Solar Energy and Architecture
IEA SHC Task 41
IEA APVA Seminar, Sept. 2011
Maria Wall, Energy and Building Design, Lund University, Sweden
Use of Solar Energy – we can do better!

A large portion of the potential to use solar energy still remains **unused!**
Barriers

Solar energy still remains unexploited, why?

Causes (IEA-SHC):

1. Economical factors
2. Lack of technical knowledge
3. Reluctance to use “new” technologies
4. Architectural (aesthetic) factors

Architects have a key role to play!

Solar Energy and Architecture / Maria Wall
IEA Project

IEA-SHC Task 41: Solar Energy and Architecture

Subtask A: Criteria for architectural integration
Leaders: Maria Cristina Munari Probst & Christian Roecker, Switzerland

Subtask B: Methods and tools for solar design
Leaders: Miljana Horvat & Marie-Claude Dubois, Canada

Subtask C: Case studies & communication
Leaders: Olaf Bruun Jørgensen, Denmark & Merete Hoff, Norway

Overall objectives of Task 41
1. Accelerate development of high-quality solar architecture
2. Improve qualifications of architects
Task 41 participants

Participating countries

Australia
Austria
Belgium
Canada
Denmark
Germany
Italy
Norway
Portugal
Singapore
Spain
Sweden
Switzerland
South Korea

Find out more by visiting: www.iea-shc.org/task41
Task 41 contributions

Contribution of IEA Task 41 to remove barriers

- Seminars / Workshops - both national and international
- International survey and state-of-the art
- Collection of high quality architectural examples
- Guidelines for architects about Solar Thermal and PV integration
- Guidelines for product developers of both technologies
- CAAD 3D parametric objects, examples
- “Architectural needs for tool developers”. Recommendations for developers of tools to be used by architects at an early design stage
- “Solar design: Examples on the use of tools for architects”. Booklet for architects.
- “Communication guidelines” to support architects
EU EPBD 2010 on the energy performance of buildings

“Nearly zero-energy buildings” – EU goal in 10 years.

The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources.

Architectural consequences – and potentials

This will increase the use of the building envelope as an active solar collector!

If a large part of the building envelope will be covered by solar thermal and/or PV collectors, it will highly influence the building’s architecture and the urban landscape…

If building integration of solar systems is not accepted – no market penetration!

- Efficiency x Usability!
Objectives

• Establish and communicate architectural criteria for the integration of active solar energy systems in the building envelope.
• Give recommendations to the industry to improve the architectural integration quality and flexibility of active solar products and systems.
• Bring together architects and product/system developers to understand each others needs.
• Educate/inform architects on integration characteristics for various technologies and on state of the art of innovative products.
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SUBTASK A: International survey among architects

Building Integration of Solar Thermal and Photovoltaics - Barriers and Needs

Main barriers:
- PV: economy, lack of interest by client…
- Solar Thermal: lack of products suitable for building integration, lack of interest by client…

Main strategies (PV and ST):
- Lower product prices, government incentives, availability of products

- Report soon finalized!
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SUBTASK A: Guidelines

Evacuated tubes collectors

Sunny Wood, multiple family house, 2002
Architect Beat Kämpfen, 8049 Zürich, Switzerland

Building facts
- Continental microthermal climate
- Building size: 6 flats - 200m² each
- Minergie and passive label
- Active solar energy use by means of vacuum-tube collectors to balcony parapets for hot water and heating.

Solar product
- SWISSPIPE Balkone by Schweizer energie AG (Im Christlach 35 / CH-8195 Raitz / http://www.schweizer-energie.ch)
- The solar modules, composed of nine tubes each, are 90 cm height and ensure the double function of solar thermal heat producer and standard balcony parapet.
- Thermal solar collectors 30.0 m² + 6 x 1400 L (tanks)
- Solar fraction: 97% - floor heating and hot water

Integration achievements
- Collector used as multifunctional construction element
- Field position and dimension
- Visible materials
- Surface texture
- Surface colour
- Module shape & size
- Jointing

Glazed flat plate collectors

School building in Gels, Switzerland, 1996
Architects Gsell und Tobler, Niederteufen Switzerland

Building facts
- Continental microthermal climate
- Building size (m² / m³ / m. of persons) N.A.
- The integration of solar thermal was clearly considered at a very early project phase, so that the design of the south facade, of the spacers behind it, and of the roof structure have all been influenced by both the size of the collectors field, and by the fixed modular dimensions of the collectors.

Solar product
- Ernst Schweizer AG, Metallbau / Behringplatz 111 CH-8908 Hedingsen / www.schweizer-metallbau.ch
- Product characteristics: no flexibility
- Fixed module size of façade: 1223 mm
- The collector field (63 m²) occupies the whole parapet area of the south façade
- Production: 250 kWh / year

Integration achievements
- Collector used as multifunctional construction element
- Field position and dimension
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Crystalline cells
Paul-Horn Arena, Tubingen, Germany, Allman Sattler, Wappner Architekten, 2004

Integration achievements

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Crystalline cells
Opera House, Oslo, Norway, Snøhetta, 2007

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Guidelines for product and system developers

- Divided into 2 guidelines:
  A) Solar Thermal
  B) PV
Monocrystalline modules

Sunstyle, Solaire France
Site Technosud, 280 Rue James Watt, 66000 Perpignan, France
info@solairefrance.fr
http://www.solairefrance.fr

The Sunstyle system is a multipurpose and aesthetic solar system which makes it possible to generate solar current while meeting standards of functionality, performance and high durability. The ties are structural components whose manufacturing process especially was developed and certified. The crystalline solar cells are laid out in a flexible way in a layer EVA (Ethyl Vinyl Acetate) between soaked frontal glass and a Tedlar sheet at the back. The edges are closed - without framework - to avoid the penetration of moisture in order to ensure the durability of the elements. At the electric level, the cells are welded in series to the terminal box which is equipped with cables and connectors.

Thin film modules

Flexcell, VHF – Technologies
Rue Edouard-Verdan 2, CH-1400 Yverdon-les-Bains, Switzerland
info@flexcell.com
http://www.flexcell.com

The FLX – MO135 module is a lightweight galvanized steel plate with PV laminate on top. It specifically adapted for trapezoidal and PVC roofing systems and it is suitable for any roof tilt and orientation. It has a quick-built system using the existing roof as backing structure.

The FLX – TO135 module is an amorphous silicon PV module laminated into a TPO (Thermo-Plastic Polyolefin) roofing membrane designed for flat roof applications. It is fully integrated. The system is installed like standard waterproofing the plastic membranes as single or double layers system.

PV "Integrability" characteristics

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Objectives

- Comprehensive review of existing methods and tools that architects currently use at early design stage (state-of-the-art)
- To identify current barriers that prevent architects from using the existing methods and tools for solar building design
- To identify important needs and criteria for new or adapted methods and tools for solar design
- To provide clear guidelines for developers of methods and tools for architects designing solar buildings.
- To initiate communication with tool developers (industry) in order to stimulate the development of improved tools.
SUBTASK B: Methods and Tools for Solar Design

Research shows that up to 80 per cent of design decisions that can influence buildings’ energy performance are made at the early design stage.

Now, the question is, do architects have the right tools to make those decisions?
Survey and State-of-the-Art

 Identified barriers - examples:

- Lack of CAAD tools supporting **architectural** integration and sizing of active solar systems - feeding an iterative design process

- To achieve an architectural integration of PV or ST into the building envelope, architects need to “see” and customize the active solar components directly in their building model – and get a rough estimate of the energy contribution simultaneously!
SUBTASK B: Methods and Tools for Solar Design

CAAD 3D parametric objects

archiCAD 13

Artlantis 3.0

SUPSI, Switzerland / Kim Nagel, Isa Zanetti

Solar Energy and Architecture / Maria Wall
Methods and tools are not yet well-defined and suitable for architects, especially not for Early Design Phase (for active and passive solar strategies)

Need to adapt current tools and methods -> accelerate development of solar architecture

Architects handle most decisions of solar energy themselves

Tools used in EDP should be flexible and provide more data about solar energy

Limitation: low response rate
SUBTASK B: Methods and Tools for Solar Design

available at: http://www.iea-shc.org/Task41

Solar Energy and Architecture / Maria Wall
SUBTASK C: Case Studies and Communication Guidelines

Objectives

• Present case studies for high quality architectural integration of solar systems by exemplary buildings and urban areas

• Develop “Communication Guidelines” with knowledge and strategies to promote an increased use of active and passive solar energy
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Selected case studies from different countries will be presented.

Selection based on:
- Architectural quality
- Energy performance

With a diversity of building type and location

Solar XXI, office building, Portugal.
Architects: Pedro Cabrito, Isabel Diniz
The vision - and the opportunity - is to make architectural design a driving force for the use of solar energy.