other agencies. It hasn't conducted all of the federally-funded research in solar energy since 1974, and all of its work hasn't been in the energy fields. But despite its size, AIA/RC has had an impact on the shape of federal involvement in solar energy and the built environment. And by bringing practicing professionals in to work on its federally-funded projects, the Research Corporation has also affected the design community. Well over 100 architects, most of them from smaller firms, have been brought into federal solar programs through AIA/RC, creating a new relationship between architects and government, between architectural practice and national policy. That relationship has played a telling role in the evolution of the nation's work in solar energy and the built environment.

Finding the Solar Designers

Tucked inside the mid-August, 1975, issue of the AIA MEMO was the first announcement of one of AIA/RC's early projects in solar energy—a survey of architects for the National Science Foundation aimed at pinpointing the problems encountered and the problems solved by architects who had designed solar buildings. NSF, in an effort to set policy for upcoming federal programs in solar energy, wanted to know exactly where architects were in solar application, and learn what they perceived to be the constraints and incentives of the field.

The MEMO announcement included a short questionnaire for solar-experienced architects. Of AIA's 24,000 members, 900 early solar designers responded. Their answers came in to AIA/RC project director Charles Masterson and research associate Michael Haggans. Haggans and Masterson went through the responses and pulled out the 40 design firms most experienced in solar design on several building types. The firms and their solar projects were spread across the U.S., so the two researchers divided the nation into quadrants, decided who was going where, and hit the road to collect information and interview each of the 40 designers.

Rather than prejudice their results by asking specific questions that would presuppose problem areas, Haggans and Masterson went to their architects with an unstructured interview process. The interviews were designed to determine what problems the architects encountered in three broad areas: Where did they run into legal and regulatory hangups? What kinds of economic constraints did they find? And what problems did they have in matters of pure design?

Six weeks later, Haggans and Masterson were back at their desks in Washington, comparing answers, compiling data, and putting together a report that would illuminate not only NSF and the other federal agencies involved in solar energy, but the Research Corporation itself.

What the researchers learned from the architects they talked to was that their problems broke down into two—not three—basic categories. The first involved their own design expertise; the second, the actual application of solar technology to the buildings they were designing. In each area, the designers were seriously hindered. They pointed to the lack of a nationwide or industrywide commitment to energy conservation, and

to a predominant conception of solar energy as a new technology of unproven technical and economic feasibility. They complained of a crucial lack of background material on energy-effective design approaches and on solar equipment. And they noted the absence of long-term national goals in solar energy, of guidelines and user requirements defining how solar buildings should perform.

Against this backdrop, the architects listed steps they believed would hasten the development of solar design and technology. They called for a realistic federal commitment to energy conservation, for an easily accessible system of information on practical applications of solar energy, for performance standards and testing procedures to ensure that solar systems work as well as they ought to, and for new research by the design profession into the impact of solar energy on such issues as climatic analysis, user requirements, land use, growth patterns, transportation, and communication.

Based on their interviews and their analysis, Haggans and Masterson added some conclusions of their own to the report. The early users of solar technology, they said, "have not experienced major barriers to the utilization of solar technologies for the heating of buildings." Instead, said the researchers, they dealt with "the innumerable minor technical difficulties associated with the use of untried and unproven methods and products" and "paid the often high price of developing new capabilities to respond to new problems and capture new opportunities . . . They have made the necessary step from conceptual research and the developing hardware technology to practical application."

The report's basic message was that there were no insurmountable problems to using solar heating and cooling in the built environment (a message, Masterson says today, that NSF in many ways hadn't expected and wasn't prepared to hear). But the report emphasized that there were many problems remaining, having as much to do with bringing architectural expertise in the field up to strength as with solar technology. It was the enumeration of those problems that opened eyes at NSF and elsewhere (the study was funded in part to give direction to solar projects underway at HUD, FEA, and ERDA). It served to consolidate a new attitude at the Research Corporation as well.

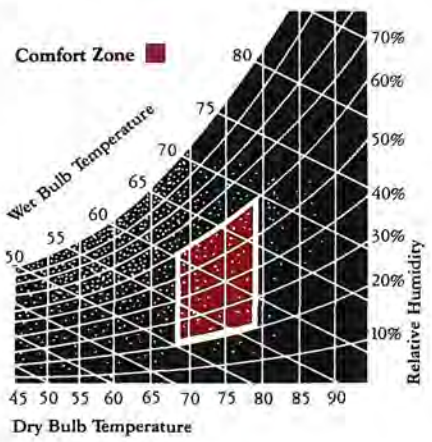
Research Corporation President John Eberhard has seen both sides of the federal government's work in architectural research. A former dean and professor of architecture, and a practitioner, he also served as director of the National Bureau of Standards' Institute for Applied Technology in the mid-1960s. It didn't take AIA/RC's Early Users Report for NSF to convince him that federal research and development in solar energy often focused too heavily on hardware. Under its new solar programs, the government was committing most of its time and money to the development of mechanical solar systems that would only serve to replace the conventionally fueled heating and cooling systems already in operation in buildings. What that meant to Eberhard was that new systems would still be applied to buildings designed in old ways—hardly the most efficient solution on its surface. Nor did that line of thinking jibe with the experiences of architects interviewed for the NSF report. They saw new building forms evolving with solar energy, not just new systems; and they saw new implications for community growth and planning.

Energy conservation, Eberhard believed—and be-

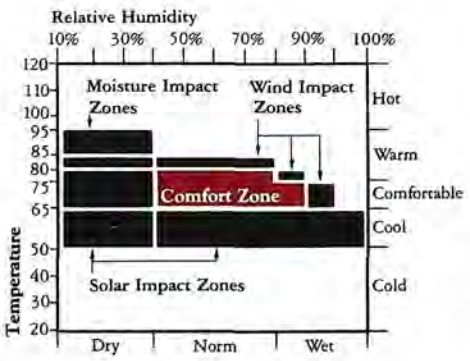
Two views of a highly successful experiment in passive solar design, the elaborate 11th-13th century pueblos of Mesa Verde, Colorado. Warmed with directly gained solar radiation when the sun is at its low winter angle, the stone dwellings are shaded by the overhanging mesatop and cooled by prevailing breezes from the valley below in summer. Heat gain is controlled with massive construction, minimal openings, and stacked space planning.

Part I: Climate defined

A year of temperature and humidity readings, taken in El Toro, Calif. by Burt, Hill and Associates and reported on this psychrometric chart in 1976, demonstrated that climatic conditions perceived as comfortable by local residents were not reflected in ASHRAE's Standard 90-75 comfort zone.



For AIA/RC's climatic analysis, a climate chart was created to portray both the base comfort zone (shaded) defined by temperature and relative humidity, and the zones of potential impact for additional climatic elements—solar radiation, wind, and variation of moisture in the air.



As part of its Passive Solar Systems Study, funded by HUD, AIA/RC has been exploring the relationship between climate and comfort for more than a year. Under the direction of architect Vivian Loftness, the research started from the premise that any design for an energy conserving building must be based on a well-defined range of the temperatures and humidities in which most people engaged in normal activity are thermally comfortable. That range is the "comfort zone," and it defines the conditions of temperature and humidity that a modern residential building must maintain to keep its users comfortable.

A great deal of effort has been expended trying to define a truly accurate comfort zone. Since the 1920s, when the Effective Temperature (ET) Scale came into existence, the lower limits of a desirable living temperature have ranged from 62 degrees Farenheit to the present day design standard of 75 degrees. In the 1950s, ASHRAE reexamined the ET Scale and replaced it with a new comfort design scale that would better reflect modern living patterns, lighter clothing habits, and diet changes. A much smaller comfort zone resulted, one that allowed a design temperature range of six degrees—72 F to 78 F—and established the stable indoor comfort standards of today.

At the same time, the United Nations was beginning work on comfort design standards for the developing nations. The UN standard recognized an *acclimatization* factor (which assumed the people develop different tolerances according to length of time spent in hotter or cooler climates) and set up a comfort zone based on *acceptable* temperature and humidity conditions for human occupancy, rather than the *desirable* standard defined in the U.S. Also at the same time, a somewhat larger comfort zone was developed by Victor Olgyay, but its increased comfort range was keyed to making demands on building users, demands related to wearing heavier clothing and tolerating a wider range of temperatures.

AIA/RC's present work on comfort standards for the built environment is a product of the energy crisis, and it is based on a new set of variables. The research is aimed at developing a new comfort zone which reflects the lower design limit of 65 F mandated by the White House, and expands the six degree maximum temperature range allowable under present design standards to a 15 degree range—65 F to 80 F. It is aimed also at acknowledging the effects of high relative humidity (70 to 80 percent) in diminishing human comfort potential in higher temperatures, and setting a relative humidity limitation (30 to 80 percent) on the design comfort zone.

The research, now nearly complete, has yielded two very basic realizations: First, earlier studies have often shortchanged the factors which influence perceived thermal comfort, and second, the comfort zones produced by those studies can now be substantially enlarged without asking a great deal more of building users, simply by taking climate into full consideration at the design stage.

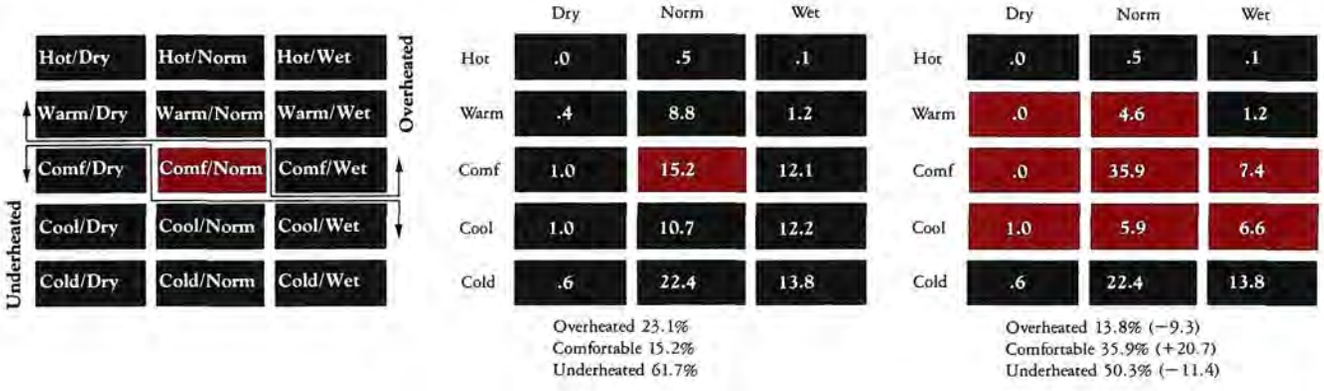
That earlier studies have been incomplete was well illustrated when Burt, Hill, and Associates were developing research for the Minimum Energy Dwelling near San Diego two years ago. By mapping daily temperature/humidity readings for the town of El Toro, Calif., onto a psychrometic chart, the firm discovered that most of the readings in that climatically comfortable jurisdiction fell *outside* the comfort zone prescribed in ASHRAE's conservation-oriented Standard 90-75, despite the fact that those readings represented conditions the residents of El Toro perceived as being quite comfortable. Why did ASHRAE's standardized comfort zone misrepresent the actual comfort conditions of the town? The answer lies in the variables that define human thermal comfort.

Four major properties of the environment influence thermal comfort: Air temperature, humidity, air velocity, and radiant temperature. The ASHRAE standard and its predecessors describe comfort in terms of ambient air temperature and humidity alone, and they yield a comfort zone that doesn't fully describe actually perceived comfort. By failing to chart the impacts of air movement for convective cooling (the wind chill factor), of moisture addition for evaporative cooling, and of mean radiant temperature and solar radiation for radiant heating, they create a gap between comfort zone and true (perceived) comfort. And though ASHRAE, Olgyay, and others have researched these latter factors and proved that they can be reliably estimated, the factors have not been

From the first climate chart, a simplified grid was drawn, enabling computer analysis of specific climatic conditions recorded at 130 primary weather stations around the country. Percentage of occurrence for each of the 15 climate conditions was charted for each monitored area, yielding a survey of base climate, and then compared with the availability of additional climatic elements to chart the potential impact of total climate on human comfort.

Analysis of the base climate—temperature and humidity alone—in Washington, D.C. indicated that in the course of an average year, conditions there fall into the standard comfort zone 15.2 percent of the time. Overheated conditions, ranging from uncomfortably warm to extremely hot, prevail 23.1 percent of the time, and underheated conditions, 61.7 percent.

After analysis of all the elements of Washington's climate—including available solar radiation, winds occurring at 5 mph or greater, day/night shifts of temperature, and the impact of moisture variation—significant shifts into comfort were revealed. The percentage of the time conditions are perceived to be comfortable by humans is more than double the comfort percentage defined in the standard comfort zone. For this particular area, wind has the greatest impact on comfort, alone accounting for a 9 percent shift of overheated conditions into the comfort range.



expressed in their climate zone definition.

Together with an understanding of thermal comfort, *regionalism* is a key concept in design/climate research. A standardized comfort zone for a nation as geographically and climatically diverse as the United States is bound to create misrepresentations as large as the El Toro case. Pursuing their research along regional lines, AIA/RC's project team gathered climatic readings from each of the nation's 130 primary weather stations, spanning the country. The data included hourly mean temperature and humidity readings, hourly wind conditions associated with those readings, and U.S. Air Force charts recording three-hourly mean temperature and humidity readings for each month to interpret, on a larger scale, the potential impact of diurnal temperature/humidity shifts—the changes between night and day.

To study the weather data, the researchers prepared a computer-generated grid capable of graphically portraying the full range of climate in the U.S. Its vertical axis was temperature in degrees Farenheit, its horizontal axis, relative humidity. Plotted on the grid were two comfort zones: The base comfort zone defined only by temperature and humidity, and an enlarged comfort zone enclosing the potential impacts of air movement, solar radiation, moisture addition, and other dynamic factors not considered in the base comfort zone's definition.

By superimposing the detailed climatic data from each of the 130 test cities on the grid, the researchers were able to graphically illustrate two separate sets of conditions for each city. A first count of the temperature/humidity readings falling in and around the base comfort zone revealed each city's basic thermal design conditions—the conditions a designer operating under the ASHRAE standard would design for. A second count of all conditions falling within the expanded comfort zone revealed the potential for natural conditioning by taking advantage of such climatic factors as sun, wind, moisture availability, and diurnal temperature range.

For some cities, the comparison revealed small opportunity for using natural elements to reduce the mechanical conditioning load; for others, the potential for using nature was shown to be substantial. A designer taking those factors into consideration—where they are available—is capable of significantly reducing energy demand.

More important, the research presents a climatically complete portrait of each of the test cities, giving designers in and around those areas their first solid information on regional climate differentiation. An architect in Washington, D.C., for example, can now assess the predominant design conditions there and estimate the impact climate will have on human comfort in a building—before planning for mechanical conditioning. By considering such design factors as solar orientation, natural ventilation, massive capacity construction, and evaporative cooling in the forms of fountain courts and enclosed atriums, the designer and effectively and accurately reduce mechanical conditioning load, saving energy and—equally important—bringing building users a little closer to the natural environment in the same motion.

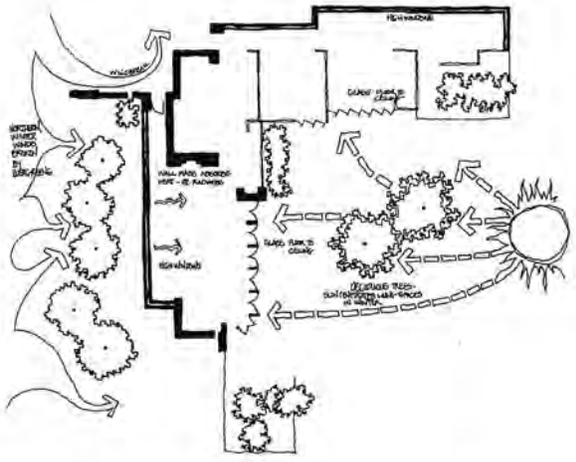
The project report on the Loftness team's climatic analysis has been published in small quantity by the Research Corporation, and copies are available now from AIA/RC. Although the project report does not contain the individual climatic data from each of the 130 test cities, AIA/RC is preparing a followup proposal to HUD and DOE for a second project phase that will involve the preparation, with the National Weather Service, of local and regional climate analyses for designers of regional energy conserving and passive solar buildings.

Part II: Climate applied

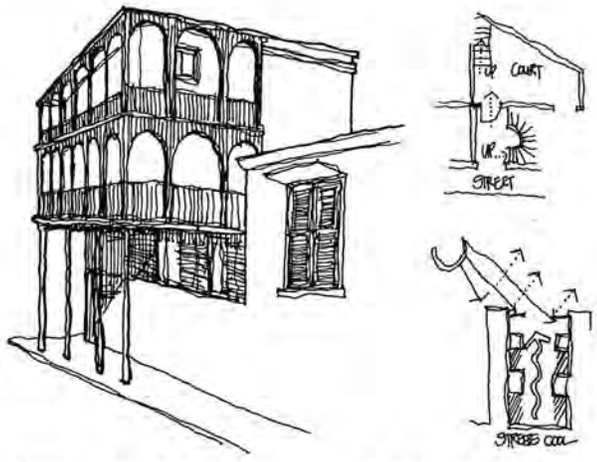
Research into climate is only valuable to designers if the research can be interpreted and applied to actual building design. AIA/RC's research involved collecting and analyzing temperature, humidity, wind, radiation, and moisture data from 130 weather stations around the country to support the theory that climate varies significantly from region to region inside the U.S., and to define those regions and describe the natural forces at work in each. The results—detailed portraits of the climate in each of 130 areas in the U.S.—can now be interpreted by designers to yield some important, and sometimes surprising, information. For example:

The Northwest
In a region extending from northern California through Oregon to the southern portion of Washington, data drawn from weather stations, Air Force charts, and national weather maps reveal a common base climate condition in which heating needs predominate, and in which solar impact percentages indicate a surprisingly strong potential for natural solar conditioning. Even low percentages of available sunshine don't lessen the usefulness of direct solar radiation for creating comfort in a Northwest home, because daytime temperatures are predominantly within the easily heated range of 50-65 degrees Farenheit. This suggests residential design solutions for the Northwest in which daytime living spaces are organized behind large areas of southfacing windows to maximize the dwellers' time in the sun. The use of thermal storage would further improve on this solar heat gain, carrying warm radiant temperatures well into the evening hours.

The Gulf Coast
In sharp contrast to the Northwest, areas from southern Florida to Louisiana and Texas register no advantage in solar conditioning, since temperatures are almost always above 65 degrees F during the sunshine hours and additional heat is undesirable. Here, unshaded glazed areas, especially large expanses to the east, west, or south, only jeopardize the natural comfort of the individual; deep overhangs and northfacing windows are more appropriate. Of much greater importance in this



Frank Lloyd Wright's Usonian homes were planned to deal sensibly with climatic conditions typical of the Northwest.



The characteristic New Orleans townhouse shades and ventilates effectively. Central courts act as thermal chimneys; hot air exits upward, drawing cooler air from the street level.

lieves no less firmly today—is first and foremost a problem of design, and secondarily a problem of systems. If a building is the context in which a conditioning system exists then the context, not the system, should be the first thing to be evaluated from an energy conserving standpoint. Only after the envelope design is attuned to maximum energy conservation should the system be created.

The NSF report rang with this conviction; both the Research Corporation's research team and the architects interviewed in the NSF study stressed the notion that energy conservation is primarily a design issue, not one of mechanics. The conviction was echoed in another AIA/RC project being done at the same time for the Federal Energy Administration, entitled Energy Conscious Design. Funded to encourage the spread of information about solar energy and energy conservation techniques among architects, it too underlined the need for *architectural* solutions to energy mismanagement. But the NSF and FEA projects did no more than recommend strategies for government funding and professional education; both agencies were listening to the architectural point of view, but neither had a stake in real design.

It was HUD's Integrated Solar Residential Demonstration Program which finally, in 1975, brought federal dollars in to work with real architectural concepts in solar energy. As part of the national solar program, HUD's effort would include installing solar systems in new and existing dwellings, developing performance criteria and certification procedures for solar equipment, developing the market for widespread acceptance of solar technologies in the housing industry, and disseminating solar heating and cooling information.

When the program was still fresh out of Congress, Eberhard had research associate Michael Holtz draw up an unsolicited proposal for a project that would let AIA/RC channel some of HUD's solar funds to architectural firms and bring some actual design concepts back to the agency. Holtz drafted an idea for a publication

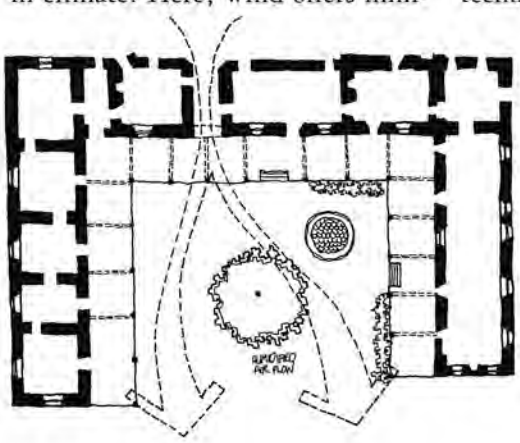
region is the value natural ventilation can have in creating comfort from temperatures and humidities that are slightly above accepted comfort levels. Research into wind factors in the area reveals a high percentage shift into comfort when the availability of winds greater than 5 mph is matched with the slightly overheated conditions. Building variations which might effectively respond to that natural ventilation potential: Elongated house plans allowing for cross ventilation in each room; operable, northfacing floor to ceiling window openings, and two notions common to Southern living—sleeping porches and screened hot weather living spaces.

The Southwest

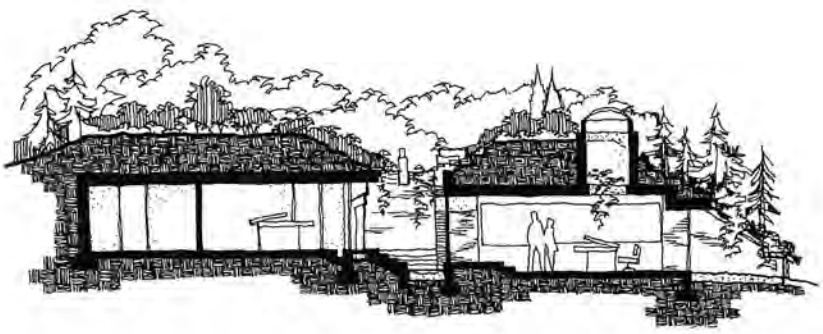
Areas in the dry Southwest provide a third contrasting regional variation in climate. Here, wind offers minimal cooling potential; in fact, due to dehydration, it often proves detrimental to health. Nor is direct solar radiation valuable for heating, since daytime temperatures are again most often in or above the comfort zone. The impact of moisture addition, though, is considerable, offering natural relief by both cooling and humidifying. Closed garden atriums, interior fountain courts, greenhouses, even evaporative coolers, all directly and intelligently influence the design of buildings in this part of the country.

The Far North

Very cold climates and very hot climates, with minimal periods of relief and little potential for solar or other natural conditioning, probably profit most by applying today's most frequently cited energy conservation techniques. These "isolation" techniques—increased insulation, compact building plans, minimal glazing—respond directly to the impact of alien climatic conditions. In doing so, they eliminate the potential of natural comfort conditioning, but where no such potential exists, nothing is lost by taking the hermetic approach.



Sited to accept prevailing breezes, this southwestern mission plan draws air quickly through a portal, ventilating the court and drawing cooling moisture from a court pool into the air. Massing reduces heat gain and provides evening warmth.



Malcolm Wells' underground office for a Pennsylvania site is appropriate for the extreme climatic conditions of regions even farther north.

that would move from a brief history of solar applications through a discussion of solar heating, cooling, and domestic hot water systems, to an exploration of the factors which influence the design of solar dwellings. The final portion of the book would illustrate actual dwelling and site design concepts responsive to those influential factors for various housing types, climates, and solar systems. HUD promptly accepted the proposal, approved a contract through the National Bureau of Standards' Office of Housing and Building Technology, and AIA/RC began work on its third project in energy-related architecture. The Energy Conscious Design project for FEA and the Early Users Report for NSF, both in their final stages, were joined by the HUD publication, *Solar Dwelling Design Concepts*.

AIA/RC subcontracted the design concept work on the new project to eight architectural firms and two schools of architecture—ten of the hundreds of schools and firms who responded to announcement of the project. Site design concepts were generated by another set of consultants, and the Research Corporation's project team assembled the final project report for presentation to HUD. It was quickly translated into one of the most popular resources in HUD's publication catalog. Available to builders, designers, and the general public, the basic solar primar has sold more than 22,000 copies to date and is well into its second printing. *Solar Dwelling Design Concepts* proved doubly successful for the Research Corporation; it gave HUD ample proof that architects had some very basic and important contributions to make to solar energy and its application in the built environment, and it proved again that AIA/RC could effectively tie design professionals into the government's solar program.

HUD scheduled its residential solar heating and cooling demonstrations to run in five consecutive project cycles, ending in 1979. The Boeing Aerospace Company was contracted to manage the complex program, which will end up involving 5,000 residential projects, as many builders, designers, and developers,

Six basic options for passive system design

The most widely accepted definition of a passive solar heating and cooling system describes a building through which thermal energy flows—from collection to storage to distribution—by natural means, enabling the system to function without external power.

The operation of a passive system is simply the control of the thermal energy flow. That includes the ability to stop energy from escaping or entering the building (by using shading or insulation) and to vary the timing or location of the energy inside the building (by opening or closing interior spaces to one another). A passive solar system is a system of *design*, not a system of mechanics, and its operation is a design problem. In a building with passive solar elements, the architect is the first determiner of the heating/cooling system's operational efficiency.

A passive system and its operation can be designed into the construction of a building (using, for example, supporting walls which incoporate mass, insulation, and venting plenums) or into its organization (by determining spatial hierarchy in response to energy flow tendencies). An efficient passive solar building will reflect the designer's understanding of nature's cyclical forces —sun and wind—on a daily and seasonal basis, because it control responds flexibly to those environmental cycles. A passive solar system is defined by the dynamics of its operation, nor by the static conditioning rules or aesthetic images of nonpassive design. It expresses a functional approach to architecture, an approach that conceives of the heating and cooling system as an intrinsic part of a building and may require architects to broaden their most basic building concepts. Even when a building incorporates active solar or more conventional mechanical conditioning elements, its passive energy system is what will most strongly affect the building's shape.

Because passive solar design represents an architectural approach to conditioning the built environment, and not a strictly mechanical approach, it has proved to be the most fascinating design problem architects involved in solar energy have encountered. Hundreds of passive design solutions have been tried by architects. AIA/RC's *Survey of Passive Solar Buildings*, compiled as part of the Passive Solar Systems Study for HUD, documents 100 of those passive solar projects in 28 states. The projects represent as complete a survey of passive design as is possible without detailing each individual—and unique—solution undertaken to date. Taken together, the projects illustrate the *range* of design solutions undertaken up until 1977. They represent six basic passive systems, all of which fall into three basic building types.

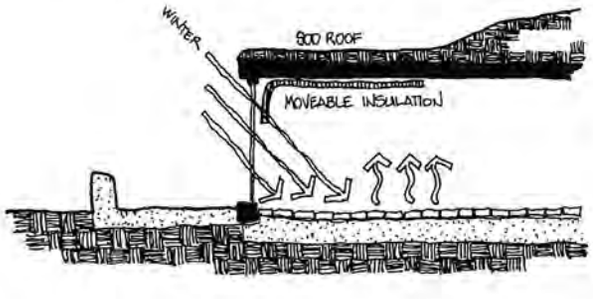
The passive building type historically and currently most common, *Direct Gain*, is usually structured so that solar radiation passes through a large glazed area into a directly exposed living space, and is then stored in an interior thermal storage mass (floor and/or wall) sized for maximum storage capacity and sited for solar exposure. The living space, directly heated by the sun, actually serves as a "live-in" solar collector. Common features of the system: Southfacing glazing for maximum solar radiation; double (or more) glazing to minimize heat loss; substantial massing for thermal storage; insulation between the interior thermal mass and the outside to prevent unnecessary heat loss; sunshading overhangs and ventilation to lessen heat gain in summer.

A second building type is *Indirect Gain*, in which the storage mass is placed between sun and living space, collecting and storing heat directly from the sun and then transferring it to the living space. When the living space is directly heated, heat can only build up to a certain level before users feel discomfort; in a space indirectly heated, thermal energy builds up in the storage mass to levels well above that limit, and its flow into the living space can be controlled for comfort.

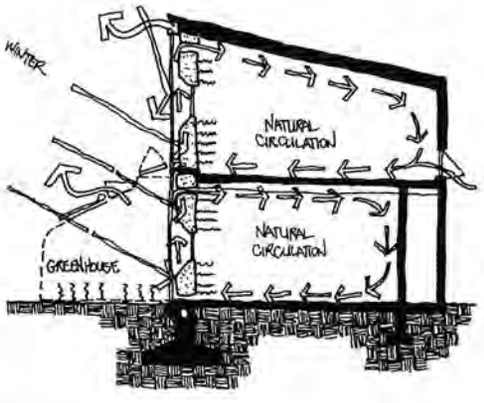
One indirect gain system uses a *mass trombe wall* for thermal storage. Solar radiation passes through the glazed collector, directly into a storage mass (concrete, adobe, stone, a composite of brick, block, or sand) designed to radiate heat to the living space after a time lag that can range in duration from moments to hours. Heated air in the space between the glazing and the mass trombe wall can also be vented to the living space, and controllable vents in the mass itself can regulate heat to the living space and draw cooler air into the mass for heating.

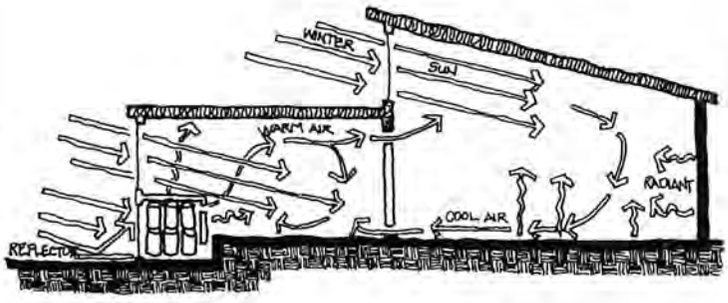
A second manifestation of indirect gain: The *water trombe wall*, in which solid massing is replaced by a liquid

This David Wright-designed direct gain house in Santa Fe faces south for maximum solar exposure. Thick adobe walls,' a sod roof, double glazing, and berming east and west insulate sufficiently. Overhangs and cross ventilation prevent summertime overheating, and 440 s.f. of vertical windows collect enough solar heat to satisfy all heating needs.

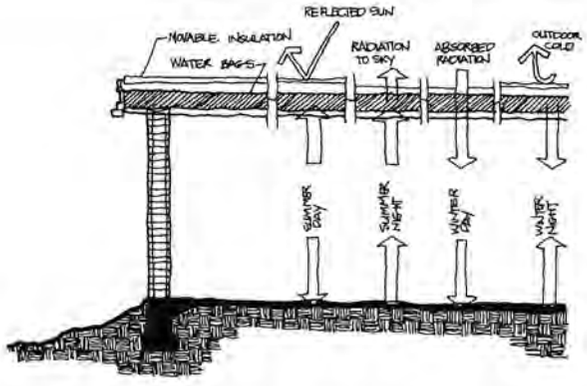


Every room except the bathroom in this Princeton, N.J. house has the building's southfacing mass trombe wall for its south wall. Designed and owned by Doug Kelbaugh, the house meets 75% percent of its own heating needs.





Steve Baer of Zomeworks designed this water trombe wall heating system for a Benedictine Monastery in Pecos, N.M. The southfacing trombe wall (140 55-gallon water drums) radiates heat to both office space and northside warehouse, meeting 95 percent of heating need.



Harold Hay's patented Skytherm roof pond system conditions this Atascadero, Calif. house designed by John Edminster and Ken Haggard. The moveable insulation panels open and close automatically depending on indoor temperature. Electric baseboard auxiliary heating is provided, but hasn't ever been used.

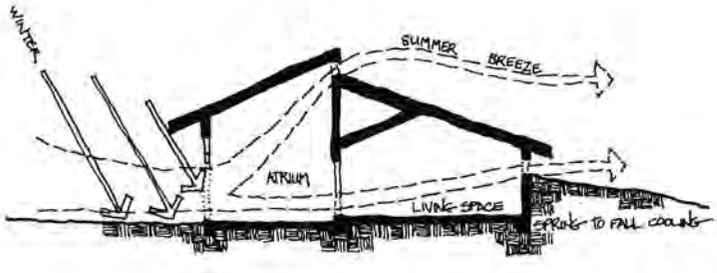
storage mass. Thermal transfer in water is rapid, and radiant distribution to the living space almost immediate, but by varying the size and shape of the water containers in the storage mass (tin cans, bottles, tubes, barrels, bags, and complete water walls have all been used) both storage capacity and distribution rate can be manipulated.

A third indirect gain system: *Roof pond.* Here, both collector and storage mass are moved from wall to roof. A body of water on the building roof, covered by exterior, moveable insulation, absorbs and stores solar radiation when exposed (insulation open) to the sun, and heat is radiated uniformly to the building below. When closed, the moveable insulation minimizes solar exposure in summer, prevents heat loss on sunless winter days, and cools the living space in regions where wide day/night temperature swings occur by absorbing heat upward and dispersing it into cool night air. Roof pond systems are the least common of indirect gain building types because they involve uncommon principles of physics and make more demands on both designer and user.

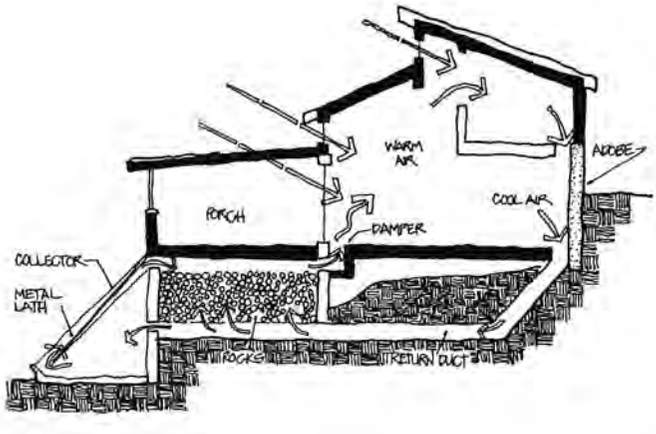
The third passive solar building type introduces an isolated collector space into the building design, generating a new energy flow formula—sun to collector space to storage mass and living space—and a third characterization, *Isolated Gain.* The concept has produced two basic system types, the first of which —*sunspace*—lies midway between the direct gain (live-in collector) and trombe wall systems. A sunspace is simply a glazed, southfacing collector space attached to, but distinct from, the living space, and linked thermally to a storage mass where heat is held and slowly released. Atriums, sunrooms, sunporches, and greenhouses all constitute sunspaces. Variability of site, form, and storage mass (which can be massive floors, walls, benches, rock beds, or water pools) lends the system a host of design options.

The second system type—*thermosiphon*—employs the isolated collector in a different fashion. A "thermosiphoning" heat flow occurs when cooling air or liquid falls to a point below a solar collector. Heated there by the sun's energy, the substance rises through a storage mass which absorbs the heat and radiates it to the living space. Now cooled, the substance falls to the collector to repeat its cycle. With its collector space separated from the living space and its heat exchange dependent on air circulation, the thermosiphon begins to resemble an active solar system. Nonetheless, the system, adaptible for both domestic water and space heating, operates on natural convection, requiring no external power, no fans, and no blowers, to complete its cycle.

Sunspace is the principle behind this Nacogdoches, Texas residence by George Way. The large, southfacing atrium absorbs solar heat in winter, storing it in a thick concrete floor slab. Shaded in summer, the atrium becomes a wind scoop, funneling breezes through the living space and out the building's bermed and minimally opened north face.



Paul Davis's Albuquerque house is heated passively on the thermosiphon principle. The system meets 75 percent of heating needs; a heatilator fireplace provides the rest.



close to $100 million in program expenditures and something more than $25 million in actual building grants. After the publication of *Solar Dwelling Design Concepts,* HUD came back to AIA/RC for direct architectural assistance on the demonstration program, and Boeing came for subcontracted assistance.

AIA/RC's subcontract with Boeing, underway for two years now, is largely a service operation concerned with making sure architectural/engineering expertise is available to Boeing. The Research Corporation has 19 solar-experienced architects and engineers around the country under subcontract to provide professional services on Boeing's call. These 19 professionals, dubbed Design Integration Monitors (DIMs), prepare field reports on individual residential projects in the program, documenting the design and construction processes and verifying the performance expectations of builders and solar equipment manufacturers. In addition, the solar equipment on selected projects has been instrumented by NASA to monitor performance. Data from the NASA instruments is fed into National Bureau of Standards computers in Gaithersburg, Md., where NBS will compare actual performance records with the predictions documented by the DIMs and come up with accurate information on solar system performance, forming the back-up for what will become the nation's first solar equipment performance standards.

The project documentation accomplished by the DIMs is called the Design Process Review, and by all the standards of professional design, it's tedious work, with a lot of paperwork and a lot of information to be sifted, weighed, and translated into usable form. But it is the kind of service that is crucial to HUD's solar demonstration effort. This five year period of federally-funded trial and error in solar design and technology is a compressed learning experience, an intensive course designed to bring architects and the rest of the building industry up to high performance as quickly as possible. The value of this multi-year crash course hangs on the documentation of the process, on the accumulation of experience derived from 5,000 residential experiments conducted in five short years.

AIA/RC is also channelling the information collected by the DIMs toward another goal quite separate from the NBS equipment standards effort. AIA/RC's aim is to provide a new design tool drawn from the analysis of HUD's projects—a solar design manual.

Greg Gibson manages the Boeing project at AIA/RC. He searches for the right phrase to describe the design manual his project team is working on, and settles on calling it "a kind of dictionary of solar systems." His desk, piled high with flow charts, structural drawings, interview forms, and project reports, makes it easy to accept the dictionary analogy. Gibson says the manual will detail every technically viable solar system or subsystem existing today, including components of active systems (collector types, transfer and storage units) and such passive design elements as skylights, thermal glazing, and trombe walls. The manual will describe the various configurations into which those elements can be put, conceptualizing full systems. And with the aid of computer analysis of the data from HUD's solar projects, the manual will set out the most accurate formulas possible for predicting the performance of any given system in a given situation. Which means, says Gibson, that the architect who has done some research on the region and site he's designing for can sit down and calculate which configuration of solar components—active and passive—will give him the system best suited to his design problem.

It's the fact that the design manual will take an impartial approach to active and passive systems that excites Gibson most on this project. His work is keyed to the assumption that the designer will make the decisions on how a building is conditioned with the sun's energy, and that the system will involve both active and passive components. It's entirely possible, he says, that a space conditioning problem can be solved through design alone. Or a combination of passive design and active equipment may be the best solution. "The point is," Gibson says, "that the options are the designer's; this manual is using the results of HUD's

"To meet the energy shortage as it applies to air-conditioning, the panes of glass are so designed that they can be moved up or down—at the occupant's will—thus allowing fresh, cool air to enter the building when desired."

Drawing by Dana Fradon; © 1974 The New Yorker Magazine Inc.

Next on the agenda: Solar regulation

As solar design and solar heating and cooling techniques become more widespread, the issue of regulation—of solar codes and standards—will grow more important to the building industry. Already problems are arising with solar equipment, and consumer confidence in solar energy altogether will depend in large measure on the building industry's interest in developing fair and appropriate standards to ensure the safety and reliability of new solar building systems.

There is also the matter of architectural confidence. A recent survey by AIA/RC gave evidence that most architects recognize the value of regulatory codes and standards to the public and the profession, but they want to be sure that new regulations allow for the development and use of innovative design approaches to applying new technologies. It is difficult to regulate something still in its developmental stages, and architects are clearly more than a little skeptical of solar regulation. But equally clear from AIA/RC's survey is the fact that architects have been doing a great deal of thinking about codes and standards lately, and that more and more designers are gaining experience in applied solar energy and getting involved in the related regulatory debate.

The National Bureau of Standards is developing a set of model solar regulatory provisions as part of the nation's solar program. AIA/RC, along with several other private and quasi-public organizations in the building industry, is involved on the project, working to make certain that architectural concerns are brought to bear on the development of solar regulations.

The NBS project is in its first phase now. AIA/RC, for its contribution, is pursuing three specific objectives. The first: Identify architectural issues and concerns relative to existing solar standards and model code provisions. The second: Recommend short-term priorities for the architectural research needed to develop final and definitive code provisions. The third: Find out how practicing architects around the nation feel about solar regulation, and carry those opinions to the other building industry organizations involved in the development of solar regulation.

Presented here are some of the early products of AIA/RC's work in the development of the nation's first comprehensive solar regulations.

ARCHITECTURAL OPINION I

"Surmounting codes is the sign of a good designer. We design and evaluate buildings in terms of performance, but you see, we are basically a design firm, and we produce art." *William Grover, Moore / Grover / Harper / Architects*

"We believe in the use and creative analysis of the codes because the ultimate weapon is the building permit." *Tim Sullivan, Stanley Tigerman and Associates, Ltd.*

"Is a heating system necessarily a code issue for life safety? This is thin ground for a code!" *William Lumpkins, Architect*

"Any set of numbers can be manipulated to yield a desired result. It is better to base codes on minimum performance standards of quality and human comfort." *Cy Merkezas, Architect*

"We should have performance codes for the unconventional design and the unconventional designer. But what about 90 percent of the cases? How can a good building be made by a builder who uses conventional materials? We need prescriptive standards for that builder to guarantee that he will become aware of orientation, of thermal performance of materials, and of non-thermal performance too." *Jon Hammond, Living Systems*

"Codes should be influential at the real points of control and change, which are financial institutions and the tax structure. Why do we allow, for instance, tax deductions for fuel costs in inefficient, speculative buildings?" *Donald Watson, Architect*

"In approaching the banks or lending institutions, we usually try to downplay solar aspects; the banks substitute 'contemporary' for 'solar.' With a solar code, code compliance would be very reassuring to these financial institutions." *James Lambeth, Architect*

"You shouldn't be able to finance a poorly energy-designed, non-conservative building. The banks are more powerful than the codes." *Bruce Anderson, Total Environmental Action*

"In New Mexico there's a strong tradition and appreciation for building one's own home. In these improvisational construction situations, the code officials appreciate and are sympathetic to this tradition." *Holly Baer, Zomeworks*

"Sometimes I fear a strict energy code might limit innovation. Overzealous officials will still follow the letter of the law, so to speak." *Richard Yelvington, Heery & Heery*

"The scope of codes is shamefully human-based. Codes don't recognize the full range of environmental factors affected adversely by misapplied technology." *Malcolm Wells, Architect*

"Small firms do small projects. If the government would assist in larger projects and assume some of the risk and liability, the smaller, more innovative firms could provi le new solutions to building. Every solar building is still a prototype." *Phil Tabb, Joint Venture*

"Government commissions for projects are far more difficult than code

(Continued on page 40)

A strong example of climate adaptive architecture in America, the post-colonial houses of Charleston, S.C. are shaded with deep porches, wrapped around wide piazzas peculiar to the port city, and oriented to catch the offshore breeze. Such design concepts do much to defeat the city's near-tropical climate.

project to tell designers exactly what their options are."

The solar design manual in its final form is still two years away. Gibson's project team finished the first phase of its operation this past December when a draft of the manual's section on solar domestic water heating systems was completed. Now AIA/RC is waiting for final approval from HUD for the section on solar space heating systems. Not until 1979, if HUD approves completion of the project, will the manual cover all domestic hot water and space heating and cooling systems.

Evolution and Integration

When the architects Haggans and Masterson interviewed for the NSF Early Users Report listed their needs in solar design, they were setting out an agenda that NSF and the other federal agencies involved in solar research hadn't contemplated, but one they were willing to pick up. For example: Dissemination of solar information has been part of the federal mandate ever since Congress enacted the national program, but the information disseminated hasn't been relevant to solar *design* until the last two years. Now, HUD's National Solar Heating and Cooling Information Center, with both a mailing address and a toll-free telephone number, is receiving close to 4,000 requests for information every week. *Solar Dwelling Design Concepts* is among the Center's resources for designers, and an up-to-date nationwide listing of architects with experience in solar design is available to builders, developers, and the general public.

The evolution of a national solar program responsive to architectural concerns wasn't planned, and it hasn't been particularly smooth. Only through the direct involvement of design professionals has the groundwork been laid for development of an *integrated* approach to solar dwelling design—the approach that is key to Gibson's design manual because it takes passive design solutions to solar heating and cooling into consideration as readily as it does active, mechanical solutions. And while the federal agencies have been willing to explore architectural concerns, it may be that solar energy has meant hardware to too many people for too long. To a certain extent, that attitude has stacked the deck against an integrated approach.

HUD holds a sizeable fortune in grant funds to be dispensed for experimental solar demonstration projects; well over $10 million has already been granted and the final total should clear $25 million. But HUD cannot, in its federal capacity, dispense any funding to non-public, non-speculative projects. Each housing venture that HUD funds must be available to the public on the open market when it reaches completion. Assume that an architect with experience in solar design is retained by a client with an inclination to experiment on a totally passive solar home; regardless of design innovation and the effectiveness of the architect's energy plan, neither designer nor client can obtain HUD assistance on the project because the home is a private venture and won't enter the public market on completion. Consequently, HUD's dollars have gone largely to builders and developers ready to approach the agency with a relatively standard building type to which an active solar system will be appended.

Another stumbling block for the demonstration program: The language in HUD's solar appropriation from Congress says that the agency can fund only that portion of a building's cost which goes toward its solar system. In addition, HUD's grant application forms are heavily slanted toward description of the active systems to be included on a project. So an applicant with a passive plan for using solar energy must create a distinctly artificial cost breakdown separating those structural elements which deal with the sun from those which do not, and then rewrite the application form to accept his awkward proposal.

In December, 1975, HUD came to the Research Corp. for help in evaluating the project proposals in its first demonstration cycle. AIA/RC signed a contract to provide technical assistance on the solar demonstration program and agreed to take on individual responsibilities on a job-to-job basis, with HUD initiating a special task order for each particular effort.

The first task order came in immediately, calling for technical review and evaluation of the Cycle One proposals. AIA/RC called six designers in to act as consultants on the technical review. It went smoothly and nine months later the technical review and evaluation process for Cycle Two began, with AIA/RC bringing in a second set of consulting designers. Again the process went well, but by the close of the cycle both the Research Corporation and the architects consulting on the program realized that the HUD effort simply wasn't developing passive solar design solutions—the focus of the program remained on active solar systems.

Although HUD was encouraging builders to take an integrated approach to the solar demonstration projects—even stipulating in its guidelines that projects proposed should include passive as well as active solar elements—solutions keyed primarily to passive design were few and far between. In the first cycle, not one proposal came in for a purely passive primary solar

system. In the second, a few passive designs came in and were funded, but the solutions were less than perfect and the number still insignificant. AIA/RC felt that the basic problem was simple: Designers, builders, and developers didn't know enough about passive design alternatives to premise their proposals on anything but mechanical solar systems.

HUD agreed with that analysis. In one way, the agency was working to solve that dilemma by writing a new task order at the end of each demonstration cycle commissioning the Research Corporation to prepare a Descriptive Summary of all the projects in the cycle. The Descriptive Summaries, complete with building sketches, system drawings, and design and climate information for every project in each cycle, are fed into NBS computers for documentation and are published by HUD to serve as design guidelines for upcoming cycles. But with few passive projects receiving funding, and correspondingly few passive projects making it into the HUD publications, little progress was made during the program's first cycles.

That's when Michael Holtz, now director of AIA/RC's solar programs, sat down with his colleagues and came up with a proposal to HUD for a new task order. The proposal was for a research project aimed solely at increasing awareness of passive solar energy systems among architects and builders. The project would establish "a clear continuity" between indigenous examples of climate adaptive architecture and present approaches to passive design by looking first at historic American examples of architecture adapted to local climate, and second at modern passive solar exercises in those same locales. The project would also point out "typical" present day dwellings, solar and non-solar, being built in those areas. The end result: An encyclopedic survey of specific passive techniques—a definitive passive system toolbox for designers.

HUD approved the proposal without hesitation and signed, last February, a new task order—the tenth under the original "technical assistance" heading (a month later the eleventh was signed and nine more architects became consultants on the Cycle Three proposal review process).

Exploring Passive Solar Design

The new project was titled the Passive Solar Systems Study, and the Research Corporation's project team, this time headed by research associate and architect Vivian Loftness, set to work. Throughout the late winter and spring of last year, Loftness' team investigated the principles of passive adaptation to climate and researched indigenous examples of climate adaptive architecture, from the cliff-shadowed pueblos of Arizona and New Mexico to New England's colonial salt boxes. It wasn't until June that the researchers settled on a format capable of presenting all of the information they were gathering.

They reasoned that the foundation of an understanding of passive solar design is an understanding of climate; after all, it's the context in which every building functions, the environment to which every heating or cooling system must finally respond. Since the human requirement for comfort, associated with a building's functional use, forms the basis for energy demand, one effective way to reduce energy consumption is to recognize the advantage, where it exists, of natural comfort conditioning—using, instead of avoiding, the local climate. An architect must have a clear understanding, before designing a building and its conditioning system, of the climatic forces that can improve or jeopardize comfort in a particular region, on a particular site.

So the first product of the study, due out later this year, will be a nationwide climate analysis, identifying climatic design regions across the country and assessing the impact climate can have on residential building design in each of those regions. Several climate classification systems have been developed before—among them Victor Olgyay's precedent-setting temperature and humidity classification scheme (1963) and the early House Beautiful/AIA Climate Control Project undertaken in the 1950s to describe the climates of 15 American cities. But most of those systems have been designed for agriculturalists, horticulturalists, mechanical engineers, and climatologists; to meet the needs of designers, the systems have had to undergo special adaptation. With assistance from the National Oceanic and Atmospheric Administration, AIA/RC has geared its climatic study specifically to the requirements of energy conscious design. It assesses the total climate, from temperature and humidity to the less well documented effects of radiation, wind, moisture addition, and diurnal temperature shifts on human comfort and building performance.

Beyond climate, an architect faced with designing a passively conditioned structure must be well informed in a relatively new field of design. But in tracing the evolution of indigenous adaptations to climate, Loftness' researchers noted that current exercises in passive design are often rooted in basic techniques that date back to prehistory. Sensing that architects are more in need of a state-of-the-art text in passive architecture than they are of a strictly historical survey, the researchers decided to put their copious research on indigenous architecture aside to compile a comprehensive contemporary passive solar project catalog—the study's second major product. Breaking the spectrum of passive projects constructed in the United States down into six basic operational modes, the project team has documented 100 projects that span the range of passive

design occurring in professional practice today. The documentation is thorough, probably more thorough than any other survey yet undertaken in applied solar energy. Both generic and individual approaches to passive design are explored, in photographs, building sketches, system schematics, detailed descriptions, and in supplemental information covering cooling techniques, percentages of required auxiliary support, and system performance—for each of the passive projects.

The passive study's third product was assured from the beginning of the project, the answer to a problem perceived by HUD itself. Literally dozens of energy conservation guidelines have been developed since the energy crisis closed its first chapter in 1973. Published by industry, professional organizations, consumer groups, state, local, and federal government agencies, the guidelines are often contradictory, repetitive, and, despite best intentions, dead wrong. HUD asked AIA/RC, as part of the passive systems study, to develop a set of guidelines for energy conservation in buildings, guidelines that would be national in scope and accurate above all.

AIA/RC's project team has finished a first draft of the new guidelines. No less than 60 different guidelines from the sources mentioned above have been analyzed, repetitions and contraditions carved out, misconceptions and fallacies routed, and recommendations for conserving energy weighed against the backdrop of regional appropriateness and conservation efficiency. The new guidelines will present architects, builders, and homeowners with the basic concepts that define thermal comfort and determine how and how much we condition the built environment. And they will also explore a tenet basic to intelligent energy conserving design—climatic regionalism.

Of the 60 guidelines reviewed for the project, only two mentioned regional variations in climate and recommended for them. Nearly all the guidelines set out recommendations for measures which seal off the living/working environment with increased insulation, weatherstripping, and other hermetic concepts—as in the Met's Irish manuscripts exhibit—without considering the energy saving potential in taking advantage of natural conditioning. Not one of the guidelines went into depth on the basic issue—human comfort—and its relationship to seasonal changes and regional variations in climate.

Nonetheless, AIA/RC's new conservation guidelines for HUD won't be revolutionary. Siting, minimal glazing, insulation, weatherstripping, and other standard conservation techniques for new and existing housing are still mentioned—but only for housing in those extreme climates where such measures are appropriate. More importantly, the new guidelines give both architects and homeowners methods for defining their individual climates, and a way to work within those definitions to develop the right conservation techniques.

The guidelines, the passive projects survey, and the climatic analysis system constitute the three lead products of AIA/RC's passive solar systems study, but not all of it. Though each addresses a different set of problems and, in the case of the energy conservation guidelines, a different audience, the three are only elements of a single approach to energy conscious design. So the Research Corporation is preparing a fourth and final element under the HUD task order, a publication that synthesizes those three efforts and places them in context with the historical and indigenous research that formed a preface to the project.

The new fourth element stands out as a measure of

Resources and good reading

Much of AIA/RC's research in solar energy and solar design has been published by the federal agencies who have contracted for the research, by the Research Corporation itself, and by the design firms who have served as subcontractors on AIA/RC projects. Five such publications came out of a single research project conducted for the Department of Housing and Urban Development in 1975-76, in which AIA/RC was asked to develop conceptual solar building designs and site plans for single family, low-rise multi-family, and mobile housing for use by HUD as a basis for its Residential Solar Heating and Cooling Demonstration Program.

Here Comes the Sun/1981
Developed by Joint Venture Inc., a Boulder, Colo. design firm, this 98-page book weighs the advantages and disadvantages of combining various energy conservation measures, active solar systems, and multi-family housing concepts, and illustrates the feasibility of integrating these components into multi-family dwellings. It's available in soft cover from AIA Publications Marketing (order # RC208) for $11.

Solar Energy and Housing Design
Giffels Associates Inc., a Detroit firm, developed this systematic guideline for selecting solar equipment appropriate for housing in the four basic climatic regions of the U.S., and incorporating it into low-rise multi-family dwellings. The 145-page book also includes a survey of solar collection and storage components. It's available from AIA Publications Marketing in soft cover (order #RC203) for $15.

Solar Energy Home Design
Total Environmental Action Inc., of Harrisville, N.H., developed single family solar dwelling designs, using an air-type solar system, for the four U.S. climatic regions. This 198-page volume explains the engineering and design methods TEA used on the project, and includes drawings, charts, tables, and a list of more than 100 solar component manufacturers. It's available in soft cover from AIA Publications Marketing (order #RC206) for $12.75.

Solar Heated Houses for New England and Other North Temperate Climates
Using over 200 computer simulations, this book by Massdesign, of Cambridge, Mass., examines the costs and performance of a wide variety of solar heating systems and energy conservation measures. The firm also presents sizing rules for system design in the book, and takes a look at solar energy's implications for dwelling design. The 68-page volume is available in soft cover from AIA Publications Marketing (order #RC205) for $7.50.

Solar Oriented Architecture
Developed by Arizona State University's Solar Energy Applications

the impact that the research into passive design has had on both HUD and the architects and researchers at AIA/RC. When HUD began its solar demonstration program in 1974, it had next to no notion of how it would use architects in the program. The agency's integrated solar demonstrations turned out to be less than fully integrated and the job of developing information on solar energy and solar design became more vast than anticipated. But the people in charge of the program at HUD recognized those problems and developed ways to cope with them, in the process giving designers an integral role in the national solar demonstration program and moving the program itself far beyond its original bounds.

To a very large extent, architects share responsibility for that sensible evolution. The solar program's focus on passive design, the research into climate and climate-adaptive architecture, the state-of-the-art reports on passive architecture and energy conservation—all of these have come about because architects have been directly involved, applying their expertise, identifying the profession's needs, and proposing intelligent alternatives. Architects are still working on HUD and other research projects today, and there are indications that HUD's solar demonstration program and the role architects are playing in it could expand significantly in the less than 24 months remaining in the program.

Since the Early Users Report for NSF and the first work for HUD on *Solar Dwelling Design Concepts,* AIA/RC has steadily mixed architects into the federal solar program. It has acted as an important catalyst in the nation's solar experiment, though possibly only by virtue of being in the right place at the right time. If being in the right place means working to understand national policy and where it can lead to work for designers, and being in the right place means staying in touch, then that is probably accurate. But there is more to it than that.

AIA/RC stays involved with national policy and the people who set it because a tremendous amount of work for practicing architects is being generated there. It's the kind of work that often crosses the generally accepted bounds of architecture into fields that are new —but by no means inappropriate—for architects. And it's the kind of work that has as much to do with the strongest traditions of architecture as it does with innovation and technology. AIA/RC also stays involved with national policy because there are opportunities for the profession to do more than react to policy, more than respond to only those research needs which find expression. AIA/RC's catalytic role in solar design has proved that the architectural community can shape policy as well. For the past four years, architects have been determiners—not bystanders—in the rapid evolution of solar architecture, and the impact of that evolution is only just beginning to be felt. Architects are doing the same thing in other fields, fields unrelated to energy, and AIA/RC is committed to furthering that kind of involvement. Architects are problem solvers, and so many of the world's problems are rooted in the same basic issues that architects face every day—art, space, freedom, comfort—that it's a wonder the profession and its methodology have been so narrowly defined up to now. The Research Corporation's commitment, in solar energy and in the other rapidly advancing fields that influence architecture, is simply to keep architects up to date. And as often as possible, slightly ahead.

—Kevin W. Green

Team, this 142-page book offers summaries and drawings of 70 dwellings that use solar energy for heating and cooling. Detailed descriptions and 10 full sets of drawings depict dwellings that illustrate the four principal methods of using solar radiation. An analysis of the basic principles of solar space heating and their implications for design is also included. It's available in soft cover from AIA Publications Marketing (order #RC204) for $12.50.

Several other publications have been produced by AIA/RC from the results of its research in solar energy. **The Basics of Solar Heating and Hot Water Systems** resulted from AIA/RC's work for HUD on the department's Intermediate Minimum Property Standards. It describes passive and active systems that can be used to heat space and domestic water in residential buildings. The design considerations of collector, storage, and heat exchange components are discussed, and the 48-page book also includes a visual state-of-the-art view of solar systems in housing. It's available in soft cover from AIA Publications Marketing (order #RC209) for $5.

Energy Conservation in Building Design is the product of a national energy policy study financed by the Ford Foundation to investigate the technological and social impacts of energy supply and consumption. The 156-page book describes the opportunities for conserving energy through building design. It's available in soft cover from AIA Publications Marketing (order #RC201 for $5.

In the fall of 1975, AIA/RC sponsored an Energy Conscious Design Student Competition as part of the FEA-supported Energy Conscious Design By Architects project. **New Design Concepts for Energy Conserving Buildings** offers the results of the competition—115 innovative approaches to designing energy efficient buildings. It's available in soft cover, 124 pages, from AIA Publications Marketing (order #RC210) for $9.95.

Ten more winning student designs, from the Solar Dwelling Design Student Competition sponsored by AIA/RC in the fall of 1976 and funded by the Exxon Corporation, are presented in **Capturing the Sun.** Published just last fall, the 34-page softbound book is available for $1.50 (to cover postage and handling) from AIA/RC's Publications Office.

One of the most popular books produced through AIA/RC's work has proved to be **Solar Dwelling Design Concepts,** the basic solar primer developed by AIA/RC for HUD. It covers everything from the first principles involved in using solar energy to heat and cool buildings, to the development of actual site planning and building design concepts. It's appropriate for builders, design professionals, and what HUD calls "advanced consumers" interested in solar heating and cooling.

The 146-page book is available in soft cover for $2.30 from the U.S. Government Printing Office, Washington, D.C. 20402 (stock #023-000-00334-1).

ABSTRACTS

The following abstracts of recently completed architectural research are drawn from the AIA Research Corporation's Research Information Retrieval System (RIRS), a computerized architectural data bank containing information on research projects touching on every aspect of architectural practice. The system, only recently developed by AIA/RC, is accessed through a keyword list. Its resources are available for quick retrieval upon request. References are being added and the keyword list expanded daily.

Research is a positive factor in design, but the success of this or any research retrieval system depends solely on the participation of its users. Abstracts of recently completed research are available to you through RIRS, and we also encourage you to contribute to the system. If you or your firm has recently completed work which may advance the expertise of the profession, as the work detailed here and elsewhere in this issue of *Research & Design* has done, please characterize it in written form and submit it for inclusion in the system. Other architects may then be able to learn from your experiences as readily as you have from theirs.

Inquiries should be addressed to Ella Hall, AIA Research Corporation, 1735 New York Avenue, N.W., Washington, D.C. 20006 (tel. 202/785-7843).

Solar Collectors

This technical paper reports an investigation of coatings for solar collectors at NASA's Lewis Research Center. Four high performance, moderate cost, widely available coatings were investigated. Two of these—black copper and black nickel—were previously known to be solar selective. The solar properties of the other two—black chrome and black zinc—were discovered at Lewis. The general solar selective characteristics of all four coatings are very similar.

The study concludes that ceramic enamel is more solar selective, i.e., has a higher solar absorbance in combination with low infrared emittance, than organic enamel, black copper, black zinc or black nickel. Ceramic enamel is matched only by black chrome in durability and has approximately the same cost. Both are currently slightly lower in cost than organic enamel, black copper, or black zinc. Black nickel is relatively unavailable and thus realistic cost comparisons are not possible.

Research retrieval system
No.: 770013

This abstract refers to: Survey of Coatings for Solar Collectors (NASA TMX-71730) by G. E. McDonald.

This publication can be ordered from: Lewis Research Center, Cleveland, OH 44135.

Project Summaries

This report is a collection of summaries of research projects conducted by the Center for Building Technology (CBT) during the calendar year 1975. The summaries presented are arranged by subject matter and include mechanical, electrical, and structural systems, disaster mitigation, mobile homes, several topics on energy conservation, plumbing and drainage, codes and standards, economics, sensory environment, building technology, and others.

The summaries are from one to five paragraphs in length. Each summary lists the project title, its progress, point of contact with CBT, and the sponsor. Generally there is a statement of the object or intent of the study or research. Descriptions are included of the experimental techniques, the models developed, survey methods, etc. and the results of the project thus far.

Research retrieval system
No.: 770012

This abstract refers to: Building Technology Project Summaries.

This publication can be ordered from: Center for Building Technology, Department of Commerce, Washington, D.C. 20234. No price listed.

Barrier Free Design

This report was prepared in response to a request from the Architecture and Transportation Barriers Compliance Board and administered by the Administration on Aging. It assesses the adequacy of residential environments for the frail, elderly, physically handicapped, and mentally retarded. It represents a series of somewhat free-standing information pieces, which can be used individually or as a whole. The entire document presents an extensive overview of issues involved in the scientific assessment of elderly/disabled housing.

Issues and problems are approached in four major areas. Population Description and Identification discusses the issues involved in classifying elderly and disabled and relates such classifications to environmental features, thus assessing

the functional status of individuals. The problems and frequency of the mentally retarded are introduced and related to special architectural needs of these individuals, emphasizing *normalization*. The various methodologies involved in evaluating environments for the elderly and disabled are explored. Separate and related findings from interviews and observations conducted in a selected sample of four HUD-developed elderly/handicapped residential facilities are described.

The consensus of project participants is summarized in final recommendations. An appendix has an extensive list of individuals who had contact with the project, as well as many key names of those who have participated in conferences and seminars in the field. A Hardware and Appliance Catalogue of items which appear to possess necessary characteristics for good barrier-free design is discussed but not included with the report.

Research retrieval system
No.: 770010

This abstract refers to: Residential Environments for the Functionally Disabled.

This publication can be ordered from: Gerontological Society, One Dupont Circle, Suite 520, Washington, D.C. 20036.

100 kw Wind Turbine Generator

This paper describes the design of a 100 kw wind turbine generator. It includes detailed descriptions of the rotor turbine blades, hub, pitch, change mechanism, transmission train, power unit, tower, control modes, site selection and costs. A complete set of diagrams is included as well as tables of wind data collected at the Lewis Research Center for 10 years.

The machine consists primarily of a rotor turbine, transmission, shaft, alternator and tower. The rotor contains two blades 125 feet in diameter operating at 40 rpm and generating 133 kw of power (100 kw at the generator) at 18 mph wind velocity. The rotor is connected to a low-speed shaft (40 rpm) which drives a gear box. In the gear box the shaft's revolutions are increased from 40 to 1800 rpm. A high-speed shaft connects the 100 kw alternator to the gear box. The entire assembly is placed on top of a tower 100 feet above ground. It is designed to generate 100 kw of electric power at wind velocities between 18 and 60 m.p.h. Between 0 and 8 mph and at wind velocities in excess of 60 mph the turbine blades will be placed in the feathered position. Between 8 and 18 mph the electric power generated will be a function of wind velocities. The generator was designed as part of the Wind Energy Program of the National Science Foundation.

Research retrieval system
No.: 770011

This abstract refers to: Preliminary Design of a 100 kw Wind Turbine Generator, by Richard L. Puthoff and Paul J. Sirocky, NASA Technical Memorandum TMX-71585.

This publication can be ordered from: Lewis Research Center, Cleveland, Ohio 44135. No charge listed.

Wind Induced Structural Vibrations

Natural turbulent wind produces both static and dynamic effects on buildings, and these effects can be described mathematically in terms of statistical averages. The theory of random process (statistical averages) is well documented in many textbooks and the results have been widely used in physics, communications, and other fields, including civil engineering. The present work describes the application of random techniques in studying the reactions of tall flexible structures to wind induced vibrations.

A theoretical background to the application of random techniques in the analysis of wind induced structural vibrations is presented. The work includes the definition of wind characteristics, evaluation of loading parameters, and the response analysis. The effects of fluctuating drag together with inertia dependent forces and non linear turbulence are incorporated and the application is shown with a numerical example.

Research retrieval system
No.: 770021

This abstract refers to: Wind Loads on Building Structures, by Kamal Handa.

This publication is available from: Chalmers Tekniska Högskola, Chalmers University of Technology, Göteborg, Sweden.

Sea Architecture

Lower marine organisms utilize the energy and materials surrounding them to build their protective formations. For instance, a significant proportion of the soluble protein of the organic matrix of mollusk shells is composed of a repeating sequence of aspartic acid separated by either glycine or serine. This regularly spaced, negatively charged aspartic acid may function as a template upon which mineralization occurs. Negatively charged residues form approximately every second layer, possibly binding with Ca^{2+} ions and thus performing mineralization. The organization of components in the matrix is not yet understood, but it can be deduced that electric potentials attract materials for shell formation from the immediate environment.

When a metal object is submerged in seawater, it is subject to electrolytic processes, which perform oxidation or reduction reactions on the compounds which are in solution. Marine life adds to the growth of encrustations by leaving protective shells (barnacles, tubeworm, coral, etc.) on the formation to be integrated.

Accordingly, electric fields have been utilized to selectively precipitate ions in solution onto conductive surfaces. The first coated samples of wiremesh were obtained in tanks containing seawater.

Very little is known about the electrochemical processes producing hard or soft layers of accretions in seawater; too many unknowns exist on either side of the equation. But while probing into the theory of electrolytic processes, empirical data should be secured soon which will allow successful work with larger surfaces, moving morphogenetic devices, and energy expenditure control mechanisms. Challenging possibilities exist to produce symbiotic processes between precipitated structures and sea organisms like different bacteria, algae, worms, barnacles, grasses, kelp, etc. The accreted substrata can provide shelter and perhaps a supplementary food base while marine organisms might give off acids, gases, etc., which might be helpful for the building and for maintenance.

Researchers are looking into the molar concentration of various ions in seawater, lakes, rivers, creeks, mineral wells, rainwater, and waste products like urine and industrial

effluent. Work continues to uncover and to formulate concepts and technologies of continuous morphogenesis and evolution of all components, structures, and lifeforms involved. Ideas range from providing dams, basins for sea-farming, smaller artifacts, and towable barge-like housing units to free-floating or stationary city-states outside the existing or claimed jurisdiction limits of any state.

Research retrieval system
No.: 770022

This abstract refers to: Electrodeposition of Minerals in Solution and Its Enhancement by Biological Growth for Structural Applications, by Wolf H. Hilbertz.

This publication can be ordered from: Wolf H. Hilbertz, School of Architecture and Planning, University of Texas at Austin, Austin, Texas 78712.

Intermediate Standards for Solar Domestic Hot Water

The U.S. Department of Housing and Urban Development (HUD) is currently offering financial assistance to homeowners in a selected area to install solar domestic hot water systems. Since there was no reference in the HUD Minimum Property Standards to solar hot water systems, it became necessary to revise those standards, and HUD turned to the Solar Energy Program Team and the Center for Building Technology of the National Bureau of Standards.

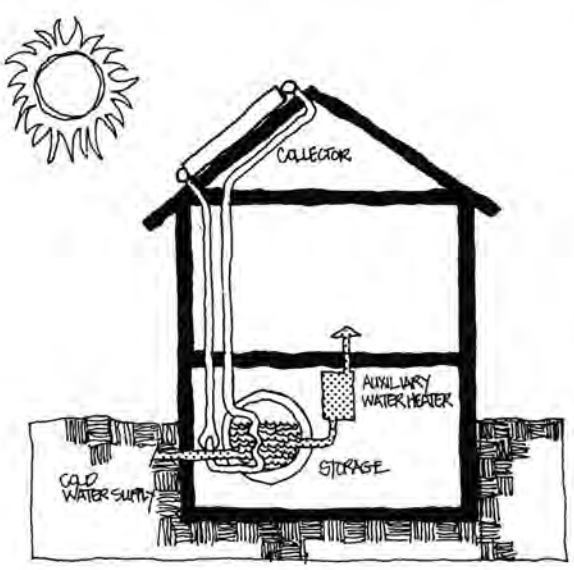
The standards consider only aspects of planning and design that are different from conventional hot water systems by reasons of the solar systems under consideration, and are based on current state-of-the-art practice and on other HUD regulations and standards.

In addition to the standards revisions, comments are included at appropriate points to call attention to particular topics which may have special consequences in a solar installation. In addition, Appendix A presents 49 pages of a method for predicting the thermal performance of domestic hot water heaters. Appendix B lists the properties of all materials found in such systems, and Appendix D is a listing of special terms, used throughout the standards, with their definitions.

Research retrieval system
No.: 770018

This abstract refers to: Intermediate Standards for Solar Domestic Hot Water Systems/HUD Initiative. NBS IR77-1272.

This publication can be ordered from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.



Observations On the Behavior of Buildings In the Romania Earthquake

On March 4, 1977 an earthquake occurred in Romania, about 150 km northeast of Bucharest, its capital. The intensity of the shock was 7.2 on the Richter scale, and it caused extensive damage, killing 1,578 and injuring over 11,000.

More than 30 buildings completely collapsed in Bucharest, many of them five- and ten-story apartment buildings. Virtually all buildings were damaged, many were completely destroyed.

At the request of the Romanian government, the U.S. Agency for International Development sent a team of engineers, seismologists, and geologists to Romania. The team assisted the Romanians in damage assessment, and made recommendations for repair and strengthening procedures for damaged buildings.

The report documents photographically the performance of buildings designed to resist earthquake shock as well as some of those not so designed. It includes an analysis of Romanian building techniques, and a comparison of U.S. and Romanian seismic design practices.

Research retrieval system
No.: 770020

This abstract refers to: Observation on the Behavior of Buildings in the Romania Earthquake of March 4, 1977. NBS SP490.

This publication can be ordered from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Building To Resist the Effect of Wind

Natural disasters involving high winds wreak tremendous damage in many places around the world, especially in developing countries. While considerable attention has been given to the reaction of tall buildings to high winds, little has been directed to low buildings, particularly those found in countries frequently subjected to tropical storms.

This five volume report represents a three and one half year project intended to update design standards for low buildings (primarily residential) of the kind most frequently found in tropical countries. As well, it developed improved siting, design and construction information which improves the resistance of such buildings to extreme winds, and which is also culturally acceptable. An additional benefit of the program was that it taught local professionals and technicians wind-load measurement/analysis and wind tunnel testing.

Volume 1 presents an overview of the project. Volume 2 is a methodology to estimate design wind speeds and a guide to the determination of wind forces. Volume 3 is a guide for improved use of masonry connectors and timber fasteners. Volume 4 furnishes a methodology to estimate and forecast housing needs at a regional level, and Volume 5 presents socioeconomic and architectural considerations applicable to the Philippines, Jamaica, and Bangladesh.

There is also an illustrated pamphlet, based on the five volume report, titled: "43 Rules: How Houses Can Better Resist High Wind."

Research retrieval system
No.: 770015

This abstract refers to: Building to Resist the Effects of Wind, Volumes

1 through 5, NBS BSS 100, and, 43 Rules: How Houses Can Better Resist High Wind, NBS IR77-1197.

This publication can be ordered from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

A Room With a View

With the growth of technological ability to artificially maintain interior environments has come a proliferation of windowless spaces. While there seems not to have been, yet, a sufficiently clear demonstration that windowless spaces are harmful to the general population, it seems that a consensus of almost any sample population would favor spaces with windows.

The report is a survey of the literature on the reaction of people to environments with and without windows. It suggests that the most adverse responses to windowless spaces are to those which are small, restricted, and essentially static. This would indicate that one function of a window is the addition of a dynamic, active quality to an interior environment, along with a view of the external world.

The report provides an analysis of studies performed in a broad range of circumstances, and discusses the optimum size and shape of a window for performing these various functions, concluding that window view with a high stimulation level is preferred.

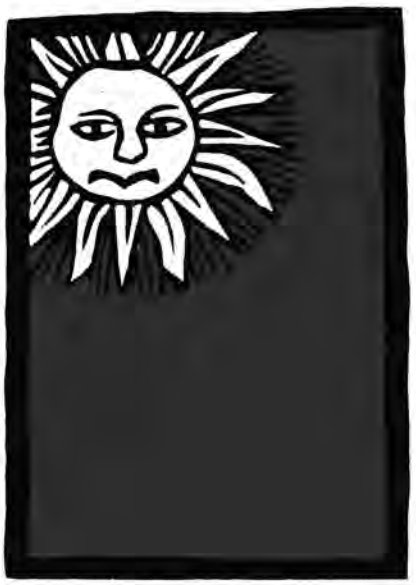
Research retrieval system No.: 770017

This abstract refers to: Windows and People: A Literature Survey. NBS BSS70.

This publication can be ordered from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Solar Energy Update

Solar Energy Update provides abstract and indexing coverage of current scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs for all sources on solar energy. All information announced, plus additional backup information, is included in the information data base of the Energy Research and Development Administration's Technical Information Service. The subject



matters covered included resource, economic, and environmental aspects; photovoltaic, thermoelectric, and biomass conversion; orbital, tower focus, and ocean thermal gradient power plants; solar radiation utilization; solar collectors, storage, etc. Also included is information on tidal power plants, wave energy converters, wind energy, engineering economics, and climatology.

Comprehensive indexes appear in each issue and are cumulated annually. In the corporate index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, such as symposium and conference headings. There is also an author index which gives the publication title and citation number with each entry. For publications with multiple authors, there is an entry for each, with a reference to the first author.

The subject index is based on the use of subject descriptors, and qualifiers (subheadings) are presented with the title which may be supplemented with additional words, or a phrase, if it appears additional information would be helpful.

Research retrieval system No.: 770014

This abstract refers to: Solar Energy Update, September 1977, Abstracts 2251-2462.

This publication can be ordered from: National Technical Information Service, Springfield, VA 22161. Single issue $3.25, Annual subscription (12 issues plus cumulative index) $27.50.

Residential Smoke Detectors

This report is a documentation of a test program undertaken to evaluate the effect of sensitivity and placement of residential smoke detectors on their response to fires in homes. There is detailed description of the experimental procedure and extensive diagrams of the buildings and test situation. Results are tabulated in numerous graphs and tables, as well as being discussed in the text and evaluated in conclusions drawn from the experiment. An appendix on Escape Criteria deals with critical smoke levels, carbon monoxide concentrations, and temperature.

The tests were conducted in two homes scheduled for demolition, using actual furnishings in typical configurations. The detectors selected for use in these experiments were typical ionization, photoelectric, dual gate (combination ionization and resistance bridge) and rate-of-rise heat detectors. One high sensitivity (1% per foot obscuration nominal) and one low sensitivity (2% per foot obscuration nominal) detector location was used at each detector location. Detector locations were selected in accordance with the four levels of protection defined in NFPA/74.

Instrumentation included equipment to monitor temperature and carbon monoxide, carbon dioxide, and oxygen levels, and light beams to measure visibility through smoke. These were placed in burn room, escape path, and representative bedrooms.

Both smoldering and flaming ignition fires were initiated in various rooms of the dwellings, using upholstered furniture and mattresses typifying the respective rooms. The rooms selected were those with the highest percentage of fatal residential fire starts in NFPA records. The research was conducted over several seasons, and the houses had different heating systems, so that the full range of outdoor conditions which significantly affect indoor conditions would be encountered.

Research retrieval system No.: 770019

This abstract refers to: Field Investigation of Residential Smoke Detectors, November 1976.

This publication can be ordered from: National Technical Information Service, Springfield, VA 22161. No price listed.

THE MARKETPLACE

August 5, 1977: President Carter signs the nation's new Department of Energy into existence.

Profile:
The Department of Energy

On Aug. 5, 1977, President Carter signed an executive order officially authorizing creation of the Department of Energy. The day after the signing ceremony, James R. Schlesinger, former war games specialist for the Rand Corporation, former Secretary of Defense, interim head of the Central Intelligence Agency and once Director of the Atomic Energy Commission, was sworn in as the nation's first Secretary of Energy. On Oct. 1, the first day of fiscal year 1978, DOE was activated, becoming the nation's 12th Cabinet-level department and the first to be formed since President Johnson created the Department of Transportation in 1966.

The new Energy Department is the first—and may finally be the best—example of the kind of government reorganization Jimmy Carter campaigned for in 1976. DOE consolidates into one department the dozens of energy agencies, offices, programs, projects, and initiatives that have proliferated within federal government in the last two decades. In its first year, the department will have 20,000 employees and a $10.4 billion budget, along with additional resources transferred to it from the Interstate Commerce Commission and the Departments of Interior, Defense (Navy), Commerce, and Housing and Urban Development. These combine with the resources and functions of the old energy agencies, led by the Federal Energy Administration (FEA) and the Energy Research and Development Administration (ERDA), all of which have been channelled into the new department to fit the nation's evolving energy policy. In terms of personnel, DOE will rank as the 8th largest Cabinet department in its first year of operation; in budget, it will rank 10th.

Under the DOE Organizational Act, the President appoints, with the advice and consent of the Senate, the agency's top personnel, including:

- The Secretary, Deputy Secretary, Under Secretary, and General Counsel
- Eight Assistant Secretaries with both specific program and general staff functions
- Administrator, Energy Information Administration
- Administrator, Economic Regulatory Administration
- Inspector General and Deputy Inspector General
- Director, Office of Energy Research
- A five-member Federal Energy Regulatory Commission, with one of the members designated by the President as chairman.

The Secretary of Energy appoints individuals for 14 other executive level positions, including a Special Assistant, several Deputy Assistant Secretaries, Controller, Director of Administration, and Director of Procurement and Contracts Management. The Secretary also appoints the Director of DOE's Executive Secretariat.

The department's organizational structure will include:

- The Office of the Secretary, supported by:
  Deputy Secretary
  Under Secretary
  Special Assistant
  Executive Secretariat
- Several programs requiring large budget outlays:
  Conservation and Solar Applications
  Resource Applications
  Energy Technology
  Environment
  Energy Research
  Defense Programs
- An independent commission:
  The Federal Energy Regulatory Commission
- Staff Offices:
  General Counsel
  Policy and Evaluation
  Intergovernmental and Institutional Relations
  Controller
  Procurement and Contracts Management
  Administration
- Inspector General
- Laboratories, field facilities and operations offices

Research and Development

Research and development expenditures in DOE will amount to approximately $5 billion in the department's first year, with the bulk of that dollar amount coming from the old Energy Research and Development Administration. It's important to realize that DOE's research and development programs aren't *new* programs initiated by DOE in the first six months of its life. The R&D efforts for 1978 and the funding for those efforts have all been transferred to the new department from the agencies previously involved in energy and non-energy research and development. What *is* new about the department's R&D is the way in which it will be handled under DOE's structure.

Since the ultimate goal of DOE's research and development is to eventually make new and advanced energy technologies commercially available to the public, the department will group its new technologies according to their evolution through the step-by-step research, development, and application process, rather than grouping them by fuel type (i.e., solar, fossil, nuclear, etc). As the research and development of a particular technology nears the stage of commercial application, that effort will most likely be transferred to the department's Resource Applications or Conservation and Solar Applications sections. There the new technology will, figuratively speaking, be slipped out into the economic mainstream from its federally sheltered womb.

The complex job of coordinating DOE's various program divisions, where research work will be conducted and contracted for, belongs to an R&D Coordinating Council composed of the Assistant Secretaries who head the divisions and chaired by the Director of Energy Research.

Below is a breakdown of each of the DOE program divisions where research involving energy and issues of design is most likely to be centered. One division, Defense, has been omitted because, as presently structured, it will not be conducting architectural research. Included for each division is a summary of primary responsibilities and major R&D programs, together with the names and telephone numbers of key personnel. If a program area appears to match your interests and your expertise, contact the office listed here and you'll be able to obtain more specific information.

Conservation and Solar Applications

Donald Beattie,
Acting Assistant Secretary

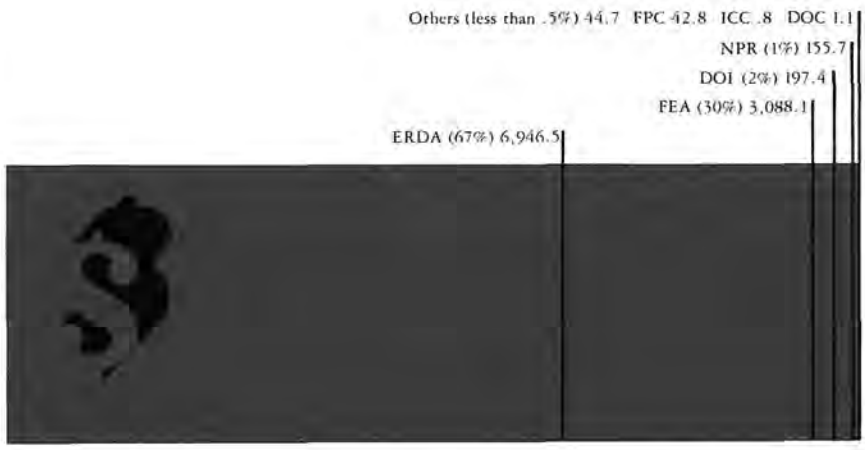
The division's key responsibilities:

> Conservation commercialization activities
> Conservation programs and standards
> Conservation and recycling technologies
> Solar applications
> Small-scale technology

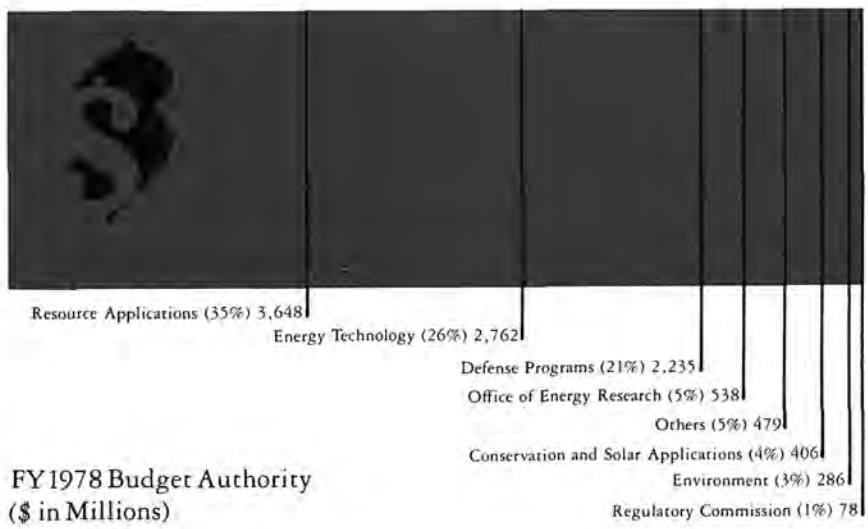
The research programs transferred to this division include activities formerly supervised by ERDA's Assistant Administrator for Conservation, and its Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems. Among the current R&D programs in the division:

> *Industrial Energy Conservation.* Under current program guidelines, R&D activities are directed towards the development of more efficient use of energy in industrial processes, the substitution of alternate fuels for those industries totally dependent on rapidly depleting or vulnerable energy supplies, and the reduction of energy consumption by the agricultural sector. In charge of the program is Douglas G. Harvey (202/376-4648).
> *Buildings and Community Systems.* This program supports projects

DOE's Money: Where it comes from ...



... and where it goes.



FY 1978 Budget Authority
($ in Millions)

designed to increase the efficiency of energy utilization in community systems, buildings, and consumer products. Projects designed to transfer new energy conservation technology and information to appropriate industries and consumers are also funded. In charge of Buildings and Community Systems is Maxine Savitz (202/376-4646), and Gerald Leighton (202/376-4714), Assistant Director for R&D.

> *Transportation Energy Conservation.* Within this program area, R&D projects are aimed at reducing energy consumption, in an environmentally acceptable manner, in the transportation sector through use of known and unused technologies, including the development of electric and/or hybrid motor vehicles; the development of new energy efficient transportation technologies; the demonstration of related hardware systems; the utilization of waste heat from transportation vehicles; and the development of non-petroleum base fuels and energy sources. In charge of the program is Vincent J. Esposito (202/376-4524).

> *Agricultural and Industrial Process (Solar) Heating.* The overall objective of this program area is to develop and demonstrate solar technologies utilizing state-of-the-art heating components and systems, and to stimulate the use of solar energy as a substitute for energy generated from fossil fuels. Although DOE provides overall direction for the solar/agricultural program, management of many projects has been delegated to the Department of Agriculture. Responsible for the program at DOE is William R. Cherry (202/376-4438).

> *Solar Heating and Cooling of Buildings.* DOE's solar heating and cooling program, of major interest to architects, is divided into two principal areas: Projects aimed at the demonstration of solar water heating and solar space heating and cooling systems for residential and commercial buildings; and research and development of advanced solar heating and cooling technologies. Responsible for DOE's solar heating and cooling projects is Ronald D. Scott (202/376-4017).

Resource Applications

Thomas Noel,
Acting Assistant Secretary

The division's key responsibilities:

> Energy production, distribution, and marketing
> Uranium enrichment
> Strategic and naval petroleum and oil shale reserves
> Energy supply commercialization activities
> Energy resource development and utilization
> Federal energy resource leasing procedures

No research programs have been transferred to Resource Applications as of this writing.

Energy Technology

Robert D. Thorne,
Assistant Secretary

The division's key responsibilities:

> R&D in energy supplies (solar, geothermal, fossil, nuclear, and magnetic fusion)
> Nuclear waste management
> Naval reactor development

R&D programs of particular interest to architects here are those associated with solar energy development. With the exception of solar heating and cooling demonstration projects and agricultural/industrial solar projects (both of which were transferred to Conservation and Solar Applications), ERDA's solar energy R&D program is now the responsibility of the Assistant Secretary for Energy Technology.

Included within this solar energy R&D is a wide range of solar electric activity, including photovoltaic, advanced thermal power, ocean thermal, wind, and biomass projects. Additionally, the Assistant Secretary for Energy Technology is responsible for administering major on-going federal solar electric demonstration programs, including the ten-megawatt solar thermal power generator planned for Barstow, Calif., and the Ocean Thermal Energy Conversion Test Facility in San Francisco. In charge of solar energy activity is Henry H. Marvin (202/376-4424).

Other R&D programs under the supervision of the Assistant Secretary for Energy Technology include Geothermal Energy Development, Director, James C. Breese (202/376-4650); Coal Research and Development, Director, Philip C. White (202/476-4652); Oil, Gas, Shale Oil, and In Situ Technology, Director, Hugh D. Guthrie (202/376-4693); Mining Research, William Schmidt, Bureau of Mines, Department of Interior (202/634-1249); Electric Energy Systems, Director, F. F. Parry (202/376-4592); Energy Storage Systems, George Pezdirtz (202/376-4884); Improved Conservation Efficiency, John Belding (202/376-4602); Magnetic Fusion Research and Development, Director, E. E. Kinnter (301/353-3347); Laser/Fusion Research and Development, Director, C. Martin Stickley (301/353-5514).

Also under the Assistant Secretary for Energy Technology are the five Energy Research Centers inherited by ERDA in 1975 from the Department of Interior. These Energy Research Centers (in Bartlesville, Okla.; Grand Forks, N.D.;

Laramie, Wyo.; Morgantown, W.Va., and Pittsburgh, Pa.) will be incorporated into the fossil energy development program.

Environment

James L. Liverman,
Acting Assistant Secretary

The division's key responsibilities:

> Environment, health, and safety
Overview and assessment
Research, development, and demonstration
> Coordination with the Environmental Protection Agency (EPA)

Programs transferred to this division from ERDA's Environment and Safety Office include environmental/energy research and development; life science and biomedical applications projects, and the safety, decontamination, and decommissioning of light water nuclear reactors.

The environmental/energy research and development program supports activities to assure that energy technologies are developed in a safe, clean, and environmentally acceptable manner. Areas of responsibility include management overview, policy analysis, and assessments to ensure safety and compliance with existing laws.

In charge of Environmental Research and Development and Life Science and Biomedical Applications is James L. Liverman (202/376-4185).

Also under the control of the Assistant Secretary for Environment is the safe and environmentally acceptable operation of energy production processes. In charge of Environmental Control Technology is William E. Mott (301/353-3016). In charge of Reactor Safety Research is Robert Barber (301/353-3548).

Office of Energy Research

Dr. John M. Deutch,
Director

The division's key responsibilities:

> Coordinate and integrate DOE research and development
> Manage basic sciences program
> Establish education policies for research
> Oversee multi-program laboratories
> Develop research assistance policies
> Conduct multi-disciplinary and advanced research

The Director of the Office of Energy Research is of an equal rank with DOE's Assistant Secretaries. The director functions as advisor to the Secretary on technological and budgetary matters. Among his other duties are the management of basic science programs and the administration of special R&D projects that do not readily fit elsewhere within the department. The director also chairs the department's R&D Coordination Council, composed of the Assistant Secretaries responsible for research, development, or applications programs.

DOE Headquarters

The Department of Energy is headquartered in the James V. Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C. Pending completion of building alterations, temporary headquarters for some key officers will be at 730 Jackson Place, NW, Washington, D.C. Many of the department's personnel will remain in place at the former FEA and ERDA buildings and the Department of Interior. For these reasons, a note of caution: If you call the telephone numbers listed here for more information on DOE programs, staff may have moved and numbers may no longer be correct, although they are correct as of this writing. Our advice to you: Don't be put off. The first rule to follow when it comes to gleaning information from the federal government is to keep trying. Sooner or later, you'll find what you're after.

October 1, 1977: Energy Secretary James R. Schlesinger dedicates DOE's first, though not permanent, headquarters across the street from the White House

Grantsmanship

Home for most of America's fabled federal bureaucracy is the Executive Branch of government, the branch over which the President presides, the branch responsible for carrying out the mandates of Congress, its legislative peer. Within it are twelve Cabinet-level departments and dozens of independent federal agencies, many of which receive tremendous support, in the form of Congressional appropriations, for programs in research and development, commonly referenced as R&D. The National Science Foundation, which keeps track of how and where the government spends its R&D money, puts its expenditures into the billions of dollars; an estimated $24.5 billion last year, $26 billion for fiscal 1978.

Many architects are already tapping into that federal marketplace, and there is plenty of room for more. The ones who have been successful in obtaining government grants and contracts for research have taken the time to explore the marketplace, to get to know its ins and outs, to learn how they can apply their special architectural skills in fields that are often new to designers. It's a complex business, but the portion of those billions of dollars available to the architectural profession is significant; it represents nothing less than a tremendous business opportunity. Taking advantage of that opportunity means taking some time to study the field. Grantsmanship, like architecture, is both art and science. It involves a knowledge of government, of where the government's billions of dollars in research grants and contracts are and who decides where they'll be spent.

And it involves a very artful application of the skills God and several years of higher education gave you to bring some of those dollars your way.

Who's Got the Money?

Facts and figures compiled by the National Science Foundation over the years show ten agencies leading the federal government in R&D support. They accounted for 98 percent of the R&D total in 1977 and they'll come close to that again this year. The top ten, in order of expenditure:

1. The Department of Defense
2. The National Aeronautics and Space Administration
3. The Energy Research and Development Administration (now part of the Department of Energy)
4. The Department of Health, Education, and Welfare
5. The National Science Foundation
6. The Department of Agriculture
7. The Department of Transportation
8. The Environmental Protection Agency
9. The Department of the Interior
10. The Department of Commerce

NSF's statistics also show that California, Maryland, Massachusetts, New York, Florida, Pennsylvania, and Texas are consistently among the leading states to receive federal R&D funding. Over the past ten years other states, including New Jersey, New Mexico, Washington, Virginia, Missouri, Ohio, and the District of Columbia have also led the R&D race.

Within each of those top ten federal agencies are programs administering research grants and contracts for which architects are eminently qualified to apply. There is, however, no research program in the federal government classified as being best accomplished by a particular special interest group. Instead, R&D monies are contained in lump sums under specific program headings. That means that if you call an agency and ask if it has any research work for an architect, you'll probably receive a prompt reply in the negative. But if you first become familiar with an agency's general parameters and with its specific programs, you can match your expertise with a particular program and stand a good chance of getting a shot at some research.

For example: If your interest and experience has been in historic preservation, read up on the National Park Service, where extensive preservation work goes on under the aegis of the Department of the Interior. If you're experienced in acquiring, planning or developing recreational facilities, look into the Bureau of Outdoor Recreation, also under Interior. Research into fire control and prevention is conducted at the National Bureau of Standards, part of the Commerce Department, and the government's work in earthquake engineering is centered at the Science Engineering Applications Directorate (SEAD) at NSF. The first rule of the federal research marketplace is to refine your aspirations; be as specific as you can in your quest for a funding source well matched to your capabilities.

Unfortunately, there is no single reference book to supply that basic information, no listing that links all of the federal program areas with the agencies working in those areas. Some sources come close, though. *The United States Government Manual* is the federal government's official handbook. It describes the purposes and programs of most government agencies and lists top personnel. The recently published 1977-78 edition (800 pages) can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $6.50. AIA's Federal Liaison Office produces a volume called *The Federal Marketplace: Are You Prepared?* Though construction oriented, it details 32 agencies active in A/E procurement. A good general source, it's available from AIA Publications Marketing for $9 ($7.20 to AIA members). And the AIA Research Corporation is preparing a new *Grantsmanship Workbook* designed specifically for architects seeking research work. It focuses on the federal agencies conducting programs in which architects are most likely to find research opportunities, and includes guidelines for preparing successful proposals. It's expected to be out by spring.

Once you have a general feel for the marketplace, the best source of information is the *Commerce Business Daily (CBD),* Uncle Sam's official shopping list. Published five times a week, Monday through Friday, the *CBD* provides an invaluable listing of U.S. Government procurement invitations, contract awards, subcontracting leads, sales of surplus property, and foreign business opportunities.

Every announcement of a Request for Proposal (RFP) exceeding $5,000 must be published in the *CBD.* An RFP is an announcement from a contracting or granting agency outlining a particular project for which the agency would like to receive proposals. It usually includes a statement of the project's required work, the desired performance schedule, criteria that will be used to evaluate proposals, and guidelines for proposal preparation. Any questions on the project can be addressed directly to the agency contracting officer named in the *CBD* announcement. Since it can be difficult to evaluate an RFP only by reading the announcement in the *CBD*, the wisest course is to respond to the announcement, obtain a copy of the full RFP, and then weigh the project's actual worth to you and your firm.

Section A (Experimental, Developmental, Test, and Research Work) of each *CBD* lists RFP announcements for both basic and applied research—a key source of architectural research opportunities. Another area of special importance is the Contract Awards section, which publishes information on unclassified contract awards exceeding $25,000 in value for civil agencies, $50,000 for military agencies. There, state and local awards are announced, awards that may provide you with an opportunity to subcontract with a receiving organization.

A subscription to the *CBD* can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20401, telephone 202/783-3238. The cost is $105/year for first-class mailing, $80/year for second class. If you want to enter the federal marketplace, it's a good investment.

Prospects

Research opportunities for a tremendous number of practicing design professionals exist in many independent federal agencies and departments. But, as already mentioned in Grantsmanship, monies for federal research and development aren't allocated in terms of performance groups; they're allocated in accordance with particular program areas, and they're spent in accordance with the particular regulations and guidelines of the granting agency and its program. As a result, basic eligibility requirements, application procedures, funding arrangements, and other parameters governing federal contractual agreements can always be expected to change from agency to agency.

Every practicing architect in the nation is capable of applying his or her skills to one federally-funded research effort or another—that's how wide the range of federal R&D is. But the architects who successfully develop grant or contractual relationships with the government are the ones familiar with the fundamentals of grantsmanship and the particulars of the agency or agencies they're dealing with.

R&D arrangements between the federal government and its grant or contract recipients are made through three basic channels, each one of which is open to some design professionals:

—Colleges, universities, and other academic institutions are the only eligible recipients for certain federal funding. Opportunities for contractual research exist here for architectural educators and for practicing professionals otherwise linked to institutions of higher learning.

—Profit and nonprofit organizations are eligible for a substantial percentage of federal R&D work. Architectural firms can pursue grants and contracts open to the private sector, but may be more likely to find work by staying in touch with the nonprofit organizations and research centers who deal often with the federal government, among them the AIA Research Corporation, the Brookings Institution, the MITRE Corporation, and others.

—State and local governments receive a major proportion of R&D funding directly from the federal level, so much that money often remains partially unspent and returned to federal coffers. Many architects are familiar with the trials and tribulations of dealing with state and local government, but the high level of funding and the range of opportunities here should be enough to overcome those reservations. More than the other two channels, state and local funds are available to the mainstream of the profession, and federally-funded research on the local, municipal, or regional level may be the easiest for you to tap into.

This section of *Research & Design* is devoted to giving you a quick glimpse of some of the federal agencies who fund architectural research through these channels. The dozen federal programs we touch on here represent only a small portion of the federal research marketplace, but we'll be looking at more in upcoming issues.

National Endowment for the Arts

NEA's Architecture + Environmental Arts Program offers many program areas in which grants are available to individuals and organizations in design. Under the **Professional Fellowships in Design** program, grants of up to $10,000 are available to practicing professional designers and planners of exceptional talent who seek time for personal professional development. The program is intended to support time taken away from practice and devoted solely to activity that will enhance the recipient's ability or permit exploration of design interests new to the recipient.

Applicants for the program must have been continuously active as practicing professionals in any one of the design fields or allied professions for the past five years. Fellowships are available to professionals in architecture, landscape architecture, city and regional planning, urban design, interior design, industrial design, fashion design, and other recognized design fields. Normally, applicants should hold at least a bachelor's degree or the equivalent in an accredited professional curriculum, and hold a license for practice. However, other applicants who are qualified by virtue of outstanding performance as professionals will be considered.

Deadlines for application are Feb. 2, 1978 for work scheduled to begin after June 1, 1978, and June 15, 1978 for work scheduled to begin after Jan. 1, 1979. Application guidelines and forms may be obtained by contacting the Architecture + Environmental Arts Program, Mail Stop 503, National Endowment for the Arts, Washington, D.C. 20506, (202/634-4276).

Another program area under Architecture + Environmental Arts is **Cultural Facilities Research and Design,** which awards matching grants of up to $30,000 to assist communities in the planning and design of exemplary cultural facilities, and to encourage the commitment of local public and private money to carry out projects. Grants are available for design and planning studies, research on aspects of facility design and management, feasibility studies, preparation of information to support promotion of a facility, planning for adaptive use of old buildings for arts-related use, and technical studies related to lighting, acoustical, and similar problems. The program places highest priority on projects which represent a compelling and immediate need and give promise of economic and social benefit to the community.

Grants are available to nonprofit, tax-exempt organizations, including universities, professional degree-granting institutions, state arts agencies, state and local governments, regional arts organizations, and national service organizations in the design fields. Any organization applying for Endowment support must meet the criteria listed under its Grants to Organizations guideline. Application deadlines and contacts are the same as those for the Professional Fellowships program.

Livable Cities, also incorporated

in Architecture + Environmental Arts, is a grant program for research, planning, and conceptualization of community projects. Grants are awarded to encourage urban governments to conserve both energy and resources by renovating and developing older buildings and neighborhoods; to facilitate cooperation and coordination in city planning between public and private sectors and preserve a community's cultural and historic identity, and to involve people in the planning and implementation of projects and foster public awareness of the quality of their designed environment. Eligible for the matching grants are the same non-profit tax-exempt organizations—universities, professional degree-granting institutions, state arts agencies, state and local governments, regional arts organizations, and national service organizations in the design fields. Deadline dates and contacts are the same.

A total listing of NEA programs is available (free of charge) in NEA's 1977-1978 Guide to Programs.

National Endowment for the Humanities

The General Research Program at the National Endowment for the Humanities (NEH) awards grants (averaging $30,000) for periods of up to 3 years to individual humanists and non-profit institutions and organizations engaged in projects involving the humanities and educational, cultural, professional, or community groups. The program encourages the development of collaborative, interdisciplinary research projects focused on the humanistic disciplines, as well as customary individual scholarship. One particular activity supported under the program is the research and writing of serious narrative history on the state and local levels. Other interests in the program include humanistic research in archaeology, history, literature, philosophy, and social sciences. Preliminary inquiries and requests for application instructions should be addressed to Phillip Marcus, Division of Research Grants, National Endowment for the Humanities, Mail Stop 350, 806 15th Street, N.W., Washington, D.C. 20506 (202/724-0341).

Program brochures for all NEH subject areas may be obtained free of charge by contacting the Endowment.

National Science Foundation

The National Science Foundation (NSF) is another granting agency of particular interest to architects. Under a restructured division—the **Science and Engineering Applications Directorate (SEAD),** formally known as Research Applied to National Needs—the **Earthquake Hazards Mitigation Program** is open to applied research at colleges, universities, profit and non-profit organizations, and state, local, or regional governments. The greatest percentage of support goes to academic institutions, but grants to individuals are occasionally made.

The program is organized and presented in three major categories—siting, design, and policy. It's aimed at developing the capability to predict time, place, magnitude, and effects of earthquakes so that more effective preparation can be undertaken. Project goals include developing techniques for controlling or altering seismic phenomena; developing procedures for assessing seismic risk and evaluating earthquake hazards so that appropriate construction and land use plans can be implemented, and developing improved, economically feasible design and construction methods for building earthquake resistant structures of all types and upgrading existing structures. Grant awards average around $125,000.

Information concerning rules and guidelines for application may be addressed to Dr. John B. Scalzi, National Science Foundation, 800 G Street, N.W., Washington, D.C. 20550 (202/632-0648). Unsolicited proposals will be accepted but should be submitted first in preliminary form for discussion. Included should be a problem statement, a proposed solution to the problem, and information on the utilitization of expected results. NSF recommends an informal inquiry to determine whether or not a potential project would qualify for support.

The Division of Social Science, another directorate at NSF, also supports research of significant interest to architects. Among the Division's programs are **Geography and Regional Science,** which supports research regarding spatial and locational aspects of human organization and activity; **Sociology,** which supports research in sociology and demography and seeks explanations of the nature and behavior of social organizations and institutions, and **Special Projects and Social Indicators,** which supports proposals involving specialized research facilities, the design or purchase of specialized research equipment, and the development of computer-based data centers and other research-resource efforts. Proposals featuring the collaboration of social scientists from several different disciplines and requiring special review procedures are also assigned to the Special Projects Program.

The Social Indicators Program supports research in sociology, social psychology, economics, and other fields aimed at the objective measurement of social change and changes in the quality of life.

Profit and non-profit professional organizations and academic institutions are eligible for grants ranging from $50,000 to $80,000 (depending on the project proposed). Proposals may be submitted at any time. To obtain instructions for preparing social science proposals, request the Grants for Scientific Research brochure (NSF publication 76-38). Formal proposals should be submitted to the Central Processing Section, National Science Foundation, Washington, D.C. 20550. Inquiries may be addressed to the following people for specific program information: Geography and Regional Science, Patricia J. McWethy (202/634-6683); Sociology, Dr. Roland J. Liebert (202/632-4204); Special Projects and Social Indicators, Dr. Murray Aborn, (202/632-4216).

Community Services Administration

For those architects involved in community efforts, planning and operational grants are awarded for Community Development Centers (CDCs) out of the **Office of Economic Development** at the Community Services Administration. Any local community organization or local government is eligible to apply for a 12-month planning grant. Planning grants range from $100,000 to $200,000 for one year, and are meant to cover establishment, operation, and long-range planning for a CDC. Operational grants, including administrative funds and investment capital, are awarded on an individual project basis, and generally extend to two

years. For application guidelines and regulations call or write James V. Digilio, Planning, Design and Evaluation Division, Community Services Administration, 1200 19th Street, N.W., Washington, D.C. 20506 (202/254-5320). The Office of Economic Development's planning grant competition will occur in the latter half of fiscal 1978. Proposals are accepted at anytime but are reviewed once a year, and the tentative deadline for FY 78 is March 31.

Department of State

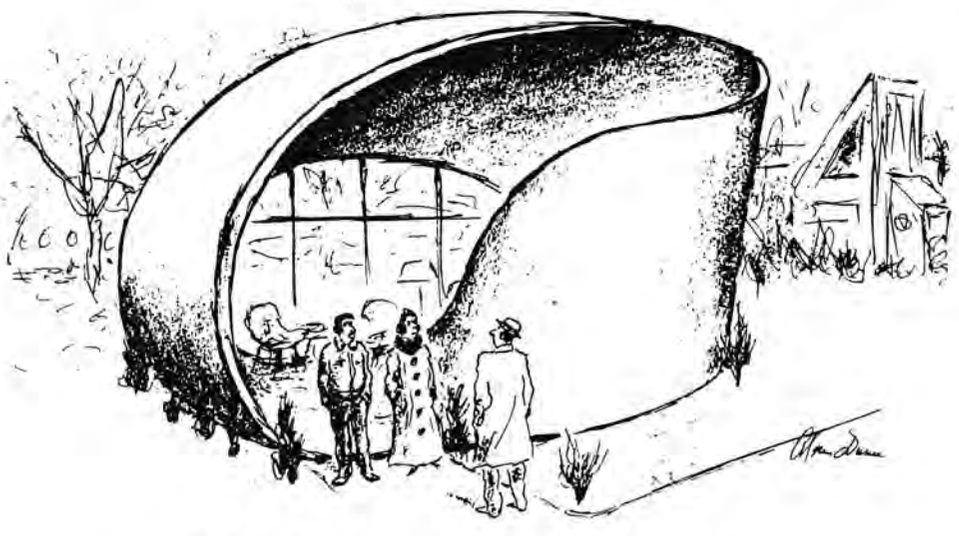
The Agency for International Development within the State Department contracts for research with educational and research institutions and with private firms. AID's **Central Research Program** develops new information and new technologies to increase production and income and improve the well-being of the poor in developing countries. AID research of particular interest to architects touches on rural development, urban development, physical and engineering sciences and technology, environment, natural resources, and energy. Average grant size ranges from $15,000 to $2,000,000 with a duration of four to five years. Unsolicited research proposals may be submitted at any time to AID's Inter-regional Research Staff. An informal preliminary proposal (original and four copies) should be submitted for comments prior to the submission of a formal proposal. Guidelines for research proposals may be obtained from the same office. Informal inquiries regarding research interests are welcomed and should be addressed to Dr. Miloslov Rechcigl, Chief of Inter-regional Research Staff, Bureau for Technical Assistance, Agency for International Development, Washington, D.C. 20523 (202/235-1720).

Department of Health, Education, and Welfare

Grants and contracts focusing on many different aspects of human development are available from HEW's **Office of Human Development.** Under a program especially administered for the aging, grants and contracts ranging from $5,000 (for dissemination of research) to $400,000 are awarded on an annual basis. The average award is $100,000 for one year. Funds are awarded on a 12-month basis, with continuation contingent upon satisfactory progress and the availability of funds. Grants may be awarded to any agency, organization, institution, or individual. The program exists to develop knowledge on the needs and conditions of older people, on the aging process, and on programs and services for improving their lives. For further information contact the Division of Research and Analysis, Office of Research Demonstration and Manpower Resources, Administration on Aging, Department of Health, Education, and Welfare, Washington, D.C. 20201 (202/245-0004). Unsolicited proposals may be submitted at any time.

Other community oriented research grants emanate from HEW's **National Institute of Mental Health** and the latter's **Center for Studies of Metropolitan Problems.** The Center serves as a focal point for NIMH activities concerned with the impact of urban life on mental helath and well-being, with an emphasis on the relationship of contemporary social issues and social structure to individual, family, and community functioning. Social processes of special interest include urban migration, social mobility, and community action.

One NIMH program focuses on **New Town Planning and Development.** Studies in this area are concerned with the social-psychological problems and processes of new town development. Universities, university-based training institutes, non-profit private organizations, and public organizations and agencies representing state and local governments are eligible for grant awards. Grant support ranges from $5,000 to $15,000 with a duration of 1 to 4 years, depending on the project. Proposals must be received by one of three deadline dates for possible funding several months later: March 1, July 1, and Nov. 1. It is strongly recommended that a rough draft or outline of a proposal be submitted prior to formal submission. Applications for research grants are available from research grant management offices at universities and other institutions around the country. They can also be obtained from the Division of Research Grants, ADAMHA, 5333 West Bard Avenue, Bethesda, Md. 20014. For additional information contact Maury Lieberman, Center for Studies of Metropolitan Problems, NIMH, Room 15-99, 5600 Fishers Lane, Rockville, Maryland 20853 (202/433-3373).



"It's designed on the principle of the Möbius strip, which has neither an inside nor an outside. We're praying for a mild winter."

Drawing by Alan Dunn; Reprinted with permission.

Solar regulation *(from page 23)*

requirements fulfillment because bureaucratic agencies require less efficient, more expensive solutions. They are inflexible amidst their red tape." *Harold Ogburn, Wolf Associates, Architects, Ltd.*

"I think codes must recognize that solar is the way to go." *Michael Cohen, The Architects Collaborative*

"Codes are written and enforced by people who no longer build." *Jeffrey Cook, Architect*

From a 1977 AIA/RC survey of architectural opinion on solar regulation.

ARCHITECTURAL OPINION II

"The performance approach is an organized procedure within which it is possible to state the desired attributes of a material, component, or system in order to satisfy the requirements of the user without regard to the specific means employed in achieving the results. The invocation of the user—man—is of the essence; it is not embroidery."

James R. Wright, Chief of the Building Research Division, National Bureau of Standards, 1972

ARCHITECTURAL DEFINITIONS
Performance vs. Prescriptive

A prescriptive requirement is a minimum means to be employed to meet specified health, safety, and welfare requirements for a building or one of its components (i.e., opening sizes, systems, subsystems, assemblies, materials); in reference to energy consumption, to meet specified thermal requirements for a building or one of its components.

A performance requirement is a minimum functional response for a given classification of building in a given climatic region, which may be satisfied through any method or system as long as health, safety, and welfare are ensured. In reference to energy consumption, performance is concerned with consuming less than a specified amount of energy.

Prescriptive code requirements are, by nature, based on precedent. But an embrionic technology such as solar energy has no precedent. Existing requirements for heating and cooling have tended to formalize procedures regarding energy loads and a building's response to the environment. These formulas do not always apply to solar energy or energy conservation. Present concerns and reasons for response are different than the ones which initiated the existing formulas. Prescriptive formulas that produce solutions to these concerns do not as yet exist. Performance standards can address health, safety and welfare without describing a formula.

Prescriptive standards, by their very nature, have to be specific and reasonably detailed if they're to be understood and implemented by members of the building industry. Although the development, implementation, and methods of compliance for prescriptive standards tend to be simpler than those for performance standards, the use of performance standards promises to be far more effective in the light of potential results.

Prescriptive standards do not apply to energy use and solar technologies for the following reasons: If prescriptive standards are specific enough to address all of the varied aspects of energy use in buildings and the interrelationships of the various building components, they will be too cumbersome to be understood and will present too many opportunities for interpretation, variance, inconsistency, and anomalies that have nothing to do with energy use in buildings.

If the prescriptive standards are general enough to avoid the above problems, they'll probably fall far short of their potential for conserving energy. An example of this is ASHRAE's recently developed prescription-based Standard 90-75. Because of the difficulties in addressing all aspects of energy consumption in buildings, many considerations of energy conscious design are left either untouched or modestly affected by this standard. Architects around the country have indicated that the buildings they've designed in the last three years are more efficient than if they had adhered only to ASHRAE's Standard 90-75.

Prescriptive standards, or at least those developed thus far, are inherently based on static design methods. Static design methods have traditionally been used to determine the maximum size of mechanical equipment necessary to serve a particular building's heating, ventilating, air conditioning and lighting requirements. This technique has little relationship to the requirements of reducing annual energy consumption.

Performance standards promise to be a more effective means of conserving energy in buildings and developing cost-effective and innovative methods for accomplishing that goal. Performance requirements concern how well something functions. They do not describe physical constructs, and therefore need to be interpreted before they can be applied. This interpretation gives latitude to the designer, and can stimulate the advancement of innovative solar technologies. A standard that addresses function rather than form allows development, individuality, and change within its acceptable range. This implies that a performance code can outlive a prescriptive one in its relevance—a critical factor in a code's ability to reinforce energy conservation in the light of innovation and technological change. This opinion seems to be shared by most governmental and professional organizations knowledgeable on the subject of energy standards.

The development of energy performance standards for buildings should in no way be considered a simple solution to the problem. In fact, one of the principle reasons that performance standards have not as yet been instituted is that they are quite difficult to develop. Energy experts agree that there are too many unknowns at present to establish good energy standards. Little is understood about how buildings use energy. While it's true that there are annual energy consumption records in the form of utility bills, there is little information telling how the energy was used. Very few buildings in the country are instrumented for the purpose of determining precisely how energy is being distributed. Since the development of performance standards presumes the establishment of some quantitative "budget" or "limit" to energy use, a rational means of establishing these standards would start from some base of knowledge concerning how buildings have historically used energy. Research to establish this base of information would need to formulate models for energy analysis and then instrument the analysis with energy use measurement which considers building type and regional differences.

From AIA/RC's preliminary report to NBS on the Solar Model Code Provisions Study

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