Category: Sustainable House

Case Study: Bioclimatic house in Sami

Project cofinanced by
European Regional Development Fund

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SOORE
Sustainable Construction in Rural and Fragile Areas for Energy efficiency

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The village of Sami in the map of Kefalonia

The bioclimatic house in Sami

General Information

Standing on 4 acres grounds with established stone wall boarders in a very private location near Sami, this house is one of the very few Ecological – Bioclimatic buildings on the island. It is located in the east side of Kefalonia, and was designed by the well known architect Mr Kostas Tsipiras. It offers 185 square meters of living area and 120 square meters of basement. The construction company which undertook its reconstruction has already built a significant number of bioclimatic buildings all over Greece that respect the principles of Holistic Architecture, bioclimatic architecture, ecological building and geobiology.

Presentation

One of the most important parameters when designing and building a house is to consider the climate of the region as a key factor and try to take advantage of its characteristics.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

The exterior walls were covered by a special plaster.

This building extends to the East – West axis and is adapted to the precise movement of the sun during the day and the seasons. Therefore, the owners enjoy to the full extent the benefits of the sun, the lighting and the heat. In mild, temperate, Mediterranean climates like Greece's, the buildings, if properly designed, can be heated by the sun in a proportion of 60 – 70% during winter and cooled in summer without using air-conditioning systems.

This residence consists of a 140 square meters ground floor, where the main house is developed and includes a living room, a kitchen, a dining room, a bathroom, three bedrooms and a guestroom. The bedrooms have wooden floors and the living areas are covered with the traditional Cotto tiles. The first floor includes an area of 30.90 square meters, which is used as an observatory.

Regarding passive heating, the main elements of passive design are the following:

- The orientation of the main spaces and openings is southern, while northern exposures are limited to avoid the decrease of temperature in the cooler periods. This is the ideal orientation because the building is protected from the southern winds, while it takes advantage of maximum solar radiation.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

Materials used for the wall insulation

- The windows located in the southern side of the house are used like solar energy collectors.
- The area of northern exposures is 24,00 square meters, while those of the southern side occupy an area of only 4,08 square meters.

In addition to the above techniques, in the living room there is a biodynamic fireplace installed to serve the requirements of the family for heating without using any conventional energy sources that aggravates the environmental pollution.

As far as passive cooling is concerned, the constructors implemented the following methods:

- They created shady spaces on the southern side of the house by constructing wooden sunshades in order to maintain the temperature at the desired level.
- On the roof there is a wind chimney that contributes to the reduction of the cooling load of the building and the improvement of thermal comfort due to the increased ventilation, while in winter, it can slightly increase the heating load.
- Another innovative method is the creation of a level filled with water in a sunny side of the house for evaporative cooling and the creation of a microclimate that benefits the residents.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

Electromagnetic field measurements

The building materials that were used were non-toxic and environmentally friendly, protecting the family from undesirable pollutants. For example, the exterior walls were covered by a special plaster that is much more resistant than the common one, is available in many colours and allows the building's shell to "breathe".

The greatest challenge that had to be confronted during the reconstruction were the emissions of radon and the geo-radiation which in Kefalonia and Zakynthos, another island of the Ionian Sea, are three times higher than the upper limit. All technological techniques were applied in order to reduce the emissions of this noble gas, which is considered to be a health hazard due to its radioactivity. Special treatment was needed for the Hartmann lines that are considered to be related to the magnetic grid of the earth and are responsible for severe diseases such as cancer. With a view to neutralize the Hartmann lines, they used special grounds and they avoided constructing bedrooms at the points where there is intersection of the above mentioned lines.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

Heraclith boards used for insulation

As for insulation, the external walls of the house were constructed according to the requirements of sustainable building. The material that was used, apart from the three rows of bricks, was Heraclith, a totally ecological herbal material that offers great thermal insulation, maintaining a stable temperature in the interior of the house. The major result of this technique is the protection of the building's shell from weather conditions, such as high humidity, rainfall and intense sunshine during the summer months. Heraclith boards are also used for soundproofing the building, while it allows the respiration of the construction materials that cover.

Finally, the needs for hot water are covered by solar power panels, which are installed on the roof of the house. As a result, the owners achieve additional money saving, apart from the fact that this technique is more energy efficient thanks to the use of a renewable source of energy.

The methods that were applied in order to create an environmentally friendly house contribute to the protection of nature, which constitutes a major factor for an island like Kefalonia that attracts every year a large number of tourists due to its natural beauty.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

The back side of the house

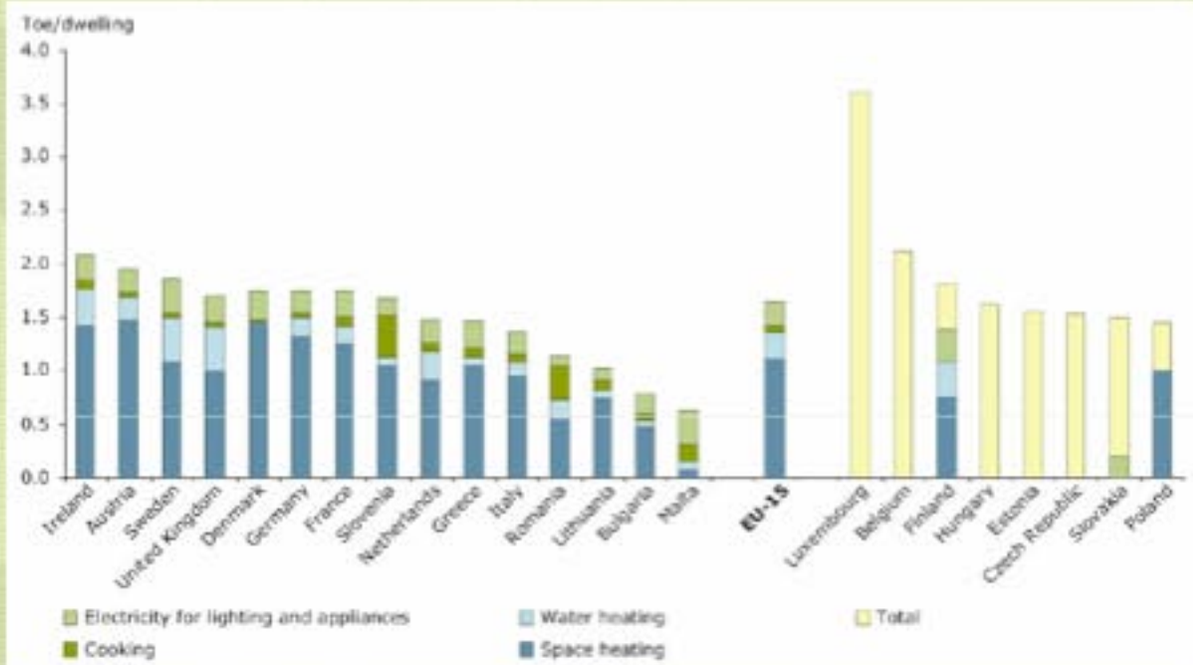
Evaluation

As far as the bioclimatic house in Sami is concerned, it constitutes a great example of ecological building in an island that dominantly attracts tourists through the promotion of nature. This house was built according to the imperatives of sustainable development in a location of natural beauty.

A key factor was the south orientation that contributes to the prolonged natural lighting and the heating during the winter period, when the temperature is much lower. In addition, the constructors limited to the minimum the northern windows, in order to protect the house from the weather condition during winter. It is widely known that dense and large south windows allow sun trajectory in winter and as a result there is a decrease in energy consumption for heating and lighting.

Energy saving is also achieved thanks to the thermodynamic fireplace placed in the living room, that covers even more the requirements of the owners for heating. In addition, the solar water heater limits the need for conventional sources of energy and takes advantage the prolonged sunny weather of the island.

Category: Sustainable House
Case Study: Bioclimatic house in Sami



Energy consumption by end use per dwelling, 2005

Source: European Environment Agency

The use of ecological non-toxic materials, the insulation with the herbal environmentally friendly Heraclith and the construction of a surface filled with water that offers natural evaporative cooling, prove that there are several measures that can be applied in order to create an energy efficient building. As illustrated in Chart 3, in Greece space heating requires the major amount of energy, fact that was taken into account when designing the house in Sami.

This bioclimatic house is one of the three ecological houses built in Kefalonia, by the company K. & TH. ST. TSIPIRAS & Co, which has also completed over 200 constructions in Greece and in Europe. One of the major factors that they measure when they undertake the design and the reconstruction of a building is the electromagnetic fields of the area and the radon emissions that are considered to influence negatively human health. As already presented, these measurements took place before the reconstruction of the house in Sami, as radon is considered to be a significant contaminant that affects indoor air quality worldwide.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

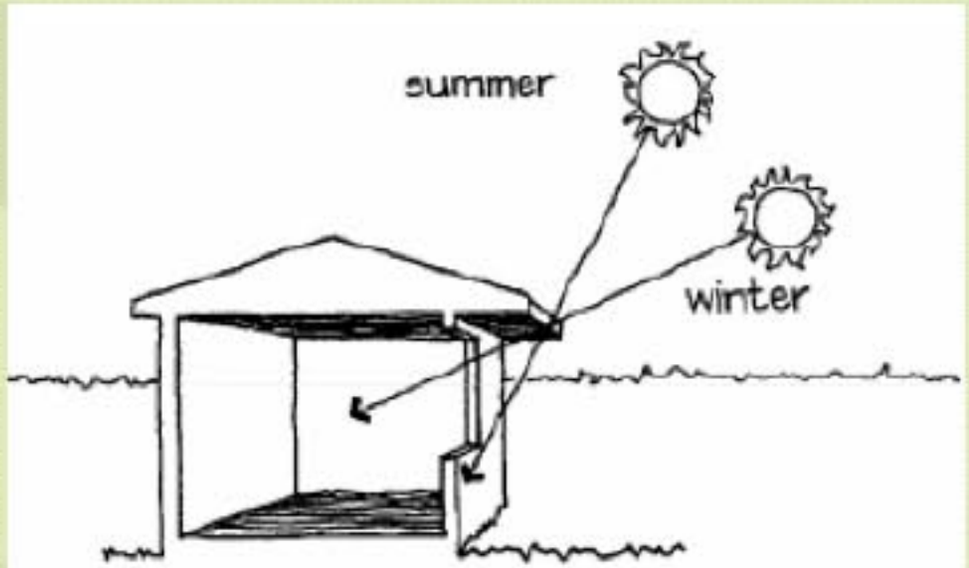


Illustration of the sun trajectory during summer and winter

As shown in the photos, the house respects the architectural characteristics of the region. Despite the innovative methods used, the building is in complete harmony with the design of the Ionian Islands, fact that plays an important role when the architecture constitutes a way of promoting the image of an area.

Undoubtedly, energy efficiency and the ecological character of this building do not depend only on the construction methods. The rational use of energy and the protection of the environment must also be supported by the owners, who are responsible of the preservation of this building.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

The wooden frame of the roof

Potential for transferability

The house in Sami uses several methods for environmentally friendlier space and water heating, lighting, cooling, ventilation and shading could also be a part of the renovation of older buildings or the construction of new ones. Even if the installation of several energy saving systems is more expensive compared to the conventional methods, the actual profit is more important due to savings in energy and natural resources which is interpreted as reduced costs.

To improve the energy efficiency of a building, there are three categories of interventions:

- Extended reconstruction that can be done in case of total renovation, like the replacement of windows and frames, adding insulation materials, installation of exterior passive systems or conversion of conventional building materials in passive components (e.g. transforming a simple wall in solar wall), external shading systems (stable or mobile), etc.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

Opening on the roof for better air circulation and ventilation

- Small low-cost interventions such as limitation of cracks, indoor shading systems, ceiling fans, planting for shading, replacing incandescent light bulbs with low energy consumption bulbs, etc.
- Non-technique interventions, such as proper operation of building systems, including proper use of windows (natural heating in winter, shading and night ventilation in summer), rational use of electric devices in order to avoid thermal charge of the building (e.g. avoid cooking during the hours that the temperature is high).

A key factor that can easily be taken into consideration when constructing a new building is its orientation. As explained in previous chapters, orientation plays a rather important role in bioclimatic architecture and in the building's protection from weather conditions.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

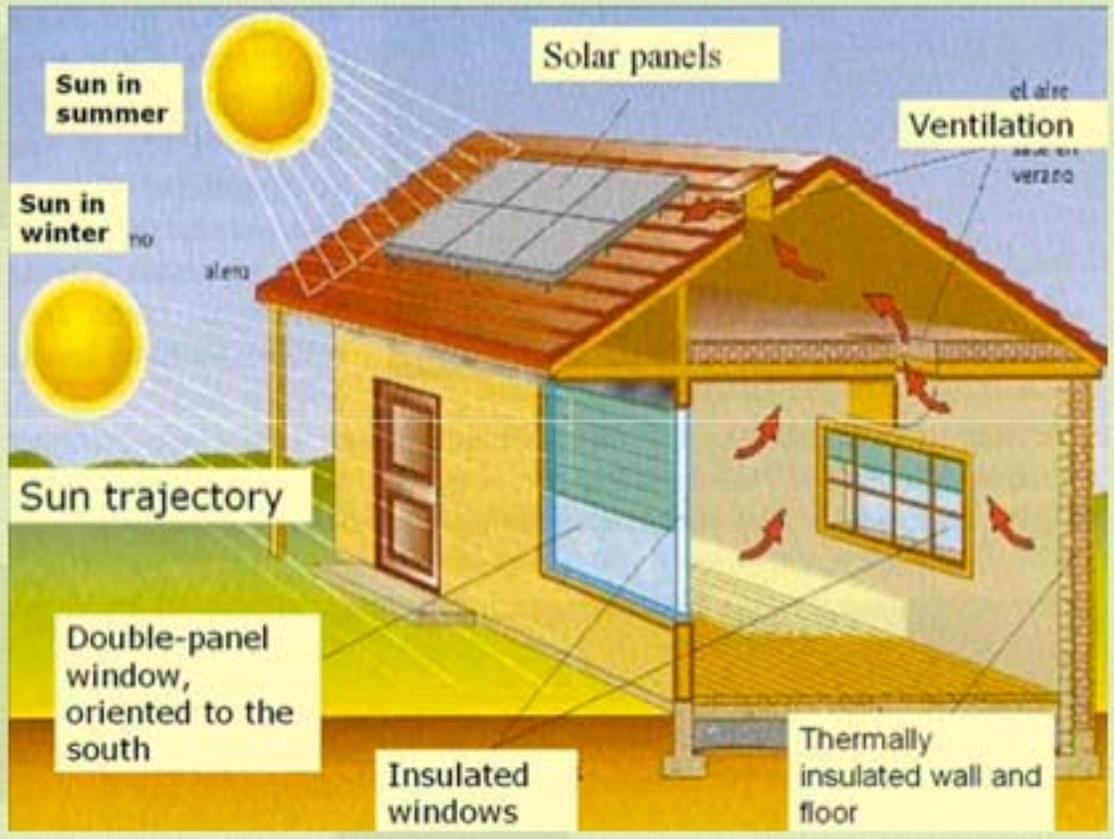


Illustration of the techniques that can be applied for an energy efficient building

The designers-constructors that aim at building energy efficient buildings apart from low energy consumption and environmental protection should also consider the end-users and install non-complicated systems, because, in some cases, the contribution of the users is necessary for the effective operation of the building. This fact should constitute a key criterion when selecting the appropriate techniques, as it has been proved that complexity can lead to reduced input from the user's side and result in inferior energy efficiency.

At this point, it should be emphasized that in Kefalonia, as in most Greek regions, public sector fails to comply with the imperatives of sustainable development, although it should set an example for the entire society. The majority of public sector's buildings are extremely energy consuming due to their age and their operation. The main problem is the irrational use of heating and cooling methods, for which the employees are mostly responsible, due to the lack of information and awareness regarding environmental issues. Moreover, the maintenance of the installations is also very important and has to be a vital part of the building's operation.

Category: Sustainable House
Case Study: Bioclimatic house in Sami

The wooden roof in the interior of the house

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