SOLAR UPDATE

NEWSLETTER OF THE INTERNATIONAL ENERGY AGENCY SOLAR HEATING AND COOLING PROGRAMME • NO. 31 AUGUST 1998

Performance of Daylighting Systems Being Evaluated at New Danish Laboratory

Daylight research has typically focused on the thermal and energy-related consequences of window panes and how to guide daylight further into a room. The new daylight laboratory at the Danish Building Research Institute (SBI), however, will also focus its research on how windows and the visual environment influence building occupants' well being. Information in this area is very limited, and therefore the SBI, in collaboration with IEA SHC Task 21, Daylight in Buildings, plans to begin the task of establishing criteria for assessing window solutions and daylighting systems as well as developing methods for measuring and evaluating daylight conditions in buildings and rooms.

The Danish daylighting test facility is similar to facilities being used by SHC Task 21 experts in other countries. The types of measurements and projects being conducted at the Danish laboratory include the testing of daylighting systems, artificial lighting systems and control systems for daylighting and artificial lighting, and the assessment of users reactions to/appraisal of the systems. The laboratory consists of two experimental rooms, a measuring room and a reference room which has been designed to make direct comparisons of the conditions in each room. The window facades are oriented towards the north, south and east providing three possible room orientations. And, each room is equipped with flexible partitions so that the room depth can be regulated, and the windows are divided into sections so that the window size and location can be changed.

The Operating Agent of SHC Task 21, Kjeld Johnsen, explains that "an important criteria for a daylighting system to function under North European climate conditions, often cloudy or overcast, is that the system can be adjusted to protect against unwanted solar transmission on clear summer days, and at the same time admit as much daylight as possible to the room on cloudy days. When we found out that the Danish company, Dasolas International Production A/S, was producing some of the most advanced solar shading systems in the world, including an automatic control system, it was obvious that we would like to test some of these as part of our contribution to SHC Task 21."

Daylight laboratory at the Danish Building Research Institute in Hørsholm, north of Copenhagen.

One of the first applciations to be tested at the new laboratory by Task experts is a movable light shelf. The shelf looks almost like a wing of an airplane and can be rotated around a horizontal axis in the middle. When the light is too bright in the area near the window, the light shelf is turned downwards and more horizontal to reduce the view to the sky and the direct sunlight near the window. When it is cloudy, the light shelf is turned upwards and more vertical to increase the view to the sky and let daylight in. In the positions between +/-20 degrees from the horizontal position, the light shelf reflects some of the light to the ceiling and further back into the room to even out the difference in illuminance between the front and back of the room.

Not only are SHC Task 21 experts

continued on page 2

$ $ $ $ $ $ $ $ $ $ $

MarketPlace

The Solar Heating and Cooling Programme is not only making strides in R&D, but also impacting the building sector. This section of the newsletter highlights solar technologies which have been developed or conceptualized in a SHC Task and are now being commercially manufactured and marketed.

Building Energy Software

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) has based its Standard Method of Test for building energy software on the SHC Programme's BESTEST (Building Energy Simulation Test and Diagnostics Method). BESTEST is a comparative evaluation method for building energy analysis. It was developed at the National Renewable Energy Laboratory in the U.S. and then refined and field tested by experts of SHC Task 12, Building Energy Analysis and Design Tools for Solar Applications. BESTEST is designed to help software developers produce reliable energy software. But another important use of the method is to assure potential software users (engineers and architects) that a particular simulation program gives reasonable results or that a program is appropriate for their particular application. BESTEST also was recently used as the basis for the Home Energy Rating Systems software certification procedures in the U.S.

Daylighting Protocol

The National Renewable Energy Laboratory in the U.S. is using daylighting protocol developed under SHC Task 21, Daylight in Buildings, to study the performance of the daylighting system and lighting controls at their award-winning Thermal Test Facility. This internationally developed protocol establishes procedures for measuring occupant satisfaction as well as quantitative daylighting performance. It is based on the first of its kind, a comprehensive analysis of daylighting systems in 21 buildings throughout Europe and North America.✷

Daylighting Systems

continued from page 1

testing specific daylighting systems such as the one above, they also are developing design guidance and daylighting design tools. These new user friendly design tools will enable design practitioners to focus on daylight integration in building design and to predict the impact on overall energy performance. This international team of experts has already developed monitoring protocols for the performance evaluation of daylighting systems and control systems as well as a questionnaire for assessing user appraisal of windows, daylight, and lighting systems and controls. Both these products are proving to be very useful for industries throughout the world. As the president of the Danish company Dasolas International, K. Lund-Hansen, comments "75% of our production is exported to the international market of Europe, North America and the Far East. Therefore, it is essential that the documentation of performance data for our systems is based on internationally recognized testing procedures. We look forward to using the procedures established in SHC Task 21, and to seeing the test results for our products."

continued on page 7

Thanks To...

André De Herde who has stepped down as the Executive Committee Chairman. Andre's dedicated leadership guided the Programme through a strategic plan and Programme extension process as well as through its celebration of 20 years of R&D and on to the next 20 years of international collaborative work. The Executive Committee greatly appreciates his many valuable contributions and is pleased that André will stay on as the Belgium representative.

Manuel Macías who served as the Spanish Executive Committee member since 1989. The Executive Committee thanks him for his many years of contributions to the Programme. His replacement will be appointed shortly.

Henry Parkinson who served as the U.K. Executive Committee member. He will be replaced by **Peter Mallaburn**, of the Department of Environment, Transport and the Regions (DETR).

Congratulations to…

Lex Bosselaar, the Dutch Executive Committee member, who has been elected as the new Executive Committee Chairman.

Welcome To...

Hans Westling, of Promandat AB in Sweden, who is serving as the Operating Agent for the new Task on Active Solar Procurement.

Werner Weiss, of AEE in Austria, who is the Operating Agent for the new Task on Solar Combisystems.

New Method for Measuring the Efficiency of Solar Air Collectors Developed

An important activity in SHC Task 19, Solar Air Systems, has been to develop an improved method for determining the efficiency of solar air heating systems. Unlike solar water collectors, the efficiency of solar air collectors is difficult to determine, but needs to be known to improve their performance. Because the performance of air collectors is very sensitive to the mass flow rate and the pressure drop, Task experts decided to conduct in-situ solar air collector array tests.

The main obstacle the experts had to tackle was how to handle the measurement accuracy of energy flow in air ducts since the measurement accuracies of both the air flow rate and air temperature are low due to problems connected with the non-uniform distribution of air flow and temperature gradients across the air duct's cross section. They also had to work on the difficult task of installing sensors within the air heating system. Due to these obstacles, it has always been difficult or near impossible to extrapolate data from testing single collectors on test stands to large solar air collectors because the flow pattern often changed considerably.

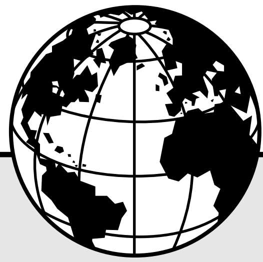
Task participants at the Solar Energy Centre Denmark at the Danish Technological Institute have developed just this type of testing methodology to address such problems. The methodology allows for accurate measurements which do not disturb the air flow pattern in the collector loop and can be carried out under dynamic conditions. This measuring method is for air flow measurements based on either a calibrated pressure drop or a calibrated air speed. The temperature measurements are based on calibrated temperature sensors located in a well-defined grid in the ducts. And, the sensors used have only a small influence on the flow pattern in the duct.

This new method has been applied and tested by the Solar Energy Centre Denmark on two large Danish solar air collectors at Havrevangen and Tjørnegade. These two collectors were selected because they are very different and the results obtained can be applied to a large range of collectors. The one common factor between the two systems is that heat from the air stream is transferred to a liquid loop by an air to water heat exchanger. As it is easier to obtain accurate measurements in a stream of liquid, this feature made it possible to test the accuracy of measurements in the air stream.

The system at Havrevangen consists of conventional solar air collectors on rowhouses. This roof-integrated system directs the air to flow behind the absorber and have fins that project down into the air stream. The absorber has a selective surface and the collector cover consists of a single layer of glass. The system at Tjørnegade has a roof space collector on a four-storey building where the southern part of the attic is used as a solar air collector. The cover consists of triple walled ribbed sheets of UV stabilized polycarbonate and behind the cover is a black felt mat to act as an absorber. The inlet air to the collector is blown into the space between the cover and the felt mat and then sucked through the felt mat.

The results from these tests showed the efficiency to be in close agreement with solar water collectors. The measured energy flows were below 2-3% between air and water measurements. This was very pleasing to the experts as it is difficult to obtain accurate measurements in air flows. The accuracy of the determined efficiency equation for the two solar air collectors also was within the range of accuracy for the efficiency curves for water solar collectors. Based on the measurement guidelines used, conditions for conducting measurements were also determined (e.g., weather conditions, length of time recommended for measurement tests and the required accuracy of measurement equipment). This test method has recently been accredited and will be used with other certified test methods at the Solar Energy Centre Denmark. ✷

For more information or a copy of the report "In-Situ Solar Air Collector Array Test" contact Søren Østergaard Jensen, Solar Energy Centre Denmark, Danish Technological Institute, Taastrup, Denmark, tel: +45 43 50 45 60, fax: +45 43 50 72 22, e-mail: Soren.OJensen @dti.dk.



The SHC Web Site

Visit the SHC web site next time you're on the Internet. The site is being updated with new information and to make it easier for you to find this information. You will find Programme information, details on Task activities, publications, names of Programme contacts, a calendar of upcoming SHC meetings and workshops, and other useful information.

Our Internet address is:

http://www.iea-shc.org

Dawn of the Solar Age in the Netherlands

An example of a typical SDHW system on a new building.

The Government of the Netherlands set a goal in 1997 to increase the contribution of renewable energy from less than 1% in 1996 to 3% in the year 2000 and 10% in the year 2020. As these goals will not be achieved spontaneously, government, industry and utilities will need to work hard to achieve them. To meet these targets, the Government has initiated the action program, “Renewable Energy, Advancing Power.” The three main themes of the program are 1) to improve the price-performance ratio, 2) to promote market penetration, and 3) to address administrative bottlenecks. The Government’s solar energy programs also support the continuation of strong public and private sector cooperation as a way to promote the growth of renewable energy in the national energy balance and to help decrease CO_2 emissions.

Due to the country’s small size, international collaboration with the IEA is often sought to conduct R&D and develop test methods for different renewable energy technologies. In the area of solar energy, the Netherlands is an active participant in three IEA Solar Heating and Cooling (SHC) Tasks and the Working Group on Materials in Solar Thermal Collectors. Dutch experts also plan to participate in the new Programme work beginning in the areas of solar cooling and solar combisystems.

Solar Thermal

A total of 30,000 solar domestic hot water heaters (SDHW) have been installed in the Netherlands, 20,000 of which have been installed in the last three years. This fast growth is the result of close cooperation between government, industry, utilities and installation sectors.

SDHW systems are the priority area of the Netherlands’ solar thermal program. The reason for this focus is that SDHW systems provide a large solar contribution, have high public visibility, and are competitively priced. As part of this priority, the Government has set a goal to install solar hot water systems in 400,000 of the 6 million homes in the country by 2010. For this reason, a long-term agreement has been made between government, industry and the utilities. The results of this agreement are illustrated in the graph above. Despite the expected market growth of 30% per year, additional work and government funding will be required to achieve the projected market growth over the coming years. One example, is the SDHW subsidy program established by the Government and utilities. The goal of this program is to create a self-supporting SDHW market by 2000 by offering subsidies which decrease incrementally each year. This subsidy is based on the performance of the systems and is measured using the dynamic system test (DST-method), that was developed in the SHC Task 14, Advanced Active Solar Systems.

Besides the small solar thermal systems for domestic use, the Dutch solar program includes other applications. For example, a 2,400 m^2 system on a factory in Breda is the largest drain back system in the world. Other applications include those for heating pools and the typical application of drying flower bulbs.

Passive solar energy is considered to be an important source of renewable energy, but often is not specified in energy statistics. The present contribution of passive solar in the Netherlands is larger than the estimated contribution of all renewables for the year 2000, and it represents 14% of the total energy use in Dutch houses. To increase the use of passive solar energy, however, will be difficult because new buildings are better insulated and therefore their total energy use is decreasing. However, passive solar energy can offer an inexpensive building application if it is taken into account at the beginning of a building's design process. A good example of this is the Urban Villa in Amstelveen which was build as part of the SHC Task 13, Advanced Solar Low Energy Buildings. This building applied passive solar applications to achieve a reduction in energy use of about 60-70% compared to conventional designs.

Passive solar applications for existing buildings are also being explored by Dutch experts. Currently the emphasis is on glazed balconies, and this is being investigated under the SHC Task 20, Solar Energy in Building Renovation. In the commercial sector, the focus is more on the use of daylight, and this is being researched under the SHC Task 21, Daylight in Buildings. Task 21 Dutch experts are active in the work being performed on control systems for artificial lighting, and are working in close collaboration with the Philips R&D laboratories. In the longer term, the Netherlands' expects that advanced glazings will play an important role in daylight applications as a means to decrease energy loss through windows and to avoid overheating problems.

World's largest drain back system, Breda, Netherlands.

Urban Villa, a 42-unit apartment building.

Photovoltaics

The Government has significantly increased its efforts in the area of photovoltaics (PV) in the past years because PV is considered to be an important energy source in the next century. In 1997, a long-term agreement was initiated with the goal of 10 MWp in the year 2000 and 250 MWp by 2010. These goals will be achieved mainly through building-integrated applications as the Netherlands has limited space for large ground mounted MW systems. A primary player in this agreement is the producer Shell Solar. Dutch experts are also working on PV through the IEA Photovoltaic Power Systems Programme.

Recently the trend has shifted from covering an entire roof with PV to smaller systems of about 4 m^2 of 4 AC-modules. These modules are easy to install and can be easily coupled. Several projects are underway using this technology, for example the "PV-growth" project. Also, non-governmental organisations, such as World Wildlife Fund and Greenpeace, are promoting these smaller scale systems.

An example of Dutch houses with building-integrated solar PV and solar thermal.

continued on page 6

Durability and Lifetime Assessment of Solar Absorber Coating

It has been known for many years that climatic conditions inside solar collectors could facilitate corrosion, especially of the absorber coatings. To address this problem and others involving the materials that comprise solar thermal collectors, the SHC Working Group on Materials in Solar Thermal Collectors was initiated. The Working Group, which is less formally structured than a Task, began its joint research work in 1994. The experts are currently focusing their research efforts in three areas: durability and life-time assessment of solar absorber coatings, antireflecting devices, and methods for characterization of microclimate for materials in collectors.

Results of this international collaborative work are many, and the following are a few examples of the research and its impact.

Service life prediction methodology

The Working Group experts have developed a methodology for the service life prediction of solar absorber coatings based on the measurements of the corrosive "microclimates" within solar collectors. The test conditions were designed to simulate a service life of 25 years, and five commercially available solar absorber coatings were tested by 1) placing samples in ovens at temperatures between 200°C - 300°C to simulate and accelerate stagnation conditions, 2) placing samples in climatic cabinets to cool samples below the ambient temperatures and to demonstrate the effect of condensation and moisture in the collector, and 3) placing samples in climatic cabinets with sulfur dioxide to determine their sensitivity toward pollutants. Researchers then took their investigations a step further to validate the reproducibility of their findings by conducting simultaneous tests at three independent and anonymous institutions. The results of this work have been used by national groups working on the draft ISO standard (ISO CD 12 952.2). Today, most of the absorber coatings on the market today have been tested according to this standard.

Measurement, simulation and optimization of the "microclimate" in solar collectors

New high efficient absorber coatings produced by physical deposition techniques are emerging in the marketplace. These coatings are usually more efficient than the traditional coatings and reach higher working and stagnation temperatures, and therefore require life prediction testing procedures. In order to address this issue as well as how to improve the life of other collector materials, the working group broadened the scope of its work to include the optimization of the microclimate in solar collectors. Five institutes in five European countries have tested and monitored the microclimate and ambient climates of identical reference collectors. The correlations from these studies show a range of occurring microclimatic conditions which allow for the modification and verification of indoor test procedures.

Collector convection and ventilation

The convection and ventilation in solar collectors have been modeled analytically and simulated by computational fluid dynamics, allowing parameter studies for identification of the major parameters. Indoor tests were developed and conducted to measure the air ventilation rate and the humidity response of the collector to quick changes in the surrounding atmosphere, yielding a tool for optimization. The most important role, besides air ventilation, seems to be played by the insulation materials acting as a moisture buffer. Based on all these investigations, Working Group members have produced guidelines for a flat plate collector design for a low corrosive internal climate.

The results from this group's work demonstrate that a good durability assessment and an optimization of the operating conditions are not only important for new absorber coatings, but also for new coating glazings for anti-reflective or shading (thermotropic) purposes. The rapid development of these new glazings has led to the initiation of new activities to investigate the development of aging test methods for anti-reflective coatings which will serve as the first step towards more comprehensive work in the area of durability assessment of advanced glazings for solar collectors and windows.

Netherlands
continued from page 5

A Sunny Future

Although the climate in the Netherlands is not particularly sunny, we are certain that solar thermal and PV can play an important role in our energy supply. Thus, we see a sunny future for these applications and all the industries that are involved with them.

The motto for our solar programs therefore is: "The year 2000 is the dawn of the solar age."

For more information on the Netherlands' solar energy programs and initiatives contact the Renewable Energy Action Program: www.minez.nl:Ministry of Economic Affairs and Novem: www.Novem.org.

IN BRIEF

New Task on Solar Combisystems Begins

Solar heating systems for combined domestic hot water and space heating, so called solar combisystems or SDHW&H systems, represent a growing market in many countries. However, a need still exists for cost reductions, performance improvements and system reliability. The new SHC Task is designed to expand this technology in the market place by surveying and improving the design and performance of solar combisystems. Task experts will conduct a survey of various combisystems, and develop tools for comparison and rating of combisystems as well as performance test methods and for the systems and their components. International collaboration through the SHC Programme will provide experts the opportunity to investigate many more systems than one country alone could cover. This is important because a cursory survey revealed that over 10 designs could be or are being sold throughout Europe and other countries as they are not dependent on a specific local climate or practice. The experts will also work closely with industry to optimize existing systems and develop new systems for the market. The Task work will continue for three years.

Workshops Held on Advanced Glazing and Window Systems

In July 1998 workshops were held in Crystal City, Virginia (USA) to help define potential new collaborative IEA work on advanced glazing and window systems for buildings. The meeting was hosted by the U.S. Department of Energy. More than 50 participants from 15 IEA Member countries attended, representing government and private research organizations, academia, and industry. The two and a half day workshops were structured to obtain participant inputs in three major areas: 1) advanced glazing and window system materials, 2) performance of buildings using advanced glazing and window systems, and 3) glazing and window system information.

The workshops were successful in identifying a broad range of promising activities that could benefit from IEA collaboration. For example, in the materials area eight activities were identified ranging from characterization studies to durability assessments, through product improvement efforts. In the performance area, nine activities were identified including improved tools for determining performance and product selection and performance information on specific building designs/constructions. Discussions in the information area resulted in a proposal for an Internet-based information management system that could be used for glazing and window system data or potentially other IEA data. During August and September, these activities will be developed into concept papers for new IEA work.

ADELINE Workshops Held in Three Countries

SHC Task 21, Daylight in Buildings, experts offered three workshops on the lighting program system ADELINE 2.0 (Advanced Daylighting and Electrical Lighting Integrated New Environment) in Canada, Germany and the Netherlands. These workshops gave architects, interior designers, consulting engineers, HVAC engineers, lighting designers and others a hands-on introduction to this useful software. ADELINE, which incorporates well known software such as SUPERLITE and RADIANCE, helps users to apply daylighting strategies and analyze the 3D effects of their innovative lighting designs. Its use not only improves the lighting performance of buildings, but also promotes the production of state-of-the-art and energy-saving architecture.

Daylighting '98 Conference

An international conference on daylighting technologies for energy efficiency in buildings was held in May in Ottawa, Canada. This conference was organized jointly by SHC Task 21, National Resources Canada, National Research Council Canada, and Public Works and Government Services Canada, and in cooperation with Canada Mortgage and Housing Society of North America and the Lawrence Berkeley National Laboratory in the US. Over 150 people attended the 2-day conference, and conference topics included design tools, monitoring techniques, prediction techniques, advanced fenestration systems and measurements, and daylighting design.✷

Daylighting Systems

continued from page 2

Recognizing this need for internationally recognized testing and evaluation procedures for industries exporting daylighting systems and solar shading, the SHC Programme has expanded its base of experts and is conducting this research jointly with the IEA Energy Conservation in Buildings and Community Systems Programme. The Task's work also has been closely coordinated with the recently completed European Union's "Daylight in Europe" project. ✷

For more information on Task 21, please contact the Operating Agent, Kjeld Johnson, Danish Building Research Institute (see page 8 for contact information).

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 international energy cooperation among its member countries, including collaborative research, development and demonstration projects in new energy technologies. The 19 members of the IEA Solar Heating and Cooling Agreement have initiated a total of 24 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 19: Solar Air Systems
Mr. Robert Hastings
Forschungstelle Solararchitektur
ETH Honggerberg
CH-8093 Zurich, Switzerland
Fax: 41/1-633-1075
E-mail: hastings@orl.arch.ethz.ch

Task 20: Solar Energy in Building Renovation
Prof. Arne Elmroth
Dept. of Building Physics
Lund Institute of Technology
Box 118
S-22100 Lund, Sweden
Fax: 46/46-222-45-35
E-mail: arne.elmroth@bggtek.lth.se

Task 21: Daylight in Buildings
Mr. Kjeld Johnsen
Danish Building Research Inst.
P.O. Box 119
DK-2970 Hoersholm, Denmark
Fax: 45/42-86-75-35
E-mail: kjj@sbi.dk

Task 22: Solar Building Energy Analysis Tools
Mr. Michael Holtz
Architectural Energy Corp.
2540 Frontier Ave.
Boulder, CO 80301 USA
Fax: 1/303-444-4304
E-mail: AECinfo@aol.com

Task 23: Optimization of Solar Energy Use in Large Buildings
Prof. Anne Grete Hestnes
Faculty of Architecture
Norwegian University of Science and Technology
N-7034 Trondheim, Norway
Fax: 47/73-59-50-45
E-mail: annegrete.hestnes@ark. ntnu. no

Task 24: Active Solar Procurement
Dr. Hans Westling
Promandat AB
Box 224205
S-104 51 Stockholm, Sweden
Phone: 46/8-667-80-20
Fax: 46/8-660-54-82
E-mail:hans.westling@promandat.se

Task 26: Solar Combisystems
Mr. Werner Weiss
AEE
Gartengasse 5
A 8200 Gleisdorf, Austria
Fax: 43/3112-5886-18
E-mail:arge-ee-gl@sime.com

Member Countries and Executive Committee Members

Australia	Prof. J. Ballinger
Austria	Prof. G. Faninger
Belgium	Prof. A. De Herde
Canada	Mr. D. McClenahan
Denmark	Mr. J. Windeleff
European Commission	Dr. G. Deschamps
Germany	Dr. V. Lottner
Finland	Dr. P. Lund
France	Mr. Y. Boileau
Italy	Dr. P. Zampetti
Japan	Mr. K. Hayashi
Netherlands	Mr. L. Bosselaar
New Zealand	Mr. M. Donn
Norway	Mr. F. Salvesen
Spain	
Sweden	Mr. C. Rolén
Switzerland	Mr. U. Wolfer
United Kingdom	Dr. P. Mallaburn
United States	Ms. M. M. Jenior

Chairman

Mr. Lex Bosselaar
NOVEM b.v.
P.O. Box 8242
3503 RE Utrecht, The Netherlands
Tel: 31/30-239-34-95
Fax: 31/30-231-64-91
E-mail: L. Bosselaar@novem.nl

Executive Secretary

Ms. Pamela Murphy Kunz
Morse Associates, Inc.
1808 Corcoran St., NW
Washington, DC 20009 USA
Tel: 1/202-483-2393
Fax: 1/202-265-2248
e-mail: pmurphykunz@compuserve.com

SOLAR UPDATE

The Newsletter of the IEA Solar Heating and Cooling Programme

No. 31, August 1998

Prepared for the IEA Solar Heating and Cooling Executive Committee
by
Morse Associates, Inc.
1808 Corcoran St., NW
Washington, DC 20009 USA

Editor:
Pamela Murphy Kunz