Bilding integrated PhotoVoltaic - TOOLS
Interactive tools and instruments supporting the design of building integrated PV

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Abstract

The BiPV Tools project is addressed specifically for architects and its aim is to provide information and tools that will allow a correct and appropriate integration of photovoltaic in the building design concept. Its purpose is to define and analyze a serie of needs requested especially by architects (and architecture students) who don't have a strong technical knowledge of PV but still would like to be able to integrated photovoltaics systems into the architectural design.

The backbone tool will be the website www.bipv.ch. It was developed in a previous SUPSI project with the intent of making it an informative web specifically for architects. With this project it will be possible to move up to a following phase of development where the contents of the website will be examined, updated and optimized with a list of examples of BiPV installations and with a CAD library that will include an implemented 3D parametric CAD object.

1. Aims of the project

In order to prevent an indiscriminate use of photovoltaics applications and to invest economic and space resources in the more effective way possible, it is necessary to offer to architects and specialists of the building sector tools and information that are effectively developed considering their specific needs and requests.

Consequently the distinctiveness of this project is the contribution of ideas, remarks and advices by many different partners. Part of the project will be done following the direction of the Solares Bauen Committee constituted by members of Swissolar (Swiss association of solar energy professionals). The Swiss BiPV Competence Centre also collaborate with the University of Applied Sciences of Southern Switzerland and with the Architecture Academy of Mendrisio. Thanks to that it is actively possible to test the developed material on architects, students and specialists of the energy field by one-day courses, workshops and practical assignments. Moreover, considering that some of the objectives are similar, is also envisaged and exchange of resources with the IEA SHC Task 41 "Solar Energy and Architecture"[1].

1.1. Objectives of the project

The main objectives of the project are the following:

- elaboration of a list of high quality BiPV installations in Switzerland and in Europe;
- updating and development of the website www.bipv.ch;

- development and improvement of a PV CAD parametric object (determination of characteristics and dynamics);
- configuration of a CAD library (several standard PV modules will be developed using the 3D CAD, it will be possible to download them together with the 3D CAD object);
- analysis of different software.

2. BiPV examples

Considering the increasing number of solar installations on the territory is necessary to prevent an architecturally and constructively indiscriminate use of PV technology. It is consequently indicated that all the actors of the building sector should take advantage of supports and tools that are not prevalently technical but focus more on general aspects such as examples of various possibilities of PV integration on new building or in case of refurbishment.

Several examples of existing BiPV plants in Switzerland and in Europe has been analyzed in order to collect architectural, technical and electrical details.

Taking into account the architect, the PV specialist and the owner point of view, the most interesting characteristics of the installation, its strengths and, if it is the case, its achille's heel, will be assessed. The results of this study will be disseminate thought the websites www.bipv.ch.

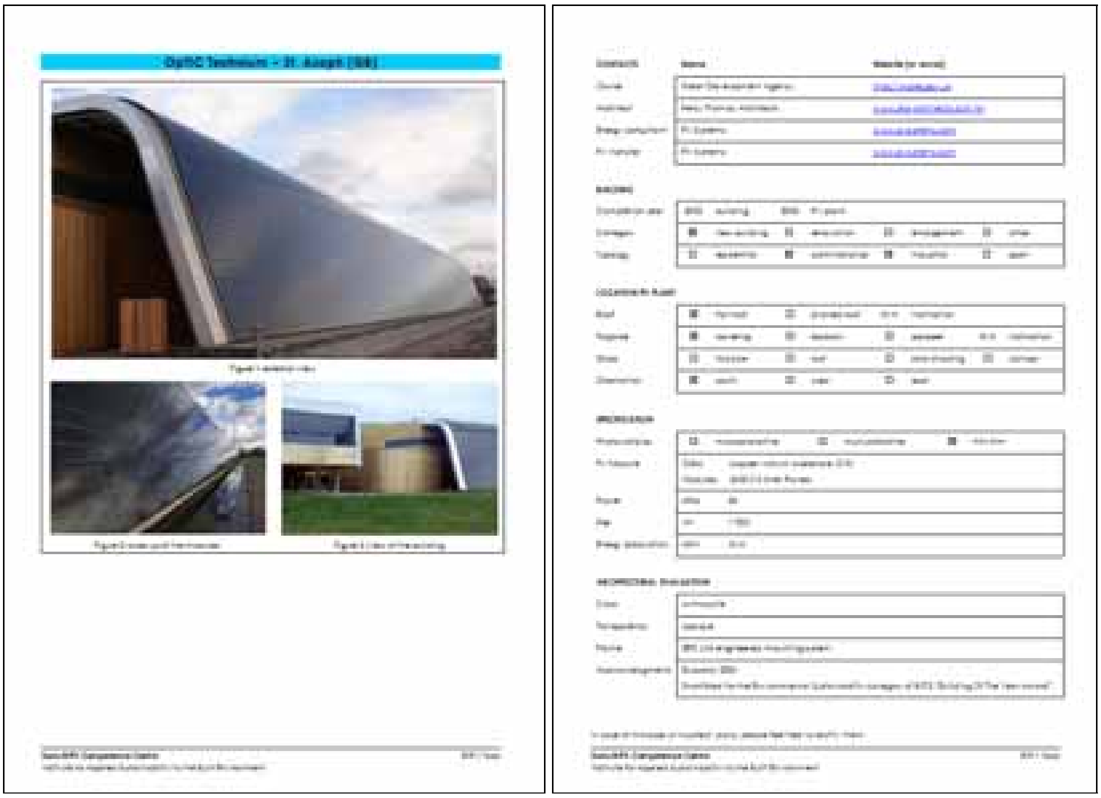

Figure 2: Layout of the datasheet where all the data regarding an installation are collected.
On the first page are insert three or more pictures, while on the second one are listed the most important information regarding the specific BiPV plant.
Source: Isa Zanetti, ISAAC-DACD-SUPSI

3. BiPV website

The website www.bipv.ch (see figure 2) is presented in four languages (it, de, en, fr). Its purpose is to give a general in sight on building integrated photovoltaics (BiPV). Even if the structure and the contents of the website are well established, it is still necessary to reorganize the web hierarchy and the information displayed in order to improve the management and the updating.

Figure 2: Homepage www.bipv.ch.
Source: Kim Nagel, ISAAC-DACD-SUPSI

4. CAD 3D object

GDL intelligent objects technology offers the optimal way of describing building components to use in construction design and facility management applications. The ability to select building components before and during the design phase will benefit both the designer, who can design using real objects, and the component manufacturers, who can successfully market their product at an earlier stage in the design process.

The physical characteristics of a standard PV product (mono and multicristalline, thin film, opaque surface, partially transparent) such as colour (cells, background, frame), shape (cells and modules), typology of the electrical contacts (standard, back contact), transparency and reflection have been analyzed. Each of these factors correspond to a GDL (Geometric Description Language) information which carries 2D and 3D geometry, product logic and behaviours, parameters, material definitions and a specific user interface.

These features allow to effortlessly customized the CAD object to the requirement of every user, reproducing most of the products currently on the market using ArchiCAD (see figure 3) or AutoCAD.

The 3D CAD object is still in its latest development phase, in order to make it more user friendly and to eliminate some bugs that were discovered during the testing process.

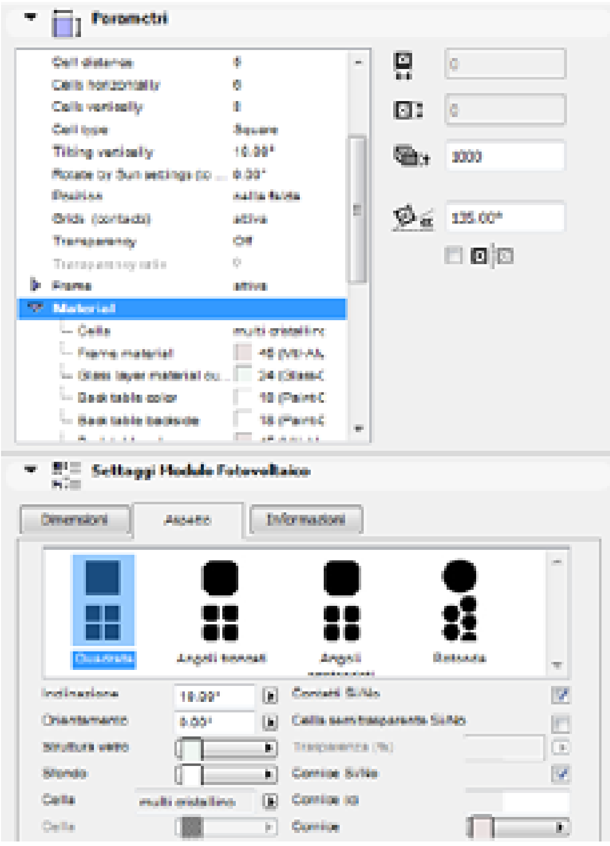

Figure 3: archiCAD 3D object window.
Source: Isa Zanetti, ISAAC-DACD-SUPSI

Using this tool, it will be possible to generate a series of virtual PV modules that will be collected into a CAD library (see figure 4). A simplified parametric CAD object reproducing standard solar thermal collectors it is also being developed.

Figure 4: The first and the second module are designed using ArchiCAD, all the parameters are the same, while the tilt and the azimuth of the sun were modified.
The third one is a picture of the real product (Multisol® 200-P5 by Scheuten solar glass).
Source: Isa Zanetti, ISAAC-DACD-SUPSI

6. Evaluation for 2009 and perspectives for 2010

One of the most interesting aspect of this project is the collaboration with Swissolar and especially with the members of the “Solares Bauen” Commission. In fact, as it was emphasized in the previous pages, BiPV Tools is a project that deals with the significant lack of communication between the actors of the building sector, but also of a the general public, and the PV sector. Having professionals with expertise in different field working together from the very first phase of solar integration and developing a common and adapted jargon is by itself a success.

Some of the subjects (collection of BiPV “good” examples, 3D CAD object) that will be covered by this project have already aroused the interest of the IEA SHC Task 41 “Solar Energy and Architecture”. This task and the BiPV Tools project deal with very similar arguments and consequently for both of them is very important to define tools and informative supports that will help the achievement of high quality architecture for buildings through a correct integration of solar energy systems.

The collection of several “referential” BiPV examples is a good way to encourage architects (see figure 5), and consequently their clients, to use PV modules into the architectural design. Case studies will be an important basis to gain experience regarding the level of successful building integration and to identify barriers related not only to technical and economical aspects, but also to an untutored attitude.

Figure 5: PV installation generally acknowledged as well integrated. Marché International Support Office in Kemptthal by Beat Arch. Kämpfen.
Source: Kämpfen für Architektur

These examples would be inserted and emphasized on the website www.bipv.ch and on the Swissolar web platform www.swissolar.ch. Eventually it would be also possible to share some of the case studies analyzed with the IEA.

Concerning the 3D CAD object, the EURAC (Accademia Europea di Bolzano) has already applicatively used this tool (see figure 6). The junior researcher Laura Maturi using the ArchiCAD version of prototype tool was able to define a list of needed ameliorations. In the upcoming months the CAD object will be tested as well with AutoCAD.

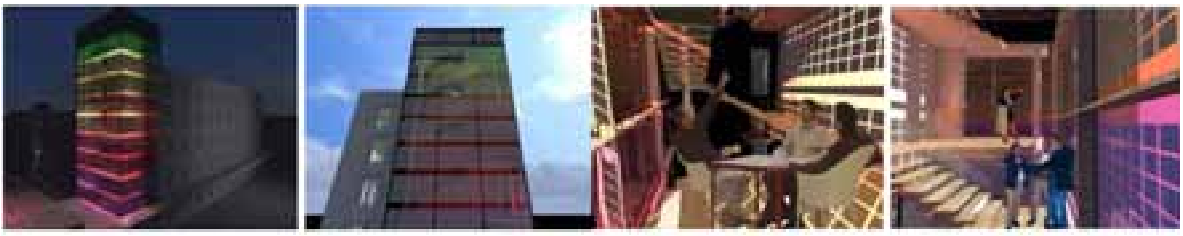

Figure 6: rendering substituting standard modules with coloured semitransparent modules.
Source: Laura Maturi EUR.AC

A list of software than permit to analyze, calculate, define and visualize the PV energy production potential was also realized. In 2010 the PV functionalities of other software will be also examined.

References

[1] IEA SHC Task 41 "Solar Energy and Architecture" - www.iea-shc.org/task41