SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 41 - Solar Energy and Architecture
Subtask B - Methods and Tools for Solar Design

T.41.B.4
Needs of architects regarding digital tools for solar building design

June 2012

IEA SHC Task 41: Solar Energy and Architecture

Subtask B: Tools and methods for solar design

http://www.iea-shc.org/task41/index.html

Attn to:YYYYY (name / affiliation of the tool developer)

June 2012

Dear Sir / Madam,

The International Energy Agency (IEA) launched a research project, Task 41: Solar Energy and Architecture, in order to recognise the key role that solar energy will have to play in our future built environment. One of the major findings of this international project is that there is a broad variety of digital tools for solar design, but they are not sufficient to satisfy the requirements of architects in the early design stage.

The purpose of the attached letter is to inform you about needs for improved digital tools in architectural design. They were identified through a comprehensive survey of architects in fourteen participating countries and additional interviews with architects in three countries.

We are hoping that you will find these results inspiring to start discussions and thought sharing on the future of digital tools for solar design.

Best regards

Subtask B expert team

IEA SHC Task 41: Solar Energy and Architecture

For additional information and clarifications, please contact:

Miljana Horvat
Subtask B co-leader
Department of Architectural Science
Ryerson University
350 Victoria St. Toronto, ON, M5B 2K3, Canada
Tel: ++ 1 416 979 5000, ex. 6512
E-mail: mhorvat@ryerson.ca

Jouri Kanters
Energy and Building Design
Lund University
P.O. Box 118, SE-221 00 Lund, Sweden
Tel:+46 46 222 7629
E-mail: Jouri.Kanters@ebd.lth.se

Introduction

The purpose of this letter is to inform digital tool developers about the results of an international research project, which revealed the limitations of existing digital tools for solar building design at the early design stage and formulated the needs from the architects' perspective.

Recognising the key role that solar energy will have to play in our future built environment, in 2009 the International Energy Agency (IEA) initiated a three year research project, titled *IEA Task 41 - Solar Energy and Architecture*. This project brought together researchers and practitioners from 14 countries: Australia, Austria, Belgium, Canada, Denmark, Germany, Italy, Norway, Portugal, Singapore, South Korea, Spain, Sweden and Switzerland. The ultimate goal of Task 41 is to accelerate the development of high quality, highly efficient solar architecture by identifying obstacles for solar design as well as providing recommendations and support for the implementation of solar strategies in buildings. This research endeavour focused mainly on the architectural profession, as the key stakeholder in the future evolution and implementation of solar energy concepts and technologies in new buildings as well as in retrofit projects.

The outcomes of *Subtask B – Tools and methods for solar design* of the Task 41, identified relevant information for digital tool developers, through an international survey distributed in all participating countries, about the current use of software tools by architects. In addition, semi-structured interviews were carried out with architectural offices in three countries to gain in depth insight into the limitations and problems that architects are facing when designing buildings with solar energy use. Finally, reviewed literature also supported the findings of the survey and interviews.

Main results of the international survey

A total of 350 surveys were completed and analysed. The survey focus group comprised predominantly of architects (88%), and, to a lesser extent, engineers, physicists and other professionals from the building design industry (12%). The respondents were mainly professionals with more than 10 years of experience.

A large proportion (69%) of respondents stated that solar technologies were first considered in the conceptual design phase. On the other hand, responses describing the decision making process in small projects indicated that the conceptual design phase was largely handled by the architect alone (53%). These facts clearly demonstrate the need for well-developed conceptual design tools for solar design at an early design stage, and which are suitable for and well integrated in the typical architectural work flow.

Barriers to using currently available tools

Survey results revealed that, although a great variety of tools for solar design exist nowadays, they are not suitable for architects and early design stage (EDP). The currently available solar design tools are more suitable for a detailed design phase: they require input that is quite detailed and that is still not developed at the EDP, i.e. conceptual and preliminary design stages. Because of the higher level of required details, simulations also take longer to perform, which, consequently, disrupt the usual architectural design work flow. Additional issues raised by the survey are presented in Figure 1.

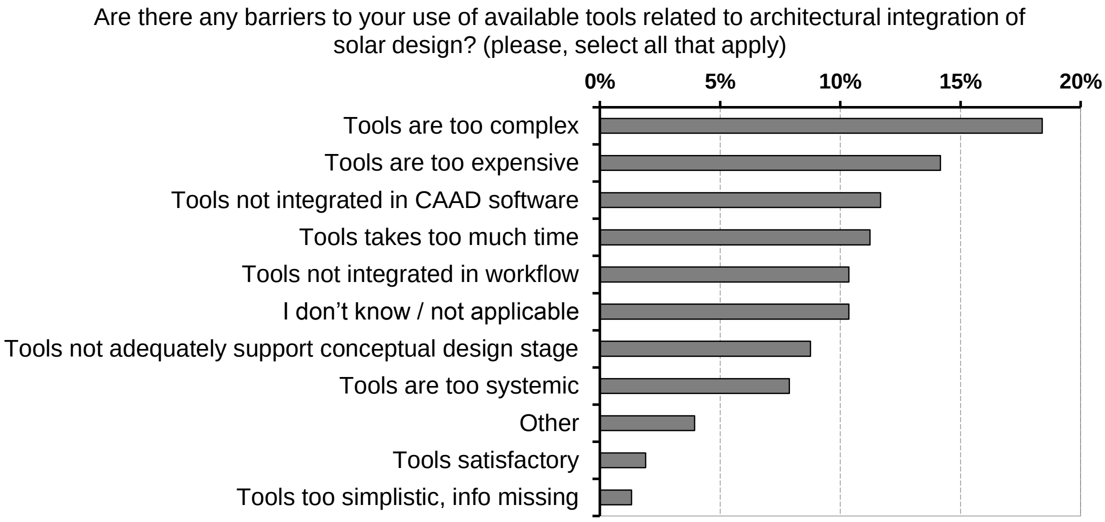

Figure 1: Distribution of answers about barriers related to the use of the tools for the architectural integration of solar design. (n=685)

Among the most prominent issues raised by respondents in the open end questions at the end of the survey is the problem of low interoperability between different software tools: often, a 3D model of a simulated design needs to be re-built within the simulation software in order to be evaluated. This creates an additional burden in terms of time and efforts, which is especially discouraging to smaller architectural firms. The actual low interoperability between software makes it difficult to quickly obtain approximate solar use potential data between various design alternatives in order to choose the best solution.

Needs for improvements

The graph in Figure 2 shows clearly the need for improved digital tools for solar design that are more suitable for the early design stage, and some of the particular aspects such improvements should include.

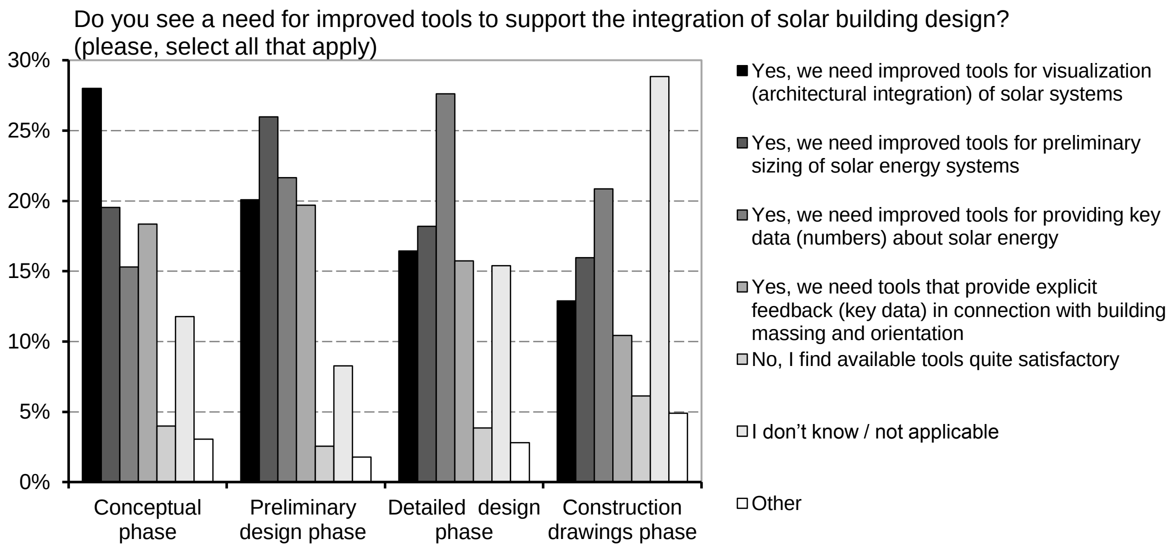

Figure 2: Distribution of answers about needs for improved tools to support solar building design (n=1382).

Factors that influence the choice of digital tools
The four most mentioned factors that influence the choice of solar design are user friendly design interface, cost, interoperability with other software and simulation capacity, as is shown in Figure 3.

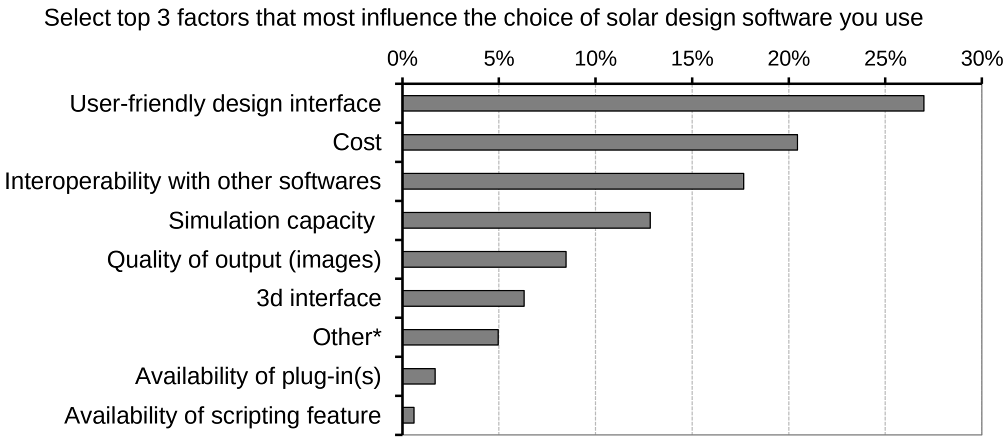

Figure 3: Major factors influencing the choice of software used for solar design (n=826).

Recommendations

Based on the international survey results, literature, interviews with practitioners as well as experts' observations, the following capabilities should be provided in a software package:

- User friendly and intuitive interface;
- Issues related to input:
    - Reliable import of 3D geometry;
    - Reliable and transparent default values which can be easily modified;
    - Accurate and accessible weather data from referenced sources, which can be easily adjusted to local conditions (e.g. microclimate);
- Issues related to output:
    - Visual (graphical) but also numerical, exportable to external data analysis programs;
    - Easy comparison between design alternatives;
    - Information about result accuracy;
    - Output information using one software:
        - Solar potential on user defined surfaces (insolation, irradiation) over time;
        - Daylight levels (indoor and outdoor);
        - Indoor air temperature;
        - Estimated energy production by PVs and ST;
        - Wanted and unwanted passive solar gains (based on default values for time of the day and use);
- Ability to assess building complexes, i.e. groups of buildings;
- Better interoperability between software packages, especially between main CAAD and simulation tools (both ways);
- Accompanying documentation:
    - Tutorials and manuals;
    - Transparency with regards to algorithms used in calculations (e.g. heat transfer, solar radiation calculation, shadow calculation, etc.).

Complete and detailed results of this study are presented in the report titled T.41.B.2: International Survey about digital tools used by architects for solar design, which is available at http://www.iea-shc.org/publications/downloads/International_Survey_About_Digital_Tools_Used_by_Architects_for_Solar_Design.pdf

ACKNOWLEDGEMENTS

The experts involved in Task 41 – Solar energy and architecture / Subtask B: Tools and methods for solar design thank their respective funding agencies for supporting their work:

- NRCan – Natural Resources Canada: CanmetENERGY/Sustainable Buildings and Communities Group, Ottawa, Canada;
- Université Laval, Faculté d'aménagement, architecture et des arts visuels, Québec, Canada ;
- Ryerson University, Faculty of Engineering, Architecture and Science, Toronto, Canada;
- ENOVA SF, Ministry of Petroleum and Energy, Norway;
- Swedish Energy Agency;
- Danish Energy Agency;
- The Swiss Federal Office of Energy;
- Lucerne University of Applied Sciences and Arts - Dept. of Engineering and ArchitectureCompetencecentre Typology & Planning in Architecture (CCTP);
- SUPSI-ISAAC, Swiss BIPV competence centre;
- Bundesministerium für Wirtschaft und Technologie, Projektträger Jülich, Germany;
- Department of Innovation, Industry, Science and Research (DIISR), Australian Government
- National Research Foundation of Korea: Green Home Technology Research Centre & Zero Energy Green Village Technology Centre.

LIST OF CONTRIBUTORS

Maria Amtmann
Division Buildings & Heating
Austrian Energy Agency
Mariahilfer Straße 136
A-1150 Vienna
AUSTRIA
maria.amtmann@energyagency.at

Marie-Claude Dubois
Subtask co-leader, Subtask B
Energy and Building Design
Department of Architecture and Built Environment
Lund University
P.O. Box 118
SE-221 00 Lund
SWEDEN
Marie-Claude.Dubios@ebd.lth.se

Doris Ehrbar
Lucerne University of Applied Sciences and Arts
Dept. of Engineering and Architecture
Technikumstrasse 21
CH-6048 Horw
SWITZERLAND
doris.ehrbar@hslu.ch

Caroline Hachem
Building, Civil and Environmental Engineering,
Concordia University
1455 boul de Maisonneuve Ouest
Montréal, QC
CANADA
carolinehachem@gmail.com

Rolf Hagen
Context AS
Rjukan Naeringspark, Bygg 270
N-3660 Rjukan
NORWAY
rolf@context.as

Miljana Horvat
Subtask co-leader, Subtask B
Dept. of Architectural Science
Ryerson University
350 Victoria St., Toronto,
CANADA
mhorvat@ryerson.ca

Jouri Kanters
Energy and Building Design
Department of Architecture and Built Environment
Lund University
P.O. Box 118
SE-221 00 Lund
SWEDEN
jouri.kanters@ebd.lth.se

Margarethe Korolkow
IBUS – Institut für Bau-, Umwelt- und Solarforschung GmbH
Alt-Tempelhof 18
12099 Berlin
GERMANY
margarethe.korolkow@ibus-berlin.de

Catherine Massart
Architecture et climat
Université Catholique de Louvain,
Place du levant, 1
1348 LLN
Belgium
catherine.massart@uclouvain.be

Maria Wall
Operating Agent
Energy and Building Design
Lund University
P.O. Box 118, SE-221 00 Lund
SWEDEN
maria.wall@ebd.lth.se

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

IEA SOLAR HEATING AND COOLING PROGRAMME

The International Energy Agency (IEA) is an autonomous body within the framework of the Organization for Economic Co-operation and Development (OECD) based in Paris. Established in 1974 after the first “oil shock,” the IEA is committed to carrying out a comprehensive program of energy cooperation among its members and the Commission of the European Communities.

The IEA provides a legal framework, through IEA Implementing Agreements such as the Solar Heating and Cooling Agreement, for international collaboration in energy technology research and development (R&D) and deployment. This IEA experience has proved that such collaboration contributes significantly to faster technological progress, while reducing costs; to eliminating technological risks and duplication of efforts; and to creating numerous other benefits, such as swifter expansion of the knowledge base and easier harmonization of standards.

The Solar Heating and Cooling Programme was one of the first IEA Implementing Agreements to be established. Since 1977, its members have been collaborating to advance active solar and passive solar and their application in buildings and other areas, such as agriculture and industry. Current members are:

Australia	Germany	Portugal
Austria	Finland	Singapore
Belgium	France	South Africa
Canada	Italy	Spain
China	Mexico	Sweden
Denmark	Netherlands	Switzerland
European Commission	Norway	United States

A total of 49 Tasks have been initiated, 35 of which have been completed. Each Task is managed by an Operating Agent from one of the participating countries. Overall control of the program rests with an Executive Committee comprised of one representative from each contracting party to the Implementing Agreement. In addition to the Task work, a number of special activities—Memorandum of Understanding with solar thermal trade organizations, statistics collection and analysis, conferences and workshops—have been undertaken.

Visit the Solar Heating and Cooling Programme website - http://www.iea-shc.org - to find more publications and to learn about the SHC Programme.

Current Tasks & Working Group:

Task 36 Solar Resource Knowledge Management
Task 39 Polymeric Materials for Solar Thermal Applications
Task 40 Towards Net Zero Energy Solar Buildings
Task 41 Solar Energy and Architecture
Task 42 Compact Thermal Energy Storage
Task 43 Solar Rating and Certification Procedures
Task 44 Solar and Heat Pump Systems
Task 45 Large Systems: Solar Heating/Cooling Systems, Seasonal Storages, Heat Pumps
Task 46 Solar Resource Assessment and Forecasting
Task 47 Renovation of Non-Residential Buildings Towards Sustainable Standards
Task 48 Quality Assurance and Support Measures for Solar Cooling
Task 49 Solar Process Heat for Production and Advanced Applications

Completed Tasks:

Task 1 Investigation of the Performance of Solar Heating and Cooling Systems
Task 2 Coordination of Solar Heating and Cooling R&D
Task 3 Performance Testing of Solar Collectors
Task 4 Development of an Insolation Handbook and Instrument Package
Task 5 Use of Existing Meteorological Information for Solar Energy Application
Task 6 Performance of Solar Systems Using Evacuated Collectors
Task 7 Central Solar Heating Plants with Seasonal Storage
Task 8 Passive and Hybrid Solar Low Energy Buildings
Task 9 Solar Radiation and Pyranometry Studies
Task 10 Solar Materials R&D
Task 11 Passive and Hybrid Solar Commercial Buildings
Task 12 Building Energy Analysis and Design Tools for Solar Applications
Task 13 Advanced Solar Low Energy Buildings
Task 14 Advanced Active Solar Energy Systems
Task 16 Photovoltaics in Buildings
Task 17 Measuring and Modeling Spectral Radiation
Task 18 Advanced Glazing and Associated Materials for Solar and Building Applications
Task 19 Solar Air Systems
Task 20 Solar Energy in Building Renovation
Task 21 Daylight in Buildings
Task 22 Building Energy Analysis Tools
Task 23 Optimization of Solar Energy Use in Large Buildings
Task 24 Solar Procurement
Task 25 Solar Assisted Air Conditioning of Buildings
Task 26 Solar Combisystems
Task 27 Performance of Solar Facade Components
Task 28 Solar Sustainable Housing
Task 29 Solar Crop Drying
Task 31 Daylighting Buildings in the 21st Century
Task 32 Advanced Storage Concepts for Solar and Low Energy Buildings
Task 33 Solar Heat for Industrial Processes
Task 34 Testing and Validation of Building Energy Simulation Tools
Task 35 PV/Thermal Solar Systems
Task 37 Advanced Housing Renovation with Solar & Conservation
Task 38 Solar Thermal Cooling and Air Conditioning

Completed Working Groups:

CSHPSS; ISOLDE; Materials in Solar Thermal Collectors; Evaluation of Task 13 Houses; Daylight Research