Architectural Integration of Solar Roofs

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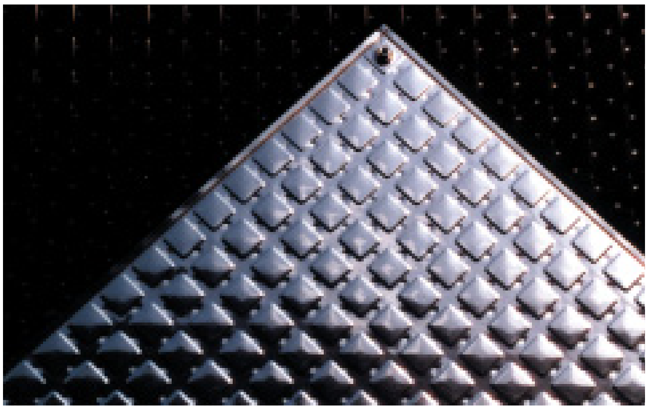
Solar energy

The sun is a constant and unlimited source of energy. The amount of energy it provides is enormous – 5.000 times the current energy requirement of the Earth.

The main methods of harnessing solar energy are (a) by bio-climatic or passive solar architecture and (b) its thermal and photovoltaic conversion. Here we will be looking at thermal solar technology, i.e. the conversion of solar energy into heat. Thanks to modern technology and the energy policy of some countries, it now definitely is cost-effective.



Stainless steel solar absorber (Photo: Energie Solaire SA)

Solar energy can be converted into heat and used to produce sanitary hot water (SHW), and to heat swimming pools and houses. The element that performs this conversion is the solar collector. The most common type of solar is the flat glazed collector.

The "AS" Solar Roof

The "AS" stainless steel solar roof is a less well-known unglazed alternative to conventional collectors. It is particularly well adapted to low temperature applications (SHW, swimming pools and room heating) and to warm climates such as that in Spain. At a reasonable price level, its performance is comparable to that of flat glazed collectors.

The basis of the solar roof is the "AS" unglazed solar collector. It is made up of two thin stainless steel sheets (grade 1.4301) with a patented, highly effective design. The exterior sheet of this collector has a selective coating of black chrome, which turns it into an efficient heat absorber.

The particular design of this solar absorber consists of a square pattern stamped onto two stainless steel sheets, which are welded together to form a sandwich. This configuration allows a uniformly spread flow over nearly the complete absorber surface area. It also provides a superior thermal transmission coefficient compared to conventional copper tube solar absorbers.

Developed at the beginning of the eighties by a Swiss company, this kind of collector has successfully been used for twenty years in central and southern European countries. Throughout this period, the unique features of this collector system have been demonstrated. They show the quality of the solution as well as the fact that it provides surprising results even under less favourable conditions.

Since this roof is an unglazed collector, there are no losses through reflection of solar radiation on the glass. It can therefore be tilted at unusual angles (from 5% to vertical) without significant reduction of its maximum efficiency, allowing it to adapt perfectly to the roof design. Along with specially designed fittings, based on aluminium profiles, corrugated panels and EPDM joints, it also operates as an inexpensive, durable and weather resistant stainless steel metal roof which facilitates architectural integration.

Thus this innovative solar roof goes one step further than traditional collectors: it combines the function of a conventional roof with that of a thermal solar collector. The metallic collector is at the same time a watertight roofing membrane of the building and therefore reduces installation and construction costs. This type of stainless steel roof offers all the qualities of a conventional roof: it is watertight, weather-resistant and durable.

Examples of projects built:

Swimming pools and sports centres

Castellbisbal municipal sports centre and swimming pool (Barcelona, Spain) (Photo: José María Gutiérrez)

Castellbisbal municipal sports centre and swimming pool (Barcelona, Spain)
Date: 1999 - 2000
Architect: J.M. Gutiérrez (Barcelona)
Surface area of the "AS" Solar Roof: 300 m^2

Application:
Heating of a 390 m^2 indoor swimming pool and production of sanitary hot water. Contribution of the solar installation: 550 kWh/m^2 per year

Installation features:
In order to take full advantage of solar energy, conventional glazed solar collectors need to be installed at an angle of 30° to 60°. The unglazed “AS” Solar Roof efficiency on the other hand is much less dependant on the collector angle. Although the Castellbisbal roof has an inclination of just a few degrees, the collector efficiency is not in the least affected thanks to the absence of solar glass. This means that the integration of the solar collectors in this building is very unobtrusive.

Varen sports centre (Switzerland)
Date: 1999
Architects: Jaun/Mooser/Petrig (Zermatt, Switzerland)
Surface area of the AS Solar Roof: 600 m^2
Production of the solar installation: 130 MWh/year

Application:
Sanitary hot water for the sports centre and the neighbouring school, solar heat-radiating floor in the sports centre

Project features:
This is an example of the integration of modern architecture in an old Swiss village. The solar roof has an elegant and slightly curved shape giving it a uniform look. The solar roof faces east/west. Both parts operate alternately.

The solar roof of the Varen (Switzerland) sports centre (Photo: Energie Solaire SA)

Ilanz (Switzerland) swimming pool (Photo: Energie Solaire SA)

Ilanz swimming pool (Switzerland)
Date: 1996
Architect: P. Curchellas (Ilanz, Switzerland)
Surface area of the AS Solar Roof: 453 m^2

Application:
Heating of a 1.250 m^2 swimming pool

Project features:
The stainless steel solar roof covers 95% of the swimming pool's heating requirements. The wave shapes on the roof are an indication of the product's high degree of flexibility.

Housing

Vilanova i la Geltrú (Barcelona, Spain)
Date: 2000
Architect: Tortajada (Barcelona, Spain)
Surface area of the AS solar roof: 220 m²

Application:
Production of sanitary hot water for 91 homes (common solar collector field with individual storage tanks)

Installation features:
In this installation, solar energy accounts for about 40% of the annual SHW requirements. The stainless steel collectors follow the curvature of the roof and cover the main part of the stairway, thus creating space for private terraces.

Curved solar roof in Vilanova (Barcelona, Spain) (Photo: Energie Solaire Hispano Swiss SA)

"Solar City" in Plan-les-Ouates (Geneva, Switzerland) (Photo: Energie Solaire SA)

"Solar City" in Plan-les-Ouates (Geneva, Switzerland)
Date: 1995 (extension in 2000)
Architect: Müller/Stucky/Koeschlen (Geneva, Switzerland)
Surface area of the AS Solar Roof:
1.450 m² (first stage built in 1995) +
300 m² (second stage in 2000)

Application:
Sanitary hot water and room heating

Installation features:
The "Solar City" in Plan-les-Ouates is a complex covered by a solar roof, and in addition to its residential function (82 + 90 homes), it includes businesses and offices with a total of 36.000 m² of heated surfaces. This is the largest solar thermal project in Switzerland. In summer the excess thermal energy generated from the sun is sold to neighbouring buildings.

Private houses

Lledoner House in Vallirana (Barcelona, Spain)
Date: 2001
Architect: B. William (Spain)
Surface area of the AS Solar Roof: 36 m²

Application:
Sanitary hot water and home heating

Installation features:
Integration of a solar roof on an old farmhouse built in the previous century, preserving the house's original characteristics.

Casa Lledoner in Vallirana (Barcelona, Spain) (Photo: Energie Solaire Hispano Swiss SA)

Blanc-Bridy (Saviése, Switzerland) (Photo: Energie Solaire SA)

Blanc-Bridy (Savièse, Switzerland)
Date: 1997
Architect: P. Varone (Sion, Switzerland)
Surface area of the AS Solar Roof: 108 m²

Application:
Sanitary hot water and building heating

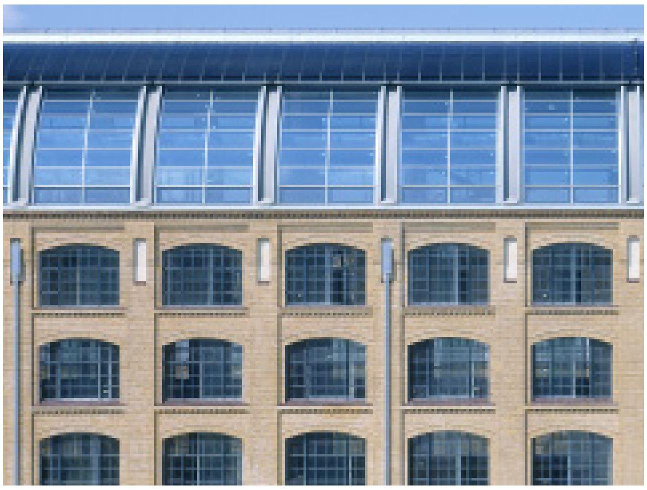
Installation features:
The aim of this project was to achieve maximum autonomy with thermal solar energy. Despite the fact that the house is located in the mountains at 1.200 m above sea level, solar energy accounts for almost 80% of the annual heating requirements of this detached home. The solar roof covers the building's entire roof.

Large buildings: Rest homes, hotels, and hospitals

Rest home and day centre, Sant Feliu de Guixols (Gerona, Spain)
Date: 2001
Architect: J. Casadevall (Spain)
Surface area of the AS Solar Roof: 640 m²

Application:
Production of sanitary hot water (3.500 litres/day) and the building's heat-radiating floors.

Installation features:
This large solar roof in a rest home for the elderly on the Catalan coast is another example of how an adequate share of solar energy of the building's energy requirements can be combined with water-tight roofing. It proves that the solar roof provides interesting solution for tourist areas.



Berlin BLEGmbh Gebäude, building awarded a prize at the Inter-Solar-2000 (Photo: Gerhard Zwickert)

BLEGmbh Gebäude A2/A2E (Berlin, Germany)
Date: 1999
Architect: F. Augustin (Berlin, Germany)
Surface area of the AS Solar Roof: 518 m²

Application:
Production of sanitary hot water, contribution to room heating, Hypothermos moisture barrier (see Grosskmehlen Castle project below)

Installation features:
This project was awarded a special prize by the jury and a special mention for its innovation and integration at the Inter-Solar-2000 in Freiburg (the largest solar energy fair in Europe). It is a former industrial building, renovated and equipped with the "AS" Solar Roof.

Special projects

Palma de Mallorca (Spain) drying plant
Date: 2001
Architect: A. Romero (Spain)
Surface area of "AS" Solar Roof:
132 m² (+ 38 m² of inactive roofing) on the southeast and southwest façade

Application:
Drying of aromatic and medicinal plants; production of sanitary hot water

Installation features:
The construction system of the "AS" Solar Roof can also be easily integrated into walls. Two façades of this drying plant are partially covered by solar absorbers. Its unusual inclination does not affect the efficiency of the collector in the least.

Palma de Mallorca (Spain) drying plant (Photo: Energie Solaire SA)

Medieval Castle in Grosskmehlen (Dresden, Germany)
Date: 2001
Architect: F. Augustin (Germany)
Surface area of the AS Solar Roof: 300 m^2
(+ 200 m^2 of inactive roofing)

Application:
Sanitary hot water for the castle and buildings; Hypothermos tempering system. This solution consists of introducing a system of copper pipes into the basement walls of this old architectural monument. Using the energy generated by the solar roof, it provides a horizontal thermal barrier at the base of the building and thus avoids the progressive deterioration of the castle as a result of humidity.

Installation features:
Installing a solar roof in this medieval castle with its irregular and highly sloped structure while at the same time conserving its unique character posed an enormous challenge. This project once again shows the flexibility of the all-stainless steel and its ability to be integrated into all kinds of buildings, even in protected buildings such as this one.

Medieval Castle in Grosskmehlen (Dresden, Germany)
(Photos: Energie Solaire SA)