SOLAR UPDATE

NEWSLETTER OF THE INTERNATIONAL ENERGY AGENCY SOLAR HEATING AND COOLING PROGRAMME • NO. 19 APRIL 1992

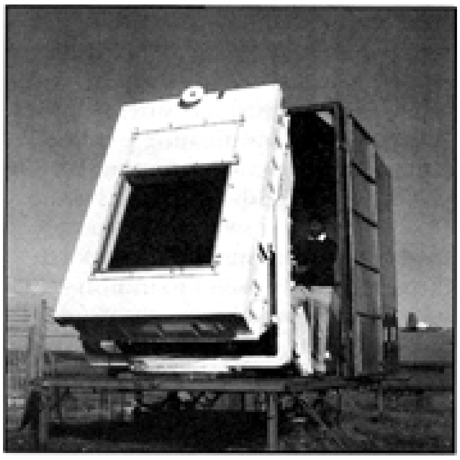
INDUSTRY GROUPS FOR ADVANCED WINDOWS LINKED TO TASK 18

The solar and building industries are key to the ultimate success of solar energy technologies. Therefore, involvement by these industries in the IEA collaborative research projects is essential-whether it be through direct participation, through review and critique of proposed and ongoing work, or merely as recipients of timely information.

Two countries have taken concrete steps to ensure effective industry liaison with the newly-established Task 18 (Advanced Glazing Materials) by establishing industry groups which will monitor and provide input to both national and IEA work in this field.

In the United Kingdom, a meeting of representatives of the glass and glazing industry, architects, and building services engineers was held last November to discuss means for academic, industrial, and commercial collaboration in the field of advanced glazing materials.

According to Prof. M. Hutchins, of Oxford Polytechnic and Operating Agent for Task 18, the meeting was attended by 50 delegates representing 40 companies and firms. It was agreed that a UK Advanced Glazing Industry Committee would be formed whose members will advise on UK participation in the IEA work, provide materials for investigation, and promptly receive results arising from the work during the course of the task.



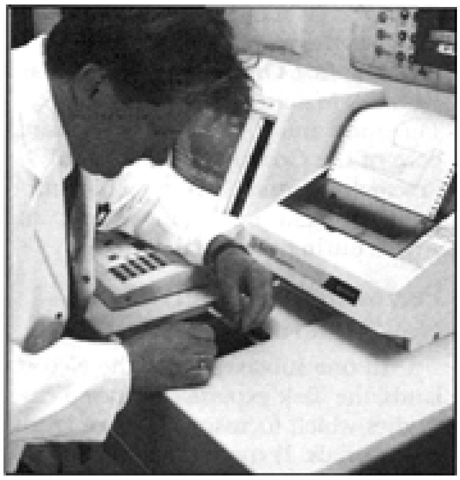
Solar Calorimeter at the University of New South Wales used to test a wide range of window types.

The Australian Advanced Windows Group (AAWG) got underway in 1991 as well, with the purpose of coordinating Australian research efforts in the advanced windows area. The ad hoc group was started because the extent of research in this field was very great - with probably more research per capita in Australia than am-where else.

At present, the group has 50 members and expects to grow to 150 as their industry-based activities get underway: The main thrust at this point is to develop a communication channel between researchers and industry in the windows area and to serve as liaison with Australia's Task 18 participants. Eventually, the group is expected to play a prominent role in establishing an energy labeling scheme for windows and window systems. The group is supported in its work by the Energy Research and Development Corporation in Canberra which is the research funding arm of the Australian government.

The National Solar Architecture Research Unit at the University of New South Wales, under the leadership of John Ballinger, is responsible for liaison with this group as well as for Australia's participation in Task 18. They will be providing two seminars each year and four newsletters for the industry group.

In Task l8, participants will be investigating a wide range of new glazing materials and products for solar control, space heating, and day lighting applications. These include aerogels, transparent insulation, evacuated glazings and low-emittance coatings which are being developed for highly insulating glazing systems. In addition, task researchers will examine switchable glazing systems based upon electrochromic, thermochromic and liquid crystal materials which can dynamically regulate solar radiation entering a building. Light guides and holographic materials as well as improvements of frame edge and seal technology will also be examined.



Spectrophotometer tests will be performed in Task 18 to measure optical properties of advanced glazings.

In addition to the materials development work, Task 18 will employ building energy analysis tools to identify appropriate applications for advanced glazing systems and determine the level of energy and environmental benefits which may result from the use of these new materials. Such work will enable the dissemination of applications guidance and assist in developing good practice in their use.*

TASK 10 PAVES THE WAY FOR MATERIALS DEVELOPMENT

The development of effective test methods for new materials is difficult and challenging but an essential activity in the materials development process. In the recently concluded Task 10, significant progress was made in devising techniques for assessing the performance and durability of new materials for solar energy heating, cooling and daylighting applications during six years of collaboration among researchers from the eleven countries.

The first Operating Agent of Task 10, Solar Materials R & D, was Dr. S. Tanemura and then Dr. K. Yoshimura, both of the Government Industrial Research Institute in Nagoya, Japan. Dr. T Noguchi provided assistance and advice during the collaboration.

Performance Criteria for New Materials

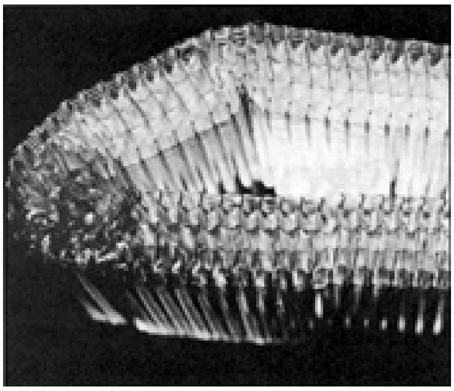
In one subtask, led by the Netherlands, the Task experts conducted case studies which focused on three kinds of materials: 1) spectral selective coatings on solar absorbers in solar DHW systems, 2) transparent insulation materials for buildings, and 3) advanced glazings.

As a result of the case studies, the following were developed:

1) Step-by-step guidelines for materials selection using climate data, operating conditions, and material properties, with appropriate simulation programs.
2) A methodology for estimating the energy benefits which can be expected with various materials.
3) The effect of material properties on system and component performance.
4) A data base of material properties relevant to solar energy applications to guide manufacturers and system designers.

Selective Absorber Materials

In the development of solar heating and cooling systems, issues of performance, cost, and durability are closely related to one another. To be able to select the most cost-effective materials requires not only knowledge of the short-term performance of a material but also its long-term performance or durability under operating conditions.



Cross section of a capillary structure transparent insulation material. A highly insulating material, it has a U-value approaching that of a wall but with high solar transmission making it very effective for heating and daylighting applications.

However; service life data on materials are still quite limited in solar energy technology. Consequently, service life prediction methods based on accelerated life testing must be utilized to forecast a material's service life. Task 10 researchers, under the leadership of Sweden, performed a case study involving four commercially - available selective absorbers as test materials. Both experimental and theoretical test methods were successfully developed to aid in prediction of durability and service life. This work was coordinated with Subtask A to obtain the materials property data/performance relationships needed.

An important outcome of this effort is that the IEA-developed service life methodology is applicable to a wide range of materials (beyond solar absorbers) and consequently will be useful to material scientists and engineers who are testing other types of solar and building materials.

Collector and Window Glazings

In the third subtask, led by the U.S., a variety of research was conducted on three classes of glazing materials: optical switching devices (both electrochromic devices and dispersed liquid crystal devices), low emittance films, and transparent insulation.

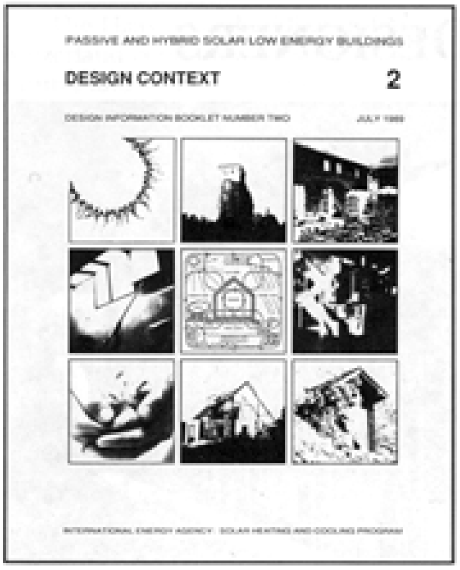
A characterization methodology and evaluation techniques were developed for several types of electrochromic devices, the first uniform approach to characterizing these glazings. Optical and electrical property measurements were made on the electrochromic and liquid crystal (LCD) windows. A study of a dispersed LCD determined the relationship of optical properties to applied voltage. Furthermore. the solar optical properties were identified for each class of glazing and the usefulness of these materials was assessed for solar control and daylighting applications. Moreover, the performance range of particular glazing materials was determined under selected operating conditions. Further work is needed to determine the physical, chemical, and operational characteristics of the electrochromic and liquid crystal devices, but a solid foundation has been established for industry.

To evaluate low-emittance films, inter-laboratory tests were conducted, comparing normal, hemispherical and angular properties, important for understanding the stability of these coatings. Also, some exposure tests were performed to determined stability.

Measurements of thermal and optical properties of transparent insulation materials-honeycomb, capillary polymers, and aerogel-were performed in various laboratories and the results compared- The work helped point out some of the problems associated with the testing of super-insulating materials and optically-complex materials such as honeycombs. The Task 10 effort comprised a preliminary evaluation, but more sophisticated measurements of total energy transmittance, U-values and other properties are required. This will be accomplished in Task 18.

The optical switching materials and transparent insulation work has been extremely useful to industry through access to important material property data, material characteristics, test methods, and guidance on usefulness of materials.

For further information on this Task and availability of reports, contact: Dr. S. Tanemura, Government Industrial Research Institute, Hirate-cho, Kita-ku. Nagova 462, Japan.



Design Information Booklet No. 2

Passive Solar Design Information Booklet No. 2

Passive and Hybrid Solar Low Energy Buildings: Design Context identifies energy-related factors that a designer should be aware of at the beginning of the residential building design process and addresses the inter-dependencies between energy , architecture, and the natural environment. This is the seventh of the Task 8 Design Information Booklet Series to be published.

The document is organized into the following subjects, representing the type of program information needed by a designer to develop a bioclimatic design: Site Analysis, Building Organization, Building System Options, Auxiliary Space Conditioning, User Influence, and Building Codes and Regulations. A checklist is presented as the introduction to each chapter; followed by extensive explanatory notes, figures and drawings related to the items in the checklist.

It is intended that the checklists be reviewed during the architectural program phase by the designer for factors relevant to the current project.

The goal is to help the project designer collect and organize energy-related design information for the purpose of developing an architectural program responsive to energy conscious and passive solar design issues.

Copies *of Passive Solar Design Information Booklet No. 2: Design Context* may be ordered from: Superintendent of Documents, U.S. Government Printing Office, Washing ton, DC 20402, USA. Report No. 061.000.00780-6. $9.00 (U.S. orders), $11.25 (foreign orders).

Collector Characterization and Testing

The Characterization and Testing of Solar Collector Thermal Performance describes new methods devised in Task 3 for characterizing and testing low temperature solar collectors including unglazed collectors, evacuated tubular; heat pipe and boiling/condensing collectors and conventional flat plate collectors.

For each of these collector types, simple models were developed to describe the sensitivities of the thermal performance of the collector to operating conditions. The models developed are all simple generalizations of the Hottel-Whillier-Bliss equation for flat plate collectors with extra terns to describe additional effects. The models form the basis both for performance testing and for predicting the performance in operation from the test results.

As a result of the work summarized in this report, conventional collector testing has been extended to a wider range of collectors and test conditions, and the performance of collectors in different localities and in different weather conditions can be predicted pore accurately.

To order this report, contact S.J.Harrison, Solar Calorimetry Lab, Dept of Mechanical Engineering, Queen's University, Kingston, Ontario, Canada K71, 3N6.

Estimation of Solar Radiation on an Inclined Surface

This report documents the results of a Task 9 investigation of the perform ante of numerical models which provide estimates of solar radiances on inclined surfaces, given direct and diffuse solar irradiances for a horizontal surface

The performance of 21 hourly inclined surface irradiance models was studied as well as seven models applicable to daily and longer-time intervals. The significance of the study lies in the large number of models tested and the large number of measured data sets employed in the validation (twenty-seven data sets from twelve countries.)

The study has resulted in recommendations on which models provide the most accurate results for estimating diffuse irradiance at time intervals of an hour or less. direct irradiance at time intervals of a day or longer, sky diffuse irradiance for time intervals of a day or longer; and global irradiance for time intervals of a day or longer. In addition to the report presenting the model validation results, both the computer programs and many of the quality controlled data sets are available on magnetic tape. A user's guide and reference manual are also available.

To obtain *Calculation of Solar Irradiauces for Inclined Surfaces: Verification of Models which Use Hourly and Daily Data* or the supporting material, contact D. C. McKay, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, Canada M3H 5T4.

Task 11 Design Sourcebook

This book presents the results of the research on a diverse range of passive solar commercial and institutional buildings performed in Task 11 by solar experts from twelve countries during 1986-1991. It features lessons learned from 45 building case studies, 22 of which were monitored and analyzed in detail. The buildings range from a large university complex with multiple atria in Nor way to a sports hall employing a mass wall in Strain. Insights gained from performance monitoring have been expanded through parametric sensitivity studies using computer models, some of which were developed specifically for this IEA project.

The sourcebook is divided into five major sections: Solar Usability, Solar Heating, Daylighting, Passive Cooling and Atria. Heavily illustrated and with a user-friendly and attractive format, this document should be a welcome addition to the library of solar architects and designers and solar engineers, particularly those whose work involves non-residential buildings.

To order Task 11 Sourcebook of Examples and Design Insights, contact S. Robert Hastings, Forschungstelle Solararchitektur; ETH Honggerberg, CH-8093 Zurich, Switzerland.

IEA RESEARCH PROVIDES WEALTH OF INFORMATION FOR COMMERCIAL BUILDING DESIGNERS

For six years, researchers from 12 IEA countries and the European Community studied the opportunities for incorporating simple, direct and cost-effective passive solar features into designs for commercial and institutional buildings. This work took place in Task 11 under the leadership of Operating Agent S. Robert Hastings of the Solar Architecture Research Group at the ETH - Honggerberg in Zurich. The Task was completed in September 1991.

Research Topics

Five topics crystallized out of earl discussions among the experts and provided a structure for the research: solar usability, solar heating, daylighting, natural cooling and atria. Important lessons were learned about applying a variety of solar features and systems to diverse building types including mixed use shopping centers, office buildings and schools under climatic conditions ranging from north of the Arctic Circle to the Mediterranean Sea.

In this issue we present selected building examples and conclusions from the Task 11 research results for the topics of solar usability; heating, and atria. Cooling and daylighting will be covered in the next issue.

Solar Usability

Designers of commercial and institutional buildings often assume extensive heat generation from occupants, equipment and lighting. If these internal gains are sufficient to cover a rooms heating requirements, solar gains only lead to overheating. It is therefore critical to investigate the magnitude, timing and spatial distribution of internal heat generation.

Task H researchers surveyed literature and conducted sample monitoring. It became apparent that the assumptions lit- internal gains varied greatly by country and were frequently exaggerated, in some cases up to a factor of five. The actual magnitude of internal heat generation as measured was substantially less than assumed.

To better understand the issue of usability of solar gains in offsetting space heating requirements in commercial and institutional buildings, solar usability was computed for a

The Haas Office Building

modern Swiss office building using three sets of internal wins vales: reduced gains from newest technology office equipment, measured internal gains, and standard practice values.

These calculations were performed for the climates of Oslo, Zurich and Rome. The conclusions appear to indicate that standard internal gains in calculations can seriously underestimate the solar contribution. For example, in Rome the solar fraction of the total heating load for such an office building would be only 3% if standard internal gains are assumed. but the solar fraction increases to 32% if measured internal gains are employed.

Passive Solar Heating

Passive solar designs can reduce the need for conventional heating energy but special consideration must be given to the comfort requirements of users through the use of thermal storage, efficient solar control, and shading devices. In addition, solar heating measures should always be utilized together with energy conserving measures such as efficient lighting, daylighting strategies, and natural cooling and ventilation.

A number of passive solar heating strategies are possible. In their heating studies, Task H researchers addressed direct gain, air collector systems, air flow windows, mass wall systems, transparent insulation systems, absorber walls, and storage.

An interesting direct gain project investigated was the Jungfraujoch restaurant which must cope with extreme conditions at an elevation of 3500 m in the Bernese Alps of Switzerland. Reflections from an adjacent glacier can increase the available solar radiation to values exceeding the solar constant (1367 Whir-'), but the average **annual temperature** is -8^{o} C and wind velocities can reach 200 km/h.

To make direct use of solar gains under such extreme conditions, a special window construction was developed. Quadruple glazing, with IR. selective coatings and a special gas-filling in the gaps, is held in an insulated frame construction. The average glazing U-value of 0.7 W/m^{2}K and frame U-value of 1.4 W/m^{2}K keep heat losses minimal.

As a result of the high performance windows, heat storage in the building mass, and acceptance of room temperature variations from 15.25^{o}, solar gains along with internal gains from the occupants (1800-2000 visitors per day) cover all the space heating needs during the daytime. The good U-values also allow guests to sit adjacent to windows without discomfort.

The Haas office building in Jona, Switzerland combines direct gain features and window air collectors.

It is equipped with a relatively large window air collector area of 41 m2 which is connected through ducts to a 60 m^3 rockbed under the floor. A dark-colored blind between glazing layers acts as a solar absorber. When heat is required and the sun is shining, the blind is raised, allowing sunlight to penetrate into the office.

As the office temperature rises, or if glare is a problem, the blinds are lowered. Air circulated over the blinds extracts the heat and transports it to the rockbed storage As the office temperature sinks during the night or during overcast periods, this stored heat is then released passively.

The building was monitored for two heating seasons. During one season the active system ryas disabled. The auxiliary heating requirement in the passive node was only 14 kWh/m^2 . During the second season, in the active ode, a value of 7 kWh/m^2 (plus 2 kWh/m2, electricity for the fans) was achieved. This is less than 12 percent of a conventional office building.

Atria

Atrium design is a complex topic because it can involve heating, ventilation, cooling and daylighting strategies for both the atrium and the enclosing building in combination. Task participants studied in detail atria in Finland. Germany, Norway, Sweden, Switzerland and the United Kingdom. An example is presented here of the atria of the ELA Building of the Norwegian Technical Institute.

Four-story high atria were placed between three parallel blocks which house offices, labs and seminar rooms. The atria were heated to 15° C by heat losses from the adjacent buildings, solar gains, internal gains and hot eater radiators. Because they are used intensively by students, the atria are now heated to 18° C which, compared to the 15° C setpoint, substantially increased the auxiliary heating requirement. Ventilation from air leakage is adequate in, winter; in summer, smoke hatches are opened.

Conclusions from detailed monitoring, computer simulation and occupant interviews may provide useful insights for the design of future atria:

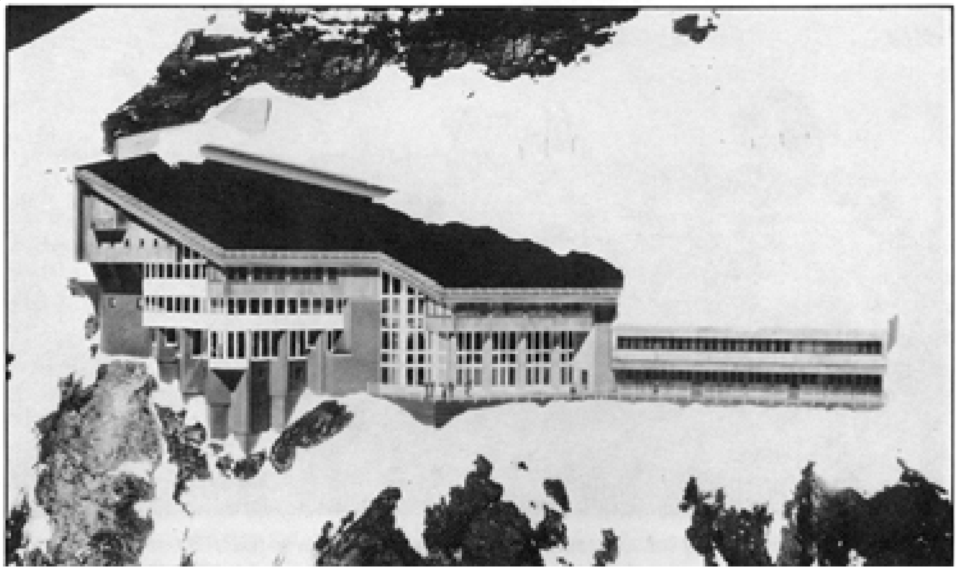
• The energy needed to heat an atrium and building together may be less than that required to heat the building alone if the atrium is unglazed and open. Critical factors are the atrium geometry, glazing and heating set point. U)' C seems to be a critical maximum temperature. Heating the ELA atria to 20° C rather than 15° C increases the total building plus atria heating energy by 20 percent in Trondheim and by 10 percent in Washington, DC, according to computer simulations.

• Thermal mass in an atrium may not be a benefit. The evened-out temperatures may be too low to provide useful heat to other parts of the building. Furthermore, mass delays the morning heat-up when comfort may be desired. For none of the studied climates did mass affect the heating energy of the building more than I percent.

The ELA Building Atrium

• Roof glazing, in this case a shed geometry, is valuable for daylighting, but it is thermally detrimental. In Trondheim. replacing the glazing of the shed's north slope with an opaque roof (U = 0.35 W/m°K) would decrease the atrium's heat demand by about 23 percent, though the building's heating demand would remain unchanged. Replacing the south glazing with an opaque roof in Washington, DC would result in a reduction of the atrium's heating energy by 27 percent and of the cooling load by about 36 percent according to computer simulations.

It is clear that the integration of an atrium in a building can result in energy savings when heating, cooling, and daylighting strategies are skillfully combined. In most cases, the inclusion of a well-designed atrium also enhances the building's amenity value.



The Jungfraujoch Restaurant

For Further Information

Only a brief sample of the significant results and lessons learned from the Task 11 research, monitoring, and analyses is provided here. A detailed compilation of the project findings are contained in the task H Sourcebook of Examples and Design Insights. (See New Publications Section in this issue.)

TASK 9 ENDS WITH A LONG LIST OF ACCOMPLISHMENTS

A total of nearly 30 person years of manpower (and womanpower) were contributed by the countries participating in Phase II of Task 9, Solar Radiation and Pyranometry between 1987 and 1991. This figure clearly illustrates one of the major advantages of collaborative research: Each of the ten countries involved benefited from the results of a large effort while funding only a small portion.

The effectiveness of this project and the significance of its contributions to the field of solar radiation measurement are evident from an overview of some of its accomplishments.

Techniques for Supplementing Network Data

While location-specific solar irradiance data are needed for designing and evaluating planned solar energy systems, it is not economically feasible to building monitoring stations at every potential site. Therefore, methods for estimating solar radiation resources at locations between measuring network sites are required. In Subtask D, led by Switzerland, IEA researchers assessed the accuracy of a large number of such methods for estimating solar radiation at various spatial and tine scales.

The simplest method for estimating daily global solar radiation received at a certain location is to extrapolate from the data of the nearest radiometric measurement station. However, this method has a root-mean-square error (RMSE) which was found to increase linearly with the square root of the distance from the station.

In Task 9 tests, better results were obtained by weighted interpolation of the data from *several* radiometric stations Surrounding the site in question. Even better results were obtained by the more sophisticated "kriging" method which minimizes the square error: Furthermore, interpolation by higher order polynomials of the station coordinates, called smooth surface fitting, was investigated.

When estimates of *daily* global solar radiation derived from data of the METEOSTAT satellite were shown to have a RMSE which increases with altitude above mean sea level, the IEA researchers were able to compensate for the error by applying the ratio of clear-day insolation at sea level as a correction factor.

Both ground-based and satellite-derived data were applied in the "co-kriging" method in which the weights of both interpolations are determined so that the square error becomes minimal. An important finding of Task 9 was that this method yielded the best estimates of daily global solar radiation.

An extensive scientific report has been compiled on the various techniques tested.

Representative Design Years

A new generation of synthetic meteorological data sets which are known as Test Reference Years (IRY) or Typical Meteorological Years (TMYs) was produced in Subtask E, headed by Denmark. These new design reference ears (DRYs) developed feature several improvements over conventional TRYs.

By an adjustment process. selected representative months were given the desired long-term mean values and standard deviations. An objective mathematical procedure was proposed to help select those months.

Several new parameters have been included in the Design Reference Years such as total cloud amount and equivalent opaque cloud amount: global, dif-fuse and direct normal illuminance; and longwave downward irradiance. Appropriate algorithms for computing these data from other meteorological quantities were tested, selected and applied.

A special novelty of the DRYs is the inclusion of short-time variations of direct solar radiation which are particularly important for concentrating solar systems. A detailed statistical model based on extensive measurements demonstrated that shorter than 5-minute averages do not improve the statistics, and also provided the tools to derive representative 5-minute values from hourly data.

Design Reference Year Manuals are now being published.

Irradiance Measurement for Solar Collector Testing

An extensive characterisation of solar irradiance meters (pyranometers) has been completed in Subtask E under the leadership of Canada.

In first class pyranometers, the variation of responsivity with temperature was found to be generally within ± 1 % at temperatures above -15%°C. The dependence of pyranometer responsivity on direction of incidence was shown to be unaffected by the state

See Task 9 on p. 7

Outdoor comparison of global solar radiation reference radiometers (GRRR) at Norrköping, Sweden. The GRRR, developed by Task 9 experts, has proved to be the most accurate system for measuring global solar radiation.

SHEILA BLUM

Executive Secretary

Sheila Blum has served as Executive Secretary of the IEA Solar Heating and Cooling Executive Committee since 1977. The impact of this job can be seen in the photos on this page!

Born and raised in Baltimore, Sheila received her Bachelor's Degree from the University of Maryland where she majored in English. Afterwards, she worked in the information office at the Embassy of Israel in Washington and as program assistant at the U.S. Office of Economic Opportunity (the long abandoned "War on Poverty"; we lost).

Sheila Blum in 1977

In 1974, she took a job as administrative assistant with the Solar Energy Group in the Department of Mechanical Engineering at the University of Maryland. She was hired for this position by Fred Morse who later served as the first Chairman of the Executive Committee.

At the time she had no idea what solar energy was and never d reamed she was beginning a lengthy career in renewable energy In her university position, she became involved with the NATO/CCMS Solar Energy Pilot Study, the first international cooperative project in solar energy A few years later; the IEA Solar H & C Program was initiated, and Sheila began her support work for the Executive Committee which has continued for almost 15 years. In addition, she headed a project which provided support for the international projects in the U.S. Department of Energy's Office of Solar Heat Technologies.

In 1979, she went to work for TPI, a solar consulting company, continuing her DOE and IEA work. She formed her own company, International Planning Associates, in 1984 and has performed a variety of meeting and conference planning, project management, editing services, and of course...the IEA solar work.

Challenging projects of the past several years have included writing the section on the technical and commercial status of renewable energy technologies in the IEA report, *Renewable Sources of Energy; editing Guidelines on the Economic Analysis of Renewable Energy Technology Applications* for the IEA Renewable Energy Working Party; and producing the IEA Solar Heating and Cooling PR brochure, "Working Together for a Solar Future."

Sheila enjoys travel, reading, theater; art, and gardening. She has two children and a large white cat. Her daughter, Orna, studied International Relations and now works for the League of Women Voters on a project to promote grassroots political participation in Eastern Europe. Her son Ari is a computer science major at the University of Maryland.

Also known as the Action Item Police, Sheila has enjoyed working with four terrific Executive Committee Chairmen as well as the other ExCo members and the Operating Agents.

However, all is nut rosy on the Executive Committee Here are some comments certain Committee members were overheard making:

"She drives me crazy with her English editing! I'd like to see her write a report in Dutch!" - Henk Faber

"I'm glad to have another woman around, but Sheila doesn't wear enough black." - Anne Crete Hestnes

"Elle parle tres mal Francais."Andre DeHerde

"Sheila made us nuts during the annex writing process." - Jurges Schmid and Mick Hutchins.

Gerhard Schriber was heard to say

Sheila Blum today

something nice, but he says nice things about *everybody.*

Nonetheless, and despite the lack of an IEA pension, Sheila contends that getting to know interesting people from 18 countries and traveling to meetings all over the IEA world has been a pleasure a privilege and an education.

Task 9 Cont. from p. 6

of polarization of the incident radiation. However; spectral responsivity in the near-infrared range of the solar spectrum decreased with increasing angle of incidence.

In the past, claims were occasionally made of dramatic drifts of pyranometer responsivity over the long term, but these were not detected in any of the major types. Typical responsivity drifts of 1 % per year are acceptable because they can be compensated for by annual recalibration.

The most precise method for determining global solar radiation is to measure its components, direct solar and diffuse solar radiation, separately. Such measuring systems, termed global solar radiation reference radiometers, consist of a pyranometer with a shading disk and a pyrheliometer on the same solar tracker. This system was developed and field tested in Task 9. The measuring uncertainty achieved was 1% RMSE.

In addition to a report on pyranometer stability, a practical manual will be available for solar engineers entitled *Using Pyranometers in Tests of Solar Energy Converters.*

Dr. Fritz Kasten served as Operating Agent for Task 9 (Phase II) on behalf of the Forschungzentrum Jülich (Germany). Further information about this task or task reports may be obtained from Dr. Kasten at Deutcher Wetterdienst, Meteorologisches Observatorium, Hamburg, Frahmredder 95, D-2000 Hamburg 65, Germany.*

IEA SOLAR HEATING AND COOLING PROGRAMME

The International Energy Agency was formed in 1974 within the framework of the Organization for Economic Cooperation and Development (OECD) to implement a program of energy cooperation. Collaborative research, development and demonstration projects in new energy technologies are an important element of the program. The 18 members of the IEA Solar Heating and Cooling Agreement have established a total of 18 R & D projects (known as Tasks) to advance solar technologies for buildings. The overall program is managed by an Executive Committee while the individual tasks are led by Operating Agents.

Current Tasks and Operating Agents

Task 12: Building Energy Analysis Tools for Solar Applications
Mr. Michael Holtz Architectural Energy Corp.
2540 Frontier Ave. Boulder, CO 80301 USA
Fax: 1/303-444-4304

Task 13: Advanced Solar Low Energy Buildings
Prof. Anne Crete Hestnes Dept. of Architecture
Norwegian Institute of Technology N-7034 Trondheim, Norway

Task 14: Advanced Active Solar Systems
.Ir. Doug Lorriman Ballinafad Research P.O. Box 97
Ballinafad, Ontario NOB 1H0, Canada Fax: 1/416-873-2735

Task 15: Advanced Central Solar Heating Plants with Seasonal Storage
(In Planning Stage)

Task 16: Photovoltaics for Buildings
Dr,Jurgen Schmid Fraunhofer Inst. for Solar Energy Systems
Oltmannstr. 22
D-7800 Freiburg, Germany Fax: 491761.401-4217

Task 17: Measuring and Modeling Spectral Radiation
Dr. Fritz Kasten Deutscher Wetterdienst Meteorologisches Observatorium
Frahmhedder 95 D-2000 Hamburg 65, Germany Fax: 49/40-601-73-299

Task 18: Advanced Glazing Materials
Prof: M. G. Hutchins Oxford Polytechnic School of Engineering Gipsy Lane
Headington, Oxford OX3 OBP, U.K. Fax: 441865.81 99 29

Task 19: Solar Air Heating Systems
(In Planning Stage)

Task 20: Solar Retrofit
(In Planning Stage)

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Denmark	Mr. P. Dorph-Peterson
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SOLAR UPDATE:

The Newsletter of **the IEA** Solar Heating and Cooling Programme

No. 19 April, 1992

Prepared for the
IEA Solar Heating and Cooling
Executive Committee

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