ARCHITECTURAL QUALITY OF BUILDING INTEGRATION OF SOLAR ENERGY - CASE STUDIES IN THE NETHERLANDS

Tjerk REIJENGA
BEAR Architecten, PO Box 349, 2800 AH, The Netherlands, Tel.: +31 182 529899, Fax.: +31 182 582899, E-mail: office@bear.nl, Internet: www.bear.nl

Abstract - This article describes a method for reviewing the (architectural) quality of building integration of photovoltaic energy as used for IEA Task VII, entitled 'project evaluation of existing PV integrated projects, architectural criteria'. The review criteria are; Natural integration (visually accepted); Architecturally pleasing (visual pleasing); Good composition between materials & colours; Fit the gridula, harmony, composition; Contextuality; Well engineered (detailed) and Innovative new design. The Task VII method for devising the criteria is discussed. A number of Dutch design examples are given and how the projecst fit the criteria.

1. PV IN THE BUILT ENVIRONMENT

The objective of Task VII is to enhance the architectural quality, the technical quality and the economic viability of PV systems in the built environment and to assess and remove non-technical barriers for their introduction as an energy-significant option. A primary focus of Task VII is on the integration of PV into the architectural design of buildings and other structures.

This enhances all types of building elements and buildings (roofs and façades of residential, commercial and industrial buildings) in the built environment. Other structures can form the function of noise barriers, parking areas and railway canopies.

Within Task VII, activity 1.1 work is done to collect good quality building integrated PV-projects. About 200 projects are stored in a database on the Internet (www.task7.org). The purpose of this activity is to collect projects, to define selection criteria and to evaluate about 20 projects.

2. ARCHITECTURAL INTEGRATED PV SYSTEMS

PV installations can be installed on different surfaces of buildings allowing the possibility to combine energy production with other functions of the building envelope, such as roof and façade integration, sun blinds and solar thermal collectors. Cost savings through these combined functions can be substantial, especially in the case of expensive façade systems where cladding costs may equal the costs of the PV modules. Additionally, no high-value land is required, no separate support structure is necessary and electricity is generated at the point of use.

The integration of PV into the architectural design offers more than cost benefits, however. It also allows the designer to create environmentally conscious and energy efficient buildings without compromising comfort, aesthetics or economic constraints.

A number of projects in the Netherlands show an emerging market for grid connected PV systems, despite the fact that electricity from solar cells still is more expensive than grid power. Pioneers in this field are beginning to install PV for energy-efficiency and ecological reasons as well as for reasons of aesthetics and prestige.

On the other hand, electric utilities view building integrated PV as a decentralised power source with a large potential for the future and are correspondingly starting to construct and operate building-integrated PV systems.

3. PROJECT EVALUATION

Within Task VII a selection is made of good looking PV projects. Most built PV-projects also have a good technical quality. Lots of PV-systems however are not very well integrated and the architectural quality can be very low.

One of the possibilities to convince the building industry (architects, clients, project developers) to use photovoltaic power, can be done by showing them good examples. A selection of good quality projects will help to disseminate PV knowledge in the building industry.

To qualify a project as a 'well integrated' project, the architectural quality has to be of a high standard. And of course, the building quality itself and the technical (PV) quality has to be met aswell.

Architectural criteria that have been formulated are:

1. Natural integration (visually accepted)
2. Architecturally pleasing (visual pleasing)
3. Good composition between materials & colours
4. Fit the gridula, harmony, composition
5. Contextuality
6. Well engineered (detailed)
7. Innovative new design

4. EXAMPLES OF THE CRITERIA

To show what is being achieved, and to illustrate which plans relate to the criteria, some Dutch cases are presented below.

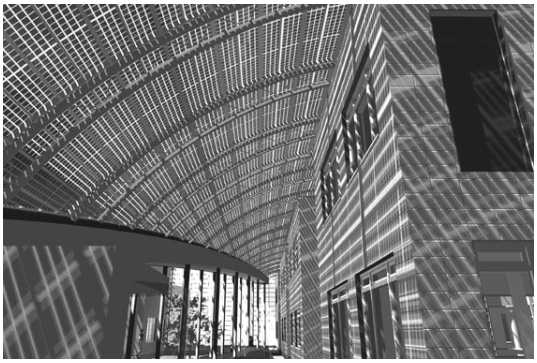
	natural integration	architec turally pleasing	good compo-sition	fit the gridula	Context -uallity	well engineered	innovative
De Kleine Aarde	X	X		X	X	X	X
ECN Petten new	X	X	X	X		X	
Leiden Zonnewende	X			X			
Leiden Oranjerie	X		X	X	X		
Langedijk	X	X			X		
Harderwijk	X	X	X		X		X
Zoetermeer	X	X					
Office Gouda	X	X			X	X	
ECN Petten retrofit		X	X	X		X	X
Dordrecht		X	X				
Amersfoort		X			X		
Geldermalsen		X	X				
Etten-Leur		X				X	

4.1 De Kleine Aarde

The project is designed as a low Energy building. High insulation values, solar thermal and photovoltaic solar energy has been used. The transparent PV laminates in the roof of the corridor are part of the shading and natural cooling system. Standard profiles have been used.

Criteria: natural integration, architecturally pleasing, fit the gridula, contextuality, well engineered, innovative new design.

4.2 ECN Petten new offices



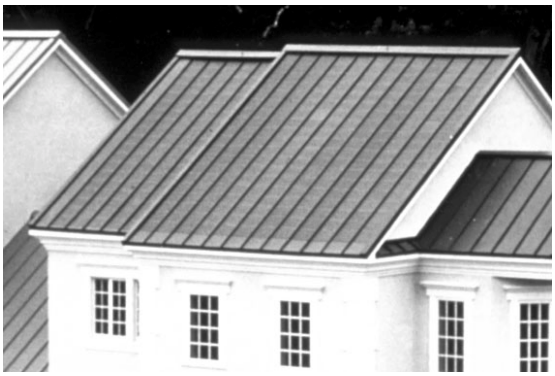
These office building are situated around a central unheated corridor. It follows the same bioclimatic principle as in the Kleine Aarde project. Standard profiles have been used.

Criteria: natural integration, architecturally pleasing, good composition between materials & colours, fit the gridula, well engineered.

4.3 Leiden Zonnewende

The roofs of these houses are renovated and PV modules are used for cladding the roof. Different extensions like the dormer windows are new too. The mounting technology used comes from the Shell/BOAL system.

Criteria: natural integration, fit the gridula.



4.4 Leiden Oranjerie

These houses are covered with amorphous silicon laminated on metal roofing. The cladding is manufactured by laura Starroof.

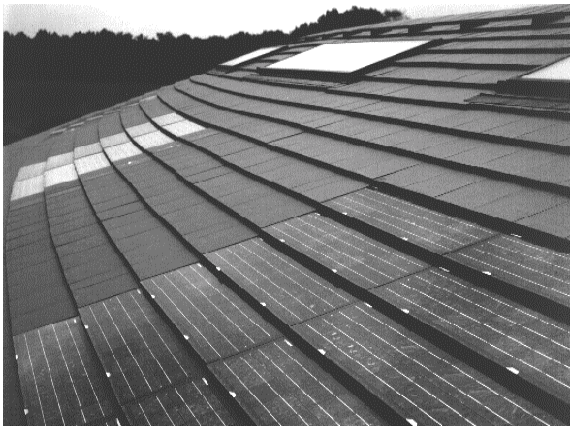
Criteria: natural integration, good composition between materials & colours, fit the gridula, contextuality.

4.5 Langedijk

Large PV roofs are constructed here. PV roofs between 30 and 50 square metres. The mounting technology is the Swiss Alutec system.

Criteria: natural integration, architecturally pleasing, contextuality.

4.6 Harderwijk



The Harderwijk installation is a World wildlife fund (WWF) Panda project with very low energy design. The roof is covered with Lafarge-Braas concrete tiles (Stonewold type). Integrated into this roof are mounted 700 RBB PV laminates. Every house has 4 to 8 square metres of laminates.

Criteria: natural integration, architecturally pleasing, good composition between materials & colours, contextuality, innovative new design.

4.7 Zoetermeer

Low energy residential housing. Wood structure with attached conservatory. A solar hot water system and 10 m^2 of transparent PV laminates are mounted within the roof of the conservatory.

Criteria: natural integration, architecturally pleasing.

4.8 Office Gouda

New low-E office building with glazed roof edges. The glazed roof edges consist for about 50% of transparent PV laminates.

Criteria: natural integration, architecturally pleasing, contextuality, well engineered.

4.9 ECN Petten retrofit

The laboratory building is retrofitted with new façades and roof extensions. The façade is an integration of a PV system, daylighting and shading system.

Criteria: architecturally pleasing, good composition between materials & colours, fit the gridula, well engineered, innovative new design.

4.10 Dordrecht

A special shading / PV mounting system is designed for these houses.

Criteria: architecturally pleasing, good composition between materials & colours.

4.11 Amersfoort

These houses are part of the 1.3 MW_p PV project in Amersfoort Nieuwland. This row of houses is located on the north side of the area. By choosing a special construction with transparent laminates, it was possible to show the PV system on the north side of the houses. The project is currently under construction.

Criteria: architecturally pleasing, contextuality.

4.12 Geldermalsen

This utility pavilion is used for electricity transformation, telecommunications and as a pumping station. The different functions are brought together under a PV structure that follows the form of the site.

Criteria: architecturally pleasing, good composition between materials & colours.

4.13 Etten-Leur

This avant-garde design is based on idea of the big PV roof that covers urban space. On this kind of structure it is possible to mount PV modules taking advantage of optimal tilt and direction.

Criteria: architecturally pleasing, well engineered.

5. CONCLUSION

As can be seen it is possible to integrate PV systems in buildings in quite different ways. A general conclusion can be made that `*a building has to be well designed in the first place. Integrating PV systems can make the design better, but a bad design will never improve by the use of PV systems.'*